

World malaria report 2023



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Contents

Foreword	vi
Acknowledgements	ix
Abbreviations and acronyms	xiv
This year’s report at a glance	xvi
1. Introduction	1
2. Overview of key events in 2022–2023	2
2.1 The Global Malaria Programme operational strategy	2
2.2 New WHO recommendations on vector control	2
2.3 Rollout of the RTS,S/AS01 malaria vaccine	3
2.4 WHO recommendation for a second malaria vaccine, R21/Matrix-M	3
2.5 WHO’s updated position on the COVID-19 pandemic	4
2.6 Other humanitarian and health emergencies	4
3. Global trends in the burden of malaria	6
3.1 Global estimates of malaria cases and deaths, 2000–2022	8
3.2 Estimated malaria cases and deaths in the WHO African Region, 2000–2022	12
3.3 Estimated malaria cases and deaths in the WHO South-East Asia Region, 2000–2022	14
3.4 Estimated malaria cases and deaths in the WHO Eastern Mediterranean Region, 2000–2022	16
3.5 Estimated malaria cases and deaths in the WHO Western Pacific Region, 2000–2022	18
3.6 Estimated malaria cases and deaths in the WHO Region of the Americas, 2000–2022	20
3.7 Estimated malaria cases and deaths in the WHO European Region, 2000–2022	22
3.8 Cases and deaths averted since 2000, globally and by WHO region	22
3.9 Burden of malaria in pregnancy	24
4. Elimination	28
4.1 Nearing elimination	28
4.2 Malaria elimination certification	28
4.3 E-2025 initiative	30
4.4 <i>P. knowlesi</i> disease burden and transmission	34
4.6 Prevention of re-establishment	36
5. High burden to high impact countries	40
5.1 Malaria burden in HBHI countries	40
5.2 Subnational tailoring support to countries	42
6. Investments in malaria programmes and research	44
6.1 Funding trends for malaria control and elimination	45
6.2 Global trends in real GDP growth and out-of-pocket health expenditure	54
6.3 Investments in malaria-related R&D	58
7. Distribution and coverage of malaria prevention, diagnosis and treatment	60
7.1 Distribution and coverage of ITNs	60
7.2 Population protected with IRS	63
7.3 Scale-up of SMC	64
7.4 Coverage of IPTp use by dose	66
7.5 Malaria diagnosis and treatment	67
8. Global progress towards the GTS milestones	72
8.1 Global progress	72
8.2 WHO African Region	76
8.3 WHO Region of the Americas	78
8.4 WHO Eastern Mediterranean Region	80
8.5 WHO South-East Asia Region	81
8.6 WHO Western Pacific Region	82

9. Biological threats to malaria interventions	84
9.1 Deletions in <i>P. falciparum</i> histidine-rich protein 2 and protein 3 genes	84
9.2 Status of antimalarial drug efficacy and resistance (2015–2022)	86
9.3 Vector resistance to insecticides	90
9.4 <i>Anopheles stephensi</i> invasion and spread	92
10. Climate change, malaria and the global response	94
10.1 Introduction	94
10.2 Climate and malaria – temperature, rainfall and humidity	94
10.3 Climate change predictions	96
10.4 Conceptual pathways of effect of climate change on malaria	98
10.5 The state of evidence – climate change effects on malaria transmission	100
10.6 Climate change preparedness of the global malaria response	104
11. Key findings and conclusion	108
11.1 Global state of malaria	108
11.2 Global state of malaria interventions	109
11.3 Climate change and malaria	110
11.4 Other drivers of malaria epidemics	111
11.5 Progress despite challenges	113
11.6 Implications for the global malaria response	114
References	116
Annexes	123
Annex 1 – Data sources and methods	124
Annex 2 – Number of ITNs distributed through campaigns in malaria endemic countries, 2020–2022	142
Annex 3 –Regional profiles	
A. WHO African Region	
a. West Africa	146
b. Central Africa	148
c. Countries with high transmission in east and southern Africa	150
d. Countries with low transmission in east and southern Africa	152
B. WHO Region of the Americas	154
C. WHO Eastern Mediterranean Region	156
D. WHO South-East Asia Region	158
E. WHO Western Pacific Region	160
Annex 4 –Data tables and methods	
A. Policy adoption, 2022	162
B. Antimalarial drug policy, 2022	166
C. Funding for malaria control, 2020–2022	168
D. Commodities distribution and coverage, 2020–2022	180
E. Household survey results, 2018–2022	
a. Compiled through STATcompiler	186
b. Compiled through WHO calculations	190
F. Population denominator for case incidence and mortality rate, and estimated malaria cases and deaths, 2000–2022	192
G. Population denominator for case incidence and mortality rate, and reported malaria cases by place of care, 2022	232
H. Reported malaria cases by method of confirmation, 2010–2022	236
I. Reported malaria cases by species, 2010–2022	260
J. Reported malaria deaths, 2010–2022	280
K. Methods for Tables A-D-G-H-I-J	283

Foreword



Each year, WHO's *World malaria report* provides a comprehensive and up-to-date assessment of trends in malaria control and elimination across the globe. This year's report includes, for the first time, a dedicated chapter focused on the intersection between climate change and malaria.

Climate variability, such as changes in temperature and rainfall, can impact the behaviour and survival of the malaria-carrying *Anopheles* mosquito. Extreme weather events such as heatwaves and flooding may lead to increases in the transmission and burden of the disease.

A changing climate has indirect effects on malaria, too. As an example, population displacement may lead to more malaria as people without immunity migrate to endemic areas. Climate variability has also led to malnutrition in many places, a risk factor for severe malaria among young children and pregnant women.

Climate change is just one of many threats to the global response to malaria. Millions of people continue to miss out on the services they need to prevent, detect and treat the disease. Conflict and humanitarian crises, resource constraints and biological challenges such as drug and insecticide resistance also continue to hamper progress.

Taken together, these threats are undermining gains in the global fight against malaria. In 2022, the global tally of malaria cases reached 249 million – well above the estimated number of cases before the COVID-19 pandemic, and an increase of five million over 2021.

The report also documents important progress. The first malaria vaccine recommended by WHO, RTS,S/AS01, has reduced early childhood deaths by 13% in Ghana, Kenya and Malawi. In October 2023, WHO recommended a second safe and effective malaria vaccine, R21/Matrix-M. A two-vaccine market will make broad scale-up across Africa possible.

Last year, 49 million children were reached with seasonal malaria chemoprevention in 17 African countries, up from just 170,000 in 2012.

Additionally, a new generation of dual-ingredient insecticide-treated bed nets, recommended earlier this year by WHO, has been shown to have greater impact against pyrethroid-resistant mosquitoes compared to standard pyrethroid-only nets.

Meanwhile, the goal of malaria elimination has been achieved in a widening circle of countries. This year alone, three more countries were certified by WHO as malaria-free: Azerbaijan, Belize, and Tajikistan. Several others are on track to eliminate the disease in the coming year.

These and other advances are a testament to both national commitment and global resolve to control and eliminate the disease. However, amid extreme weather events, scarce resources and a growing number of biological threats, there is still a long way to go to achieve our vision of a world free from malaria.

A substantial pivot with much greater resourcing, data-driven strategies and new tools is needed to rebuild momentum in the fight against malaria. With the added threat of climate change, sustainable and resilient malaria responses are needed now more than ever.

A handwritten signature in black ink, reading 'Tedros Adhanom Ghebreyesus'.

Dr Tedros Adhanom Ghebreyesus
Director-General
World Health Organization

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Abbreviations and acronyms

ACT	artemisinin-based combination therapy	IPTp3	third dose of IPTp
AIDS	acquired immunodeficiency syndrome	IPTp4	fourth dose of IPTp
AL	artemether-lumefantrine	IRS	indoor residual spraying
AMFm	Affordable Medicines Facility–malaria	ITN	insecticide-treated mosquito net
ANC	antenatal care	LLIN	long-lasting insecticidal net
ANC1	first ANC visit	LMIC	low- and middle-income countries
AS	artesunate	MIS	malaria indicator survey
AQ	amodiaquine	MQ	mefloquine
BMGF	The Bill & Melinda Gates Foundation	NIH	National Institutes of Health
CDC	Centers for Disease Control and Prevention	NMP	national malaria programme
COVID-19	coronavirus disease	OECD	Organisation for Economic Co-operation and Development
CQ	chloroquine	PBO	pyrethroid-piperonyl butoxide
CRS	creditor reporting system	PCR	polymerase chain reaction
DAC	Development Assistance Committee	<i>Pfhrp</i>	<i>Plasmodium falciparum</i> histidine-rich protein (gene)
DHA	dihydroartemisinin	<i>PfKelch13</i>	<i>Plasmodium falciparum</i> Kelch13 (gene)
<i>dhfr</i>	dihydrofolate reductase (gene)	PPQ	piperaquine
<i>dhps</i>	dihydropteroate synthase (gene)	PY	pyronaridine
DHS	demographic and health survey	R&D	research and development
E-2020	malaria eliminating countries for 2020	R21	R21/Matrix-M
E-2025	malaria eliminating countries for 2025	RDT	rapid diagnostic test
EIP	extrinsic incubation period	RTS,S	RTS,S/AS01
Gavi	Gavi, the Vaccine Alliance	SDG	Sustainable Development Goal
GDG	Guideline Development Group	SMC	seasonal malaria chemoprevention
GDP	gross domestic product	SNT	subnational tailoring
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria	SP	sulfadoxine-pyrimethamine
GMP	Global Malaria Programme	SSP	shared socioeconomic pathway
GMS	Greater Mekong subregion	TES	therapeutic efficacy studies
GTS	<i>Global technical strategy for malaria 2016–2030</i>	UN	United Nations
HBHI	high burden to high impact	UNICEF	United Nations Children’s Fund
HRP2	histidine-rich protein 2	United Kingdom	United Kingdom of Great Britain and Northern Ireland
HRP3	histidine-rich protein 3	US	United States
iDES	integrated drug efficacy surveillance	US DoD	United States Department of Defense
IHR	International Health Regulations	USA	United States of America
IPCC	Intergovernmental Panel on Climate Change	USAID	United States Agency for International Development
IPTp	intermittent preventive treatment of malaria in pregnancy	WHO	World Health Organization
IPTp1	first dose of IPTp	WHO-CHOICE	WHO-CHOosing Interventions that are Cost-Effective
IPTp2	second dose of IPTp		

This year's report at a glance

Key events in 2022–2023

The Global Malaria Programme operational strategy

- Global malaria progress has stalled in recent years, and a “business as usual” approach will take countries and their development partners further off course. Recognizing that getting back on track will require major changes in the malaria response, the World Health Organization Global Malaria Programme (WHO/GMP) has developed a departmental operational strategy for the period 2024–2030.
- The strategy reflects inputs from countries, partners and WHO colleagues who have contributed to a better understanding of the root causes of stalled progress.
- The operational strategy focuses on four strategic objectives: norms and standards, new tools and innovation, strategic information for impact and leadership. A fifth cross-cutting pillar – context-based country support – completes the objectives.

New WHO recommendations

- WHO issued a *strong recommendation* for the deployment of pyrethroid-chlorfenapyr insecticide-treated mosquito nets (ITNs) versus pyrethroid-only ITNs to prevent malaria in adults and children in areas where mosquitoes have become resistant to pyrethroids.
- WHO issued a *conditional recommendation* for the deployment of pyrethroid-chlorfenapyr ITNs instead of pyrethroid-piperonyl butoxide (PBO) nets to prevent malaria in adults and children in areas with pyrethroid resistance. The conditionality of the recommendation is based on the judgement of the WHO Guideline Development Group (GDG) that the balance of desirable and undesirable effects probably favours pyrethroid-chlorfenapyr nets over pyrethroid-PBO nets, with evidence drawn from a single trial in the WHO African Region.
- WHO issued a *conditional recommendation* for the deployment of pyrethroid-pyriproxyfen nets instead of pyrethroid-only nets to prevent malaria in adults and children in areas with pyrethroid resistance. The conditionality of the recommendation was based on the GDG's concerns around the poor cost-effectiveness of pyrethroid-pyriproxyfen nets compared with pyrethroid-only nets, because the extra resources currently required to purchase these ITNs may have a negative impact on coverage and equity.

Rollout of the RTS,S/AS01 malaria vaccine in areas of moderate to high malaria transmission

- Since 2019, Ghana, Kenya and Malawi have been delivering the malaria vaccine RTS,S/AS01 (RTS,S) through the Malaria Vaccine Implementation Programme, which is coordinated by WHO and funded by Gavi, the Vaccine Alliance (Gavi); the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund); and Unitaïd.
- Since the WHO recommendation for use of RTS,S in October 2021, at least 28 countries in the WHO African Region have expressed interest in introducing the malaria vaccine. Several countries submitted applications to Gavi, and 18 countries have been approved to receive support for malaria vaccine rollout.

- Given the initial constrained vaccine supply for RTS,S, a framework for allocation of limited malaria vaccine supply was developed and applied to prioritize the 18 million doses of the first-ever malaria vaccine available for 2023–2025 to 12 countries, for subnational introduction in areas of greatest need.
- The first doses of the vaccine are expected to arrive in countries during the last quarter of 2023, with countries starting to roll them out by early 2024.

WHO recommendation for a second malaria vaccine, R21/Matrix-M

- In October 2023, the R21/Matrix-M (R21) malaria vaccine became the second vaccine recommended by WHO to prevent malaria in children living in areas of risk.
- The addition of the R21 malaria vaccine to complement the ongoing rollout of the first malaria vaccine, RTS,S, is expected to result in sufficient vaccine supply to benefit children living in areas where malaria is a major public health problem.
- WHO recommends the use of malaria vaccines (RTS,S or R21) for the prevention of *Plasmodium falciparum* malaria in children living in malaria endemic areas, prioritizing areas of moderate and high transmission.
- Next steps for R21 include completing the ongoing WHO prequalification to enable international procurement of the vaccine for broader rollout. This will be followed by efforts on the part of WHO, Gavi and partners to support countries as they prepare to introduce malaria vaccines, so that countries can reap the full benefits of the life-saving vaccines.

WHO's updated position on the COVID-19 pandemic

- During the 15th meeting of the International Health Regulations (2005) Emergency Committee regarding the coronavirus disease (COVID-19) pandemic, held in May 2023, the WHO Director-General, Tedros A. Ghebreyesus, determined that COVID-19 is now an established and ongoing health issue that no longer constitutes a public health emergency of international concern.

Other humanitarian and health emergencies

- In the period 2019–2022, 41 malaria endemic countries have suffered humanitarian and health emergencies, not including the COVID-19 pandemic.
- During this time, an estimated 145–267 million people needed assistance because of health and humanitarian emergencies.
- Famine and flooding were the major contributors to these humanitarian emergencies, sometimes compounded by disease outbreaks.

Trends in the burden of malaria

Malaria cases

- Globally in 2022, there were an estimated 249 million malaria cases in 85 malaria endemic countries and areas (including the territory of French Guiana), an increase of 5 million cases compared with 2021. The main countries contributing to the increase were Pakistan (+2.1 million), Ethiopia (+1.3 million), Nigeria (+1.3 million), Uganda (+597 000) and Papua New Guinea (+423 000). In 2015, the baseline year of the *Global technical strategy for malaria 2016–2030* (GTS), there were an estimated 231 million malaria cases.
- Malaria case incidence declined from 81 per 1000 population at risk in 2000 to 57 in 2019. Following a small increase of 3% in 2020, incidence rates have remained stable over the past 3 years. In 2022, malaria case incidence was 58 per 1000 population at risk.
- The proportion of cases due to *P. vivax* decreased from about 8% (20.5 million) in 2000 to 3% (6.9 million) in 2022.

- Twenty-nine countries accounted for 95% of malaria cases globally. Four countries – Nigeria (27%), the Democratic Republic of the Congo (12%), Uganda (5%) and Mozambique (4%) – accounted for almost half of all cases globally.
- The WHO African Region, with an estimated 233 million cases in 2022, accounted for about 94% of cases globally.
- Between 2000 and 2019, case incidence in the WHO African Region decreased from 370 to 226 per 1000 population at risk, but increased to 232 per 1000 population at risk in 2020, mainly because of disruptions to services during the COVID-19 pandemic. In 2022, case incidence declined to 223 per 1000 population at risk.
- Cabo Verde reported zero indigenous cases for 4 consecutive years, ending its malaria epidemic.
- The WHO South-East Asia Region accounted for about 2% of malaria cases globally. Malaria cases declined by 76%, from 23 million in 2000 to about 5 million in 2022. Malaria case incidence in this region decreased by 83%, from about 18 cases per 1000 population at risk in 2000 to about three cases per 1000 population at risk in 2022.
- In 2022, India accounted for 66% of cases in the region. Almost 46% of all cases in the region were due to *P. vivax*. Sri Lanka was certified malaria free in 2016 and remains malaria free.
- Despite an overall decrease of 11.9% in estimated cases between 2021 and 2022 in the region, increases in cases and incidence were seen in Bangladesh, Indonesia, Myanmar and Thailand.
- In the WHO Eastern Mediterranean Region, malaria cases decreased by 38%, from about 7 million cases in 2000 to about 4 million in 2015. Between 2015 and 2022, cases rose by 92% to 8.3 million.
- Between 2021 and 2022, the region experienced an increase of 25%, mainly due to a large increase (2.1 million malaria cases) in Pakistan following the catastrophic flooding that affected more than 30 million people.
- Over the period 2000–2015, malaria case incidence declined from 20.2 to 9.0 cases per 1000 population at risk, before increasing to 15.2 cases per 1000 population at risk in 2022. Sudan is the leading contributor to malaria in this region, accounting for about 41% of cases. In 2022, the Islamic Republic of Iran reported 1439 locally acquired cases, which included indigenous cases, despite reporting zero indigenous cases for 4 consecutive years (2018–2021). Saudi Arabia reported zero indigenous cases for the second consecutive year.
- In the WHO Western Pacific Region, numbers of malaria cases decreased by 48% in 2021, from 2.6 million cases in 2000 to an estimated 1.4 million cases. An increase of 23% was seen between 2021 and 2022, reaching 1.9 million cases. Over the same period, malaria case incidence decreased from four to two cases per 1000 population at risk. Papua New Guinea accounted for nearly 90% of all cases in this region in 2022. China was certified malaria free in 2021. Malaysia had no cases of human malaria for 5 consecutive years, despite experiencing an increase in *P. knowlesi* malaria cases, with 2500 cases reported in 2022.
- In the WHO Region of the Americas, malaria cases declined by 64%, from 1.5 million to 0.6 million. Case incidence declined by 73%, from 13 to 4 cases per 1000 population at risk between 2000 and 2022. The region's progress in recent years has suffered from the major increase in malaria in the Bolivarian Republic of Venezuela, which had about 35 500 cases in 2000, rising to over 483 000 by 2017. In 2020, however, cases decreased by more than half compared with 2019, to 223 000 cases; they decreased further in 2021 and 2022, to 205 000 and 154 000 cases, respectively. Factors contributing to this reduction were the low levels of population mobility resulting from the COVID-19 pandemic restrictions, and an increase in malaria diagnosis and treatment commodities.
- The Bolivarian Republic of Venezuela, Brazil and Colombia accounted for 73% of all cases in the WHO Region of the Americas.
- Argentina, Belize, El Salvador and Paraguay were certified malaria free in 2019, 2023, 2021 and 2018, respectively.
- The WHO European Region has been free of malaria since 2015.

Malaria deaths

- Globally, malaria deaths declined steadily from 864 000 in 2000 to 586 000 in 2015 and to 576 000 in 2019. In 2020, malaria deaths increased by 10% compared with 2019, to an estimated 631 000. Estimated deaths declined in 2022 to 608 000. The percentage of total malaria deaths in children aged under 5 years decreased from 87% in 2000 to 76% in 2015. Since then, there has been no change.
- Globally, the malaria mortality rate (i.e. deaths per 100 000 population at risk) halved from about 29 in 2000 to 15 in 2015. It then continued to decrease but at a slower rate, falling to 14 in 2019. In 2020, the mortality rate increased again, to 15.2, before decreasing slightly to 14.3 in 2022.
- About 96% of malaria deaths globally were in 29 countries. Four countries accounted for just over half of all malaria deaths globally in 2022 – Nigeria (31%), the Democratic Republic of the Congo (12%), Niger (6%) and the United Republic of Tanzania (4%).
- Malaria deaths in the WHO African Region decreased from 808 000 in 2000 to 548 000 in 2017, before increasing to 604 000 in 2020. Estimated deaths decreased again to 580 000 in 2022. The malaria mortality rate decreased by 60% between 2000 and 2019, from 143 to 57 deaths per 100 000 population at risk, before rising to 61 in 2020 and decreasing again to 56 in 2022.
- Cabo Verde has reported zero malaria deaths since 2018.
- In the WHO South-East Asia Region, malaria deaths decreased by 77%, from about 35 000 in 2000 to 8000 in 2022. India and Indonesia accounted for about 94% of all malaria deaths in the WHO South-East Asia Region.
- In the WHO Eastern Mediterranean Region, malaria deaths declined by 45%, from about 13 600 in 2000 to 7500 in 2014, and then more than doubled between 2014 and 2022, to 15 900. Most of the deaths were observed in Sudan, where around 90% of cases are due to *P. falciparum*, which is associated with a higher case fatality rate than *P. vivax*.
- In the WHO Eastern Mediterranean Region, the malaria mortality rate decreased by 43% between 2000 and 2015, and remained largely unchanged until 2021, before increasing by 14% between 2021 and 2022 to about three deaths per 100 000 population at risk.
- In the WHO Western Pacific Region, malaria deaths dropped by 56%, from about 6300 deaths in 2000 to 2600 deaths in 2021. Between 2021 and 2022, there was a 29% increase in deaths to 3600, mainly due to increases in Papua New Guinea.
- Between 2000 and 2022, the WHO Region of the Americas experienced a reduction in malaria deaths of 63%, from 850 to 343. The mortality rate decreased by 71%, from 0.7 to 0.2 per 100 000 population at risk.

Malaria cases and deaths averted

- Globally, an estimated 2.1 billion malaria cases and 11.7 million malaria deaths were averted in the period 2000–2022.
- Most of the cases and deaths averted were in the WHO African Region (cases 82%, deaths 94%), followed by the WHO South-East Asia Region (cases 10%, deaths 3%).

Burden of malaria in pregnancy

- In 2022, in 33 moderate and high transmission countries in the WHO African Region, there were an estimated 35.4 million pregnancies, of which 12.7 million (36%) were exposed to malaria infection during pregnancy.
- By WHO subregion, prevalence of exposure to malaria during pregnancy in 2022 was highest in west Africa (39.3%) and central Africa (40.1%), and lower in the east and southern Africa subregion (27.0%).
- It is estimated that, without a pregnancy-specific intervention, malaria infection during pregnancy in these 33 countries would have resulted in 914 000 neonates with low birthweight, compared with about 393 000 neonates with low birthweight estimated at the current intermittent preventive treatment during pregnancy (IPTp) coverage levels in the three subregions.

- If all the pregnant women visiting antenatal care (ANC) clinics at least once received a single dose of IPTp – assuming they were all eligible and that second and third doses of IPTp (IPTp2 and IPTp3) remained at current levels – an additional 60 000 low birthweights would be averted in 33 countries with information on IPTp.
- If IPTp3 coverage was raised to the same levels as that of ANC first visit coverage, and if subsequent ANC visits were equally high, an additional 164 000 low birthweights would be averted.
- If IPTp3 coverage reached 90% of all pregnant women, an additional 229 000 low birthweights would be averted.
- Given that low birthweight is a strong risk factor for neonatal and childhood mortality, averting a substantial number of low birthweights will save many lives.

Malaria elimination and prevention of re-establishment

- Over time, the elimination of malaria has gained momentum in numerous countries as they approach the milestone of zero indigenous malaria cases and as more countries are certified malaria free.
- The number of countries that were malaria endemic in 2000 and that reported fewer than 100 malaria cases increased from six in 2000 to 27 in 2022, a slight decrease from 28 in 2021.
- The number of countries with fewer than 10 indigenous cases increased from four in 2000 to 25 in 2021 and 2022.
- Between 2000 and 2022, 25 countries that were malaria endemic in 2000 have achieved 3 consecutive years of zero indigenous malaria cases. Twelve of these countries were certified malaria free by WHO.
- No countries were certified malaria free in 2022, but three countries – Azerbaijan, Belize and Tajikistan – were granted certification in 2023.
- Two countries – Egypt and Timor-Leste – submitted official requests for certification in 2023.
- Cabo Verde has reported zero indigenous cases for 4 consecutive years and is at the final stage of the certification process.
- From 2010 to 2022, there was a 72.3% reduction in indigenous malaria cases across the countries and one territory that are part of the malaria eliminating countries for 2025 (E-2025) initiative, with increases observed in 2017–2018 and then again since 2021.
- The increase in 2022 was largely due to a surge in cases in the Comoros, which almost doubled its cases from 10 537 in 2021 to 20 675 in 2022. Other countries also experienced substantial increases during this period: Costa Rica more than doubled its caseload, from 189 in 2021 to 409 in 2022; Panama saw an increase from 4354 in 2021 to 7102 in 2022; Thailand reported a significant increase, from 2426 in 2021 to 6263 in 2022; Honduras more than doubled its cases, from 1542 in 2021 to 3534 in 2022; and Vanuatu had an almost fourfold increase, from 312 in 2021 to 1102 in 2022.
- Other countries that reported varying levels of increase in cases for the same period were the Dominican Republic (12.6%), Guatemala (45.7%), Nepal (12.5%), the Republic of Korea (39.4%) and Sao Tome and Principe (46.0%).
- There was a resurgence of cases in the Islamic Republic of Iran in 2022, with 1439 locally acquired cases reported in 2022 after 4 consecutive years of zero indigenous cases.
- Despite the setbacks, several countries and one territory saw notable reductions in indigenous transmission: Botswana (43.5%), the Democratic People's Republic of Korea (9.3%), Ecuador (38.0%), Eswatini (57.6%), French Guiana (71.6%), Mexico (32.6%) and South Africa (31.3%).
- Malaysia reported zero indigenous cases of human *Plasmodium* species for the fifth consecutive year.
- After an outbreak of three cases in Timor-Leste in 2020, the country managed to realign its efforts, achieving 2 consecutive years with zero indigenous cases in 2021 and 2022 (for 36 consecutive months if 2023 is taken into consideration). Saudi Arabia also achieved 2 consecutive years with zero indigenous cases in 2021 and 2022.

- Bhutan and Suriname reported zero indigenous cases for the first time.
- Over recent years, *P. knowlesi* has emerged as a notable concern in malaria cases, especially in the WHO South-East Asia Region countries of Indonesia, Malaysia and Thailand.
- In 2022, a total of 2768 *P. knowlesi* cases were reported globally, a decrease of 24.2% compared with 2021 (3651 cases). Indigenous *P. knowlesi* cases also saw a decrease of 26%, from 3629 cases in 2021 to 2682 cases in 2022.
- Malaysia continues to be the predominant source of *P. knowlesi* cases, followed by Thailand and Indonesia, which contributed 90.5%, 3.1% and 0.1%, respectively, in 2022.
- Between 2000 and 2022, the countries of the Greater Mekong subregion (GMS) reported a 55.5% decrease in indigenous malaria cases and an 89.1% decline in indigenous *P. falciparum* malaria cases. This excludes China, because it is the only country that reported zero indigenous cases and remains malaria free.
- In the GMS, indigenous cases increased from 90 082 cases in 2021 to 170 527 in 2022. Similarly, the number of indigenous *P. falciparum* cases nearly doubled, increasing from 16 490 in 2021 to 30 789 cases in 2022.
- Myanmar remains the largest contributor to the region's malaria burden, accounting for 92.4% of indigenous malaria cases and 95% of indigenous *P. falciparum* malaria cases.
- Several E-2025 countries that achieved zero indigenous cases have recently faced challenges related to migrants and border areas. WHO is developing guidance for border malaria, which remains a challenge for malaria elimination and for prevention of re-establishment.
- Bhutan, Saudi Arabia and Suriname, having recently attained their first year of reporting zero indigenous cases, are proactively implementing strategies to prevent the reintroduction of indigenous malaria cases.
- After 5 years of zero local transmission, the Islamic Republic of Iran is currently facing an outbreak of indigenous malaria cases. Frequent border movement of people contributed to the introduction of cases and to the further re-establishment of local transmission.
- Recognizing the policy gaps in the prevention of re-establishment, WHO is in the process of developing guidance for the prevention of re-establishment.

High burden to high impact approach

- Since November 2018, all 11 high burden to high impact (HBHI) countries have implemented HBHI-related activities across the four response elements.
- In 2022, Sudan joined the first group of HBHI countries, at the request of the Sudanese Federal Ministry of Health. This inclusion expanded the official number of HBHI countries to 12. Full implementation in Sudan was hindered, however, due to the conflict that erupted in early 2023.
- Estimated malaria incidence and mortality remained largely unchanged in the original 11 HBHI countries between 2021 and 2022, with increases in cases mainly due to increases in population.
- In 2022, the 11 HBHI countries accounted for 67% of all cases and 73% of deaths globally.
- As a result of the positive outcomes observed in the initial HBHI countries, several additional countries in the WHO African and Eastern Mediterranean regions have begun implementing the second pillar of the HBHI approach, which focuses on strategic use of information, with an emphasis on subnational tailoring (SNT) of interventions.
- SNT is the use of local data and contextual information to determine the appropriate mix of interventions and strategies for a given area to achieve optimum impact on transmission and burden of disease at the strategic level or within a specific resource envelope.
- Since 2018, more than 30 malaria endemic countries have implemented SNT to inform single or multiple intervention strategic planning, resource mobilization efforts, funding requests, budget negotiations or optimization of intervention implementation.

- The application of SNT has sparked the integration of data as part of countries' regular decision-making processes. In turn, this has strengthened efforts to improve the collection, review and quality of data on a regular basis.
- It has also revealed variations in the capacity of countries to fully implement the SNT process locally. Any gaps in capacity need to be collectively addressed by countries, their partners and donors.

Investments in malaria programmes and research

- The GTS sets out estimates of the funding required to achieve milestones for 2025 and 2030. Total annual resources needed were estimated at US\$ 6.8 billion in 2020, rising to US\$ 9.3 billion in 2025 and US\$ 10.3 billion by 2030. An additional US\$ 0.85 billion is estimated to be required annually for global malaria research and development (R&D) during the period 2021–2030.
- Total funding for malaria control and elimination in 2022 was estimated at US\$ 4.1 billion, compared with US\$ 3.5 billion in 2021 and US\$ 3.3 billion in 2020. Total funding over the past 5 years has averaged around US\$ 3.3 billion per year. The amount invested in 2022 continues to fall short of the US\$ 7.8 billion estimated to be required globally to stay on track towards the GTS milestones.
- The funding gap between the amount invested and the resources needed has continued to widen dramatically over recent years, increasing from US\$ 2.3 billion in 2018 to US\$ 3.7 billion in 2022. Despite total funding increasing by a sizeable amount from 2021 to 2022, the total amount of funding in 2022 equated to only 52% of the required funding as set by the GTS targets.
- Over the period 2010–2022, 66% of the total funding for malaria control and elimination stemmed from international sources. The United States of America contributed over US\$ 1.5 billion through planned bilateral funding and malaria-adjusted share of multilateral contributions agencies. This was followed by bilateral and multilateral disbursements of over US\$ 0.4 billion from France, Germany and the United Kingdom of Great Britain and Northern Ireland combined; contributions of about US\$ 0.1 billion each from Australia, Canada and Japan; and a combined US\$ 0.4 billion from other countries that are members of the Development Assistance Committee and from private sector contributors.
- Governments of malaria endemic countries contributed more than a third of total funding in 2022, with investments of over US\$ 1.5 billion, of which nearly US\$ 0.4 billion was spent on malaria case management in the public sector and over US\$ 1.1 billion on other malaria control activities. This was a substantial increase of over US\$ 0.4 billion since 2021, largely stemming from an influx of domestic spending in the WHO African Region.
- Of the US\$ 4.1 billion invested in 2022, almost US\$ 2.6 billion was sourced internationally, with nearly US\$ 1.6 billion (39%) channelled through the Global Fund. Compared with previous years, the Global Fund disbursements to malaria endemic countries have increased by about US\$ 0.1 billion since 2021 and by US\$ 0.5 billion since 2018.
- The World Bank's classifications by income group vary from year to year. In 2022, the 25 low-income countries accounted for 44% of total funding, similar to previous years, with 70% of funding provided by international sources. The 40 lower-middle-income countries accounted for 43% of total funding in 2022. The remaining countries and unspecified regions where no geographical information on recipients was available accounted for 13% of malaria funding.
- The assessment of malaria funding per person at risk highlights the variation in domestic and international funding across WHO regions and has shown sizeable changes over the past decade. Most WHO regions have seen funding per person at risk fall to levels below those of 2010, apart from the WHO African Region, in which funding per person at risk has increased slightly since 2010, and more significantly (by >30%) compared with 2021. This reflects the increase in domestic funding within the WHO African Region in 2022, which has increased by over US\$ 0.3 billion since 2021.
- Of the US\$ 4.1 billion invested in 2022, over three quarters (80%) went to the WHO African Region; 4% each went to the South-East Asia Region, the Eastern Mediterranean Region and the Region of the Americas;

and 2% went to the Western Pacific Region. The remaining 6% of total funding in 2022 was allocated to unspecified regions. Funding to WHO regions showed a significant increase in the WHO African Region but remained relatively stable in all other regions.

- Many countries have experienced changes in their real gross domestic product (GDP) due to the COVID-19 pandemic and other crises. In turn, this has affected the global economy, which expanded by 5.5% in 2021 after a contraction of 3.4% in 2020. In 2022, there was significant growth among all low- and middle-income countries (LMIC), from nearly 70% of countries within this group having experienced a shock in 2020 to only 5% in 2022, demonstrating a positive upswing in the global economy. Nevertheless, it is anticipated that high-income countries and other international organizations will continue to prioritize COVID-19 efforts into 2024, particularly if there are ongoing challenges or emerging variants. Additionally, geopolitical tensions may lead to increased volatility in the global economy, which in turn may affect resource allocation and spending on health care.
- The proportion of households' out-of-pocket expenditure on total health care is a critical factor to consider. Although this report does not identify malaria-specific costs, health care expenses, both direct and indirect, can impose a substantial burden on households. In 2020, 47% of households in LMIC were considered to have experienced catastrophic costs (defined as spending on health exceeding 40% of household income), affecting 1.9 billion individuals at risk for malaria who live in these countries.
- Total R&D funding for malaria was US\$ 603 million in 2022, a decrease of over 10% since 2021 and the lowest recorded level of R&D funding in the past 15 years.
- This is the fourth consecutive year of funding decline since the peak in 2018, with malaria R&D funding declining primarily across vaccines (for the fifth consecutive year) and basic research, by 13% and 20%, respectively. Medicines continued to receive the largest share of funding, despite also decreasing by 12%.
- Funding for biologics continued to rise for a fourth consecutive year, jumping more than 250% in 2022, nearly 14 times the level seen in 2018. The Bill & Melinda Gates Foundation provided the first-ever biologics clinical development funding, in the form of a US\$ 3.9 million grant to the CDC Foundation.
- Funding from the public sector in high-income countries fell heavily (18%) to the lowest level in more than a decade, although they remained the main funder of malaria R&D. Funding from other sectors also dropped, apart from the private sector, which rebounded and saw an increase of US\$ 10 million in funding in 2022.

Distribution and coverage of malaria prevention

- Manufacturers' delivery data for 2004–2022 show that almost 2.9 billion ITNs were supplied globally in that period, of which 2.5 billion (86%) were supplied to sub-Saharan Africa. In 2022, manufacturers delivered about 282 million ITNs to malaria endemic countries. Of these, 260 million ITNs were delivered to sub-Saharan Africa in 2022, of which 131.5 million were pyrethroid-PBO nets. Dual active ingredient ITNs made up 8% of the total ITNs delivered in 2022. In 2022, 254 million ITNs were distributed globally by national malaria programmes (NMPs) in malaria endemic countries. Of these, 235 million were distributed in sub-Saharan Africa.
- In 2022, there were 44 countries with ITN campaigns planned to distribute about 241 million nets. By the end of 2022, 83% of all ITNs planned for distribution in 2022 had been distributed.
- Of the 11 countries supported under the first phase of the HBHI approach, seven countries had a mass distribution campaign, and five countries in 2022 distributed more than 85% of their nets – Burkina Faso (90%), India (91%), Mozambique (100%), Nigeria (93%) and the United Republic of Tanzania (100%). Cameroon and the Democratic Republic of the Congo distributed 67% and 75% of their nets, respectively. Within these seven countries, about 11 million nets were surplus from the 2021 campaign.
- By 2022, 70% of households in sub-Saharan Africa had at least one ITN, increasing from about 5% in 2000. The percentage of households owning at least one ITN for every two people increased from 1% in 2000 to 40% in 2022. In the same period, the percentage of the population with access to an ITN within their household increased from 3% to 56%.

- The percentage of the population sleeping under an ITN increased between 2000 and 2022 for the whole population (from 2% to 49%), for children aged under 5 years (from 3% to 56%) and for pregnant women (from 3% to 56%).
- No significant increase in the overall access to and use of ITNs has been observed since 2015.
- Globally, the percentage of the population at risk protected by indoor residual spraying (IRS) in malaria endemic countries declined from 5.5% in 2010 to 1.8% in 2022. The percentage of the population protected by IRS has remained stable since 2016, with less than 6% of the population protected in each WHO region.
- The number of people protected by IRS globally fell from 153 million in 2010 to 62 million in 2022.
- The average number of children treated per cycle of seasonal malaria chemoprevention (SMC) has increased steadily, from about 0.2 million in 2012 to 49 million in 2022. Nigeria makes the largest contribution, with an average of 25.5 million children treated per cycle of SMC.
- In total, about 200 million treatment doses were delivered in the 17 countries implementing SMC in the Sahel and other seasonal areas of sub-Saharan Africa in 2022.
- Using data from 33 countries in the WHO African Region, the percentage of IPTp use by dose was computed. In 2022, 78% of pregnant women used ANC services at least once during their pregnancy. About 64% of pregnant women received one dose of IPTp, 54% received two doses and 42% received three doses.

Distribution and coverage of malaria diagnosis and treatment

- Globally, 3.9 billion rapid diagnostic tests (RDTs) for malaria were sold by manufacturers in 2010–2022, with 82% of these sales being in sub-Saharan African countries. In the same period, NMPs distributed 2.9 billion RDTs – 90% in sub-Saharan Africa.
- In 2022, 415.5 million RDTs were sold by manufacturers and 345 million were distributed by NMPs.
- Globally, more than 4 billion treatment courses of artemisinin-based combination therapies (ACT) were delivered by manufacturers between 2010 and 2022. About 2.7 billion of these deliveries were to the public sector in malaria endemic countries, and the rest were either public or private sector co-payments (or both), or exclusively through the private retail sector.
- National data reported by NMPs in 2010–2022 show that 2.5 billion ACTs were delivered to health service providers to treat people with malaria in the public health sector.
- In 2022, some 210 million ACTs were delivered by manufacturers to the public health sector. In the same year, 217 million ACTs were distributed to this sector by NMPs, of which 97% were in sub-Saharan Africa.
- Aggregated data from household surveys conducted in sub-Saharan Africa between 2005 and 2022 in 22 countries with at least two surveys (baseline 2005–2011, and most recent 2015–2022) were used to analyse coverage of treatment seeking, diagnosis and use of ACTs in children aged under 5 years.
- Comparing the baseline and latest surveys, there was little change in prevalence of fever within the 2 weeks preceding the surveys (median 26% versus 23%) or in treatment seeking for fever (median 65% versus 66%).
- Comparisons of the source of treatment between the baseline and more recent surveys show that the proportion who received care from public health facilities increased from a median of 58% to 69%. The use of community health workers remained low, with a median percentage of 2% in both the baseline and later surveys. The proportion who received care from the private sector decreased from a median of 40% at baseline to 28% in the more recent surveys, indicating an increase in population access to the public health sector and consequently to the associated public surveillance system.
- The rate of diagnosis among children aged under 5 years with fever and for whom care was sought increased from a median of 30% at baseline to 54% in the latest household surveys, indicating an improvement in case management, despite evidence of inadequate levels of diagnostic services.
- Use of ACTs among children aged under 5 years for whom care was sought increased from 13% at baseline to 24% in the latest surveys.
- Among those for whom care was sought and who received a finger or heel prick, use of ACTs was 34% in the most recent survey, compared with 21% at baseline. Among those for whom care was sought and who

were treated with an antimalarial drug, the median increased from 38% at baseline to 65% in the latest surveys, indicating either an improvement in treatment rates or an increase in test positivity rates among the people tested. This indicator should be interpreted according to the individual country context, given a lack of information on the type of diagnostic test performed or the result of the test.

Progress towards the GTS milestones of 2020

- The GTS calls for a reduction in malaria case incidence and mortality rate of at least 40% by 2020, 75% by 2025 and 90% by 2030 from a 2015 baseline.
- Despite the considerable progress made since 2000, if the current trends continue, it is likely that the GTS 2025 targets will not be achieved globally.
- The malaria case incidence of 58 cases per 1000 population at risk in 2022 instead of the expected 26 cases per 1000 for the same year if the world were on track for the GTS 2025 morbidity milestone means that, globally, we are off track by 55%.
- Although relative progress in the mortality rate is greater than progress in case incidence, the expected target of 6.6 malaria deaths per 100 000 population at risk in 2022 – if the world were on track for the GTS 2025 mortality milestone – was 53% lower than the actual mortality rate of 14.3 observed in that year.
- Of the 93 countries that were malaria endemic (including the territory of French Guiana) globally in 2015, 23 countries (24.7%) are on track to meet the GTS morbidity milestone for 2025, having achieved a reduction of 55% or more in case incidence or having reported zero malaria cases in 2022.
- Twenty-four countries (26%) had made progress in reducing malaria case incidence, but by less than the expected target.
- Twenty-five countries (27%) had experienced increased case incidence, and 15 countries (16%) had an increase of 55% or more in malaria incidence in 2022 compared with 2015.
- In 14 countries (15.1%), malaria case incidence in 2022 was similar to that of 2015.
- Thirty-one countries (33%) that were malaria endemic in 2015 are on track to meet the GTS mortality milestone for 2025, with 22 of them reporting zero malaria deaths.
- Thirty-one countries (33%) achieved reductions in malaria mortality rates, but of less than the 55% target for 2022.
- Malaria mortality rates remained at the same level in 2022 as in 2015 in seven countries (7.5%), whereas mortality rates increased in 17 countries (18.3%), eight of which had increases of 55% or more.
- The WHO South-East Asia Region met the GTS 2020 milestones for both mortality and morbidity and remains on track to meet the GTS 2025 and 2030 targets. All countries in the region except for Indonesia and Myanmar reduced case incidence and mortality by 55% or more or remained unchanged.

Biological and other threats to malaria intervention tools

Parasite deletions of genes

- *P. falciparum* parasites that do not express histidine-rich protein 2 (HRP2) may escape detection by RDTs based on detection of HRP2. Further, the histidine-rich protein 3 (HRP3) protein, a homologue protein of HRP2, can cross-react with the monoclonal antibodies used for HRP2 detection at high parasite densities. *P. falciparum* parasites that express neither HRP2 nor HRP3 will completely evade detection by RDTs based on HRP2. According to data provided by manufacturers, about 415.5 million such RDTs were sold in 2022.
- WHO recommends that countries with reports of *Pfhrp2/3* deletions, and their neighbouring countries, should conduct representative baseline surveys among suspected malaria cases, to determine whether the prevalence of *Pfhrp2/3* deletions causing false negative RDT results exceeds the threshold that requires a change of RDT.

- Based on literature searches informing the Malaria Threats Map, 16 new articles were published in 2022. These included data from the WHO African Region (Burundi, Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Ethiopia, Ghana, Kenya, Madagascar, Rwanda, Sierra Leone, South Sudan and the United Republic of Tanzania); the WHO Region of the Americas (Brazil, Ecuador and Peru); and Cambodia, India and Viet Nam.
- Studies of *Pfhrp2* deletions were published for the first time in 2022 in six countries (Burundi, Cambodia, Cameroon, Sierra Leone, South Sudan and Viet Nam), of which only Burundi and Viet Nam did not detect *Pfhrp2* deletions.
- Based on data from publications included in the Malaria Threats Map, some form of investigation for *Pfhrp2/3* deletions has been conducted in 50 countries.
- The WHO response plan for *Pfhrp2/3* deletions outlines several areas for action, including identifying new biomarkers, improving the performance of non-HRP2 RDTs, undertaking market forecasting and strengthening laboratory networks, to support the demand for using molecular characterization to determine the presence or absence of these gene deletions.

Parasite resistance to antimalarial drugs (2015–2022)

- Efficacy of antimalarial drugs is monitored through therapeutic efficacy studies (TES), which track clinical and parasitological outcomes among people receiving antimalarial treatment. TES are considered the gold standard by which countries can best determine their national treatment policies.
- Resistance to antimalarial drugs can be assessed using several tools. For some drugs, genetic changes associated with reduced sensitivity have been identified. Artemisinin partial resistance is monitored using an established list of validated and candidate *PfKelch13* markers associated with delayed clearance after a treatment containing artemisinin.
- As part of the response to counter the threat of resistance to antimalarial drugs, WHO calls on malaria endemic countries and global malaria partners to strengthen the surveillance of antimalarial drug efficacy and resistance, and to ensure that the most effective treatments are selected for national treatment policy.
- **WHO African Region:** most TES conducted according to the WHO standard protocol demonstrate good efficacy of antimalarial treatment. During the reporting period (2015–2022), some studies undertaken in the WHO African Region of antimalarial treatment efficacy against *P. falciparum* detected higher levels of treatment failure. These results warrant further investigation and could be a sign of emergence of ACT partner drug resistance. Five studies of artemether-lumefantrine (AL), which applied the standard WHO methodology for polymerase chain reaction correction, reported treatment failure rates greater than 10%. These studies were conducted in Burkina Faso, Kenya and Uganda. Additionally, five studies of AL and one study of dihydroartemisinin-piperaquine (DHA-PPQ) reported treatment failure rates of greater than 10% when using Bayesian algorithms to distinguish between reinfection and recrudescence; these studies were conducted in Angola, the Democratic Republic of the Congo and Uganda. Following surveillance of *PfKelch13* polymorphisms associated with artemisinin partial resistance in several countries, there is now evidence of artemisinin partial resistance associated with clonal expansion of *PfKelch13* mutations in Eritrea, Rwanda, Uganda and the United Republic of Tanzania. The United Republic of Tanzania is the fourth country in the WHO African Region to have confirmed artemisinin partial resistance. The efficacy of chloroquine (CQ) and DHA-PPQ for the treatment of *P. vivax* was investigated in Ethiopia: treatment failure rates were less than 5% in nine studies of CQ and two studies of DHA-PPQ.
- **WHO Region of the Americas:** limited data are available from the WHO Region of the Americas. TES undertaken using AL in Brazil (2015) and Colombia (2018) demonstrated high efficacy of this medicine against *P. falciparum*. In Guyana, the C580Y mutation was sporadically observed between 2010 and 2017; the mutation has not been found in any of the more recent samples, indicating that the mutation has likely disappeared. All malaria endemic countries in this region recommend CQ as a first-line treatment for *P. vivax*. Efficacy of CQ was studied in Brazil and was found to be high.
- **WHO South-East Asia Region:** all studies of treatment efficacy against *P. falciparum* that were conducted during the study period found less than 10% treatment failure. Treatment failure with artesunate plus sulfadoxine-pyrimethamine (AS+SP) remained low in India. Findings from a study in Chhattisgarh state

between 2015 and 2017 looking at *dhfr* and *dhps* mutations, however, could be an early warning of the need for treatment policy change from AS+SP in north-eastern India. *PfKelch13* mutations associated with artemisinin partial resistance have reached a high prevalence in Myanmar and Thailand.

- **WHO Eastern Mediterranean Region:** data on the efficacy of AL for the treatment of *P. falciparum* are available from Afghanistan, Pakistan, Somalia, Sudan and Yemen (2015–2020). All demonstrated high treatment efficacy. Data on the efficacy of the first-line treatments for *P. vivax* are available from one study of AL from Somalia (2018) and two studies of CQ in Afghanistan (2016 and 2022); no treatment failures were observed.
- **WHO Western Pacific Region:** studies of antimalarial treatment efficacy against *P. falciparum* have found high levels of treatment failure. A treatment failure rate of 13.5% with AL was found in western Cambodia in 2018–2020; amodiaquine (AQ) resistance was documented in Cambodia in 2016–2017, with high treatment failure rates with AS-AQ in the provinces of Monduliri (22.6%) and Pursat (13.8%); and high rates of treatment failure were detected with DHA-PPQ in Cambodia, the Lao People's Democratic Republic and Viet Nam. In Cambodia, the findings prompted the replacement of DHA-PPQ with artesunate-mefloquine (AS-MQ) as the first-line treatment in 2016. In Viet Nam, artesunate-pyronaridine (AS-PY) has replaced DHA-PPQ in provinces where high treatment failure rates were detected. *PfKelch13* wild-type parasites were found in 29.9% of samples collected between 2015 and 2020 in Cambodia, the Lao People's Democratic Republic and Viet Nam. In Papua New Guinea, the *PfKelch13* C580Y mutation has emerged and appears to be spreading. For *P. vivax*, one study of CQ in Viet Nam in 2015 found treatment failure rates of 9.8%.

Vector resistance to insecticides

- Since 2021, insecticide resistance data have been reported to WHO from 35 countries. These data are under collation and will be updated in 2024 in the WHO global database on insecticide resistance in malaria vectors and the Malaria Threats Map.
- Of the 88 malaria endemic countries that provided data for 2010–2020, 78 have detected resistance to at least one insecticide class in at least one malaria vector and one collection site; 29 have already detected resistance to pyrethroids, organochlorines, carbamates and organophosphates across different sites; and 19 have confirmed resistance to all four classes of insecticide in at least one site and at least one local vector.
- Globally, resistance to pyrethroids was detected in at least one malaria vector in 87% of the countries and 68% of the sites, to organochlorines in 82% of the countries and 64% of the sites, to carbamates in 69% of the countries and 34% of the sites, and to organophosphates in 60% of the countries and 28% of the sites. Resistance to these four insecticide classes was confirmed in all WHO regions; however, its geographical extent varied considerably between regions.
- Of the 38 countries that reported data on the intensity of pyrethroid resistance (2010–2020), high intensity resistance was detected in 27 countries and 293 sites.
- Between 2019 and 2020, WHO Member States reported the results of 835 bioassays conducted with chlorfenapyr and 603 with clothianidin. For chlorfenapyr, WHO requirements are more elaborate than for previous procedures for testing of mosquito resistance to insecticides. To date, WHO has received results from 502 tests conforming to these requirements, conducted in 391 sites across 20 countries. However, until three complete tests are available from each of these sites, WHO cannot interpret the results. For clothianidin, so far only 13 results using this bioassay have been reported to WHO, with only one case of possible resistance reported – from Senegal.
- To guide resistance management, countries should develop and implement national insecticide resistance monitoring and management plans, drawing on the WHO framework for a national plan for monitoring and management of insecticide resistance in malaria vectors.
- Technical and funding support is required to support countries to monitor and manage insecticide resistance.

Anopheles stephensi invasion and spread

- To date, WHO has received reports of *An. stephensi* detections from Djibouti, Eritrea, Ethiopia, Ghana, Kenya, Nigeria, Somalia, Sri Lanka, Sudan and Yemen.
- The characteristics of this vector make its control challenging; for example, *An. stephensi* quickly adapts to the local environment, surviving extremely high temperatures during the dry season, when malaria transmission usually reaches a seasonal low.
- Insecticide resistance data reported to WHO show that *An. stephensi* has exhibited resistance to pyrethroids, organophosphates, carbamates and organochlorines in the Arabian Peninsula and Asia. In the Horn of Africa, it has exhibited resistance to pyrethroids, organophosphates and carbamates.
- *An. stephensi* poses a threat to malaria control and elimination in Africa, the Arabian Peninsula and southern Asia. If uncontrolled, its spread across Africa, combined with rapid and poorly planned urbanization, may increase the risk of malaria transmission in African cities.
- WHO encourages countries in which *An. stephensi* invasion is suspected or has been confirmed to take immediate action, by increasing vector surveillance to delineate the geographical spread of this vector, and by using data to implement interventions aimed at preventing its further spread, especially into urban and periurban areas.
- Research institutions and implementation partners are encouraged to immediately report any detection of *An. stephensi* to ministries of health and WHO, to inform national and global responses.
- Studies of invasive species detected that are reported to WHO and published in scientific journals can be explored in the Malaria Threats Map.

Climate change, malaria and the global response

- WHO has declared climate change the single biggest health threat facing humanity.
- Climate change threatens to derail progress in global health by affecting livelihoods; increasing the risks of harmful exposures to particulates, pathogens and disease; overburdening health systems; and widening existing inequalities. Thus, climate change is not just a singular threat but a major multiplier of other threats.
- Climate change and its interaction with malaria transmission is complex, and empirical evidence to support reliable predictions is sparse.
- Climate change is also responsible for more extreme and frequent weather events, such as flooding, which can result in malaria epidemics or severe droughts that suppress transmission for a period but are often followed by epidemics when the rains arrive.
- The direction of the effect of climate change on malaria transmission and burden will be non-linear and is likely to vary across different contexts, being dependent on factors such as variations in temperature, rainfall or humidity; the extent of malaria control and elimination; the degree of socioeconomic development; and the management of the environment.
- Temperature, rainfall and humidity influence larval development, mosquito survival, parasite development within the mosquito and vector competence. Changes in these aspects will affect vectorial capacity (i.e. the number of new infections that the population of a given vector would induce per case per day at a given place and time), and hence affect the intensity of malaria transmission.
- The potential direct effects of climate change on malaria could include expansion of its geographical limit, increases or reductions in transmission intensity within the current limits of transmission, reintroduction of malaria in areas where malaria was eliminated, or imperceptible changes in transmission.
- The potential indirect effects of climate change on malaria could include loss of livelihoods and increased economic and food insecurity, displacements and service disruptions, increased difficulty and cost of malaria programmes, and variations in access to and quality of health delivery systems.

- The empirical evidence of the effect of climate change on malaria transmission is mixed; this is partly because of data limitations, but also because of the many parallel determinants of malaria transmission that occur against a background of a changing climate.
- The strongest evidence, perhaps, comes from long time-series data from African highland areas that are on the fringes of endemic transmission; these data suggest that, over recent decades, rising temperatures have led to the expansion of malaria to highland areas.
- In 2022 and 2023, extreme monsoon rainfall affected many parts of Pakistan, with evidence suggesting that the severity of the monsoon season was heightened by climate change. This flooding led to a large malaria epidemic that increased the malaria cases in the country by fivefold compared with the year before.
- Under the Strategic Advisory Group for malaria eradication (SAGme), WHO commissioned a study, led by the Malaria Atlas Project, to predict future malaria trajectories under various intervention, socioeconomic and climate change scenarios based on the shared socioeconomic pathways (SSPs) developed by the Intergovernmental Panel on Climate Change (IPCC).
- Under the “middle-of-the-road” climate scenario (SSP2), the analysis suggests that, with current levels of intervention coverage, combined with changing environmental and socioeconomic conditions, malaria incidence is likely to decrease even if malaria cases increase slightly as a result of population growth.
- If current interventions are scaled up to high levels of coverage, and the predicted changes in environmental and socioeconomic conditions are maintained, the analysis suggests the potential for substantial reductions in malaria incidence.
- Similar trends of lower magnitude were projected when considering the continuation of the current level of development and fossil fuel use (SSP5) under different intervention scenarios. The scaling up of interventions has not yet been fully costed under the different SSP scenarios, but costs are likely to be far higher than currently estimated under the GTS. The increased cost and the disproportionate impact on those facing vulnerability further highlights the need for ensuring more effective and equitable use of the limited resources available.
- However, the debate over the direction and magnitude of the effect of climate change on malaria should not deter the global community from ensuring sustainable and resilient malaria responses in the face of the threat of climate change.
- This report proposes a focus on strategic, technical and operational actions.
- The strategic actions include freeing the world of malaria while reducing overall climate change vulnerability, establishing a common voice and building partnerships to share a common narrative that promotes multisectoral actions that both reduce carbon emissions and improve health, decarbonizing and making health systems more environmentally sound, and shifting the locus of decision-making towards countries.
- The technical actions include producing information on the climate change–health nexus; building better, more climate-resilient and environmentally sustainable health systems; and providing guidance and tools for climate and health surveillance, and for monitoring and evaluation.
- The operational actions include using climate and disease information for decision-making; establishing robust epidemic detection, preparedness and response systems; and enhancing national capacity to analyse and use climate and malaria information.
- Malaria eradication is the only way to resolve the devastating effects of this disease, with or without the added threat of climate change. As such, investments should be made to mitigate biological threats to malaria and develop more efficacious tools.
- Investment is needed to research the ways in which climatic variations and climate change influence the malaria response across different timescales, and effective ways to communicate these risks to policy-makers, funders and the public. Also needed is research into lowering the carbon footprint of the health sector, including the malaria response.
- Future products and their delivery will need to suit an operating environment that has been redefined by climate change – for example, medicines and diagnostics that are heat stable and prevention tools that are suited for displaced or migrant populations. Their design should also minimize their environmental impact, by identifying future products that are biodegradable, or can be easily manufactured locally. Building

the resilience of malaria responses to the risks of climate change will require vastly increased financing for combating the disease, combined with better use of local data to effectively tailor interventions dynamically and subnationally.

- The commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to jointly mobilize and to fully operationalize the Green Climate Fund should include malaria and recognize the need for broader climate mitigation, not just the reduction of greenhouse gas emissions.

Avant-propos



Chaque année, le *Rapport sur le paludisme dans le monde* de l'OMS évalue de manière détaillée et actualisée les tendances en matière de contrôle et d'élimination du paludisme au niveau mondial. Pour la première fois cette année, le rapport inclut un chapitre consacré à l'interaction entre changement climatique et paludisme.

La variabilité du climat, notamment les changements de températures et de niveaux de précipitations, peuvent avoir un impact sur le comportement et la survie du moustique anophèle, vecteur du paludisme. Des phénomènes météorologiques extrêmes, tels que les vagues de chaleur ou les inondations, peuvent augmenter la transmission et le poids du paludisme.

Le changement climatique a également des effets indirects sur le paludisme. Les déplacements de population, par exemple, risquent d'entraîner une augmentation du nombre de cas de paludisme, avec des personnes non immunisées migrant vers

des zones d'endémie. Dans de nombreuses régions du monde, le changement climatique entraîne la malnutrition, un facteur de risque de paludisme grave chez les jeunes enfants et les femmes enceintes.

Le changement climatique n'est qu'une des nombreuses menaces qui pèsent sur la lutte contre le paludisme au niveau mondial. Des millions de personnes restent encore privées des services dont elles ont besoin pour prévenir, détecter et traiter la maladie. Les conflits, les crises humanitaires, le manque de ressources et les défis biologiques, tels que la résistance aux médicaments et aux insecticides, continuent également d'entraver les progrès.

Dans l'ensemble, ces menaces compromettent les avancées en matière de lutte contre le paludisme au niveau mondial. En 2022, le nombre total de cas de paludisme dans le monde a atteint 249 millions, bien au delà du nombre de cas estimés avant la pandémie de COVID 19 et cinq millions de plus qu'en 2021.

Ce rapport fait aussi état de progrès importants. Le premier vaccin antipaludique recommandé par l'OMS, RTS,S/AS01, a permis de réduire le nombre de décès chez les jeunes enfants de 13 % au Ghana, au Kenya et au Malawi. En octobre 2023, l'OMS a recommandé un deuxième vaccin sûr et efficace contre le paludisme, R21/Matrix-M. Un marché proposant deux vaccins permettra d'intensifier la couverture en Afrique.

En 2022, 49 millions d'enfants ont été traités par chimioprévention du paludisme saisonnier dans 17 pays d'Afrique au total, contre 170 000 seulement en 2012.

Par ailleurs, une nouvelle génération de moustiquaires à double substance active, recommandées par l'OMS plus tôt cette année, a démontré un impact plus fort contre les moustiques résistants aux pyréthréinoïdes par rapport aux moustiquaires imprégnées de ce seul type d'insecticide.

Dans le même temps, l'objectif d'élimination du paludisme a été atteint dans un plus grand nombre de pays. Rien que cette année, trois pays supplémentaires, l'Azerbaïdjan, le Belize et le Tadjikistan, ont été certifiés exempts de paludisme par l'OMS, et plusieurs autres pays sont en passe d'éliminer cette maladie l'année prochaine.

Ces progrès, et bien d'autres, témoignent de l'engagement national et de la volonté mondiale de contrôler et d'éliminer le paludisme. Néanmoins, avec des conditions météorologiques extrêmes, des ressources limitées et des menaces toujours plus nombreuses, la vision d'un monde sans paludisme paraît encore difficilement accessible.

Une bien meilleure allocation des ressources, des stratégies fondées sur des données précises et de nouveaux outils sont requis pour relancer la lutte contre le paludisme. Avec la menace supplémentaire liée au changement climatique, des actions de riposte face au paludisme, à la fois résilientes et durables, s'avèrent nécessaires aujourd'hui plus que jamais.

Dr Tedros Adhanom Ghebreyesus
Directeur général
Organisation mondiale de la Santé (OMS)

Le rapport de cette année en un clin d’œil

Événements clés en 2022-2023

Stratégie opérationnelle du Programme mondial de lutte contre le paludisme

- Les progrès en matière de lutte contre le paludisme au niveau mondial stagnent depuis quelques années, et une approche habituelle ou classique ne fera qu'éloigner davantage les pays et leurs partenaires de développement des objectifs qu'ils s'étaient fixés. Reconnaissant que « corriger le tir » exigerait des changements importants pour lutter contre le paludisme, le Programme mondial de lutte contre le paludisme de l'Organisation mondiale de la Santé (OMS/GMP) a développé une stratégie opérationnelle au niveau du département pour la période 2024-2030.
- Cette stratégie reflète les informations fournies par différents pays, partenaires et collègues de l'OMS qui ont aidé à mieux comprendre pourquoi les progrès se sont quasiment arrêtés.
- Cette stratégie opérationnelle s'articule autour de quatre objectifs : normes et standards, nouveaux outils et innovation, informations stratégiques pour l'impact et leadership. Le support aux pays, tenant compte du contexte spécifique, constitue un cinquième axe transversal en complément de ces objectifs.

Nouvelles recommandations de l'OMS

- L'OMS a énoncé une *recommandation « forte »* pour le déploiement de moustiquaires imprégnées d'insecticide (MII) associant pyréthrinioïde et chlorfénapyr par rapport aux MII imprégnées uniquement de pyréthrinioïdes pour prévenir le paludisme chez les enfants et les adultes vivant dans des zones où les moustiques ont développé une résistance aux pyréthrinioïdes.
- L'OMS a également publié une *recommandation « conditionnelle »* pour le déploiement de MII associant pyréthrinioïde et chlorfénapyr plutôt que de MII traitées avec du pyréthrinioïde et du butoxyde de pipéronyle (PBO) pour prévenir le paludisme chez les enfants et les adultes dans les zones où la résistance aux pyréthrinioïdes est avérée. Le caractère conditionnel de cette recommandation repose sur l'évaluation du Groupe d'élaboration des lignes directrices (GDG) de l'OMS, qui estime que l'équilibre entre effets désirables et indésirables penche davantage en faveur des MII associant pyréthrinioïde et chlorfénapyr que des MII pyréthrinioïde-PBO et ce, sur la base de données probantes issues d'un seul essai clinique dans la région Afrique de l'OMS.
- L'OMS a également publié une *recommandation « conditionnelle »* pour le déploiement de MII à base de pyréthrinioïdes-pyriproxyfène par rapport aux MII imprégnées uniquement de pyréthrinioïdes pour prévenir le paludisme chez les enfants et les adultes dans les zones où la résistance aux pyréthrinioïdes est avérée. Le caractère conditionnel de cette recommandation traduit les préoccupations du GDG concernant la faible rentabilité des MII à base de pyréthrinioïdes-pyriproxyfène par rapport aux MII imprégnées uniquement de pyréthrinioïdes. En effet, les ressources supplémentaires nécessaires à l'achat de ce type de MII risquent d'avoir un impact négatif tant sur la couverture que sur l'équité.

Déploiement du vaccin antipaludique RTS,S/AS01 dans les zones de transmission modérée à élevée

- Depuis 2019, le Ghana, le Kenya et le Malawi distribuent le vaccin antipaludique RTS,S/AS01 (RTS,S) dans le cadre du Programme de mise en œuvre du vaccin antipaludique (MVIP), qui est coordonné par l'OMS et financé par Gavi, l'Alliance du Vaccin, le Fonds mondial de lutte contre le sida, la tuberculose et le paludisme (Fonds mondial) et Unitaid.
- Depuis que l'OMS a recommandé l'utilisation du vaccin RTS,S en octobre 2021, au moins 28 pays de la région Afrique de l'OMS ont exprimé leur intérêt vis-à-vis de l'introduction de ce vaccin antipaludique. Plusieurs pays ont soumis leur candidature à Gavi et 18 ont déjà obtenu l'approbation d'un support pour le déploiement du vaccin.
- Compte tenu des contraintes initiales en matière d'approvisionnement en vaccins RTS,S, un cadre d'allocation d'un approvisionnement limité en vaccins antipaludiques a été mis au point et appliqué pour allouer les 18 millions de doses du tout premier vaccin antipaludique à 12 pays pour 2023-2025 et ce, pour une introduction sous-nationale là où les besoins sont les plus importants.
- Les premières doses de vaccin devraient arriver dans les pays au cours du dernier trimestre 2023, pour un déploiement prévu début 2024.

Recommandation par l'OMS d'un deuxième vaccin antipaludique R21/Matrix M

- En octobre 2023, l'OMS a recommandé un second vaccin antipaludique, R21/Matrix M (R21), pour prévenir le paludisme chez les enfants vivant dans des zones à risque.
- L'introduction du vaccin R21, conjugué au déploiement en cours du premier vaccin antipaludique, le RTS,S, devrait permettre un approvisionnement suffisant en vaccins pour les enfants vivant dans des zones où le paludisme constitue un risque majeur pour la santé publique.
- L'OMS recommande l'utilisation des vaccins antipaludiques (RTS,S ou R21) pour prévenir le paludisme à *Plasmodium falciparum* chez les enfants vivant dans des régions d'endémie palustre, en priorité là où la transmission du paludisme est modérée à élevée.
- Concernant le vaccin R21, les prochaines étapes consistent à finaliser le processus de préqualification par l'OMS pour permettre son achat au niveau international et, ainsi, étendre son déploiement. L'OMS, Gavi et les partenaires s'efforceront ensuite d'aider les pays à préparer l'introduction des vaccins antipaludiques, afin qu'ils tirent pleinement profit de cette intervention qui sauve des vies.

Récente position de l'OMS sur la pandémie de COVID-19

- Durant la quinzième réunion du Comité d'urgence du Règlement sanitaire international (2005) concernant la pandémie de maladie à coronavirus 2019 (COVID-19), qui s'est tenue en mai 2023, le Directeur général de l'OMS, Tedros A. Ghebreyesus, a estimé que la COVID-19 est maintenant un problème de santé établi et à caractère persistant qui ne constitue plus une urgence de santé publique de portée internationale.

Autres urgences sanitaires et humanitaires

- De 2019 à 2022, 41 pays d'endémie palustre ont été confrontés à diverses urgences sanitaires et humanitaires, sans compter la pandémie de COVID-19.
- Durant cette période, on estime que 145 à 267 millions de personnes ont eu besoin d'assistance face à ces urgences.
- La famine et les inondations ont été les principales causes d'urgences humanitaires, parfois aggravées par des épidémies.

Poids du paludisme : évolution du nombre de cas et de décès

Cas de paludisme

- Au niveau mondial, le nombre de cas de paludisme est estimé à 249 millions en 2022 dans 85 pays et territoires d'endémie palustre (y compris la Guyane française), soit une hausse de 5 millions par rapport à 2021. Les principaux pays qui contribuent à cette augmentation sont le Pakistan (+2,1 millions), l'Éthiopie (+1,3 million), le Nigéria (+1,3 million) et la Papouasie-Nouvelle-Guinée (+423 000). En 2015, l'année de référence de la *Stratégie technique mondiale de lutte contre le paludisme 2016-2030* (le GTS), le nombre de cas de paludisme était estimé à 231 millions.
- L'incidence du paludisme a diminué de 81 cas pour 1 000 habitants exposés au risque de paludisme en 2000 à 57 cas en 2019. Suite à une légère augmentation de 3 % en 2020, l'incidence s'est stabilisée ces trois dernières années et, en 2022, elle a atteint 58 cas pour 1 000 habitants.
- Le pourcentage des infections à *P. vivax* a diminué, passant de 8 % (20,5 millions) en 2000 à 3 % (6,9 millions) en 2022.
- Vingt-neuf pays ont concentré 95 % du nombre total de cas de paludisme dans le monde. Quatre d'entre eux ont enregistré, à eux seuls, près de la moitié des cas : le Nigéria (27 %), la République démocratique du Congo (12 %), l'Ouganda (5 %) et le Mozambique (4 %).
- En 2022, la région Afrique de l'OMS représentait environ 94 % (233 millions) des cas estimés dans le monde.
- Dans la région Afrique de l'OMS, l'incidence du paludisme a baissé de 370 à 226 cas pour 1 000 habitants exposés au risque de paludisme sur la période 2000-2019 avant de remonter à 232 pour 1 000 en 2020, principalement en raison de la perturbation des services pendant la pandémie de COVID-19. En 2022, l'incidence du paludisme a reculé pour atteindre 223 cas pour 1 000 habitants.
- Le Cabo Verde a rapporté zéro cas de paludisme indigène pour la quatrième année consécutive, mettant fin à l'épidémie de paludisme.
- La région Asie du Sud-Est de l'OMS a concentré près de 2 % des cas de paludisme dans le monde. Le nombre de cas y a chuté de 76 %, passant de 23 millions en 2000 à environ 5 millions en 2022. De même, l'incidence du paludisme dans cette région a diminué de 83 %, avec quelque 18 cas pour 1 000 habitants exposés au risque de paludisme en 2000, contre 3 en 2022.
- En 2022, l'Inde a représenté à elle seule 66 % des cas de paludisme dans la région. Près de 46 % des cas dans cette région étaient des infections à *P. vivax*. Le Sri Lanka a été certifié exempt de paludisme en 2016 et reste sans paludisme.
- Malgré une baisse globale de 11,9 % du nombre de cas estimés dans la région entre 2021 et 2022, une augmentation du nombre de cas et de l'incidence du paludisme a été observée au Bangladesh, en Indonésie, au Myanmar et en Thaïlande.
- Le nombre de cas de paludisme dans la région Méditerranée orientale de l'OMS a réduit de 38 %, passant de près de 7 millions de cas en 2000 à 4 millions environ en 2015. Entre 2015 et 2022, il a augmenté de 92 % pour atteindre 8,3 millions.
- Entre 2021 à 2022, 25 % de cas de paludisme en plus ont été estimés dans la région, principalement en raison d'une forte augmentation (2,1 millions de cas) au Pakistan, suite à des inondations catastrophiques qui ont touché plus de 30 millions de personnes.
- Sur la période 2000-2015, l'incidence du paludisme avait diminué de 20,2 à 9 cas pour 1 000 habitants exposés au risque de paludisme, avant de remonter à 15,2 cas pour 1 000 habitants en 2022. Avec quelque 41 % des cas, le Soudan est le pays le plus touché dans cette région. En 2022, la République islamique d'Iran a rapporté 1 439 cas acquis localement, dont des cas de paludisme indigène, alors qu'elle n'avait rapporté aucun cas de paludisme indigène pendant quatre années consécutives (2018-2021). L'Arabie saoudite n'a rapporté aucun cas de paludisme indigène pour la deuxième année consécutive.
- Dans la région Pacifique occidental de l'OMS, 1,4 million de cas ont été estimés en 2021, soit une baisse de 48 % par rapport aux 2,6 millions de cas de 2000. Néanmoins, une augmentation de 23 % a été enregistrée entre 2021 et 2022, soit 1,9 million de cas en 2022. Sur la même période, l'incidence du paludisme est passée de quatre à deux cas pour 1 000 habitants exposés au risque de paludisme. La Papouasie-Nouvelle-Guinée a enregistré près de 90 % des cas dans cette région en 2022. La Chine a été certifiée exempte de paludisme en 2021. La Malaisie n'a rapporté aucun cas de paludisme humain pour la cinquième année consécutive, malgré une augmentation des infections à *P. knowlesi* (2 500 en 2022).

- Dans la région Amériques de l'OMS, le nombre de cas de paludisme a diminué de 64 %, (passant de 1,5 million à 0,6 million) et l'incidence du paludisme de 73 % (de 13 à 4 cas pour 1 000 habitants à risque) entre 2000 et 2022. Les progrès réalisés dans cette région ces dernières années ont souffert de la forte hausse du paludisme en République bolivarienne du Venezuela, qui avait recensé près de 35 500 cas en 2000, contre plus de 483 000 en 2017. En 2020, le nombre de cas y a été réduit de plus de 50 % (223 000) par rapport à 2019, avant de continuer à décroître en 2021 (205 000) et 2022 (154 000). Ce recul s'explique par la limitation des déplacements due à la pandémie de COVID-19, et une plus grande disponibilité des outils de diagnostic et de traitement du paludisme.
- Le Brésil, la Colombie et la République bolivarienne du Venezuela ont concentré 73 % des cas de paludisme dans la région Amériques de l'OMS.
- L'Argentine, le Belize, El Salvador et le Paraguay ont respectivement été certifiés exempts de paludisme par l'OMS en 2019, 2023, 2021 et 2018.
- Depuis 2015, la région Europe de l'OMS est exempte de paludisme.

Mortalité associée

- Au niveau mondial, le nombre de décès dus au paludisme a baissé de façon régulière, passant de 864 000 en 2000 à 586 000 en 2015, puis à 576 000 en 2019. En 2020, le nombre de décès dus au paludisme a augmenté de 10 % par rapport à 2019, atteignant 631 000 selon les estimations. Les estimations concernant le nombre de décès en 2022 s'élèvent à 608 000. Les enfants de moins de 5 ans représentaient 87 % des décès associés au paludisme en 2000, contre 76 % en 2015. Aucune évolution n'est à noter depuis lors.
- La mortalité associée au paludisme (i. e. nombre de décès pour 100 000 habitants exposés au risque de paludisme) a diminué de moitié au niveau mondial, passant de 29 en 2000 à 15 en 2015. La baisse s'est ensuite poursuivie à un rythme plus modeste pour atteindre 14 en 2019. En 2020, le taux de mortalité est remonté à 15,2, avant de légèrement diminuer à 14,3 en 2022.
- Au niveau mondial, près de 96 % des décès dus au paludisme ont été enregistrés dans 29 pays. Quatre pays ont concentré un peu plus de la moitié des décès dus au paludisme dans le monde en 2022 : le Nigéria (31 %), la République démocratique du Congo (12 %), le Niger (6 %) et la République-Unie de Tanzanie (4 %).
- Dans la région Afrique de l'OMS, le nombre de décès dus au paludisme a diminué, passant de 808 000 en 2000 à 548 000 en 2017, avant de remonter à 604 000 en 2020. Selon les estimations, le nombre de décès a de nouveau baissé en 2022 pour atteindre 580 000. Sur la période 2000-2019, la mortalité associée a baissé de 60 %, chutant de 143 à 57 décès pour 100 000 habitants exposés au risque de paludisme, avant de remonter à 61 en 2020 pour finalement retomber à 56 en 2022.
- Depuis 2018, le Cabo Verde n'a signalé aucun décès dû au paludisme.
- Dans la région Asie du Sud-Est de l'OMS, le nombre de décès dus au paludisme a diminué de 77 %, avec 35 000 décès en 2000 contre 8 000 en 2022. L'Inde et l'Indonésie ont concentré environ 94 % de tous les décès dus au paludisme dans la région Asie du Sud-Est de l'OMS.
- Dans la région Méditerranée orientale de l'OMS, le nombre de décès dus au paludisme a diminué de 45 %, passant de 13 600 en 2000 à 7 500 en 2014. Il a ensuite plus que doublé entre 2014 et 2022 pour atteindre 15 900. La plupart de ces décès ont été observés au Soudan, où près de 90 % des cas sont des infections à *P. falciparum*, dont le taux de létalité est supérieur aux infections à *P. vivax*.
- Dans la région Méditerranée orientale de l'OMS, la mortalité associée au paludisme a baissé de 43 % de 2000 à 2015. Elle est restée pratiquement inchangée jusqu'en 2021, avant d'augmenter de 14 % de 2021 à 2022 pour atteindre environ 3 décès pour 100 000 habitants à risque.
- Dans la région Pacifique occidental de l'OMS, le nombre de décès dus au paludisme a diminué de 56 %, passant de 6 300 décès en 2000 à 2 600 en 2021. De 2021 à 2022, la mortalité a augmenté de 29 % pour atteindre 3 600 décès, principalement en raison de l'aggravation de la situation en Papouasie-Nouvelle-Guinée.
- Dans la région Amériques de l'OMS, le nombre de décès dus au paludisme a diminué de 63 % (850 contre 343) entre 2000 et 2022, et la mortalité associée de 71 % (0,7 décès pour 100 000 habitants à risque contre 0,2).

Nombre de cas de paludisme et de décès évités

- Selon les estimations, 2,1 milliards de cas de paludisme et 11,7 millions de décès associés ont été évités dans le monde entre 2000 et 2022.
- La plupart des cas (82 %) et des décès (94 %) évités l’auraient été dans la région Afrique de l’OMS, suivie par la région Asie du Sud-Est (10 % des cas et 3 % des décès).

Poids du paludisme pendant la grossesse

- En 2022, sur les 35,4 millions de femmes enceintes vivant dans 33 pays de la région Afrique de l’OMS où la transmission est modérée à élevée, 12,7 millions (36 %) ont été exposées à une infection palustre durant leur grossesse.
- En détaillant les sous-régions de l’OMS, l’Afrique de l’Ouest et l’Afrique centrale ont affiché la plus forte prévalence d’exposition au paludisme durant la grossesse (avec 39,3 % et 40,1 %, respectivement), alors que la sous-région Afrique de l’Est et Afrique australe a enregistré une prévalence plus faible (27 %).
- Sans prévention spécifique du paludisme pendant la grossesse, il est estimé que 914 000 enfants auraient présenté un faible poids à la naissance dans ces 33 pays, contre environ 393 000 estimés avec les taux de couverture actuels en traitement préventif intermittent pendant la grossesse (TPIp) dans ces trois sous-régions.
- Si toutes les femmes enceintes se rendant au moins une fois à une consultation prénatale recevaient une seule dose de TPIp, en supposant qu’elles soient toutes éligibles et que le taux de couverture en TPIp par deux et trois doses restait aux niveaux actuels, 60 000 cas supplémentaires de faible poids à la naissance auraient été évités dans ces 33 pays qui fournissent des données sur le TPIp.
- Si la couverture en TPIp par trois doses atteignait le taux de couverture des soins prénataux (une visite), et si ce taux de couverture était maintenu pour les consultations prénatales suivantes, 164 000 enfants supplémentaires ne présenteraient pas un faible poids à la naissance.
- Si 90 % des femmes enceintes recevaient trois doses de TPIp, 229 000 enfants supplémentaires ne présenteraient pas un faible poids à la naissance.
- Éviter l’insuffisance pondérale à la naissance, qui représente un risque important de mortalité néonatale et infantile, permettrait de sauver de nombreuses vies.

Élimination du paludisme et prévention de sa réapparition

- L’élimination du paludisme suscite un intérêt croissant dans de nombreux pays à mesure qu’ils se rapprochent de l’objectif de zéro cas de paludisme indigène et que, dans le même temps, davantage de pays sont certifiés exempts de paludisme.
- Le nombre de pays où le paludisme était endémique en 2000 et qui ont rapporté moins de 100 cas a augmenté, passant de 6 en 2000 à 27 en 2022, même si un léger recul est enregistré par rapport au niveau de 2021 (28).
- Les pays comptant moins de 10 cas de paludisme indigène sont passés de 4 en 2000 à 25 en 2021 et 2022.
- De 2000 à 2022, 25 pays où le paludisme était endémique en 2000 ont rapporté zéro cas de paludisme indigène pendant trois années consécutives, et 12 de ces pays ont été certifiés exempts de paludisme par l’OMS.
- Aucun pays n’a été certifié exempt de paludisme en 2022, mais l’Azerbaïdjan, le Belize et le Tadjikistan ont obtenu leur certification en 2023.
- Deux pays, l’Égypte et le Timor-Leste, ont déposé une demande formelle de certification en 2023.
- Le Cabo Verde a rapporté zéro cas de paludisme indigène pour la quatrième année consécutive, et se trouve maintenant à la dernière étape du processus de certification.

- Entre 2010 et 2022, le nombre de cas de paludisme indigène rapportés dans les pays et le territoire participant à l’initiative « visant l’élimination du paludisme d’ici 2025 » (initiative E-2025) a baissé de 72,3 %, malgré une augmentation observée en 2017-2018, puis une autre depuis 2021.
- L’augmentation des cas observée en 2022 est surtout liée à une flambée épidémique aux Comores, où le nombre de cas a quasiment doublé, 10 537 en 2021 contre 20 675 en 2022. D’autres pays ont également connu de fortes hausses durant cette période : le Costa Rica (189 cas en 2021 contre 409 en 2022), le Panama (4 354 cas en 2021 contre 7 102 en 2022), la Thaïlande (2 426 cas en 2021 contre 6 263 en 2022), le Honduras où le nombre de cas a plus que doublé (1 542 en 2021 contre 3 534 en 2022) et Vanuatu où le nombre de cas a été multiplié par presque quatre (312 en 2021 contre 1 102 en 2022).
- Durant la même période, le nombre de cas a augmenté dans d’autres pays à des degrés divers : le Guatemala (+45,7 %), le Népal (+12,5 %), la République de Corée (+39,4 %), la République dominicaine (+12,6 %) et Sao Tomé-et-Principe (+46 %).
- En 2022, la République islamique d’Iran a connu une résurgence de cas de paludisme, avec 1 439 cas acquis localement rapportés en 2022 après quatre années consécutives sans aucun cas de paludisme indigène.
- Malgré ces revers, plusieurs pays et un territoire ont enregistré une forte baisse du nombre de cas de paludisme indigène : l’Afrique du Sud (-31,3 %), le Botswana (-43,5 %), l’Équateur (-38 %), Eswatini (-57,6 %), la Guyane française (-71,6 %), le Mexique (-32,6 %) et la République populaire démocratique de Corée (-9,3 %).
- Pour la cinquième année consécutive, la Malaisie n’a rapporté aucun cas de paludisme indigène humain du genre *Plasmodium*.
- Après la résurgence de trois cas de paludisme au Timor-Leste en 2020, le pays a réussi à réorganiser ses efforts et enregistre pour la deuxième année consécutive (2021 et 2022 – et 36 mois si on prend en compte 2023) zéro cas de paludisme indigène. En 2022, l’Arabie saoudite rapporte également zéro cas de paludisme indigène pour la deuxième année consécutive.
- Le Bhoutan et le Suriname ont rapporté zéro cas de paludisme indigène pour la première fois.
- Ces dernières années, *P. knowlesi* est devenu un vif sujet de préoccupation en ce qui concerne les cas de paludisme, surtout en Indonésie, en Malaisie et en Thaïlande, trois pays de la région Asie du Sud-Est de l’OMS.
- En 2022, 2 768 infections par *P. knowlesi* ont été rapportées au total dans le monde, soit une baisse de 24,2 % par rapport à 2021 (3 651 infections). Les cas de paludisme indigène à *P. knowlesi* ont également diminué de 26 %, passant de 3 629 en 2021 à 2 682 en 2022.
- Au niveau mondial, la Malaisie représente à elle seule 90,5 % des infections par *P. knowlesi* en 2022, suivie par la Thaïlande et l’Indonésie (respectivement 3,1 % et 0,1 %).
- Dans les pays de la sous-région du Grand Mékong, le nombre total de cas de paludisme indigène a baissé de 55,5 % entre 2000 et 2022, et le nombre de cas de paludisme indigène à *P. falciparum* a chuté de 89,1 % sur la même période. Seule la Chine n’a rapporté aucun cas de paludisme indigène et reste donc exempte de paludisme.
- Dans la sous-région du Grand Mékong, les cas de paludisme indigène ont augmenté, passant de 90 082 cas en 2021 à 170 527 en 2022. De même, le nombre de cas de paludisme indigène à *P. falciparum* a presque doublé, de 16 490 cas en 2021 à 30 789 en 2022.
- Le Myanmar paie le plus lourd tribut au paludisme dans la région, avec 92,4 % des cas de paludisme indigène et 95 % des infections par *P. falciparum*.
- Plusieurs pays E-2025 qui avaient atteint l’objectif de zéro cas de paludisme indigène ont récemment été confrontés à des difficultés liées aux migrants et aux zones frontalières. L’OMS élabore à l’heure actuelle des lignes directrices sur la lutte contre le paludisme au niveau transfrontalier, qui reste un défi pour l’élimination du paludisme et la prévention de sa réapparition.
- L’Arabie saoudite, le Bhoutan et le Suriname, qui rapportent zéro cas de paludisme indigène depuis un peu plus d’an, mettent en œuvre de manière proactive des stratégies de prévention de la réintroduction des cas de paludisme indigène.
- Après cinq ans d’absence de transmission locale, la République islamique d’Iran connaît actuellement une résurgence de cas de paludisme indigène. De fréquents mouvements de populations aux frontières ont contribué à l’introduction des cas et à une reprise de la transmission locale.

- Reconnaisant le besoin en directives sur la question, l’OMS élabore actuellement des lignes directrices en matière de prévention de la réapparition du paludisme.

Approche « high burden to high impact »

- Depuis novembre 2018, les 11 pays de l’approche « high burden to high impact » (HBHI) ont mis en œuvre des activités en rapport avec les quatre éléments de riposte définis.
- En 2022, le Soudan a rejoint le premier groupe de pays HBHI, à la demande du Ministère Fédéral de la Santé soudanais. Cet ajout a fait passer à 12 le nombre officiel des pays HBHI. La mise en œuvre complète de l’approche a toutefois été freinée au Soudan par le conflit qui a éclaté début 2023.
- Selon les estimations, l’incidence du paludisme et la mortalité associée dans les 11 pays HBHI d’origine sont restées en grande partie inchangées de 2021 à 2022, avec quelques hausses du nombre de cas principalement en raison de la croissance démographique.
- En 2022, les 11 pays HBHI ont représenté 67 % des cas de paludisme et 73 % des décès associés dans le monde.
- Suite aux résultats positifs observés dans les pays HBHI d’origine, plusieurs autres pays des régions Afrique et Méditerranée orientale de l’OMS ont commencé à implémenter le deuxième pilier de l’approche HBHI, qui porte sur l’utilisation stratégique des informations, en mettant plus particulièrement l’accent sur l’adaptation sous-nationale (ASN) des interventions.
- L’ASN repose sur l’utilisation de données locales et d’informations contextuelles pour déterminer la combinaison appropriée de stratégies et d’interventions pour une zone spécifique, afin d’optimiser l’impact sur la transmission et le poids du paludisme à un niveau stratégique ou dans le cadre d’une enveloppe budgétaire donnée.
- Depuis 2018, plus de 30 pays d’endémie ont mis en œuvre l’ASN pour orienter la planification stratégique d’une seule ou de plusieurs interventions, guider les efforts de mobilisation des ressources, les demandes de financement, les négociations budgétaires ou l’optimisation de la mise en œuvre des interventions.
- La mise en œuvre de l’ASN a stimulé l’intégration des données dans le cadre des processus habituels de prise de décisions des pays. Par conséquent, davantage d’efforts sont déployés pour améliorer la collecte, la révision et la qualité des données à intervalles réguliers.
- Des disparités ont été observées sur le plan de la capacité des pays à totalement mettre en œuvre l’ASN au niveau local. Les insuffisances en termes de capacité doivent être traitées collectivement par les pays, leurs partenaires et les bailleurs de fonds.

Investissements dans les programmes et la recherche antipaludiques

- Le GTS donne une estimation des fonds requis pour atteindre les objectifs intermédiaires de 2025 et 2030. Au total, les ressources annuelles nécessaires ont été estimées à US\$ 6,8 milliards en 2020, avec une hausse à US\$ 9,3 milliards en 2025 et US\$ 10,3 milliards d’ici 2030. Toujours selon les estimations, US\$ 850 millions supplémentaires seront requis chaque année pour la recherche et le développement (R&D) sur le paludisme au niveau mondial durant la période 2021-2030.
- En 2022, US\$ 4,1 milliards ont été investis au total pour le contrôle et l’élimination du paludisme, contre US\$ 3,5 milliards en 2021 et US\$ 3,3 milliards en 2020. Sur les cinq dernières années, le total des fonds investis a atteint en moyenne US\$ 3,3 milliards par an. Les investissements de 2022 sont toujours bien inférieurs aux US\$ 7,8 milliards estimés nécessaires au niveau mondial pour rester sur la voie des objectifs du GTS.
- L’écart entre investissements et ressources nécessaires a continué d’augmenter de façon spectaculaire au cours de ces dernières années, passant de US\$ 2,3 milliards en 2018 à US\$ 3,7 milliards en 2022. Malgré la

croissance considérable du financement total entre 2021 et 2022, le montant des fonds investis en 2022 n’a couvert que 52 % des ressources requises par les objectifs du GTS.

- Sur la période 2010-2022, 66 % des fonds dédiés à la lutte contre le paludisme et à son élimination provenaient de sources internationales. La contribution des États-Unis s’est élevée à plus de US\$ 1,5 milliard au travers de financements bilatéraux planifiés et de la part, ajustée au paludisme, provenant des agences de contributions multilatérales. Sont venues s’y ajouter les contributions de partenaires bilatéraux et multilatéraux : l’Allemagne, la France et le Royaume-Uni de Grande-Bretagne et d’Irlande du Nord (plus de US\$ 400 millions en cumul), l’Australie, le Canada et le Japon (plus de US\$ 100 millions chacun), ainsi que d’autres pays membres du Comité d’aide au développement et bailleurs de fonds du secteur privé pour des contributions totales à hauteur de US\$ 400 millions.
- En 2022, les gouvernements des pays d’endémie ont contribué à hauteur de plus d’un tiers du financement total, soit plus de US\$ 1,5 milliard. Sur ce montant, US\$ 400 millions ont été investis dans la prise en charge des cas de paludisme dans le secteur public et plus de US\$ 110 millions dans d’autres activités antipaludiques, ce qui correspond à une augmentation substantielle de plus de US\$ 400 millions par rapport à 2021, liée en grande partie à un accroissement des dépenses nationales dans la région Afrique de l’OMS.
- Sur les US\$ 4,1 milliards investis en 2022, quelque US\$ 2,6 milliards provenaient de sources internationales, dont presque US\$ 1,6 milliard (39 %) ont transité par le Fonds mondial. Les décaissements du Fonds mondial en faveur des pays d’endémie ont augmenté de près de US\$ 100 millions depuis 2021 et de US\$ 500 millions depuis 2018.
- Les classifications de la Banque mondiale par groupes de revenus varient d’une année sur l’autre. En 2022, les 25 pays du groupe à faible revenu ont représenté 44 % du financement total, un pourcentage comparable aux années précédentes, avec 70 % de ces fonds en provenance de sources internationales. Les 40 pays à revenu faible et intermédiaire ont obtenu 43 % du financement total en 2022. Les autres pays et certaines régions non précisées (aucune donnée géographique sur les destinataires n’était disponible) ont représenté 13 % du financement de la lutte contre le paludisme.
- L’évaluation du financement de la lutte contre le paludisme par personne à risque révèle des écarts entre les financements nationaux et internationaux au sein des régions de l’OMS, et montre des changements importants au cours des dix dernières années. La plupart des régions de l’OMS ont vu le financement par personne à risque chuter à des niveaux inférieurs à 2010, hormis la région Afrique de l’OMS, où le financement a légèrement augmenté depuis 2010 et encore plus par rapport à 2021 (de plus de 30 %). Cette hausse reflète l’accroissement des financements nationaux au sein de la région Afrique de l’OMS en 2022, en augmentation de plus de US\$ 300 millions depuis 2021.
- Sur les US\$ 4,1 milliards investis en 2022, plus des trois quarts (80 %) ont été dirigés vers la région Afrique de l’OMS, suivie par les régions Asie du Sud-Est, Méditerranée orientale, Amériques (4 % chacune) et Pacifique occidental (2 %). Les 6 % restants ont été alloués à des régions non précisées. Les fonds destinés à la région Afrique de l’OMS ont augmenté de façon significative, alors qu’ils sont restés stables dans les autres régions.
- De nombreux pays ont vu leur produit intérieur brut (PIB) réel fluctuer du fait de la pandémie de COVID-19 et d’autres crises. Ces fluctuations ont affecté l’économie mondiale, qui a progressé de 5,5 % en 2021 après une contraction de 3,4 % en 2020. En 2022, les pays à revenu faible et intermédiaire ont affiché une croissance significative. En effet, seuls 5 % de ces pays ont subi un contrecoup négatif sur leur PIB réel, alors qu’ils étaient 70 % en 2020, ce qui témoigne d’une reprise de l’économie mondiale. Néanmoins, on s’attend à ce que les pays à revenu élevé et d’autres organisations internationales continuent à consacrer leurs efforts à la lutte contre la COVID-19 en 2024, surtout s’ils doivent faire face à des problématiques durables ou à l’émergence de variants. De plus, les tensions géopolitiques risquent d’entraîner une volatilité accrue de l’économie mondiale, qui pourrait influencer en retour sur les dépenses et l’affectation des ressources destinées aux soins de santé.
- La part des dépenses des ménages consacrée à l’ensemble des soins de santé est un facteur essentiel à prendre en compte. Même si ce rapport n’identifie pas les coûts spécifiquement liés au paludisme, les dépenses de santé, qu’elles soient directes ou indirectes, peuvent faire peser une charge très lourde sur les ménages. En 2020, 47 % des ménages habitant dans des pays à revenu faible et intermédiaire ont dû faire face à des dépenses catastrophiques (à savoir des dépenses de santé dépassant 40 % du revenu des ménages), ce qui a eu un impact sur 1,9 milliard de personnes exposées au risque du paludisme dans ces pays.

- Les fonds dédiés à la recherche et au développement (R&D) se sont élevés à US\$ 603 millions en 2022, ce qui correspond à une baisse de plus de 10 % depuis 2021 et au niveau le plus bas jamais enregistré en termes de R&D au cours des quinze dernières années.
- Depuis le pic de 2018, ce financement diminue pour la quatrième année de suite et ce, surtout dans le domaine des vaccins (pour la cinquième année consécutive) et de la recherche fondamentale, avec -13 % et -20 %, respectivement. Le secteur des médicaments a continué à recevoir la majeure partie des fonds, malgré une baisse de 12 %.
- Le financement de la recherche et du développement des produits biologiques a augmenté pour la quatrième année consécutive, plus de 250 % en 2022 et presque 14 fois le niveau constaté en 2018. La Fondation Bill & Melinda Gates a octroyé le tout premier financement jamais réalisé pour le développement clinique de produits biologiques, sous la forme d'une subvention de US\$ 3,9 millions à la Fondation CDC.
- Dans les pays à revenu élevé, les fonds provenant du secteur public ont fortement diminué (-18 %) pour atteindre leur niveau le plus bas depuis plus de dix ans, même s'ils demeurent la principale source de financement en matière de R&D contre le paludisme. Le financement provenant des autres secteurs a également chuté, à l'exception du secteur privé là où US\$ 10 millions supplémentaires ont été alloués en 2022.

Distribution et couverture des outils de prévention du paludisme

- Les fabricants de MII ont indiqué en avoir livré près de 2,9 milliards dans le monde entre 2004 et 2022, dont 2,5 milliards (86 %) en Afrique subsaharienne. En 2022, ces fabricants ont livré près de 282 millions de MII à des pays d'endémie. À elle seule, l'Afrique subsaharienne en a reçu 260 millions en 2022, dont 131,5 millions étaient des moustiquaires imprégnées de pyréthrinioïde et de butoxide de pipéronyle (PBO). Les MII à double substance active ont représenté 8 % de toutes les MII livrées en 2022. En 2022, les programmes nationaux de lutte contre le paludisme (PNLP) dans les pays d'endémie palustre ont distribué 254 millions de MII, dont 235 millions en Afrique subsaharienne.
- Quarante-quatre pays avaient des campagnes de distribution de MII prévues sur 2022, pour un total de 241 millions de moustiquaires à distribuer. Fin 2022, 83 % de toutes les MII dont la distribution était prévue sur l'année avaient effectivement été distribuées.
- Sur les 11 pays soutenus dans le cadre de la première phase de l'approche HBHI, sept ont organisé une campagne de distribution de masse et cinq ont distribué plus de 85 % de leurs moustiquaires en 2022 : le Burkina Faso (90 %), l'Inde (91 %), le Mozambique (100 %), le Nigéria (93 %) et la République-Unie de Tanzanie (100 %). Le Cameroun et la République démocratique du Congo ont respectivement distribué 67 % et 75 % de leurs moustiquaires. Dans ces sept pays, près de 11 millions de moustiquaires étaient en fait des surplus de la campagne de 2021.
- En 2022, 70 % des ménages vivant en Afrique subsaharienne disposaient d'au moins une MII, contre 5 % environ en 2000. Le pourcentage des ménages disposant d'au moins une MII pour deux membres du foyer est passé de 1 % en 2000 à 40 % en 2022. Durant la même période, le pourcentage de la population ayant accès à une MII dans son foyer a augmenté de 3 % à 56 %.
- Le pourcentage de la population dormant sous MII a considérablement augmenté entre 2000 et 2022, qu'il s'agisse de la population dans son ensemble (de 2 % à 49 %), des enfants âgés de moins de 5 ans (de 3 % à 56 %) ou des femmes enceintes (de 3 % à 56 %).
- Depuis 2015, les indicateurs sur l'accès aux MII et sur leur utilisation n'affichent aucune augmentation significative.
- Au niveau mondial, le pourcentage de la population à risque protégée par pulvérisation intradomiciliaire d'insecticides à effet rémanent (PID) dans les pays d'endémie a reculé, passant de 5,5 % en 2010 à 1,8 % en 2022. Le pourcentage de la population protégée par PID est stable depuis 2016, avec moins de 6 % dans chacune des régions de l'OMS.
- Au niveau mondial, la population protégée par PID a chuté de 153 millions en 2010 à 62 millions en 2022.

- Le nombre moyen d'enfants traités par cycle de chimioprévention du paludisme saisonnier (CPS) n'a cessé d'augmenter, passant de quelque 0,2 million en 2012 à 49 millions en 2022. Le Nigéria a contribué le plus à ce résultat, avec une moyenne de 25,5 millions d'enfants traités par cycle de CPS.
- Au total, près de 200 millions de doses de traitement ont été livrées en 2022 dans les 17 pays mettant en œuvre la CPS au Sahel et dans d'autres régions d'Afrique subsaharienne où la transmission du paludisme est saisonnière.
- Le taux d'utilisation (par nombre de doses) du TPIp a été calculé sur la base des données provenant de 33 pays de la région Afrique de l'OMS. En 2022, 78 % des femmes enceintes ont reçu des soins prénataux au moins une fois durant leur grossesse. Environ 64 % des femmes enceintes ont reçu une dose de TPIp, alors que 54 % ont reçu deux doses, et 42 % trois doses.

Distribution et couverture des outils de diagnostic et de traitement du paludisme

- De 2010 à 2022, 3,9 milliards de tests de diagnostic rapide (TDR) du paludisme ont été vendus dans le monde, dont 82 % à destination des pays d'Afrique subsaharienne. Durant la même période, 2,9 milliards de TDR ont été distribués, dont 90 % en Afrique subsaharienne.
- En 2022, 415,5 millions de TDR ont été vendus par les fabricants et 345 millions distribués par les PNLP.
- Entre 2010 et 2022, plus de 4 milliards de traitements par combinaison thérapeutique à base d'artémisinine (ACT) ont été vendus dans le monde. Sur ces ventes, environ 2,7 milliards ont été livrés au secteur public des pays d'endémie. Le reste correspond à des mécanismes de co-paiement public ou privé (ou les deux), voire à des livraisons au secteur du commerce de détail privé exclusivement.
- Les données nationales rapportées par les PNLP montrent que, de 2010 à 2022, 2,5 milliards de traitements par ACT ont été livrés à des prestataires de santé pour le traitement des patients au sein d'un établissement public.
- En 2022, quelque 210 millions de traitements par ACT ont été livrés par les fabricants au secteur public. Cette même année, les PNLP ont distribué 217 millions de traitements par ACT dans ce secteur, dont 97 % en Afrique subsaharienne.
- Les données compilées à partir d'enquêtes réalisées auprès des ménages entre 2005 et 2022 dans 22 pays d'Afrique subsaharienne (ayant mené au moins deux enquêtes : l'une entre 2005-2011 pour servir de référence et l'autre entre 2015-2022 pour la plus récente) ont permis d'analyser le taux de sollicitation de traitement, la couverture en diagnostic et l'utilisation des ACT chez les enfants de moins de 5 ans.
- En comparant enquêtes de référence et enquêtes plus récentes, peu de différences sont apparues concernant la prévalence de la fièvre dans les 2 semaines précédant les enquêtes (médiane de 26 % contre 23 %) ou la sollicitation de traitement en cas de fièvre (médiane de 65 % contre 66 %).
- Les comparaisons de la source du traitement entre enquêtes de référence et enquêtes plus récentes indiquent une médiane de 58 % puis de 69 % pour les soins reçus dans des établissements de santé publics. Le recours aux agents de santé communautaires est resté faible, avec une médiane de 2 % aussi bien pour les enquêtes de référence que les enquêtes plus récentes. La part des soins reçus dans des établissements privés a diminué, passant d'une médiane de 40 % lors des enquêtes de référence à 28 % dans le cadre des enquêtes plus récentes, ce qui indique une amélioration de l'accès de la population aux établissements de santé publics et, par voie de conséquence, au système de surveillance de la santé publique associé.
- Le taux de couverture en diagnostic chez les enfants de moins de 5 ans avec de la fièvre et pour lesquels des soins ont été sollicités a progressé, d'une médiane de 30 % au départ à 54 % dans les dernières enquêtes, ce qui démontre une amélioration de la prise en charge des cas, malgré l'évidence de niveaux inadéquats des services de diagnostic.
- L'utilisation des ACT parmi les enfants fiévreux de moins de 5 ans pour lesquels des soins ont été sollicités a augmenté, passant de 13 % à 24 % dans les dernières enquêtes.

- Parmi les enfants fiévreux ayant subi un prélèvement sanguin au doigt ou au talon, le recours aux ACT a atteint 34 % dans les dernières enquêtes, alors qu’il était de 21 % dans les enquêtes de référence. Parmi ceux pour lesquels des soins ont été sollicités et qui ont reçu un médicament antipaludique, la médiane est passée de 38 % lors des enquêtes de référence à 65 % dans les enquêtes plus récentes, ce qui prouve soit une amélioration des taux de traitement, soit une augmentation des taux de positivité des tests. En raison du manque d’informations sur le type de test de diagnostic réalisé ou le résultat du test, il convient d’interpréter cet indicateur en fonction du contexte spécifique à chaque pays.

Progrès vers l’atteinte des objectifs du GTS pour 2025

- Le GTS appelle à réduire l’incidence du paludisme et la mortalité associée d’au moins 40 % d’ici 2020, 75 % d’ici 2025 et 90 % d’ici 2030 en se basant sur les données de référence de 2015.
- En dépit des progrès considérables accomplis depuis 2000, si la tendance actuelle se confirme, les objectifs du GTS pour 2025 ne seront pas atteints au niveau mondial.
- En 2022, l’incidence du paludisme s’est établie à 58 cas pour 1 000 habitants à risque, au lieu des 26 cas représentés par l’objectif intermédiaire de morbidité fixé dans le GTS pour 2025. En d’autres termes, nous sommes à 55 % en deçà de notre objectif.
- Même si la baisse de la mortalité est plus nette, relativement, que la baisse de l’incidence, l’objectif intermédiaire de 6,6 décès pour 100 000 habitants exposés au risque de paludisme pour 2022 (si le monde était réellement en passe d’atteindre l’objectif intermédiaire du GTS pour 2025), était 53 % en deçà de la mortalité établie au niveau mondial à 14,3 pour 100 000 en 2022.
- Sur les 93 pays où le paludisme était endémique en 2015 (y compris le territoire de la Guyane française), 23 (24,7 %) sont en passe d’atteindre l’objectif intermédiaire du GTS pour 2025 en matière de morbidité. En effet, ils ont réduit leur incidence de 55 % ou plus, ou ont rapporté zéro cas de paludisme en 2022.
- Vingt-quatre pays (26 %) ont réussi à faire baisser l’incidence du paludisme, mais pas suffisamment pour atteindre l’objectif fixé.
- Vingt-cinq pays (27 %) ont enregistré une hausse de l’incidence, et dans 15 pays (15 %), elle a augmenté de 55 % ou plus en 2022 par rapport à 2015.
- Dans quatorze pays (15,1 %), l’incidence du paludisme en 2022 a été estimée à un niveau équivalent à celui de 2015.
- Trente-et-un pays (33 %) où le paludisme était endémique en 2015 sont en passe d’atteindre l’objectif intermédiaire du GTS pour 2025 en matière de mortalité, et 22 d’entre eux ont rapporté zéro décès lié au paludisme.
- Trente-et-un pays (33 %) ont réduit la mortalité due au paludisme, mais leurs progrès sont restés en deçà de l’objectif de -55 % pour 2022.
- En 2022, la mortalité due au paludisme est restée au même niveau qu’en 2015 dans sept pays (7,5 %) ; elle a augmenté dans 17 pays (18,3 %), et de 55 % ou plus dans huit d’entre eux.
- La région Asie du Sud-Est de l’OMS a atteint les objectifs intermédiaires du GTS pour 2020 à la fois en matière de morbidité et de mortalité. Elle est en bonne voie pour atteindre les objectifs du GTS pour 2025 et 2030. Tous les pays de la région, à l’exception de l’Indonésie et du Myanmar, ont réduit l’incidence et la mortalité de 55 % ou plus, voire n’ont enregistré aucun changement.

Menaces biologiques et autres pesant sur les outils d’intervention

Suppression des gènes du parasite

- Les parasites *P. falciparum* incapables d’exprimer la protéine riche en histidine 2 (HRP2) présentent le risque de ne pas être détectés par les TDR basés sur HRP2. De plus, la protéine riche en histidine 3 (HRP3), une homologue de la protéine HRP2, peut provoquer une réaction croisée avec les anticorps monoclonaux

utilisés pour la détection HRP2 à de fortes densités parasitaires. Les parasites *P. falciparum* qui n’expriment ni HRP2 ni HRP3 sont complètement indétectables au moyen des TDR basés sur HRP2. Selon les données fournies par les fabricants, près de 415,5 millions de TDR de ce type ont été vendus en 2022.

- L’OMS recommande aux pays rapportant des suppressions des gènes *Pfhrp2/3* et à leurs pays voisins de mener des études de référence représentatives sur les cas suspectés de paludisme, afin de déterminer si la prévalence des suppressions *Pfhrp2/3* causant des « faux » résultats de TDR négatifs a atteint un seuil qui nécessite un changement de TDR.
- En se basant sur les recherches documentaires renseignant la Carte des menaces du paludisme, 16 nouveaux articles ont été publiés en 2022. Ils contiennent des données provenant de la région Afrique de l’OMS (Burundi, Cameroun, Éthiopie, Ghana, Guinée équatoriale, Kenya, Madagascar, République démocratique du Congo, République-Unie de Tanzanie, Rwanda, Sierra Leone et Soudan du Sud), de la région Amériques de l’OMS (Brésil, Équateur et Pérou), ainsi que du Cambodge, de l’Inde et du Viet Nam.
- Des études sur les suppressions du gène *Pfhrp2* ont été publiées pour la première fois en 2022 dans six pays (Burundi, Cambodge, Cameroun, Sierra Leone, Soudan du Sud et Viet Nam). Seuls le Burundi et le Viet Nam n’ont détecté aucune suppression du gène *Pfhrp2*.
- En se basant sur les données de ces publications, y compris la Carte des menaces du paludisme, une forme d’enquête a été menée dans 50 pays sur les suppressions *Pfhrp2/3*.
- Dans son plan de réponse mondiale aux délétions *pfhrp2/3*, l’OMS expose plusieurs domaines d’action, notamment l’identification de nouveaux biomarqueurs, l’amélioration des performances des TDR non HRP2, la réalisation de prévisions de marché et le renforcement des réseaux de laboratoires pour soutenir la demande concernant l’utilisation de la caractérisation moléculaire pour déterminer la présence ou l’absence de ces suppressions de gènes.

Résistance des parasites aux antipaludiques (2015-2022)

- L’efficacité des médicaments antipaludiques fait l’objet d’une surveillance par le biais d’études relatives à l’efficacité thérapeutique, qui suivent les résultats cliniques et parasitologiques parmi les personnes recevant des médicaments antipaludiques. Ces études relatives à l’efficacité thérapeutique sont considérées comme la norme de référence grâce à laquelle les pays peuvent établir au mieux leurs politiques de traitement.
- Plusieurs outils permettent d’évaluer la résistance aux médicaments antipaludiques. Dans certains cas, des mutations génétiques associées à une sensibilité réduite ont été identifiées. La résistance partielle à l’artémisinine est surveillée grâce à une liste établie de marqueurs *PfKelch13* candidats et validés, associés à une élimination retardée suite à un traitement contenant de l’artémisinine.
- Dans le cadre de la riposte à la menace de résistance aux médicaments antipaludiques, l’OMS appelle les pays d’endémie palustre et les partenaires internationaux de la lutte contre le paludisme à renforcer la surveillance de la résistance aux antipaludiques et de leur efficacité, ainsi qu’à veiller à sélectionner les traitements les plus efficaces pour leur politique nationale de traitement.
- **Région Afrique de l’OMS :** la plupart des études relatives à l’efficacité thérapeutique conduites en suivant le protocole normalisé de l’OMS démontrent la bonne efficacité des traitements antipaludiques. Durant la période 2015-2022, certaines études menées dans la région Afrique de l’OMS sur l’efficacité des traitements antipaludiques contre les infections à *P. falciparum* ont toutefois constaté des taux d’échec plus élevés. Ces résultats justifient une enquête plus approfondie et pourraient être interprétés comme un signe d’émergence d’une résistance au médicament partenaire des ACT. Cinq études avec l’artéméther-luméfantrine (AL), appliquant la méthodologie standardisée de l’OMS pour la correction de la réaction en chaîne par polymérase, ont constaté des taux d’échec supérieurs à 10 %. Ces études ont été menées au Burkina Faso, au Kenya et en Ouganda. Cinq autres études avec l’AL et une étude avec la dihydroartémisinine-pipéraquline (DHA-PPQ) ont rapporté des taux d’échec au traitement supérieurs à 10 % lors de l’utilisation d’algorithmes bayésiens pour opérer une distinction entre réinfection et recrudescence. Ces études ont été menées en Angola, en Ouganda et en République démocratique du Congo. Suite à la surveillance des polymorphismes du gène *PfKelch13* associés à la résistance partielle à l’artémisinine dans plusieurs pays, il existe désormais des preuves de cette résistance partielle liée à l’expansion clonale des mutations du gène *PfKelch13* en Érythrée, en Ouganda, en République-Unie de Tanzanie et au Rwanda. La République-Unie de Tanzanie est le quatrième pays de la région Afrique de l’OMS à confirmer la résistance partielle à l’artémisinine. L’efficacité de la chloroquine (CQ) et de la

DHA -PPQ pour le traitement des infections à *P. vivax* a été étudiée en Éthiopie : neuf études avec la CQ et deux études avec la DHA-PPQ ont constaté des taux d'échec au traitement inférieurs à 5 %.

- **Région Amériques de l'OMS :** les données disponibles pour la région Amériques de l'OMS sont limitées. Les études relatives à l'efficacité thérapeutique de l'AL conduites au Brésil (2015) et en Colombie (2018) ont démontré une efficacité élevée contre *P. falciparum*. Au Guyana, la mutation C580Y a été observée sporadiquement entre 2010 et 2017, mais n'a pas été détectée parmi les échantillons plus récents, ce qui indique que cette mutation a probablement disparu. Tous les pays d'endémie palustre de cette région recommandent la CQ comme traitement de première intention contre les infections à *P. vivax*. L'efficacité de la CQ a été étudiée au Brésil et s'est avérée élevée.
- **Région Asie du Sud-Est de l'OMS :** toutes les études relatives à l'efficacité thérapeutique contre les infections à *P. falciparum* qui ont été menées durant la période concernée ont constaté des taux d'échec inférieurs à 10 %. Les taux d'échec au traitement par artésunate-sulfadoxine-pyriméthamine (AS+SP) restent faibles en Inde. Les résultats d'une étude conduite dans l'État du Chhattisgarh entre 2015 et 2017 sur les mutations de *dhfr* et *dhps* pourraient toutefois être un signe avant-coureur de la nécessité de changer la politique de traitement par AS+SP au nord est de l'Inde. Les mutations *PfKelch13* associées à la résistance partielle à l'artémisinine affichent une forte prévalence au Myanmar et en Thaïlande.
- **Région Méditerranée orientale de l'OMS :** des données sur l'efficacité de l'AL contre les infections à *P. falciparum* sont disponibles pour l'Afghanistan, le Pakistan, la Somalie, le Soudan et le Yémen (période 2015-2020). Toutes prouvent un haut niveau d'efficacité du traitement. Une étude avec l'AL en Somalie (2018) et deux études avec la CQ en Afghanistan (2016 et 2022) fournissent des données sur l'efficacité des traitements de première intention contre les infections à *P. vivax* : aucun échec de ces traitements n'a été observé.
- **Région Pacifique occidentale de l'OMS :** les études relatives à l'efficacité des médicaments antipaludiques contre les infections à *P. falciparum* ont constaté de forts taux d'échec. Un taux d'échec au traitement par AL de 13,5 % a été observé à l'ouest du Cambodge entre 2018 et 2020. La résistance à l'amodiaquine (AQ) a été documentée au Cambodge sur la période 2016-2017, avec de forts taux d'échec au traitement par AS-AQ dans les provinces de Monduliri (22,6 %) et de Pursat (13,8 %). De forts taux d'échec au traitement par DHA-PPQ ont également été constatés au Cambodge, en République démocratique populaire lao et au Viet Nam. Au Cambodge, ces résultats ont accéléré le remplacement de la DHA-PPQ par l'artésunate-méfloquine (AS-MQ) comme traitement de première intention dès 2016. Au Viet Nam, les traitements par artésunate-pyronaridine (AS-PY) ont été remplacés par la DHA-PPQ dans les provinces où de forts taux d'échec avaient été observés. Des parasites sauvages *PfKelch13* ont été trouvés dans 29,9 % des échantillons prélevés entre 2015 et 2020 au Cambodge, en République démocratique populaire lao et au Viet Nam. La mutation *PfKelch13* C580Y est apparue en Papouasie-Nouvelle-Guinée et elle semble se propager. Concernant les infections à *P. vivax*, une étude menée avec la CQ au Viet Nam en 2015 a observé des taux d'échec de 9,8 %.

Résistance des vecteurs aux insecticides

- Depuis 2021, 35 pays ont transmis à l'OMS des données de surveillance sur la résistance aux insecticides. Ces données sont compilées à l'heure actuelle et seront mises à jour en 2024 dans la base de données mondiales de l'OMS sur la résistance aux insecticides chez les vecteurs du paludisme et dans la Carte des menaces du paludisme.
- Sur les 88 pays d'endémie ayant fourni des données pour la période 2010-2020, 78 ont détecté une résistance à au moins une des classes d'insecticides chez l'un des vecteurs du paludisme et sur un site de collecte. Par ailleurs, 29 pays ont constaté une résistance aux pyréthrinoides, aux organochlorés, aux carbamates et aux organophosphorés sur différents sites, et 19 pays ont confirmé la résistance aux quatre classes d'insecticides chez au moins un des vecteurs du paludisme et sur au moins un site de collecte.
- Au niveau mondial, la résistance aux pyréthrinoides a été détectée chez au moins un des vecteurs du paludisme dans 87 % des pays et 68 % des sites. La résistance aux organochlorés a été rapportée dans 82 % des pays et sur 64 % des sites. La résistance aux carbamates a touché 69 % des pays et 34 % des sites. Quant à la résistance aux organophosphorés, elle a été détectée dans 60 % des pays et 28 % des sites. La résistance à ces quatre classes d'insecticides a été confirmée dans toutes les régions de l'OMS. Cependant, sa propagation géographique varie considérablement d'une région à l'autre.

- Sur les 38 pays ayant fourni des données sur l'intensité de la résistance aux pyréthrinoides (de 2010 à 2020), une résistance de forte intensité a été observée sur 293 sites répartis dans 27 pays.
- Entre 2019 et 2020, les États membres de l'OMS ont communiqué les résultats de 835 bio-essais réalisés avec le chlorfénapyr et 603 avec la clothianidine. Pour le chlorfénapyr, les exigences de l'OMS sont plus strictes que dans le cadre des anciennes procédures de test de la résistance du moustique aux insecticides. À ce jour, l'OMS a reçu les résultats de 502 tests conformes à ces nouvelles exigences et conduits sur 391 sites répartis dans 20 pays. Il va néanmoins falloir attendre que trois tests complets soient disponibles pour chacun de ces sites avant que l'OMS ne puisse interpréter les résultats. Pour la clothianidine, seuls 13 résultats sur la base de ce bio-essai ont été rapportés à l'OMS et un unique cas de résistance éventuelle a été signalé par le Sénégal.
- Pour orienter la gestion de la résistance, les pays doivent développer et mettre en œuvre des plans nationaux de suivi et de gestion de la résistance aux insecticides, en se basant sur le *Cadre conceptuel d'un plan national de suivi et de gestion de la résistance aux insecticides chez les vecteurs du paludisme* élaboré par l'OMS.
- Un support technique et financier est nécessaire pour aider les pays à surveiller et à gérer la résistance aux insecticides.

Invasion et propagation du moustique *Anopheles stephensi*

- À ce jour, l'OMS a reçu des rapports confirmant la présence du moustique *An. stephensi* à Djibouti, en Érythrée, en Éthiopie, au Ghana, au Kenya, au Nigéria, en Somalie, au Soudan, au Sri Lanka et au Yémen.
- Les caractéristiques de ce vecteur compliquent son contrôle. Par exemple, *An. stephensi* s'adapte rapidement à l'environnement local, survivant à des températures extrêmement élevées durant la saison sèche, où la transmission du paludisme enregistre généralement une baisse saisonnière.
- Les données sur la résistance aux insecticides transmises à l'OMS indiquent que le moustique *An. stephensi* s'est avéré résistant aux pyréthrinoides, aux organochlorés, aux carbamates et aux organophosphorés dans la péninsule arabique et en Asie. Dans la Corne de l'Afrique, il s'est montré résistant aux pyréthrinoides, aux organophosphorés et aux carbamates.
- *An. stephensi* constitue une menace pour la lutte contre le paludisme et son élimination en Afrique, dans la péninsule arabique et dans le sud de l'Asie. Faute d'être contrôlée, sa propagation dans toute l'Afrique va se combiner à une urbanisation rapide et mal planifiée pour accroître le risque de transmission du paludisme dans les villes africaines.
- L'OMS encourage les pays où une invasion d'*An. stephensi* est suspectée ou a déjà été confirmée à prendre des mesures immédiates, en exerçant notamment une surveillance vectorielle plus étroite pour délimiter sa propagation géographique et en utilisant les données collectées pour mettre en œuvre des interventions destinées à prévenir sa propagation, surtout en zones urbaines et périurbaines.
- Les instituts de recherche et les partenaires de mise en œuvre sont encouragés à rapporter immédiatement la moindre détection d'*An. stephensi* aux ministères de la Santé et à l'OMS, afin de guider les ripostes nationales et internationales.
- La Carte des menaces du paludisme permet de découvrir les études sur les espèces invasives détectées qui sont signalées à l'OMS et publiées dans des revues scientifiques.

Changement climatique, paludisme et riposte mondiale

- Selon l'OMS, « le changement climatique est la plus grande menace sanitaire à laquelle l'humanité est confrontée ».
- Le changement climatique menace les progrès de la santé mondiale en affectant les moyens de subsistance, en augmentant les risques d'expositions nocives aux particules, aux agents pathogènes et aux maladies, en surchargeant les systèmes de santé et en creusant les inégalités existantes. Ainsi, le changement climatique n'est pas seulement une menace singulière, mais un multiplicateur majeur d'autres menaces.

- Les interactions entre le changement climatique et la transmission du paludisme sont complexes, et il existe peu de preuves empiriques pour des prédictions fiables.
- Le changement climatique est également responsable d'événements météorologiques plus extrêmes et plus fréquents, tels que les inondations, qui peuvent entraîner des épidémies de paludisme, ou de graves sécheresses qui suppriment la transmission pendant un certain temps, mais qui sont souvent suivies d'épidémies lorsque les pluies arrivent.
- Les effets sur la transmission du paludisme et sur le poids de la maladie seront non linéaires et varieront probablement d'un contexte à l'autre, car ils dépendent de facteurs tels que la température, l'humidité, les précipitations, le degré de développement socioéconomique et la gestion environnementale.
- La température, les précipitations et l'humidité ont un impact sur le développement des larves, la survie des moustiques, le développement des parasites au sein des moustiques et la compétence des vecteurs. Ainsi, toute évolution de ces facteurs influera sur la capacité vectorielle (i. e. le nombre de nouvelles infections que la population d'un vecteur donné provoquerait par cas et par jour en un lieu et à un moment donnés) et donc sur l'intensité de la transmission.
- Les effets directs potentiels du changement climatique sur le paludisme pourraient inclure l'extension de son périmètre géographique, des variations d'intensité de la transmission au sein de ce périmètre, la réintroduction du paludisme dans des régions où il a été éliminé ou d'imperceptibles changements dans son mode de transmission.
- Quant à ses effets indirects potentiels, ils pourraient inclure la perte des moyens de subsistance, une augmentation de l'insécurité alimentaire et économique, des déplacements et des interruptions des services, des programmes de lutte contre le paludisme plus compliqués et plus coûteux, ainsi que des disparités dans l'accès et la qualité des systèmes de prestation de soins.
- Les preuves empiriques des effets du changement climatique sur la transmission du paludisme sont mitigées, ce qui s'explique en partie par le peu de données disponibles, mais aussi par les nombreux déterminants simultanés de la transmission de la maladie qui interviennent sur fond de changement climatique.
- Les preuves les plus solides proviennent peut-être de longues séries de données chronologiques issues des régions montagneuses d'Afrique qui sont à la limite de la transmission endémique; ces données suggèrent qu'au cours des dernières décennies, l'augmentation des températures a conduit à l'expansion du paludisme dans les régions montagneuses.
- En 2022 et 2023, des pluies de mousson extrêmes ont touché de nombreuses régions du Pakistan et les données disponibles suggèrent que la sévérité de la mousson a été accentuée par le changement climatique. Ces inondations ont entraîné une épidémie de paludisme qui a multiplié par cinq le nombre de cas de paludisme dans le pays par rapport à l'année précédente.
- Sous l'égide du Groupe consultatif stratégique de l'OMS sur l'éradication du paludisme (SAGme), l'OMS a commandé une étude, dirigée par le Malaria Atlas Project, afin de prédire les futures trajectoires du paludisme dans le contexte de divers scénarios d'intervention, de changement climatique et socioéconomique basés sur les trajectoires socioéconomiques partagées (ou SSP) développées par le Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC).
- En combinant les niveaux actuels de couverture des interventions à l'évolution des conditions socioéconomiques et environnementales, l'analyse basée sur le scénario climatique « Milieu de la route » (SSP2) suggère que l'incidence du paludisme devrait vraisemblablement diminuer, même si le nombre de cas de paludisme augmentait légèrement en raison de la croissance démographique.
- Si les interventions actuelles s'intensifient pour atteindre des niveaux élevés de couverture et si les prédictions concernant l'évolution des conditions socioéconomiques et environnementales se vérifient, l'analyse suggère la possibilité de baisses substantielles de l'incidence du paludisme.
- Des projections de tendances similaires, quoi que de moindre ampleur, ont été obtenues en considérant le maintien du niveau actuel de développement alimenté par les combustibles fossiles (SSP5) dans le cadre de différents scénarios d'intervention. Le coût de l'intensification des interventions n'a pas encore été entièrement évalué dans le cadre des différents scénarios SPP, mais il est probable qu'il soit beaucoup plus élevé que celui actuellement estimé dans le cadre du GTS. L'augmentation des coûts et l'impact disproportionné sur les personnes vulnérables soulignent la nécessité d'assurer une utilisation plus efficace et plus équitable du peu de ressources disponibles.

- Le débat sur le sens et l'ampleur des effets du changement climatique sur le paludisme ne doivent cependant pas dissuader la communauté internationale de garantir l'efficacité de services antipaludiques résilients et durables face à la menace du changement climatique.
- Ce rapport propose de mettre l'accent sur des actions stratégiques, techniques et opérationnelles.
- Les actions stratégiques consistent notamment à éliminer le paludisme au niveau mondial tout en réduisant la vulnérabilité au changement climatique; parler d'une seule et même voix et nouer des partenariats pour partager un discours commun en faveur d'actions multi-sectorielles visant à réduire les émissions de carbone et améliorer la santé; décarboniser les systèmes de santé et les rendre plus durables sur le plan environnemental; et déplacer le pouvoir de prise de décisions au niveau des pays.
- Les actions techniques regroupent la production d'informations sur le lien entre changement climatique et santé; la mise en place de systèmes de santé de meilleure qualité, plus résilients face au changement climatique et plus durables écologiquement; et la mise à disposition de lignes directrices et d'outils dans les domaines de la surveillance de la santé et du climat, et de suivi et d'évaluation.
- Les actions opérationnelles comprennent l'utilisation de données sur les maladies et le climat pour la prise de décisions; la mise en place de systèmes robustes de détection, de préparation et de réponse aux épidémies; et le renforcement des capacités nationales d'analyse et d'utilisation des informations sur le paludisme et le climat.
- L'éradication du paludisme est le seul moyen de remédier aux effets dévastateurs de cette maladie, avec ou sans la menace supplémentaire liée au changement climatique. Il convient donc d'investir pour atténuer les menaces biologiques liées au paludisme et développer des outils plus efficaces.
- Des investissements sont indispensables pour étudier l'influence des variations et du changement climatiques sur la lutte contre le paludisme sur différentes échelles de temps, et pour mettre en place des méthodes de communication efficaces de ces risques aux décideurs politiques, aux bailleurs de fonds et au public. Des efforts de recherche supplémentaires sont aussi nécessaires pour réduire l'empreinte carbone du secteur de la santé, y compris de la riposte au paludisme.
- Les futurs produits et leur distribution devront s'adapter à un environnement opérationnel redéfini par le changement climatique. Par exemple, des médicaments et des outils de diagnostic résistants à la chaleur et des outils de prévention adaptés aux populations déplacées ou migrantes. Leur conception devra également minimiser l'impact sur l'environnement en identifiant les futurs produits qui sont biodégradables ou qui peuvent être fabriqués localement. Pour mettre en œuvre des actions antipaludiques plus résilientes face aux risques liés au changement climatique, il faudra augmenter considérablement le financement de la lutte contre la maladie et mieux utiliser les données locales afin d'adapter les interventions de manière efficace, dynamique et au niveau sous-national.
- Les pays ayant ratifié la *Convention-cadre des Nations Unies sur les changements climatiques* (appelés « Parties à la Convention ») se sont engagés à se mobiliser conjointement et à rendre pleinement opérationnel le Fonds vert pour le climat. Cet engagement devrait inclure le paludisme et reconnaître la nécessité d'une stratégie plus vaste d'atténuation des changements climatiques, pas seulement de réduire les émissions de gaz à effet de serre.

Prefacio



Cada año, el *Informe Mundial sobre la Malaria* de la OMS brinda una evaluación completa y actualizada de las tendencias en el control y la eliminación de la malaria en todo el mundo. El informe de este año incluye, por primera vez, un capítulo dedicado a la intersección entre el cambio climático y la malaria.

La variabilidad climática, como los cambios en la temperatura y las precipitaciones, puede influir en el comportamiento y la supervivencia del mosquito *Anopheles*, portador de la malaria. Los fenómenos meteorológicos extremos, como las olas de calor y las inundaciones, pueden provocar un aumento de la transmisión y la carga de la enfermedad.

El cambio climático también tendrá efectos indirectos sobre la malaria. Por ejemplo, el desplazamiento de la población puede provocar más malaria, ya que las personas sin inmunidad pueden migrar a zonas endémicas. La variabilidad climática también ha provocado malnutrición en muchos lugares, un factor de riesgo para malaria

severa entre los niños pequeños y las mujeres embarazadas.

El cambio climático es sólo una de las muchas amenazas que se ciernen sobre la respuesta mundial a la malaria. Millones de personas siguen sin recibir los servicios que necesitan para prevenir, detectar y tratar la enfermedad. Los conflictos y las crisis humanitarias, la escasez de recursos y los retos biológicos, como la resistencia a los medicamentos y a los insecticidas, también siguen obstaculizando los avances.

En conjunto, estas amenazas están frenando los avances en la lucha mundial contra la malaria. En 2022, el cálculo de casos de malaria a nivel mundial alcanzó los 249 millones, muy por encima del número de casos estimado antes de la pandemia de COVID-19, y un aumento de cinco millones respecto a 2021.

El informe también documenta importantes avances. La primera vacuna contra la malaria recomendada por la OMS, RTS,S/AS01, ha reducido las muertes en la primera infancia en un 13% en Ghana, Kenia y Malawi. En octubre de 2023, la OMS recomendó una segunda vacuna segura y eficaz contra la malaria, R21/Matrix-M. Un mercado de dos vacunas hará posible una amplia expansión en toda África.

El año pasado, 49 millones de niños recibieron quimioprevención para la malaria estacional en 17 países africanos, frente a solo 170.000 en 2012.

Además, se ha demostrado que una nueva generación de mosquiteras tratadas con insecticidas de doble ingrediente, recomendada a principios de este año por la OMS, tiene un mayor impacto contra los mosquitos resistentes a los piretroides que las mosquiteras estándar sólo con piretroides.

Mientras tanto, el objetivo de la eliminación de la malaria se ha alcanzado en un círculo cada vez más amplio de países. Sólo este año, otros tres países han obtenido el certificado de país libre de malaria de la OMS: Azerbaiyán, Belice y Tayikistán. Varios otros están en vías de eliminar la enfermedad el año que viene.

Estos y otros avances son testimonio tanto del compromiso nacional como de la determinación mundial de controlar y eliminar la enfermedad. Sin embargo, en medio de fenómenos meteorológicos extremos, escasez de recursos y un número creciente de amenazas biológicas, la visión de un mundo libre de malaria está aún lejos de alcanzarse.

Es necesario un giro sustancial con muchos más recursos, estrategias basadas en datos y nuevas herramientas para recuperar el impulso en la lucha contra la malaria. Con la amenaza añadida del cambio climático, ahora más que nunca se necesitan respuestas sostenibles y resistentes contra esta enfermedad.

Dr Tedros Adhanom Ghebreyesus
Director General
Organización Mundial de la Salud (OMS)

El informe de este año de un vistazo

Eventos clave en 2022-2023

Estrategia operativa del Programa Mundial contra la Malaria

- El progreso mundial contra la malaria se ha estancado en los últimos años, y un enfoque de “seguir como hasta ahora” desviará aún más a los países y a sus socios de los objetivos predefinidos. Consciente de que para volver al buen camino serán necesarios cambios importantes en la respuesta a la malaria, el Programa Mundial contra la Malaria de la Organización Mundial de la Salud (OMS/PMM) ha elaborado una estrategia operativa departamental para el periodo 2024-2030.
- La estrategia refleja los aportes de los países, socios y colegas de la OMS que han contribuido a comprender mejor las causas profundas del estancamiento del progreso.
- La estrategia operativa se centra en cuatro objetivos estratégicos: normas y estándares, nuevas herramientas e innovación, información estratégica para el impacto, y liderazgo. Un quinto pilar transversal -el apoyo contextual a los países - completa los objetivos.

Nuevas recomendaciones de la OMS

- La OMS emitió una *recomendación fuerte* para el uso de mosquiteros tratados con la combinación de piretroides-clorfenapir en lugar de mosquiteros tratados únicamente con piretroides para prevenir la malaria en adultos y niños en zonas donde los mosquitos se han hecho resistentes a los piretroides.
- La OMS emitió una *recomendación condicional* para el uso de mosquiteros tratados con la combinación de piretroides-clorfenapir en lugar de mosquiteros tratados con piretroides-butóxido de piperonilo (PBO) para prevenir la malaria en adultos y niños en zonas con mosquitos resistentes a piretroides. La condicionalidad de la recomendación se basa en la apreciación del Grupo de Desarrollo de Directrices (GDD) de la OMS de que el balance de efectos deseables e indeseables probablemente favorece a los mosquiteros con piretroide-clorfenapir frente a los mosquiteros con piretroide-PBO, teniendo como evidencia un único ensayo en la Región de África de la OMS.
- La OMS emitió una *recomendación condicional* para el empleo de mosquiteros con la combinación de piretroide-piriproxifeno en lugar de mosquiteros sólo con piretroide para prevenir la malaria en adultos y niños en zonas con mosquitos resistentes a los piretroides. La condicionalidad de la recomendación se basó en la preocupación del GDD por la baja costo-efectividad de los mosquiteros con piretroides-piriproxifeno en comparación con los mosquiteros sólo con piretroides, ya que los recursos adicionales necesarios actualmente para adquirir estos mosquiteros tratados con piretroides-piriproxifeno pueden tener un impacto negativo en la cobertura y la equidad.

Puesta en marcha de la vacuna contra la malaria RTS,S/AS01 en zonas de moderada y alta transmisión de malaria

- Desde 2019, Ghana, Kenia y Malaui han venido suministrando la vacuna antimalárica RTS,S/AS01 (RTS,S) a través del Programa de Implementación de la Vacuna Antimalárica, coordinado por la OMS y financiado por Gavi, la Alianza para las Vacunas (Gavi), el Fondo Mundial de Lucha contra el Sida, la Tuberculosis y la Malaria (Fondo Mundial) y Unitaid.

- Desde la recomendación de la OMS para el uso de la vacuna RTS,S en octubre de 2021, al menos 28 países de la Región de África de la OMS han expresado su interés en introducir la vacuna contra la malaria. Varios países presentaron solicitudes a Gavi, y 18 países se han aprobado para recibir apoyo para la introducción de la vacuna contra la malaria.
- Dada la restricción inicial en el suministro de la vacuna RTS,S, se desarrolló y aplicó un mecanismo para la asignación de las limitadas vacunas contra la malaria para priorizar las 18 millones de dosis disponibles para 2023-2025 a 12 países, para su introducción a nivel subnacional en las áreas de mayor necesidad.
- Se espera que las primeras dosis de la vacuna lleguen a los países durante el último trimestre de 2023, y que los países empiecen a distribuirlas a principios de 2024.

La OMS recomienda una segunda vacuna contra la malaria, la R21/Matrix-M

- En octubre de 2023, la vacuna contra la malaria R21/Matrix-M (R21) se convirtió en la segunda vacuna recomendada por la OMS para prevenir la malaria en niños que viven en zonas de riesgo.
- Se espera que la adición de la vacuna contra la malaria R21 para complementar la distribución en curso de la primera vacuna contra la malaria, RTS,S, dé lugar a un suministro de vacunas suficiente para beneficiar a todos los niños que viven en zonas donde la malaria es un importante problema de salud pública.
- La OMS recomienda el uso de vacunas contra la malaria (RTS,S o R21) para la prevención de la malaria por *Plasmodium falciparum* en niños que viven en zonas donde la malaria es endémica, dando prioridad a las zonas de moderada y alta transmisión.
- Los próximos pasos para la R21 incluyen completar la precalificación en curso de la OMS para permitir la adquisición internacional de la vacuna para una distribución más amplia. A esto le seguirán esfuerzos de la OMS, Gavi y sus socios para apoyar a los países mientras se preparan para introducir las vacunas contra la malaria, de modo que los países puedan aprovechar todos los beneficios de las vacunas que salvan vidas.

Posición actualizada de la OMS sobre la pandemia de COVID-19

- Durante la 15ª reunión del Comité de Emergencias del Reglamento Sanitario Internacional (2005) relacionada con la pandemia de la enfermedad por coronavirus (COVID-19), celebrada en mayo de 2023, el Director General de la OMS, Tedros A Ghebreyesus, determinó que la COVID-19 es ahora un problema de salud establecido y que continúa, que ya no constituye una emergencia de salud pública de preocupación internacional.

Otras emergencias humanitarias y sanitarias

- En el periodo 2019-2022, 41 países donde la malaria es endémica han sufrido emergencias humanitarias y sanitarias, sin incluir la pandemia de COVID-19.
- Durante este tiempo, se estima que entre 145 y 267 millones de personas necesitaron asistencia debido a emergencias sanitarias y humanitarias.
- Hambrunas e inundaciones fueron las principales causantes de estas emergencias humanitarias, en ocasiones agravadas por brotes de enfermedades.

Tendencias de la carga de la malaria

Casos de malaria

- A nivel mundial, en 2022 se calcula que hubo 249 millones de casos de malaria en 85 países y áreas con malaria endémica (incluido el territorio de la Guayana Francesa), un incremento de 5 millones de casos en comparación con 2021. Los principales países que contribuyeron al aumento fueron Pakistán (+2,1 millones), Etiopía (+1,3 millones), Nigeria (+1,3 millones), Uganda (+597 000) y Papúa Nueva Guinea (+423 000). En 2015, año de referencia de la *Estrategia técnica mundial contra la malaria 2016-2030* (ETM), hubo un estimado de 231 millones de casos de malaria.

- La incidencia de casos de malaria disminuyó de 81 por 1000 habitantes en riesgo en el año 2000 a 57 en 2019. Tras un pequeño aumento del 3% en 2020, las tasas de incidencia se han mantenido estables en los últimos 3 años. En 2022, la incidencia de casos de malaria fue de 58 por 1000 habitantes en riesgo.
- La proporción de casos debidos a *P. vivax* se redujo de cerca del 8% (20,5 millones) en el año 2000 al 3% (6,9 millones) en 2022.
- Veintinueve países registraron el 95% de los casos de malaria en el mundo. Cuatro países -Nigeria (27%), la República Democrática del Congo (12%), Uganda (5%) y Mozambique (4%)- representaron casi la mitad de todos los casos a nivel mundial.
- La Región de África de la OMS, con un estimado de 233 millones de casos en 2022, representó alrededor del 94% de los casos a nivel mundial.
- Entre 2000 y 2019, la incidencia de casos en la Región de África de la OMS se redujo de 370 a 226 por 1000 habitantes en riesgo, pero aumentó a 232 por 1000 habitantes en riesgo en 2020, principalmente debido a las alteraciones de los servicios durante la pandemia de COVID-19. En 2022, la incidencia de casos disminuyó a 223 por 1000 habitantes en riesgo.
- Cabo Verde notificó cero casos autóctonos durante 4 años consecutivos, poniendo fin a su epidemia de malaria.
- La Región de Asia Sudoriental de la OMS representó alrededor del 2% de los casos de malaria a nivel mundial. Los casos de malaria se redujeron en un 76%, de 23 millones en 2000 a unos 5 millones en 2022. La incidencia de casos de malaria en esta región se redujo en un 83%, pasando de unos 18 casos por 1000 habitantes en riesgo en el año 2000 a cerca de tres casos por 1000 habitantes en riesgo en 2022.
- En 2022, India representó el 66% de los casos de la región. Casi el 46% de todos los casos de la región se debieron a *P. vivax*. Sri Lanka fue certificada libre de malaria en 2016 y sigue estándolo.
- A pesar de una disminución general del 11,9% en los casos estimados entre 2021 y 2022 en la región, se observaron aumentos en los casos y la incidencia en Bangladesh, Indonesia, Myanmar y Tailandia.
- En la Región del Mediterráneo Oriental de la OMS, los casos de malaria se redujeron en un 38%, de alrededor de 7 millones de casos en el año 2000 a alrededor de 4 millones en 2015. Entre 2015 y 2022, los casos aumentaron un 92%, llegando a 8,3 millones.
- Entre 2021 y 2022, la región experimentó un aumento del 25%, debido principalmente a un gran incremento (2,1 millones de casos de malaria) en Pakistán tras las catastróficas inundaciones que afectaron a más de 30 millones de personas.
- En el periodo 2000-2015, la incidencia de casos de malaria disminuyó de 20,2 a 9,0 casos por 1000 habitantes, antes de aumentar a 15,2 casos por 1000 habitantes en riesgo en 2022. Sudán es el principal contribuyente a la malaria en esta región, con cerca del 41% de los casos. En 2022, la República Islámica de Irán notificó 1439 casos contraídos a nivel local, incluidos casos autóctonos, a pesar de haber notificado cero casos autóctonos durante 4 años consecutivos (2018-2021). Arabia Saudita notificó cero casos autóctonos por segundo año consecutivo.
- En la Región del Pacífico Occidental de la OMS, el número de casos de malaria disminuyó un 48% en 2021, pasando de 2,6 millones de casos en 2000 a una cifra estimada de 1,4 millones de casos. Entre 2021 y 2022 se observó un aumento del 23%, alcanzando 1,9 millones de casos. Durante el mismo periodo, la incidencia de casos de malaria se redujo de cuatro a dos casos por cada 1000 habitantes en riesgo. Papúa Nueva Guinea representó casi el 90% de todos los casos de esta región en 2022. China fue certificada libre de malaria en 2021. Malasia no ha tenido casos de malaria humana durante 5 años consecutivos, a pesar de experimentar un aumento de los casos de malaria por *P. knowlesi*, con 2500 casos notificados en 2022.
- En la Región de las Américas de la OMS, los casos de malaria disminuyeron un 64%, de 1,5 millones a 0,6 millones. La incidencia de casos se redujo en un 73%, de 13 a 4 casos por cada 1000 habitantes en riesgo entre 2000 y 2022. El progreso de la región en los últimos años se ha visto afectado por el gran aumento de la malaria en la República Bolivariana de Venezuela, que tenía unos 35 500 casos en el año 2000 y pasó a más de 483 000 en 2017. En 2020, sin embargo, los casos se redujeron en más de la mitad en comparación con 2019, reportándose 223 000 casos, y se redujeron aún más en 2021 y 2022, con 205 000 y 154 000 casos, respectivamente. Los factores que contribuyeron a esta reducción fueron los bajos niveles de movilidad de la población como resultado de las restricciones por la pandemia de COVID-19, y un aumento de los productos básicos para el diagnóstico y el tratamiento de la malaria.

- La República Bolivariana de Venezuela, Brasil y Colombia representaron el 73% de todos los casos en la Región de las Américas de la OMS.
- Argentina, Belice, El Salvador y Paraguay fueron certificados libres de malaria en 2019, 2023, 2021 y 2018, respectivamente.
- La Región de Europa de la OMS está libre de malaria desde 2015.

Muertes por malaria

- A nivel mundial, las muertes por malaria disminuyeron constantemente de 864 000 en 2000 a 586 000 en 2015 y a 576 000 en 2019. En 2020, las muertes por malaria aumentaron un 10% en comparación con 2019, hasta un estimado de 631 000. Las muertes disminuyeron en 2022 a un estimado de 608 000. El porcentaje del total de muertes por malaria en niños menores de 5 años se redujo del 87% en 2000 al 76% en 2015. Desde entonces, no se han producido cambios.
- A nivel mundial, la tasa de mortalidad por malaria (es decir, muertes por 100 000 habitantes en riesgo) se redujo a la mitad, pasando de unas 29 en el año 2000 a 15 en 2015. Después siguió disminuyendo, pero a un ritmo más lento, cayendo a 14 en 2019. En 2020, la tasa de mortalidad volvió a aumentar, a 15,2, antes de disminuir ligeramente a 14,3 en 2022.
- Alrededor del 96% de las muertes por malaria a nivel mundial se produjeron en 29 países. Cuatro países representaron algo más de la mitad de todas las muertes por malaria a nivel mundial en 2022: Nigeria (31%), la República Democrática del Congo (12%), Níger (6%) y la República Unida de Tanzania (4%).
- Las muertes por malaria en la Región de África de la OMS disminuyeron de 808 000 en el año 2000 a 548 000 en 2017, antes de aumentar a 604 000 en 2020. Las muertes disminuyeron de nuevo a un estimado de 580 000 en 2022. La tasa de mortalidad por malaria se redujo en un 60% entre 2000 y 2019, de 143 a 57 muertes por 100 000 habitantes en riesgo, antes de aumentar a 61 en 2020 y volver a disminuir a 56 en 2022.
- Cabo Verde ha notificado cero muertes por malaria desde 2018.
- En la Región de Asia Sudoriental de la OMS, las muertes por malaria se redujeron en un 77%, de alrededor de 35 000 en el año 2000 a 8000 en 2022. India e Indonesia representaron alrededor del 94% de todas las muertes por malaria en la Región de Asia Sudoriental de la OMS.
- En la Región del Mediterráneo Oriental de la OMS, las muertes por malaria disminuyeron en un 45%, de unas 13 600 en el año 2000 a 7500 en 2014, y luego se duplicaron entre 2014 y 2022, llegando hasta 15 900. La mayoría de las muertes se observaron en Sudán, donde alrededor del 90% de los casos se debe a *P. falciparum*, que se asocia con una mayor tasa de letalidad que *P. vivax*.
- En la Región del Mediterráneo Oriental de la OMS, la tasa de mortalidad por malaria se redujo en un 43% entre 2000 y 2015, y se mantuvo prácticamente sin cambios hasta 2021, antes de aumentar un 14% entre 2021 y 2022, hasta unas tres muertes por cada 100 000 habitantes en riesgo.
- En la Región del Pacífico Occidental de la OMS, las muertes por malaria se redujeron en un 56%, pasando de unas 6300 muertes en 2000 a 2600 muertes en 2021. Entre 2021 y 2022, se produjo un aumento del 29% en las muertes llegando hasta 3600, debido principalmente a los aumentos en Papúa Nueva Guinea.
- Entre 2000 y 2022, la Región de las Américas de la OMS experimentó una reducción de las muertes por malaria del 63%, de 850 a 343. La tasa de mortalidad se redujo en un 71%, de 0,7 a 0,2 por cada 100 000 habitantes en riesgo.

Casos de malaria y muertes evitadas

- Se estima que en el periodo 2000-2022 se evitaron 2.100 millones de casos de malaria y 11,7 millones de muertes por esta enfermedad en todo el mundo.
- La mayoría de los casos (82%) y muertes (94%) evitados se produjeron en la Región de África de la OMS, seguida de la Región de Asia Sudoriental de la OMS (casos 10%, muertes 3%).

Carga de la malaria en el embarazo

- En 2022, en 33 países con transmisión moderada y alta en la Región de África de la OMS, se produjeron unos 35,4 millones de embarazos, de los cuales 12,7 millones (36%) estuvieron expuestos a la infección por malaria durante el embarazo.
- Por subregiones de la OMS, la prevalencia de exposición a la malaria durante el embarazo en 2022 fue mayor en África occidental (39,3%) y África central (40,1%), y menor en la subregión de África oriental y meridional (27,0%).
- Se estima que, sin una intervención específica durante el embarazo, la infección por malaria durante el embarazo en estos 33 países habría dado lugar a 914 000 neonatos con bajo peso al nacer, frente a los cerca de 393 000 neonatos con bajo peso al nacer estimados con los actuales niveles de cobertura del tratamiento preventivo intermitente durante el embarazo (TPIe) en las tres subregiones.
- Si todas las mujeres embarazadas que acudieron al menos una vez a las clínicas de atención prenatal (CAP) hubiesen recibido una única dosis de TPIe - asumiendo que todas ellas fuesen elegibles y que la segunda y tercera dosis de TPIe (TPIe2 y TPIe3) se mantuvieran en los niveles actuales- se hubiesen evitado 60 000 nacimientos prematuros adicionales en 33 países con información sobre TPIe.
- Si la cobertura de TPIe3 se elevara a los mismos niveles que la cobertura de la primera visita a la clínica de atención prenatal, y si las visitas posteriores a éstas fueran igual de elevadas, se evitarían adicionalmente 164 000 casos de bebés con bajo peso al nacer.
- Si la cobertura de TPIe3 alcanzara el 90% de todas las mujeres embarazadas, se evitarían otros 229 000 casos de bebés con bajo peso al nacer.
- Dado que el bajo peso al nacer es un importante factor de riesgo de mortalidad neonatal e infantil, evitar un número considerable de casos de bajo peso al nacer salvará muchas vidas.

Eliminación del malaria y prevención de su restablecimiento

- Con el tiempo, la eliminación de la malaria ha tomado impulso en numerosos países a medida que se acercan al hito de cero casos autóctonos de malaria y a medida que más países obtienen la certificación como libres de malaria.
- El número de países en los que la malaria era endémica en el año 2000 y que notificaron menos de 100 casos de malaria pasó de seis en 2000 a 27 en 2022, lo que supone un ligero descenso respecto a los 28 de 2021.
- El número de países con menos de 10 casos autóctonos aumentó de cuatro en 2000 a 25 en 2021 y 2022.
- Entre los años 2000 y 2022, 25 países que eran endémicos de malaria en el 2000 han logrado 3 años consecutivos de cero casos autóctonos de malaria. Doce de estos países han sido ya certificados como libres de malaria por la OMS.
- Ningún país fue certificado como libre de malaria en 2022, pero tres países -Azerbaián, Belice y Tayikistán- obtuvieron la certificación en 2023.
- Dos países -Egipto y Timor Oriental- presentaron solicitudes oficiales para su certificación en 2023.
- Cabo Verde ha notificado cero casos autóctonos durante 4 años consecutivos y se encuentra en la fase final del proceso de certificación.
- De 2010 a 2022, se produjo una reducción del 72,3% en los casos de malaria autóctona en todos los países y un territorio que forman parte de la iniciativa de países que eliminarán la malaria en 2025 (E-2025), con aumentos observados en 2017-2018 y luego de nuevo desde 2021.
- El aumento en casos autóctonos en 2022 se debió en gran medida a las Comoras, en donde casi se duplicaron sus casos de 10 537 en 2021 a 20 675 en 2022. Otros países también experimentaron aumentos sustanciales durante este periodo: Costa Rica más que duplicó su número de casos, de 189 en 2021 a 409 en 2022; Panamá experimentó un aumento de 4354 en 2021 a 7102 en 2022; Tailandia informó de un aumento significativo, de 2426 en 2021 a 6263 en 2022; Honduras más que duplicó sus casos, de 1542 en 2021 a 3534 en 2022; y Vanuatu tuvo un aumento de casi cuatro veces, de 312 en 2021 a 1102 en 2022.

- Otros países que notificaron niveles variables de aumento de casos para el mismo periodo fueron la República Dominicana (12,6%), Guatemala (45,7%), Nepal (12,5%), la República de Corea (39,4%) y Santo Tomé y Príncipe (46,0%).
- Hubo un resurgimiento de casos en la República Islámica de Irán en 2022, con 1439 casos contraídos a nivel local notificados en 2022 tras 4 años consecutivos de cero casos autóctonos.
- A pesar de los retrocesos, varios países y un territorio experimentaron notables reducciones en la transmisión autóctona: Botsuana (43,5%), República Popular Democrática de Corea (9,3%), Ecuador (38,0%), Eswatini (57,6%), Guayana Francesa (71,6%), México (32,6%) y Sudáfrica (31,3%).
- Malasia notificó cero casos autóctonos de *Plasmodium* humano por quinto año consecutivo.
- Después de un brote de tres casos en Timor-Leste en 2020, el país consiguió reorientar sus esfuerzos, logrando 2 años consecutivos con cero casos autóctonos en 2021 y 2022 (durante 36 meses consecutivos si se tiene en cuenta 2023). Arabia Saudita también logró 2 años consecutivos con cero casos autóctonos en 2021 y 2022.
- Bhután y Surinam notificaron cero casos autóctonos por primera vez en el 2022.
- En los últimos años, *P. knowlesi* ha surgido como una preocupación notable en casos de malaria, especialmente en los países de la Región de Asia Sudoriental de la OMS: Indonesia, Malasia y Tailandia.
- En 2022, se notificaron un total de 2768 casos de *P. knowlesi* en todo el mundo, lo que supone un descenso del 24,2% en comparación con 2021 (3651 casos). Los casos autóctonos de *P. knowlesi* también experimentaron un descenso del 26%, pasando de 3629 casos en 2021 a 2682 casos en 2022.
- Malasia sigue siendo la fuente predominante de casos de *P. knowlesi*, seguida de Tailandia e Indonesia, que contribuyeron con un 90,5%, 3,1% y 0,1%, respectivamente, en 2022.
- Entre 2000 y 2022, los países de la subregión del Gran Mekong (SGM) notificaron un descenso del 55,5% en los casos autóctonos de malaria y del 89,1% en los casos autóctonos por *P. falciparum*. Esto excluye a China, ya que es el único país que notificó cero casos autóctonos y sigue estando libre de malaria.
- En la SGM, los casos autóctonos aumentaron de 90 082 casos en 2021 a 170 527 en 2022. Del mismo modo, el número de casos autóctonos de *P. falciparum* casi se duplicó, pasando de 16 490 en 2021 a 30 789 casos en 2022.
- Myanmar sigue siendo el país que más contribuye a la carga de malaria de la región, con el 92,4% de los casos autóctonos de malaria y el 95% de los casos autóctonos por *P. falciparum*.
- Varios de los países del grupo E-2025 que lograron cero casos autóctonos se han enfrentado recientemente a problemas relacionados con los migrantes y las zonas fronterizas. La OMS está desarrollando orientaciones para la malaria fronteriza, que sigue siendo un reto para la eliminación de la malaria y para la prevención de su restablecimiento.
- Arabia Saudita, Bhután y Surinam, tras haber alcanzado recientemente su primer año de notificación de cero casos autóctonos, están aplicando de forma proactiva estrategias para prevenir la reintroducción de casos autóctonos de malaria.
- Tras 5 años de cero transmisión local, la República Islámica de Irán se enfrenta actualmente a un brote de casos autóctonos de malaria. Los frecuentes movimientos fronterizos de personas contribuyeron a la introducción de casos y al posterior restablecimiento de la transmisión local.
- Reconociendo los vacíos en las políticas de prevención del restablecimiento, la OMS está en el proceso de desarrollar una guía para la prevención del restablecimiento de la transmisión.

Enfoque de alta carga a alto impacto

- Desde noviembre de 2018, los 11 países de alta carga a alto impacto (ACAI) han implementado actividades relacionadas con ACAI en los cuatro elementos de respuesta.
- En 2022, Sudán se unió al primer grupo de países ACAI, a petición del Ministerio Federal de Salud de Sudán. Esta inclusión amplió el número oficial de países ACAI a 12. Sin embargo, la plena aplicación en Sudán se vio obstaculizada por el conflicto que estalló a principios de 2023.

- La incidencia estimada de los casos de malaria y de la mortalidad se mantuvieron prácticamente sin cambios en los 11 países originales de ACAI entre 2021 y 2022, con aumentos en los casos debidos principalmente al aumento de la población.
- En 2022, los 11 países de ACAI representaron el 67% de todos los casos y el 73% de las muertes a nivel mundial.
- Como resultado de los avances positivos observados en los países iniciales de ACAI, varios países adicionales en las regiones de África y el Mediterráneo Oriental de la OMS han comenzado a implementar el segundo pilar del enfoque ACAI, que se centra en el uso estratégico de la información, con énfasis en la adaptación subnacional (ASN) de las intervenciones.
- ASN es el uso de datos locales e información del contexto para determinar la combinación adecuada de intervenciones y estrategias para un área determinada con el fin de lograr un impacto óptimo en la transmisión y la carga de la enfermedad a nivel estratégico o dentro de una partida específica de recursos.
- Desde 2018, más de 30 países endémicos de malaria han implementado ASN para orientar la planeación estratégica de una o varias intervenciones, los esfuerzos de movilización de recursos, las solicitudes de financiamiento, las negociaciones presupuestarias o la optimización de la implementación de intervenciones.
- La aplicación de ASN ha desencadenado la integración de datos como parte de los procesos regulares de toma de decisiones de los países. A su vez, esto ha reforzado los esfuerzos para mejorar la recopilación, revisión y calidad de los datos de forma regular.
- También ha revelado variaciones en la capacidad de los países para implementar plenamente el proceso ASN a nivel local. Es necesario que los países, sus socios y los donantes aborden colectivamente las posibles deficiencias en capacidades.

Inversiones en los programas de malaria e investigación

- La *Estrategia técnica mundial contra la malaria* (ETM) establece estimaciones de la financiación necesaria para alcanzar los hitos para 2025 y 2030. Se calcula que los recursos anuales totales necesarios serán de 6.800 millones de dólares en 2020, 9.300 millones en 2025 y 10.300 millones en 2030. Se calcula que se necesitarán otros 850 millones de dólares anuales para investigación y desarrollo (I+D) a nivel mundial en malaria durante el periodo 2021-2030.
- La financiación total para el control y la eliminación de la malaria en 2022 se estimó en 4.100 millones de dólares, frente a 3.500 millones en 2021 y 3.300 millones en 2020. La financiación total en los últimos 5 años ha rondado una media de 3.300 millones de dólares anuales. La cantidad invertida en 2022 sigue siendo inferior a los 7.800 millones de dólares que se calcula que serán necesarios en todo el mundo para mantener el rumbo hacia los hitos de la ETM.
- El déficit de financiación entre la cantidad invertida y los recursos necesarios ha seguido aumentando drásticamente en los últimos años, pasando de 2.300 millones de dólares en 2018 a 3.700 millones en 2022. A pesar de que la financiación total aumentó en una cantidad considerable de 2021 a 2022, la cantidad total de financiación en 2022 equivalía a solo el 52% de la financiación requerida según lo establecido por los objetivos de la ETM.
- Durante el periodo 2010-2022, el 66% de la financiación total para el control y la eliminación de la malaria procedió de fuentes internacionales. Los Estados Unidos de América contribuyeron con más de 1.500 millones de dólares a través de la financiación bilateral prevista y la parte ajustada a la malaria de las agencias de contribuciones multilaterales. Le siguieron desembolsos bilaterales y multilaterales de más de 400 millones de dólares de Francia, Alemania y el Reino Unido de Gran Bretaña e Irlanda del Norte juntos; contribuciones de unos 100 millones de dólares de Australia, Canadá y Japón cada uno; y un total de 400 millones de dólares de otros países miembros del Comité de Ayuda al Desarrollo y de contribuyentes del sector privado.
- Los gobiernos de los países donde la malaria es endémica aportaron más de un tercio de la financiación total en 2022, con inversiones de más de 1.500 millones de dólares, de los cuales casi 400 millones se destinaron al manejo de casos de malaria en el sector público y más de 1.100 millones a otras actividades

de control de la malaria. Esto supuso un aumento sustancial de más de 400 millones de dólares desde 2021, debido en gran parte a inversiones nacionales en la Región de África de la OMS.

- De los US\$ 4.100 millones invertidos en 2022, casi US\$ 2.600 millones se obtuvieron a nivel internacional, y casi US\$ 1.600 millones (39%) se canalizaron a través del Fondo Mundial. En comparación con años anteriores, los desembolsos del Fondo Mundial a los países donde la malaria es endémica han aumentado en unos US\$ 100 millones desde 2021 y en US\$ 500 millones desde 2018.
- Las clasificaciones del Banco Mundial por grupos según el ingreso varían de un año a otro. En 2022, los 25 países del grupo de ingresos bajos representaron el 44 % de la financiación total, similar a la de años anteriores, y el 70 % de la financiación provino de fuentes internacionales. Los 40 países de renta media-baja representaron el 43% de la financiación total en 2022. El resto de países y regiones no especificadas en las que no se disponía de información geográfica sobre los receptores representaron el 13% de la financiación para malaria.
- La estimación de la financiación para malaria por persona en riesgo pone de manifiesto la variación de la financiación nacional e internacional entre las regiones de la OMS y ha mostrado cambios considerables en la última década. En la mayoría de las regiones de la OMS, la financiación por persona en riesgo ha caído a niveles inferiores a los del 2010, salvo en la Región de África de la OMS, en la que la financiación por persona en riesgo ha aumentado ligeramente desde 2010, y de forma más significativa (en >30%) en comparación con 2021. Esto es sinónimo del aumento de la financiación nacional en la Región de África de la OMS en 2022, que ha aumentado en más de US\$ 300 millones desde 2021.
- De los 4.100 millones de dólares invertidos en 2022, más de tres cuartas partes (80%) se destinaron a la Región de África de la OMS; un 4% a cada una de las Regiones de Asia Sudoriental, Mediterráneo Oriental y las Américas; y un 2% fue para la Región del Pacífico Occidental. El 6% restante de la financiación total en 2022 se asignó a regiones no especificadas. La financiación a las regiones de la OMS mostró un aumento significativo en la Región de África de la OMS, pero se mantuvo relativamente estable en todas las demás regiones.
- Muchos países han experimentado cambios en su producto interior bruto (PIB) real debido a la pandemia de COVID-19 y a otras crisis. A su vez, esto ha afectado a la economía mundial, que se expandió un 5,5% en 2021 tras una contracción del 3,4% en 2020. En 2022, se produjo un crecimiento significativo entre todos los países de renta baja y media (PRMB), pasando de casi el 70% de los países de este grupo que habían experimentado un shock en 2020 a solo el 5% en 2022, lo que demuestra un repunte positivo de la economía mundial. No obstante, se prevé que los países de ingresos altos y otras organizaciones internacionales sigan dando prioridad a los esfuerzos en COVID-19 en 2024, sobre todo si se plantean desafíos constantes o surgen variantes. Además, las tensiones geopolíticas pueden provocar un aumento de la volatilidad en la economía mundial, lo que a su vez puede afectar la asignación de recursos y al gasto en atención en salud.
- La proporción del gasto en atención en salud del bolsillo de los hogares es un factor crítico a tener en cuenta. Aunque este informe no identifica los costos específicos por malaria, los gastos en salud, tanto directos como indirectos, pueden suponer una carga sustancial para los hogares. En 2020, se consideró que el 47% de los hogares de los PIBM habían experimentado gastos catastróficos (definidos como un gasto en salud superior al 40% de los ingresos del hogar), lo que afecta a 1.900 millones de personas en riesgo de contraer malaria que viven en estos países.
- La financiación total para I+D en malaria fue de 603 millones de dólares en 2022, un descenso de más del 10% desde 2021 y el nivel más bajo registrado de financiación para I+D en los últimos 15 años.
- Este es el cuarto año consecutivo de disminución de la financiación desde el pico alcanzado en 2018, con financiación para I+D en malaria disminuyendo principalmente en vacunas (por quinto año consecutivo) e investigación básica, en un 13% y 20%, respectivamente. Los medicamentos siguieron recibiendo la mayor parte de la financiación, a pesar de que también disminuyeron en un 12%.
- La financiación para productos biológicos siguió aumentando por cuarto año consecutivo, con un incremento de más del 250% en 2022, casi 14 veces más que en 2018. La Fundación Bill y Melinda Gates proporcionó la primera financiación para el desarrollo clínico de biológicos, en forma de una subvención de 3,9 millones de dólares a la Fundación CDC.
- La financiación procedente del sector público en los países de ingresos altos cayó fuertemente (18%) hasta el nivel más bajo en más de una década, aunque siguieron siendo el principal financiador de I+D en malaria. La financiación procedente de otros sectores también descendió, a excepción del sector privado, que repuntó y experimentó un aumento de 10 millones de dólares en financiación en 2022.

Distribución y cobertura de la prevención de la malaria

- Los datos de los fabricantes para 2004-2022 muestran que en ese periodo se suministraron casi 2.900 millones de mosquiteros tratados con insecticidas (MTI) en todo el mundo, de los cuales 2.500 millones (86%) se suministraron al África subsahariana. En 2022, los fabricantes suministraron unos 282 millones de MTI a países donde la malaria es endémica. De ellos, 260 millones se entregaron en el África subsahariana en 2022, de los cuales 131,5 millones eran mosquiteros con piretroide y PBO. Los MTI con doble principio activo representaron el 8% del total de MTI entregados en 2022. En 2022, los programas nacionales contra la malaria (PNM) distribuyeron 254 millones de mosquiteros tratados con insecticida en países donde la malaria es endémica. De ellos, 235 millones se distribuyeron en el África subsahariana.
- En 2022, 44 países realizaron campañas de distribución de MTI planeando distribuir unos 241 millones de mosquiteros. A finales de 2022, se había distribuido el 83% de todos los MTI que se planeó distribuir en 2022.
- De los 11 países con apoyo en la primera fase del enfoque ACAI, siete países tuvieron una campaña de distribución masiva, y cinco países distribuyeron en 2022 más del 85% de sus mosquiteros: Burkina Faso (90%), India (91%), Mozambique (100%), Nigeria (93%) y la República Unida de Tanzania (100%). Camerún y la República Democrática del Congo distribuyeron el 67% y el 75% de sus mosquiteros, respectivamente. En estos siete países sobraron unos 11 millones de mosquiteros de la campaña de 2021.
- En 2022, el 70% de los hogares del África subsahariana dispondrán de al menos un MTI, frente a aproximadamente el 5% en 2000. El porcentaje de hogares que poseen al menos un MTI por cada dos personas pasó del 1% en 2000 al 40% en 2022. En el mismo periodo, el porcentaje de la población con acceso a un MTI en su hogar aumentó del 3% al 56%.
- El porcentaje de la población que durmió bajo un MTI aumentó entre los años 2000 y 2022 para toda la población (del 2% al 49%), para los niños menores de 5 años (del 3% al 56%) y para las mujeres embarazadas (del 3% al 56%).
- Desde 2015 no se ha observado ningún aumento significativo en el acceso general a los MTI ni en su uso.
- A nivel mundial, el porcentaje de la población en riesgo protegida por el rociado residual intradomiciliar (RRI) en los países donde la malaria es endémica disminuyó del 5,5% en 2010 al 1,8% en 2022. El porcentaje de la población protegida por RRI se ha mantenido estable desde el año 2016, con menos del 6% de la población protegida en cada región de la OMS.
- El número de personas protegidas por el RRI a nivel mundial se redujo de 153 millones en 2010 a 62 millones en 2022.
- El número promedio de niños tratados por ciclo de quimioprevención estacional de la malaria (QEM) ha aumentado de forma constante, pasando de unos 0,2 millones en 2012 a 49 millones en 2022. Nigeria es el país que más contribuye, con una media de 25,5 millones de niños tratados por ciclo de QEM.
- En total, en 2022 se administraron unos 200 millones de dosis de tratamiento en los 17 países que aplican la QEM en el Sahel y otras zonas estacionales del África subsahariana.
- Utilizando datos de 33 países de la Región Africana de la OMS, se calculó el porcentaje de uso del tratamiento preventivo intermitente durante el embarazo (TPle) por dosis. En 2022, el 78% de las mujeres embarazadas utilizaron los servicios de atención prenatal al menos una vez durante el embarazo. Alrededor del 64% de las embarazadas recibieron una dosis de TPLE, el 54% recibieron dos dosis y el 42% recibieron tres dosis.

Distribución y cobertura del diagnóstico y tratamiento de la malaria

- A nivel mundial, los fabricantes vendieron 3.900 millones de pruebas de diagnóstico rápido (PDR) para la malaria en el periodo 2010-2022, y el 82% de estas ventas se realizó en países del África subsahariana. En el mismo periodo, los programas nacionales contra la malaria (PNM) distribuyeron 2.900 millones de PDR, el 90% en el África subsahariana.

- En 2022, los fabricantes vendieron 415,5 millones de PDR y los PNM distribuyeron 345 millones.
- A nivel mundial, los fabricantes suministraron más de 4.000 millones de tratamientos combinados con artemisinina (TCA) entre 2010 y 2022. Alrededor de 2.700 millones de estas entregas fueron para el sector público en países donde la malaria es endémica, y el resto fueron copagos del sector público o privado (o ambos), o exclusivamente a través del sector minorista privado.
- Los datos nacionales reportados por los PNM en 2010-2022 muestran que se entregaron 2.500 millones de TCA a proveedores de servicios de salud para tratar a personas con malaria en el sector público.
- En 2022, los fabricantes entregaron unos 210 millones de TCA al sector público de salud. Ese mismo año, los PNM distribuyeron 217 millones de TCA a este sector, de los cuales el 97% se encontraron en el África subsahariana.
- Se utilizaron datos agregados de encuestas de hogares realizadas en África subsahariana entre 2005 y 2022 en 22 países con al menos dos encuestas (de referencia 2005-2011, y la más reciente 2015-2022) para analizar la cobertura de la búsqueda de tratamiento, diagnóstico y el uso de TCA en niños menores de 5 años.
- Comparando las encuestas de referencia y las más recientes, hubo pocos cambios en la prevalencia de fiebre en las 2 semanas anteriores a las encuestas (mediana del 26% frente al 23%) o en la búsqueda de tratamiento para la fiebre (mediana del 65% frente al 66%).
- Las comparaciones de la procedencia de los tratamientos entre las encuestas de referencia y las más recientes muestran que la proporción de los que recibieron atención en centros de salud públicos aumentó de una mediana del 58% al 69%. El uso de trabajadores de salud comunitarios siguió siendo bajo, con un porcentaje promedio del 2% tanto en la encuesta de referencia como en las posteriores. La proporción de los que recibieron atención por el sector privado disminuyó de una mediana del 40% en la línea de base al 28% en las encuestas más recientes, lo que indica un aumento del acceso de la población al sector de salud público y, en consecuencia, al sistema asociado de vigilancia público.
- La tasa de diagnóstico entre los niños menores de 5 años con fiebre y para los que se buscó atención aumentó de una mediana del 30% en la línea de base al 54% en las últimas encuestas de hogares, lo que indica una mejora en el manejo de los casos, a pesar de la evidencia de niveles inadecuados de servicios de diagnóstico.
- El uso de tratamientos combinados con artemisinina (TCA) entre los niños menores de 5 años atendidos aumentó del 13% en la encuesta inicial al 24% en las últimas encuestas.
- Entre los que solicitaron atención y recibieron un pinchazo en el dedo o en el talón, el uso de TCA fue del 34% en la encuesta más reciente, en comparación con el 21% en la encuesta inicial. Entre las personas que solicitaron atención y fueron tratadas con un medicamento antimalárico, la mediana aumentó del 38% al inicio al 65% en las últimas encuestas, lo que indica una mejora en las tasas de tratamiento o un aumento en las tasas de positividad de las pruebas entre las personas a quienes se les realizó la prueba. Este indicador debe interpretarse de acuerdo al contexto de cada país, dada la falta de información sobre el tipo de prueba diagnóstica realizada o el resultado de la misma.

Avances hacia los hitos de la ETM de 2025

- La estrategia técnica mundial (ETM) aboga por una reducción de la incidencia de casos de malaria y de la tasa de mortalidad de al menos un 40% para 2020, un 75% para 2025 y un 90% para 2030 con respecto a la línea de base de 2015.
- A pesar de los considerables progresos realizados desde el año 2000, si se mantienen las tendencias actuales, es probable que a nivel mundial no se alcancen las metas de la ETM para el 2025.
- La incidencia de casos de malaria de 58 casos por 1000 habitantes en riesgo en 2022 en lugar de los 26 casos por 1000 esperados para el mismo año si el mundo estuviera en el buen camino para alcanzar el hito de morbilidad de la ETM 2025 significa que, globalmente, estamos desviados del objetivo en un 55%.
- Aunque el progreso relativo en la tasa de mortalidad es mayor que el de la incidencia de casos, el objetivo esperado de 6,6 muertes por malaria por cada 100.000 habitantes en riesgo en 2022 -si el mundo estuviera

en el buen camino para alcanzar el hito de mortalidad de la ETM de 2025- fue un 53% inferior a la tasa de mortalidad real de 14,3 observada en ese año.

- De los 93 países en los que la malaria era endémica (incluido el territorio de la Guayana Francesa) a nivel mundial en 2015, 23 países (24,7%) están en vías de alcanzar el hito de morbilidad de la ETM para 2025, habiendo logrado una reducción del 55% o más en la incidencia de casos o habiendo notificado cero casos de malaria en 2022.
- Veinticuatro países (26%) han avanzado en la reducción de la incidencia de casos de malaria, pero por debajo del objetivo esperado.
- Veinticinco países (27%) han experimentado un aumento de la incidencia de casos, y 15 países (16%) han tenido un aumento del 55% o más en la incidencia de la malaria en 2022 en comparación con 2015.
- En 14 países (15,1%), la incidencia de casos de malaria en 2022 fue similar a la de 2015.
- Treinta y un países (33%) que eran endémicos de malaria en 2015 están en vías de cumplir el hito de mortalidad de la ETM para 2025, con 22 de ellos con cero muertes por malaria.
- Treinta y un países (33%) lograron reducciones en las tasas de mortalidad por malaria, pero inferiores al objetivo del 55% para 2022.
- Las tasas de mortalidad por malaria se mantuvieron al mismo nivel en 2022 que en 2015 en siete países (7,5%), mientras que las tasas de mortalidad aumentaron en 17 países (18,3%), ocho de los cuales registraron aumentos del 55% o más.
- La Región de Asia Sudoriental de la OMS cumplió los hitos de la ETM 2020 tanto para la mortalidad como para la morbilidad y sigue en camino de cumplir los objetivos de la ETM 2025 y 2030. Todos los países de la región, excepto Indonesia y Myanmar, redujeron la incidencia de casos y la mortalidad en un 55% o más, o se mantuvieron sin cambios.

Amenazas biológicas y de otro tipo para las herramientas de intervención contra el malaria

Deleción de genes en parásitos

- Los parásitos de *P. falciparum* que no expresan la proteína 2 rica en histidina (HRP2) pueden escapar a la detección de las pruebas de diagnóstico rápidas (PDR) que están basadas en la detección de la HRP2. Además, la proteína rica en histidina 3 (HRP3), una proteína homóloga de la HRP2, puede presentar reacciones cruzadas con los anticuerpos monoclonales utilizados para la detección de la HRP2 a altas densidades de parásitos. Los parásitos de *P. falciparum* que no expresen ni la HRP2 ni la HRP3 eludirán completamente la detección por las PDR basadas en la HRP2. Según los datos facilitados por los fabricantes, en 2022 se vendieron unos 415,5 millones de este tipo de PDR.
- La OMS recomienda que los países con registros de delecciones *Pfhrp2/3*, y sus países vecinos, lleven a cabo estudios representativos como referencia entre los casos sospechosos de malaria, para determinar si la prevalencia de delecciones de *Pfhrp2/3* que causan resultados de falsos negativos de las PDR supera el umbral que requiere un cambio de PDR.
- En 2022 se publicaron 16 artículos nuevos, según búsquedas de la literatura que sirvieron de base al Mapa de Amenazas de la Malaria. Estos incluyeron datos de la Región de África de la OMS (Burundi, Camerún, Guinea Ecuatorial, Etiopía, Ghana, Kenia, Madagascar, República Democrática del Congo, República Unida de Tanzania, Ruanda, Sierra Leona y Sudán del Sur); la Región de las Américas de la OMS (Brasil, Ecuador y Perú); y Camboya, India y Vietnam.
- En 2022 se publicaron por primera vez estudios sobre delecciones de *Pfhrp2* en seis países (Burundi, Camboya, Camerún, Sierra Leona, Sudán del Sur y Vietnam), de los cuales sólo en Burundi y Vietnam no se detectaron delecciones de *Pfhrp2*.
- Según los datos de las publicaciones incluidas en el Mapa de Amenazas de la Malaria, en 50 países se ha llevado a cabo algún tipo de investigación para detectar delecciones de *Pfhrp2/3*.

- El plan de respuesta de la OMS para las delecciones de *Pfhrp2/3* esboza varias áreas de actuación, entre las que se incluyen la identificación de nuevos biomarcadores, la mejora del rendimiento de las PDR que no sean basadas en HRP2, la realización de previsiones de mercado y el fortalecimiento de las redes de laboratorios, para apoyar la demanda de uso de la caracterización molecular para determinar la presencia o ausencia de estas delecciones génicas.

Resistencia de los parásitos a los medicamentos antimaláricos (2015-2022)

- La eficacia de los medicamentos antimaláricos se vigila mediante estudios de eficacia terapéutica (EET), que realizan un seguimiento de los resultados clínicos y parasitológicos de las personas que reciben tratamiento antimalárico. Los EET se consideran el patrón de referencia que permite a los países determinar mejor sus políticas nacionales de tratamiento.
- La resistencia a los medicamentos antimaláricos puede evaluarse mediante varias herramientas. Para algunos medicamentos, se han identificado cambios genéticos asociados a una sensibilidad reducida. La resistencia parcial a la artemisinina se vigila utilizando una lista establecida de marcadores *PfKelch13* validados asociados a un retraso en la eliminación de los parásitos tras un tratamiento que contenga artemisinina.
- Como parte de la respuesta para contrarrestar la amenaza de la resistencia a los medicamentos antimaláricos, la OMS hace un llamado a los países donde la malaria es endémica y a los socios mundiales contra la malaria para que refuercen la vigilancia de la eficacia y la resistencia a los medicamentos antimaláricos, y para asegurar que se seleccionen los tratamientos más eficaces para la política nacional de tratamiento.
- **Región de África de la OMS:** la mayoría de los EET realizados según el protocolo estándar de la OMS demuestran una buena eficacia del tratamiento antimalárico. Durante el periodo de notificación (2015–2022), algunos estudios realizados en la Región de África de la OMS sobre la eficacia del tratamiento antimalárico contra *P. falciparum* detectaron altos niveles de falla terapéutica. Estos resultados justifican una investigación más a fondo y podrían ser un signo de la aparición de resistencia a los fármacos de la combinación de los TCA. Cinco estudios sobre arteméter-lumefantrina (AL), que aplicaron la metodología estándar de la OMS para la corrección de la reacción en cadena de la polimerasa, notificaron tasas de falla terapéutica superiores al 10%. Estos estudios se realizaron en Burkina Faso, Kenia y Uganda. Además, cinco estudios con AL y uno con dihidroartemisinina-piperaquina (DHA-PPQ) notificaron tasas de falla terapéutica superiores al 10% cuando se utilizaron algoritmos bayesianos para distinguir entre reinfección y recrudescencia; estos estudios se realizaron en Angola, la República Democrática del Congo y Uganda. Tras la vigilancia de los polimorfismos de *PfKelch13* asociados a la resistencia parcial a la artemisinina en varios países, ahora hay pruebas de resistencia parcial a la artemisinina asociada a la expansión clonal de las mutaciones de *PfKelch13* en Eritrea, Ruanda, Uganda y la República Unida de Tanzania. La República Unida de Tanzania es el cuarto país de la Región de África de la OMS en el que se ha confirmado la resistencia parcial a la artemisinina. En Etiopía se investigó la eficacia de la cloroquina (CQ) y la DHA-PPQ para el tratamiento de *P. vivax*: las tasas de falla terapéutica fueron inferiores al 5% en nueve estudios de CQ y dos de DHA-PPQ.
- **Región de las Américas de la OMS:** se dispone de datos limitados de la Región de las Américas de la OMS. Las EET realizadas con AL en Brasil (2015) y Colombia (2018) demostraron una alta eficacia de este medicamento contra *P. falciparum*. En Guyana, la mutación C580Y se observó esporádicamente entre 2010 y 2017; la mutación no se ha encontrado en ninguna de las muestras más recientes, lo que indica que es probable que la mutación haya desaparecido. Todos los países con malaria endémica en esta región recomiendan la CQ como tratamiento de primera línea para *P. vivax*. La eficacia de la CQ se estudió en Brasil y resultó ser alta.
- **Región de Asia Sudoriental de la OMS:** todos los estudios sobre la eficacia del tratamiento contra *P. falciparum* realizados durante el periodo de estudio revelaron menos de un 10% de falla terapéutica. Las fallas terapéuticas con artesunato más sulfadoxina-pirimetamina (AS+SP) siguieron siendo bajas en la India. Sin embargo, los hallazgos de un estudio realizado en el estado de Chhattisgarh entre 2015 y 2017 en el que se analizaron las mutaciones *dhfr* y *dhps* podrían ser una advertencia temprana de la necesidad de cambiar la política de tratamiento con AS+SP en el noreste de la India. Las mutaciones *PfKelch13* asociadas con la resistencia parcial a la artemisinina han alcanzado una alta prevalencia en Myanmar y Tailandia.

- **Región del Mediterráneo Oriental de la OMS:** se dispone de datos sobre la eficacia del AL para el tratamiento de *P. falciparum* en Afganistán, Pakistán, Somalia, Sudán y Yemen (2015-2020). En todos se ha demostrado una alta eficacia del tratamiento. Se dispone de datos sobre la eficacia de los tratamientos de primera línea para *P. vivax* de un estudio de AL de Somalia (2018) y dos estudios de CQ en Afganistán (2016 y 2022); no se observaron fallas terapéuticas.
- **Región del Pacífico Occidental de la OMS:** los estudios sobre la eficacia del tratamiento antimalárico contra *P. falciparum* han encontrado altas fallas terapéuticas. En Camboya occidental se detectó una tasa de falla terapéutica del 13,5% con AL en 2018-2020. En Camboya se documentó resistencia a la amodiaquina (AQ) en 2016-2017, con altas tasas de falla terapéutica con AS-AQ en las provincias de Mondulkiri (22,6%) y Pursat (13,8%); y se detectaron altas tasas de falla terapéutica con DHA-PPQ en Camboya, la República Democrática Popular Lao y Vietnam. En Camboya, los hallazgos motivaron la sustitución del DHA-PPQ por artesunato-mefloquina (AS-MQ) como tratamiento de primera línea en 2016. En Viet Nam, el artesunato-pironaridina (AS-PY) ha sustituido al DHA-PPQ en las provincias donde se detectaron altas tasas de falla terapéutica. Se encontraron parásitos con el *PfKelch13* de tipo silvestre en el 29,9% de las muestras recogidas entre 2015 y 2020 en Camboya, la República Democrática Popular Lao y Vietnam. En Papúa Nueva Guinea, la mutación *PfKelch13* C580Y ha surgido y parece estar extendiéndose. Para *P. vivax*, un estudio de CQ en Vietnam en 2015 encontró tasas de falla del tratamiento del 9,8%.

Resistencia de los vectores a los insecticidas

- Desde 2021 se han notificado a la OMS datos de resistencia a los insecticidas en 35 países. Estos datos se están cotejando y se actualizarán en 2024 en la base de datos mundial de la OMS sobre la resistencia a los insecticidas en los vectores del malaria y en el Mapa de Amenazas de Malaria.
- De los 88 países con malaria endémica que proporcionaron datos para 2010-2020, 78 han detectado resistencia a al menos una clase de insecticida en al menos un vector del malaria y un lugar de recolección; 29 ya han detectado resistencia a piretroides, organoclorados, carbamatos y organofosforados en diferentes lugares; y 19 han confirmado resistencia a las cuatro clases de insecticidas en al menos un lugar y al menos un vector local.
- A nivel mundial, se detectó resistencia a los piretroides en al menos un vector de la malaria en el 87% de los países y el 68% de los lugares, a los organoclorados en el 82% de los países y el 64% de los lugares, a los carbamatos en el 69% de los países y el 34% de los lugares, y a los organofosforados en el 60% de los países y el 28% de los lugares. La resistencia a estas cuatro clases de insecticidas se confirmó en todas las regiones de la OMS; sin embargo, su extensión geográfica varió considerablemente entre regiones.
- De los 38 países que notificaron datos sobre la intensidad de la resistencia a los piretroides (2010-2020), se detectó resistencia de alta intensidad en 27 países y 293 sitios.
- Entre 2019 y 2020, los Estados miembros de la OMS notificaron los resultados de 835 bioensayos realizados con clorfenapir y 603 con clotianidina. Para el clorfenapir, los requisitos en los bioensayos de la OMS son más elaborados que los procedimientos para evaluar la resistencia de mosquitos a otros insecticidas. Hasta la fecha, la OMS ha recibido resultados de 502 pruebas que cumplen estos requisitos, realizadas en 391 lugares de 20 países. Sin embargo, hasta que no se disponga de tres pruebas completas en cada uno de estos lugares, la OMS no podrá interpretar estos resultados. En cuanto a la clotianidina, hasta la fecha sólo se han notificado a la OMS 13 resultados con éste insecticida, y sólo se ha notificado un caso de posible resistencia, en Senegal.
- Para orientar el manejo de la resistencia, los países deben elaborar y aplicar planes nacionales de vigilancia y manejo de la resistencia a los insecticidas, basándose en el marco de la OMS para un plan nacional de vigilancia y manejo de la resistencia a los insecticidas en los vectores de la malaria.
- Se necesita apoyo técnico y financiero para ayudar a los países a vigilar y manejar la resistencia a los insecticidas.

Invasión y propagación de *Anopheles stephensi*

- Hasta la fecha, la OMS ha recibido informes de detecciones de *An. stephensi* en Yibuti, Eritrea, Etiopía, Ghana, Kenia, Nígeria, Somalia, Sri Lanka, Sudán y Yemen.

- Las características de este vector hacen que su control sea todo un reto; por ejemplo, *An. stephensi* se adapta rápidamente al entorno local, sobreviviendo a temperaturas extremadamente altas durante la estación seca, cuando la transmisión del malaria suele alcanzar su mínimo estacional.
- Los datos sobre resistencia a los insecticidas reportados a la OMS muestran que *An. stephensi* ha mostrado resistencia a los piretroides, organofosforados, carbamatos y organoclorados en la Península Arábig y Asia. En el Cuerno de África, ha mostrado resistencia a los piretroides, organofosforados y carbamatos.
- *An. stephensi* representa una amenaza para el control y la eliminación de la malaria en África, la Península Arábig y el sur de Asia. Si no se controla, su propagación por África, combinada con una urbanización rápida y mal planificada, puede aumentar el riesgo de transmisión de malaria en las ciudades africanas.
- La OMS anima a los países en los que se sospecha o se ha confirmado la invasión de *An. stephensi* a que tomen medidas inmediatas, aumentando la vigilancia de los vectores para delimitar su propagación geográfica y utilizando los datos para poner en marcha intervenciones destinadas a prevenir su propagación ulterior, especialmente en zonas urbanas y periurbanas.
- Se pide a las instituciones de investigación y a los socios de implementación que notifiquen inmediatamente cualquier detección de *An. stephensi* a los ministerios de salud y a la OMS, para orientar las respuestas nacionales y mundiales.
- Los estudios sobre especies invasoras detectadas que se notifiquen a la OMS y se publiquen en revistas científicas pueden explorarse en el Mapa de Amenazas de la Malaria.

Cambio climático, malaria y respuesta mundial

- La OMS ha declarado que el cambio climático es la mayor amenaza para la salud a la que se enfrenta la humanidad.
- El cambio climático amenaza con hacer descarrilar el progreso de la salud mundial al afectar a los medios de subsistencia; aumentar los riesgos de exposiciones nocivas a partículas, patógenos y enfermedades; sobrecargar los sistemas sanitarios; y ampliar las desigualdades existentes. Por tanto, el cambio climático no es sólo una amenaza singular, sino un importante multiplicador de otras amenazas.
- El cambio climático y su interacción con la transmisión de la malaria son complejos y son escasas las pruebas empíricas que apoyen predicciones fiables.
- El cambio climático también es responsable de fenómenos meteorológicos más extremos y frecuentes, como las inundaciones, que pueden provocar epidemias de paludismo, o de sequías graves que suprimen la transmisión durante un periodo, pero que suelen ir seguidas de epidemias cuando llegan las lluvias.
- La dirección del efecto sobre la transmisión y la carga de la malaria no será lineal y es probable que varíe según los distintos contextos, dependiendo de factores como los cambios de temperatura, lluvia or humedad, el nivel de control y eliminación de la malaria, el grado de desarrollo socioeconómico y el manejo del medio ambiente.
- La influencia de la temperatura, las precipitaciones y la humedad en el desarrollo larvario, la supervivencia del mosquito, el desarrollo del parásito dentro del mosquito y la competencia del vector afectan la capacidad vectorial (es decir, el número de nuevas infecciones que la población de un vector dado induciría por caso por día en un lugar y momento determinados), y por tanto afectan la intensidad de la transmisión del malaria.
- Los posibles efectos directos del cambio climático sobre el paludismo podrían incluir la ampliación de su límite geográfico, el aumento o la reducción de la intensidad de la transmisión dentro de los límites actuales de transmisión, la reintroducción de la malaria en zonas donde se había eliminado, o cambios imperceptibles en la transmisión.
- Los posibles efectos indirectos del cambio climático sobre la malaria podrían incluir la pérdida de medios de subsistencia y el aumento de la inseguridad económica y alimentaria, desplazamientos e interrupciones de los servicios, aumento de la dificultad y el costo de los programas contra la malaria, y variaciones en el acceso y la calidad de los sistemas de prestación de servicios de salud.

- La evidencia empírica del efecto del cambio climático en la transmisión de la malaria es contradictoria; esto se debe en parte a las limitaciones de los datos, pero también a los numerosos determinantes paralelos de la transmisión de la malaria que se producen en un contexto de clima cambiante.
- Las pruebas más sólidas, quizás, proceden de datos de series temporales largas de altiplanos africanos que están al margen de la transmisión endémica; estos datos sugieren que, en las últimas décadas, el aumento de las temperaturas ha provocado la expansión de la malaria en estas zonas.
- En 2022 y 2023, las lluvias monzónicas extremas afectaron a muchas partes de Pakistán, y hay pruebas que sugieren que la gravedad de la estación monzónica se vio agravada por el cambio climático. Estas inundaciones provocaron una gran epidemia de malaria que multiplicó por cinco los casos de esta enfermedad en el país en comparación con el año anterior.
- En el marco del Grupo Estratégico Asesor para la Erradicación de la Malaria (SAGme), la OMS encargó un estudio, dirigido por el Proyecto Atlas de la Malaria, para predecir las trayectorias futuras de la malaria en distintos escenarios de intervención, socioeconómicos y de cambio climático, basándose en las vías socioeconómicas compartidas (SSP) desarrolladas por el Grupo Intergubernamental de Expertos sobre el Cambio Climático (IPCC).
- Bajo el escenario climático “intermedio” (SSP2), el análisis sugiere que con los niveles actuales de cobertura de las intervenciones, combinados con unas condiciones medioambientales y socioeconómicas cambiantes, es probable que la incidencia de la malaria se reduzca incluso si los casos de malaria aumentan ligeramente como resultado del crecimiento de la población.
- Si las intervenciones actuales se intensifican hasta alcanzar altos niveles de cobertura, y se mantienen los cambios previstos en las condiciones medioambientales y socioeconómicas, el análisis sugiere la posibilidad de que se produzcan reducciones sustanciales en la incidencia de malaria.
- Se proyectaron tendencias similares de menor magnitud al considerar la continuación del nivel actual de desarrollo y uso de combustibles fósiles (SSP5) bajo diferentes escenarios de intervención. Todavía no se ha calculado el coste total de la ampliación de las intervenciones en los distintos escenarios del SSP, pero es probable que los costes sean mucho más elevados que los estimados actualmente en el marco del ETM. El aumento de los costes y el impacto desproporcionado sobre quienes se enfrentan a la vulnerabilidad ponen aún más de relieve la necesidad de garantizar un uso más eficaz y equitativo de los limitados recursos disponibles.
- Sin embargo, el debate sobre la direccionalidad y la magnitud del efecto del cambio climático sobre la malaria no debería disuadir a la comunidad mundial de garantizar respuestas sostenibles y resilientes contra la malaria ante la amenaza del cambio climático.
- Este informe propone centrarse en acciones estratégicas, técnicas y operativas.
- Las acciones estratégicas incluyen liberar al mundo de la malaria y reducir al mismo tiempo la vulnerabilidad general al cambio climático; el establecimiento de una voz común y la creación de asociaciones para compartir una narrativa común que promueva acciones multisectoriales que reduzcan las emisiones de carbono y mejoren la salud; la descarbonización de los sistemas de salud haciéndolos más sostenibles desde el punto de vista medioambiental, y el desplazamiento de la toma de decisiones hacia los países.
- Las acciones técnicas incluyen la producción de información sobre el nexo entre el cambio climático y la salud; la creación de mejores sistemas de salud, más resilientes al clima y sostenibles desde el punto de vista medioambiental; y la provisión de guías y herramientas para la vigilancia del clima y la salud, y seguimiento y la evaluación.
- Las acciones operativas incluyen el uso de información sobre el clima y la enfermedad para la toma de decisiones; el establecimiento de sistemas sólidos de preparación y respuesta para la detección de epidemias; y la mejora de la capacidad nacional para analizar y utilizar la información sobre el clima y la malaria.
- La erradicación de la malaria es la única forma de resolver los efectos devastadores de esta enfermedad, con o sin la amenaza añadida del cambio climático. Por ello, deben realizarse inversiones para mitigar las amenazas biológicas a la malaria y desarrollar herramientas más eficaces.
- Es necesario invertir en la investigación de las formas en que las variaciones climáticas y el cambio climático influyen en la respuesta de la malaria a lo largo de diferentes escalas temporales, así como en formas eficaces de comunicar estos riesgos a los responsables de las políticas, los financiadores y el

público. También es necesario investigar sobre cómo reducir la huella de carbono del sector salud, incluida la respuesta a la malaria.

- Los futuros productos y su suministro tendrán que adaptarse a un entorno operativo que ha sido redefinido por el cambio climático. Por ejemplo, medicamentos y diagnósticos estables al calor y herramientas de prevención adecuadas para poblaciones desplazadas o migrantes. Su diseño también debe minimizar su impacto medioambiental, identificando futuros productos que sean biodegradables, o que puedan fabricarse fácilmente a nivel local. Desarrollar resiliencia en las respuestas a la malaria ante los riesgos del cambio climático requerirá de un gran aumento de la financiación para combatir la enfermedad, combinado con un mejor uso de los datos locales para adaptar eficazmente las intervenciones de manera dinámica y subnacional.
- El compromiso asumido por los países desarrollados que forman parte de la Convención Marco de las Naciones Unidas sobre el Cambio Climático, de movilizar conjuntamente y poner en pleno funcionamiento el Fondo Verde para el Clima debe incluir la malaria y reconocer la necesidad de una mitigación climática más amplia, no solo la reducción de las emisiones de gases de efecto invernadero.



1 Introduction

The *World malaria report 2023* presents progress against several important health and development goals in global efforts to reduce the burden of malaria overall and eliminate the disease where possible. These goals are outlined in the Sustainable Development Goals (SDGs) framework (1), the World Health Organization (WHO) *Global technical strategy for malaria 2016–2030* (GTS) (2) and the RBM Partnership to End Malaria (formerly known as Roll Back Malaria) *Action and investment to defeat malaria 2016–2030* (3). For most indicators, the report covers the period 2000–2022.

Section 2 tracks some of the key events that are relevant to the global state of malaria, including new WHO malaria recommendations. **Section 3** presents the global trends in malaria morbidity and mortality, and estimates of the burden of malaria during pregnancy. **Section 4** shows the trends in countries that are in the last stages of eliminating malaria, and those that are malaria free or have received WHO certification. **Section 5** reports the latest updates on the high burden to high impact (HBHI) approach, and presents a summary of the process and implementation status of countries' subnational tailoring of malaria interventions. **Section 6** focuses on total funding for malaria control and elimination, and for malaria research and development. The supply of key commodities to endemic countries and the population-level coverage achieved through these investments are presented in **Section 7**. **Section 8** summarizes global progress, by region and country, towards

the GTS milestones for 2020 and the trajectory towards 2025 and 2030. **Section 9** describes the threats posed by *Plasmodium falciparum* parasites that no longer express histidine-rich protein 2 (HRP2), which is detected by the most widely used malaria rapid diagnostic test (RDT), and the threats posed by drug and insecticide resistance. **Section 10** provides an overview of the relationship between climate and malaria, global climate predictions, and the potential effects of climate change on malaria transmission and burden, including implications for the global malaria response. **Section 11** summarizes the findings of the report and presents concluding remarks.

The main text is followed by annexes that contain data sources and methods, regional profiles and data tables. Country profiles can be found online (4). The latest data from the *World malaria report 2023* is available on the WHO Malaria Toolkit app (5).



2 Overview of key events in 2022–2023

This section presents the key events relevant to the global malaria response that occurred in 2022–2023, including new WHO recommendations and strategies, and updates on humanitarian and health emergencies that have direct or indirect implications for the global malaria response.

2.1 The Global Malaria Programme operational strategy

Global progress on malaria has stalled in recent years, and a “business as usual” approach will take countries and their development partners further off course. Recognizing that getting back on track will require major changes in the malaria response, the WHO Global Malaria Programme (WHO/GMP) has developed a departmental operational strategy for the period 2024–2030.

The operational strategy focuses on WHO/GMP’s role, but also acknowledges the importance of a concerted effort across the ecosystem to accelerate progress towards the GTS 2030 targets. It is therefore fully aligned with both the GTS and WHO’s 14th General Programme of Work.

The strategy reflects inputs from countries, partners and WHO colleagues who have contributed to a better

understanding of the root causes of stalled progress. Their inputs have enabled WHO/GMP to identify how the department can better deliver on its mandate to address current challenges and maximize new opportunities.

The operational strategy focuses on four strategic objectives: norms and standards, new tools and innovation, strategic information for impact and leadership. A fifth cross-cutting pillar – context-based country support – completes the objectives. The strategy will be accompanied by detailed operational plans outlining specific activities and a results framework, to provide greater transparency and accountability.

2.2 New WHO recommendations on vector control

WHO published recommendations to cover two new classes of dual ingredient insecticide-treated mosquito nets (ITNs) with different modes of action (6):

- *pyrethroid-chlorfenapyr* nets, which combine a pyrethroid and a pyrrole insecticide to enhance the killing effect of the net; and

- *pyrethroid-pyriproxyfen* nets, which combine a pyrethroid with an insect growth regulator that disrupts mosquito growth and reproduction.

WHO issued a *strong recommendation* for the deployment of pyrethroid-chlorfenapyr ITNs versus pyrethroid-only nets to prevent malaria in adults and children in areas

where mosquitoes have become resistant to pyrethroids. The recommendation considers that, compared with pyrethroid-only nets or pyrethroid-piperonyl butoxide (PBO) nets, pyrethroid-chlorfenapyr ITNs had an increased killing effect against pyrethroid-resistant malaria vectors and should have a greater impact against malaria.

WHO also issued a *conditional recommendation* for the deployment of pyrethroid-chlorfenapyr ITNs instead of pyrethroid-PBO nets to prevent malaria in adults and children in areas with pyrethroid resistance. The conditionality of the recommendation is based on the judgement of the WHO Guideline Development Group (GDG) that the balance of desirable and undesirable

effects probably favours pyrethroid-chlorfenapyr nets over pyrethroid-PBO nets, with evidence drawn from a single trial in the WHO African Region.

WHO also issued a *conditional recommendation* for the deployment of pyrethroid-pyriproxyfen nets instead of pyrethroid-only nets to prevent malaria in adults and children in areas with pyrethroid resistance. The conditionality of the recommendation was based on the GDG’s concerns around the poor cost-effectiveness of pyrethroid-pyriproxyfen nets compared with pyrethroid-only nets, because the extra resources currently required to purchase these ITNs may have a negative impact on coverage and equity.

2.3 Rollout of the RTS,S/AS01 malaria vaccine

Since 2019, Ghana, Kenya and Malawi have been delivering the malaria vaccine RTS,S/AS01 (RTS,S) through the Malaria Vaccine Implementation Programme, which is coordinated by WHO and funded by Gavi, the Vaccine Alliance (Gavi); the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund); and Unitaid. To date, the RTS,S vaccine has been administered to over 2 million children in Ghana, Kenya and Malawi, and has been shown to be safe and effective (7), resulting in a drop of 13% in all-cause early childhood deaths and a substantial reduction in severe malaria. Vaccine uptake of RTS,S is high, with no reduction in ITN use, uptake of other vaccines or change in health-seeking behaviours. Additionally, the RTS,S vaccine is reaching children who are not using other forms of malaria prevention.

Since the WHO recommendation for use of RTS,S in October 2021, at least 28 countries in the WHO African Region have expressed interest in introducing the malaria vaccine. Several countries submitted applications to Gavi, and 18 countries have been approved to receive support for malaria vaccine rollout (Benin, Burkina Faso, Burundi,

Cameroon, the Central African Republic, Chad, the Democratic Republic of the Congo, Ghana, Kenya, Liberia, Niger, Nigeria, Malawi, Mozambique, Sierra Leone, South Sudan, Sudan and Uganda).

Given the initial constrained vaccine supply for RTS,S, a framework for allocation of limited malaria vaccine supply was developed and applied to prioritize the 18 million doses of the first-ever malaria vaccine available for 2023–2025 to 12 countries, for subnational introduction in areas of greatest need. The allocations were determined through the application of the principles outlined in the vaccine allocation framework (8), which prioritizes doses to areas of highest need, where the risk of malaria illness and death among children is highest. This allocation round makes use of the supply of vaccine doses available to Gavi via the United Nations Children’s Fund (UNICEF). The first doses of the vaccine are expected to arrive in countries during the last quarter of 2023, with countries starting to roll them out through the childhood immunization programme by early 2024.

2.4 WHO recommendation for a second malaria vaccine, R21/Matrix-M

In October 2023, the R21/Matrix-M (R21) malaria vaccine became the second vaccine recommended by WHO to prevent malaria in children living in areas of risk (9). The recommendation follows advice from the WHO Strategic Advisory Group of Experts on Immunization (SAGE) and the Malaria Policy Advisory Group and was endorsed by the WHO Director-General following the SAGE regular biannual meeting held on 25–29 September 2023 (10). The addition of the R21 malaria vaccine to complement the ongoing rollout of the first malaria vaccine, RTS,S, is expected to result in sufficient vaccine supply to benefit children living in areas where malaria is a major public health problem. Tens of thousands of young lives could be saved every year with the broad rollout of these malaria vaccines.

WHO recommends the use of malaria vaccines (R21 or RTS,S) for the prevention of *P. falciparum* malaria in children living in malaria endemic areas, prioritizing areas of moderate and high transmission. The malaria vaccine (R21 or RTS,S) is to be provided in a schedule of four doses from around 5 months of age for the reduction of malaria disease and burden. Full programmatic recommendations will be available early in 2024.

Key findings from an ongoing R21 vaccine clinical trial and other studies informed the updated recommendation, including the following:

- High vaccine efficacy when given just before the high transmission season – In areas with highly seasonal malaria transmission (where malaria transmission is



largely limited to 4–5 months per year), the R21 vaccine was shown to reduce symptomatic malaria cases by 75% during the 12 months following a three-dose series. A fourth dose given a year after the third maintained efficacy. This high efficacy is similar to the efficacy demonstrated when RTS,S is given seasonally.

- Good vaccine efficacy when given in an age-based schedule – The vaccine showed good efficacy (66%) during the 12 months following the first three doses, when provided to children from 5 months of age. A fourth dose given a year after the third maintained efficacy.
- Safety – The R21 vaccine was shown to be safe in clinical trials. As with other new vaccines, safety monitoring will continue.

- Similarity to the RTS,S malaria vaccine – Both malaria vaccines are safe and effective. The vaccines have not been tested in direct (head-to-head) comparison studies; however, given the similarity of the vaccines and the fact that RTS,S is efficacious in high, moderate and low transmission settings, it is likely that R21 will also be efficacious in all malaria endemic settings.

Next steps for R21 include completing the ongoing WHO prequalification, to enable international procurement of the vaccine for broader rollout. This will be followed by efforts from WHO, Gavi and partners to support countries as they prepare to introduce malaria vaccines, so that countries can reap the full benefits of these life-saving vaccines.

2.5 WHO’s updated position on the COVID-19 pandemic

The 15th meeting of the International Health Regulations (2005) (IHR) Emergency Committee regarding the coronavirus disease (COVID-19) pandemic was held in May 2023. At that meeting, the WHO Director-General, Dr Tedros A. Ghebreyesus, determined that COVID-19 is now an established and ongoing health issue that no longer constitutes a public health emergency of international concern.

This decision was based on the decreasing trend in COVID-19 deaths, the decline in hospitalizations and intensive care unit admissions related to COVID-19, and the high levels of population immunity to the SARS-CoV-2 virus. In its advice to the Director-General, the IHR committee recognized the remaining uncertainties posed by the potential evolution of SARS-CoV-2 and advised a transition

to long-term management of the COVID-19 pandemic; for example, by (11, 12):

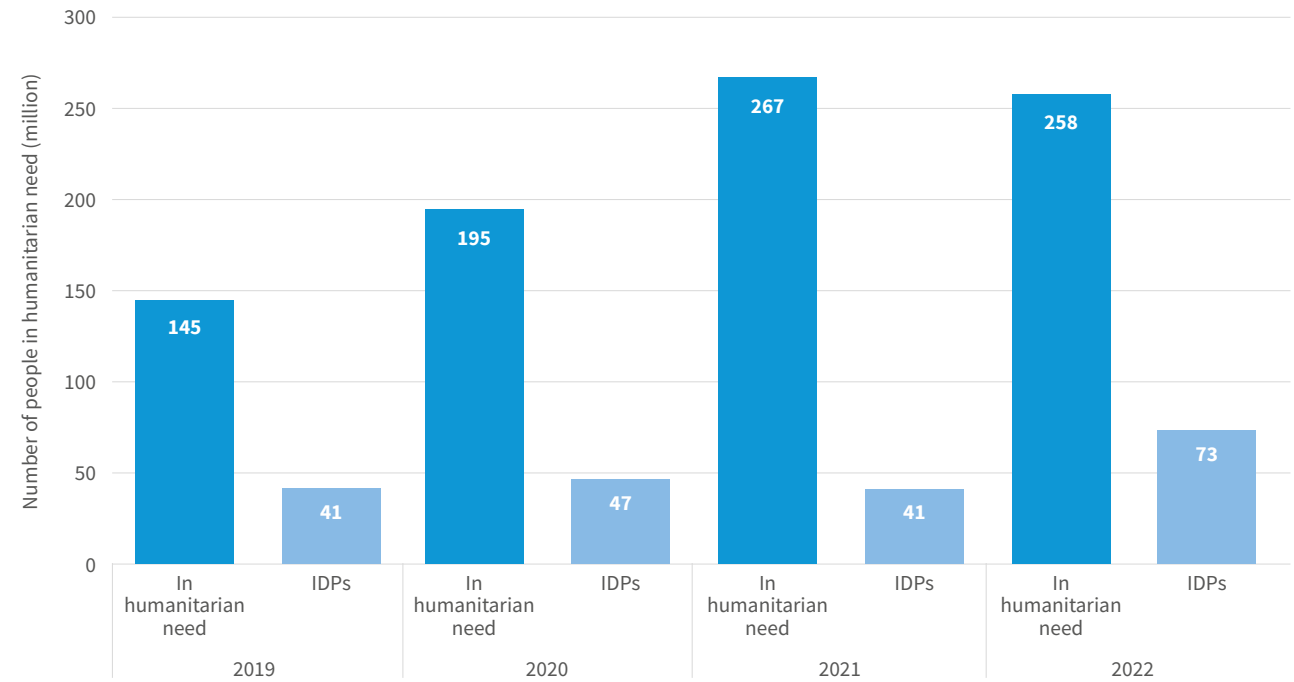
- sustaining the national capacity gains and preparing for future events;
- integrating COVID-19 vaccinations into life-course vaccination programmes;
- bringing together information on respiratory pathogen surveillance from diverse data sources, to allow a comprehensive situational awareness;
- preparing for medical countermeasures to be authorized within national regulatory frameworks, to ensure long-term availability and supply;
- continuing to lift COVID-19 international travel-related health measures; and
- continuing to provide support to research and development (R&D).

2.6 Other humanitarian and health emergencies

In the period 2019–2022, 41 malaria endemic countries have suffered humanitarian and health emergencies, in addition to the COVID-19 pandemic (13). During this time, there were an estimated 145 million to 267 million people who needed assistance because of health and humanitarian emergencies (Fig. 2.1). The numbers of affected people increased during the COVID-19 pandemic, highlighting the negative synergies

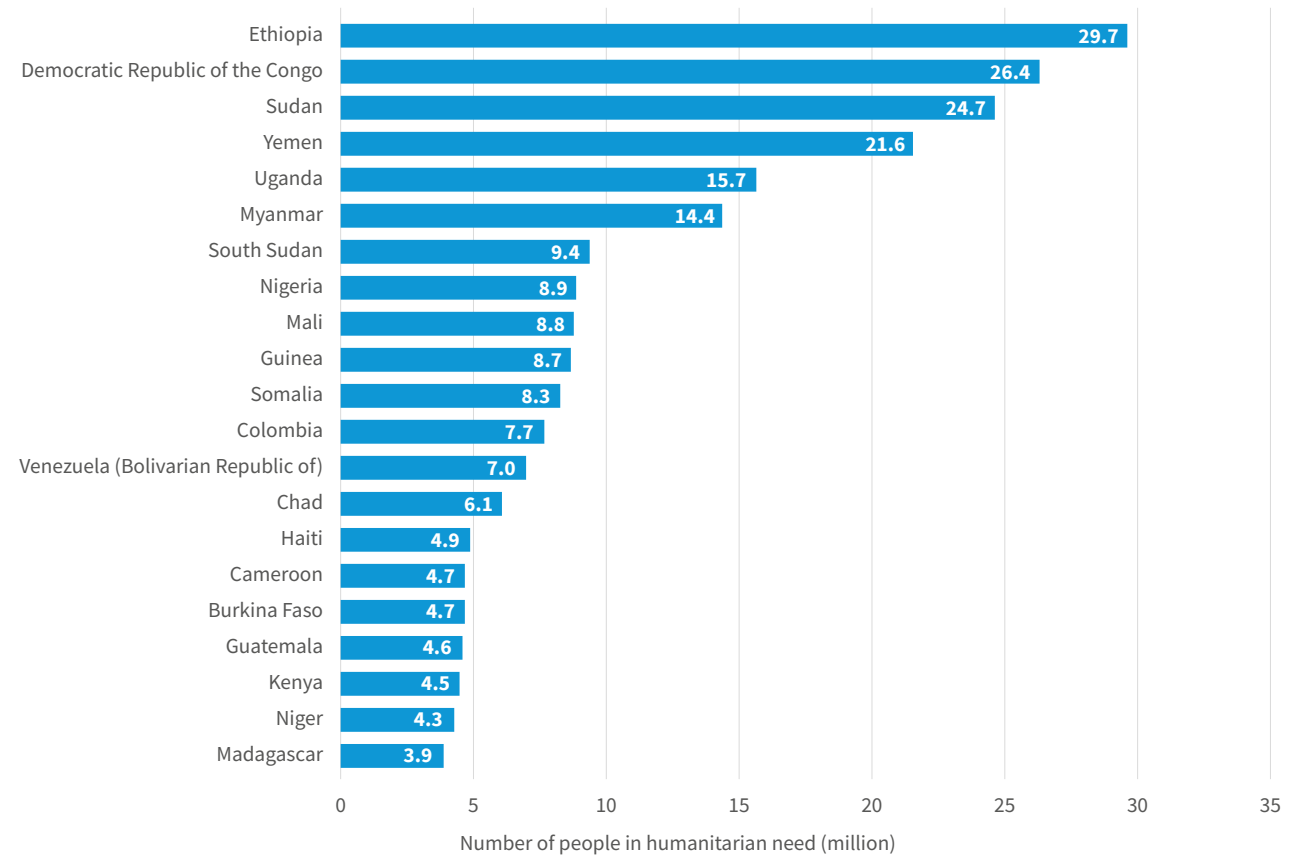
of the pandemic with other health emergencies. Famine and flooding were the major contributors to these humanitarian emergencies, sometimes compounded by disease outbreaks. Among the countries with the highest need in 2022, a total of 21 countries accounted for 89% of people affected, as shown in Fig. 2.2.

Fig. 2.1.
People in humanitarian need in malaria endemic countries as of December 2022 Source: *Global humanitarian overview 2022 (13)*.



IDPs: internally displaced persons.

Fig. 2.2.
Malaria endemic countries that account for 89% of people in humanitarian aid in 2022 Source: *Global humanitarian overview 2022 (13)*.



3 Global trends in the burden of malaria

This section considers the period between 2000 and 2022, presenting the number of clinical malaria cases and deaths estimated to have occurred at the community level during that period, and the malaria case incidence and mortality rates. These estimates were then used to compute the number of cases and deaths averted, globally and by WHO region, since 2000. This section also presents estimates of the prevalence of exposure to malaria during pregnancy and the burden of low birthweights averted under different scenarios of intermittent preventive treatment during pregnancy (IPTp) coverage.

The methods used to estimate the burden of malaria cases and deaths depend on the quality of the national surveillance systems and the availability of data over time (**Annex 1**). Most of the global malaria burden is accounted for by countries with moderate to high transmission in sub-Saharan Africa (**Fig. 3.1**); however, these countries generally have weak surveillance systems. Case estimates for these countries are calculated using an approach that transforms modelled community parasite prevalence into case incidence within a geospatial framework. Each year, population estimates are updated in line with United Nations (UN) population growth projections (14). As these population estimates change, the number of malaria cases estimated for a given level of incidence may also change.

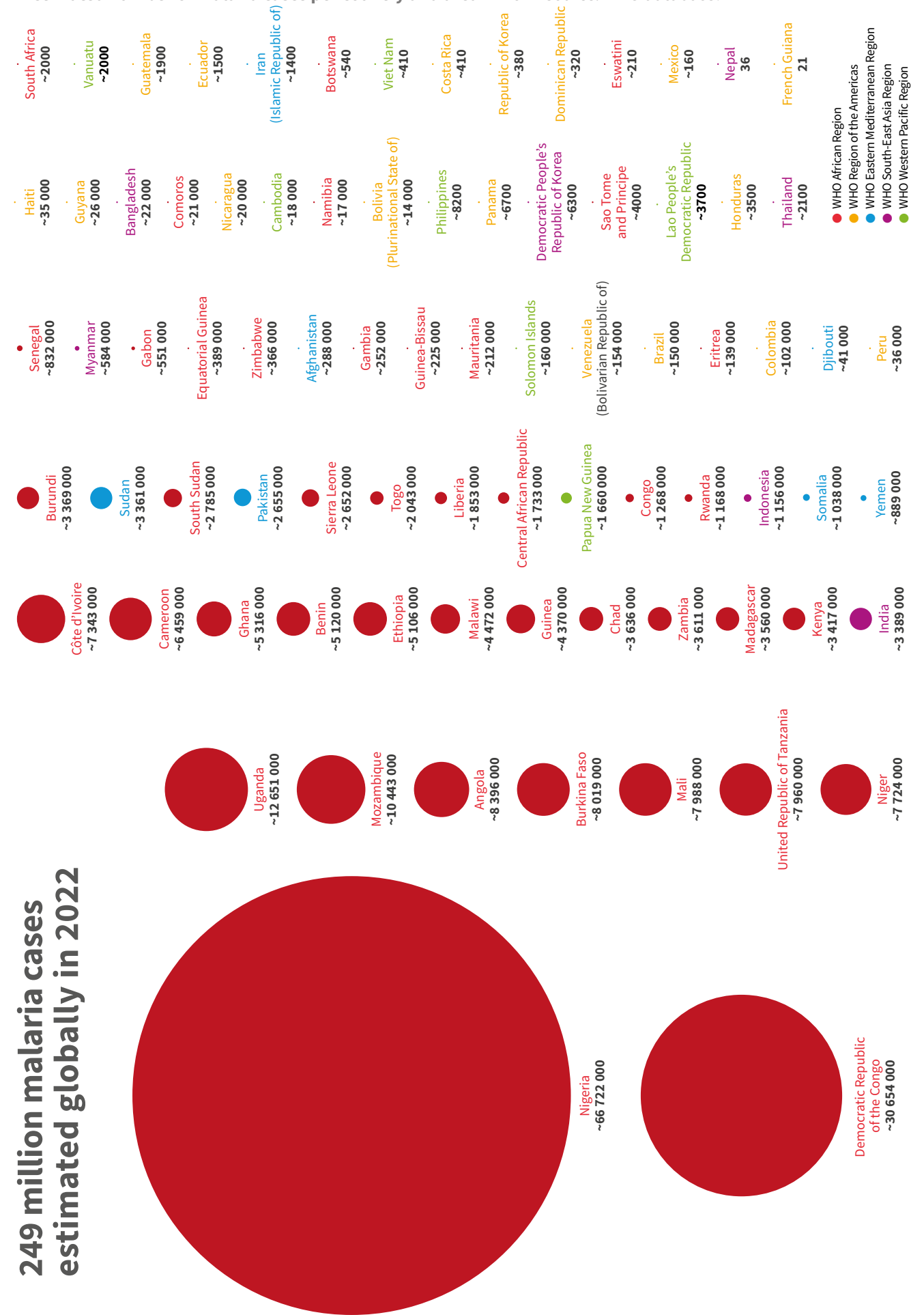
Malaria deaths for these countries are also estimated from a cause of death fraction (15) for malaria that is applied to the

trends in all-cause mortality in children aged under 5 years (16), and to which a quadratic transformation for malaria deaths among those aged 5 years and over is applied. For countries with stronger surveillance systems, either reported data are used or cases are estimated by adjusting national data for rates of treatment seeking, testing and reporting. Where adjustments are applied to national case data, malaria deaths are estimated by applying a species-specific case fatality rate to the data.

Between 2020 and 2022, estimates for both cases and deaths included the impact of disruptions to essential malaria services during the COVID-19 pandemic (as reported by countries through the WHO global pulse surveys on continuity of essential health services during the pandemic) (17).

249 million malaria cases estimated globally in 2022

Fig. 3.1.
Estimated number of malaria cases per country and area in 2022 *Source: WHO database.*



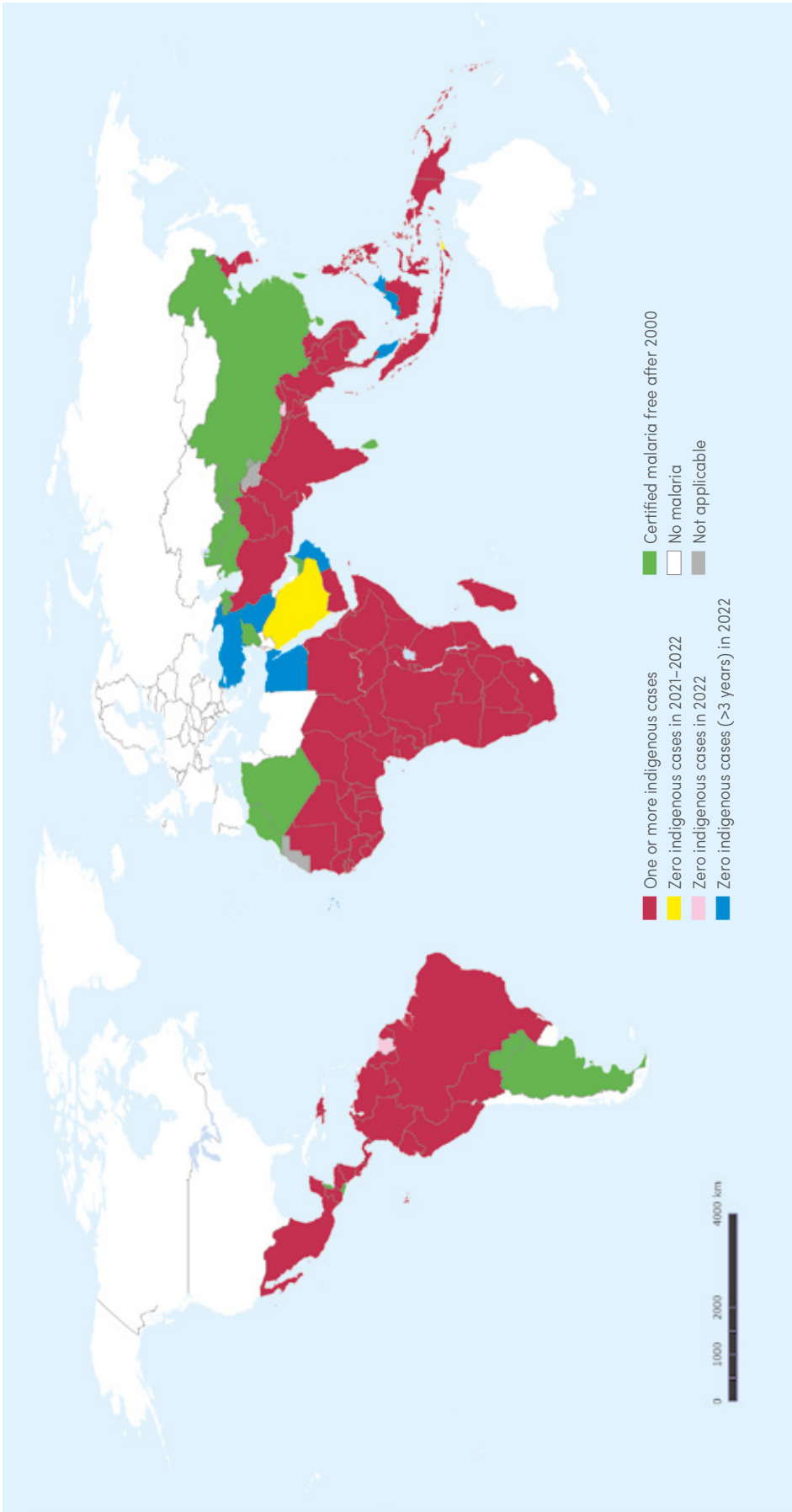


3.1 Global estimates of malaria cases and deaths, 2000–2022

Globally in 2022, there were 249 million estimated malaria cases (**Fig. 3.1, Table 3.1**) in 85 malaria endemic countries and areas (including the territory of French Guiana) (**Fig. 3.2**), an increase of 5 million cases compared with 2021. Between 2000 and 2014, although the trend in case numbers fluctuated, there was an overall decrease from 243 million to 230 million across the 108 countries that were malaria endemic in 2000. Since 2015, malaria cases have increased; the largest annual increase of 11 million cases was estimated between 2019 and 2020. Most of the increase in case numbers over the past 5 years occurred in countries in the WHO African Region (**Section 3.2**). The main countries contributing to

the increase in cases between 2021 and 2022 were Pakistan (+2.1 million), Ethiopia (+1.3 million), Nigeria (+1.3 million), Uganda (+597 000) and Papua New Guinea (+423 000). Among these countries, the increase in Nigeria was attributable to population growth as incidence remained unchanged. In the other four countries and compared with 2021, incidence increased in 2022 fivefold in Pakistan (2.2 to 11.5 cases per 1000 population at risk), by 32% in Ethiopia (46.3 to 60.9 cases per 1000 population at risk), by 32% in Papua New Guinea (124.3 to 163.7 cases per 1000 population at risk) and by 2% in Uganda (262.9 to 267.8 cases per 1000 population at risk).

Fig. 3.2.
Countries with indigenous cases in 2000 and their status by 2022^{a,b} Source: WHO database.



WHO: World Health Organization.
^a Malaysia has a significant number of indigenous malaria cases caused by *Plasmodium knowlesi* infection.
^b Countries with zero indigenous cases for at least 3 consecutive years are considered to have eliminated malaria. In 2022, Malaysia reported zero indigenous cases caused by human *Plasmodium* species^a for the fifth consecutive year and Cabo Verde reported zero indigenous cases for the fourth year. Belize was certified malaria free in 2023, following 4 years of zero malaria cases.

Table 3.1. Global estimated malaria cases and deaths, 2000–2022 ^a Source: WHO estimates.							
Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% <i>P. vivax</i>	Point	Lower bound	Upper bound
2000	243 000	227 000	263 000	8.3%	864 000	835 000	905 000
2001	248 000	230 000	271 000	8.3%	873 000	841 000	918 000
2002	245 000	227 000	267 000	7.7%	841 000	811 000	885 000
2003	249 000	232 000	271 000	8.0%	813 000	783 000	856 000
2004	250 000	232 000	277 000	7.9%	808 000	774 000	866 000
2005	249 000	232 000	273 000	8.0%	770 000	738 000	819 000
2006	244 000	226 000	268 000	6.9%	776 000	745 000	826 000
2007	240 000	223 000	262 000	6.6%	754 000	723 000	796 000
2008	239 000	223 000	259 000	6.4%	716 000	686 000	757 000
2009	245 000	227 000	267 000	6.4%	726 000	692 000	775 000
2010	247 000	229 000	272 000	6.6%	703 000	668 000	755 000
2011	241 000	225 000	263 000	7.0%	665 000	633 000	707 000
2012	237 000	221 000	257 000	7.0%	619 000	590 000	660 000
2013	232 000	215 000	251 000	6.0%	591 000	560 000	633 000
2014	230 000	209 000	253 000	5.5%	588 000	551 000	643 000
2015	231 000	211 000	254 000	4.9%	586 000	548 000	645 000
2016	232 000	214 000	253 000	4.6%	582 000	546 000	645 000
2017	237 000	219 000	258 000	3.7%	580 000	545 000	644 000
2018	232 000	215 000	253 000	3.0%	581 000	545 000	656 000
2019	233 000	213 000	255 000	2.7%	576 000	537 000	660 000
2020	244 000	221 000	271 000	1.9%	631 000	587 000	747 000
2021	244 000	220 000	272 000	2.1%	610 000	568 000	726 000
2022	249 000	225 000	278 000	2.8%	608 000	566 000	738 000

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.
^a Estimated cases and deaths are shown with 95% upper and lower confidence intervals.

Globally, malaria case incidence declined from 81.0 per 1000 population at risk in 2000 to 56.8 in 2019. Following a small increase of 3% in 2020, incidence rates have remained stable over the past 3 years. In 2022, malaria case incidence was 58.4 per 1000 population at risk (**Fig. 3.3a**).

Between 2000 and 2019, malaria deaths declined steadily, from 864 000 in 2000 to 576 000 in 2019. In 2020, there was an increase of 55 000 malaria deaths to an estimated 631 000 (**Table 3.1**), partly as a result of the disruptions in

access to malaria prevention and case management tools due to the COVID-19 pandemic; this increase was followed by a marginal decline in 2021 and 2022, to 610 000 and 608 000, respectively.

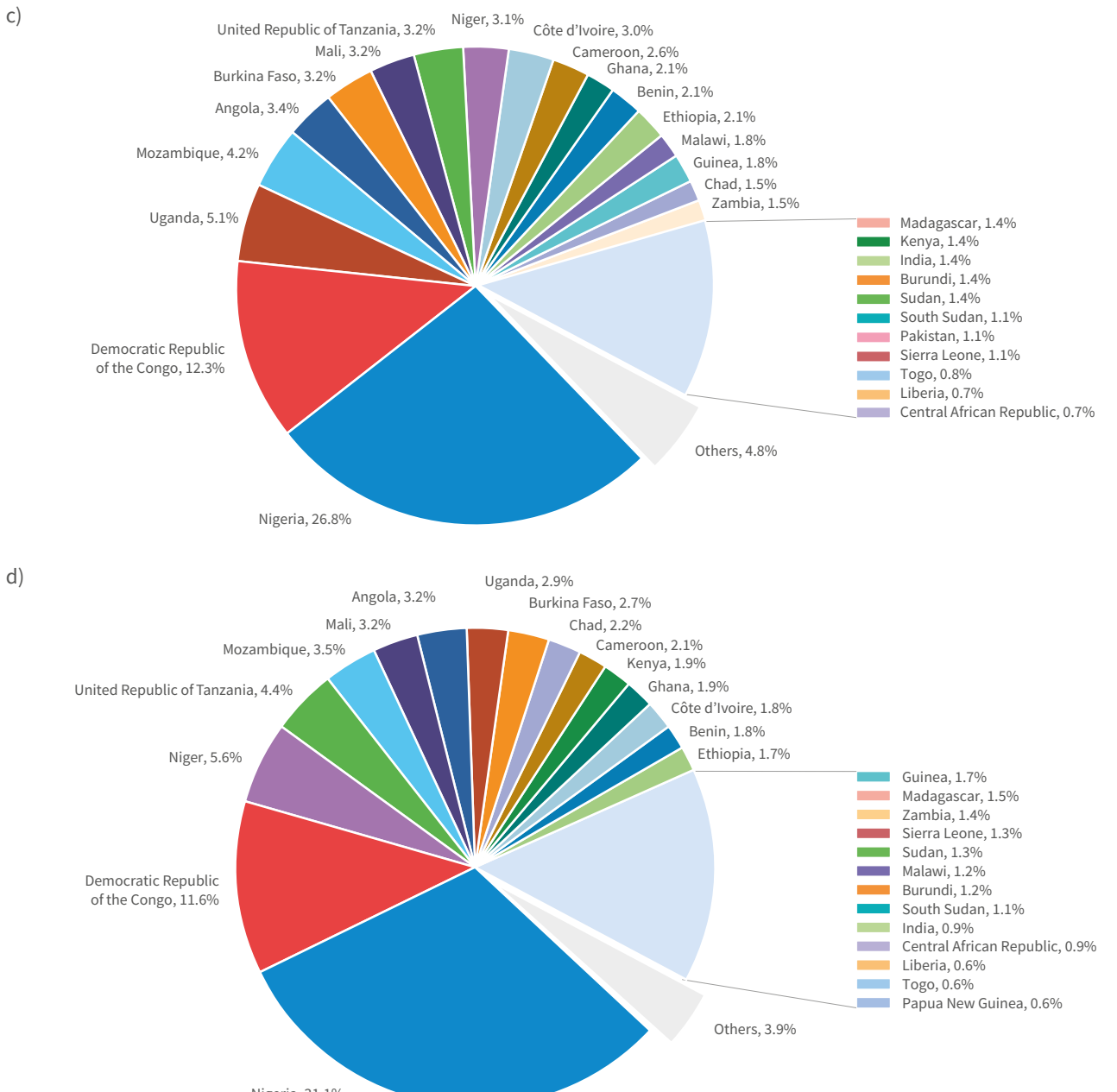
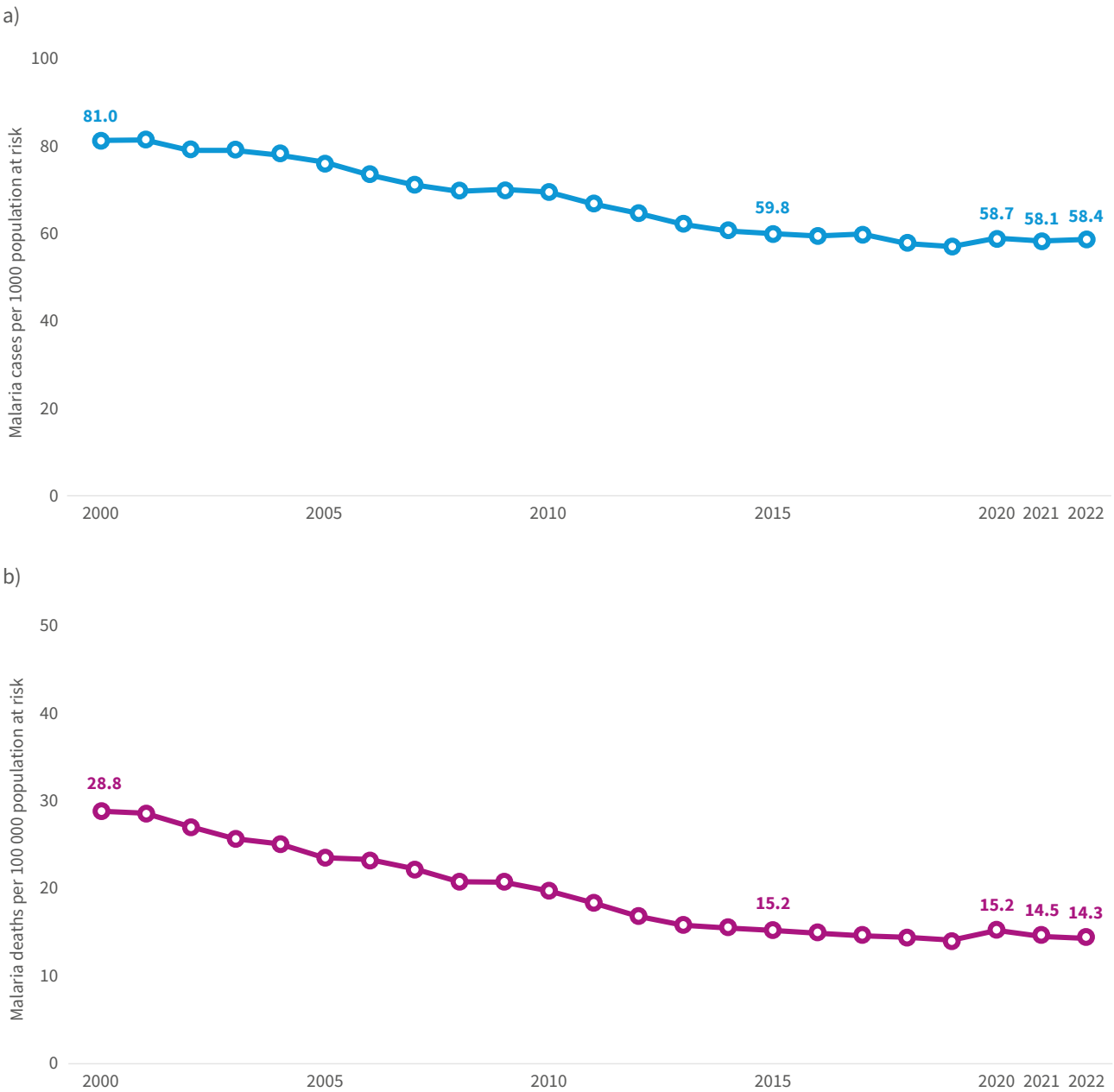
The malaria mortality rate halved between 2000 and 2019, from 28.8 per 100 000 population at risk to 14.1 (**Fig. 3.3b**). In 2020, the mortality rate increased to 15.2 per 100 000 population at risk before decreasing slightly to 14.5 in 2021 and 14.3 in 2022.

The percentage of total malaria deaths among children aged under 5 years declined from 86.8% in 2000 to 76.0% in 2022. In 2022, 29 of the 85 countries and one area that were malaria endemic accounted for about 95% of malaria cases and 96% of malaria deaths globally (**Fig. 3.4a-b**).

Almost half of all cases were accounted for by four countries: Nigeria (26.8%), the Democratic Republic of the Congo (12.3%), Uganda (5.1%) and Mozambique (4.2%) (**Fig. 3.3c**). Also, four countries accounted for just over

half of all malaria deaths globally: Nigeria (31.1%), the Democratic Republic of the Congo (11.6%), Niger (5.6%) and the United Republic of Tanzania (4.4%) (**Fig. 3.3d**). Nigeria accounted for 38.5% of global malaria deaths in children aged under 5 years.

Fig. 3.3.
Global trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) distribution of malaria cases and d) deaths by country, 2022
Source: WHO estimates.



3.2 Estimated malaria cases and deaths in the WHO African Region, 2000–2022

In 2022, the WHO African Region accounted for about 93.6% of cases and 95.4% of deaths globally; 78.1% of all deaths in this region were among children aged under 5 years in 2022, compared with 90.7% in 2000. Between 2019 and 2020, estimated malaria cases increased from 218 million to 230 million, and deaths from 552 000 to 604 000 in this region (**Table 3.2**). Between 2020 and 2022, there was almost no change in the estimated number of cases in the region, while deaths decreased to 580 000. However, between 2019 and 2022, there were substantial increases in estimated case numbers in Nigeria (5.3 million), Ethiopia (2.4 million),

Madagascar (1.5 million), Uganda (1.3 million), the United Republic of Tanzania (1.3 million), Mali (1.1 million) and Mozambique (1 million). Over the same period, Rwanda saw a decrease of more than 3.8 million cases. The distribution of cases by country in 2022 is shown in **Fig. 3.3c**.

For 28 of the 45 countries in the WHO African Region, cases are estimated by transforming modelled community parasite prevalence since the year 2000 into case incidence within a geospatial framework (**Annex 1**). This approach can provide estimates that diverge from country-reported data because of factors such as the modelling approach used

for the estimates, the quality of the surveillance system used for the collection of the routine data reported and differences in case definitions between the two sources of information. In this year's report, the modelled estimates are lower than the reported confirmed cases for Burkina Faso, Burundi, the Central African Republic, Côte d'Ivoire, Kenya, Mozambique, Uganda and Zambia.

Malaria case incidence decreased from 369.3 per 1000 population at risk in 2000 to 225.6 in 2019; it then increased to 231.5 per 1000 population at risk in 2020, but declined to 222.6 in 2022 (**Fig. 3.4a**). Between 2021 and 2022, the increasing trend in estimated cases (despite the decline in incidence) was the result of a population at risk that is rapidly increasing, having nearly doubled in sub-Saharan

Africa since the turn of the century. Between 2000 and 2019, the malaria mortality rate decreased by 60%, from 142.6 to 57.1 per 100 000 population at risk (**Fig. 3.4b**). In 2020, the mortality rate increased to 60.9 per 100 000 population before decreasing to 55.5 in 2022.

Cabo Verde has reported zero malaria deaths since 2018. In 2022, the Comoros, and Sao Tome and Principe reported zero malaria deaths for the first time; also, Botswana, Eritrea and Eswatini all reported fewer than 10 deaths. Since 2015, the rate of progress in both cases and deaths has stalled in several countries with moderate or high transmission; the situation was made worse, especially in sub-Saharan Africa, by disruptions during the COVID-19 pandemic and other humanitarian emergencies (**Fig. 3.4a-b**).

Table 3.2.
Estimated malaria cases and deaths in the WHO African Region, 2000–2022^a Source: WHO estimates.

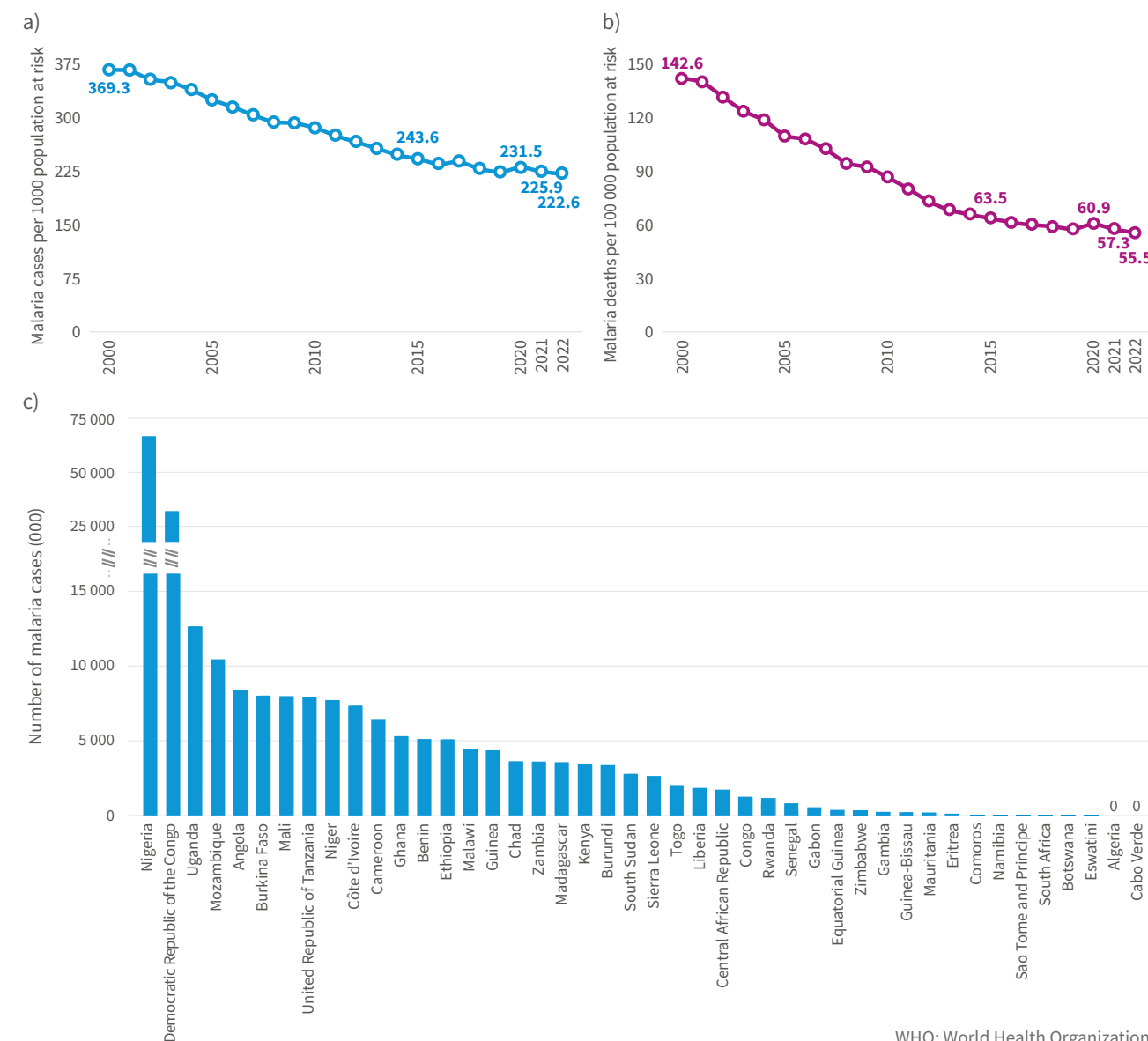
Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% <i>P. vivax</i>	Point	Lower bound	Upper bound
2000	209 000	194 000	227 000	2.9%	808 000	785 000	839 000
2001	214 000	196 000	235 000	2.6%	819 000	791 000	856 000
2002	213 000	195 000	233 000	2.3%	790 000	764 000	825 000
2003	216 000	199 000	236 000	2.3%	761 000	736 000	798 000
2004	216 000	198 000	242 000	1.8%	754 000	726 000	807 000
2005	213 000	196 000	235 000	1.2%	715 000	690 000	757 000
2006	213 000	196 000	235 000	1.3%	726 000	699 000	767 000
2007	211 000	194 000	232 000	1.3%	707 000	681 000	744 000
2008	210 000	195 000	229 000	1.2%	669 000	646 000	702 000
2009	215 000	198 000	236 000	1.4%	677 000	649 000	719 000
2010	216 000	199 000	238 000	1.6%	652 000	623 000	700 000
2011	214 000	198 000	234 000	2.3%	621 000	595 000	659 000
2012	213 000	197 000	231 000	2.8%	580 000	554 000	617 000
2013	212 000	196 000	230 000	2.7%	558 000	530 000	599 000
2014	210 000	190 000	233 000	2.9%	553 000	520 000	606 000
2015	211 000	192 000	233 000	2.2%	551 000	517 000	608 000
2016	211 000	193 000	231 000	1.4%	545 000	512 000	601 000
2017	219 000	201 000	240 000	1.0%	548 000	515 000	611 000
2018	216 000	198 000	237 000	0.2%	555 000	520 000	630 000
2019	218 000	198 000	240 000	0.3%	552 000	513 000	636 000
2020	230 000	207 000	257 000	0.3%	604 000	561 000	721 000
2021	230 000	207 000	259 000	0.3%	584 000	542 000	700 000
2022	233 000	209 000	261 000	0.5%	580 000	538 000	710 000

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

^a Estimated cases and deaths are shown with 95% upper and lower confidence intervals.

Fig. 3.4.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO African Region, 2022 Source: WHO estimates.



WHO: World Health Organization.

3.3 Estimated malaria cases and deaths in the WHO South-East Asia Region, 2000–2022

The WHO South-East Asia Region had nine malaria endemic countries in 2022, accounting for 5.2 million cases and contributing to 2% of the burden of malaria cases globally (**Table 3.3**). In 2022, India accounted for about 65.7% of all malaria cases in the region (**Fig. 3.5c**). Almost 46% of all cases in the region were due to *P. vivax*.

Between 2000 and 2022, malaria cases decreased by 77%, from 22.8 million in 2000 to 5.2 million in 2022, and incidence decreased by 83%, from 17.6 to 3.0 per 1000 population at risk (**Fig. 3.5a**). Sri Lanka was certified malaria free in

2016. In 2022, Timor-Leste reported zero indigenous cases for the second consecutive year, and Bhutan reported zero indigenous cases for the first time.

Despite an overall decrease of 11.9% in estimated cases between 2021 and 2022, increases in cases and incidence were seen in Bangladesh, Indonesia, Myanmar and Thailand. Between 2019 and 2022, there was an increase of more than 500 000 cases in Myanmar due to the political and social instability in the country (18), with a sevenfold increase in cases, from 78 000 to 584 000 cases. The increase in malaria

case burden in Myanmar over the past 3 years has now had an impact on the neighbouring country of Thailand, where cases more than doubled between 2021 (2426 cases) and 2022 (6263 cases) (19). Reported imported cases in Thailand also significantly increased over the same period, from 800 to 3726 cases. Most of these additional cases are diagnosed and treated in the area of Thailand that borders Myanmar, where displaced populations from Myanmar can more easily access health care services. This situation has led to an increase in the required resources for malaria diagnosis and treatment in Thailand.

Estimated malaria deaths decreased by 77.1%, from about 35 000 in 2000 to 8000 in 2022. Between 2000 and 2022, the

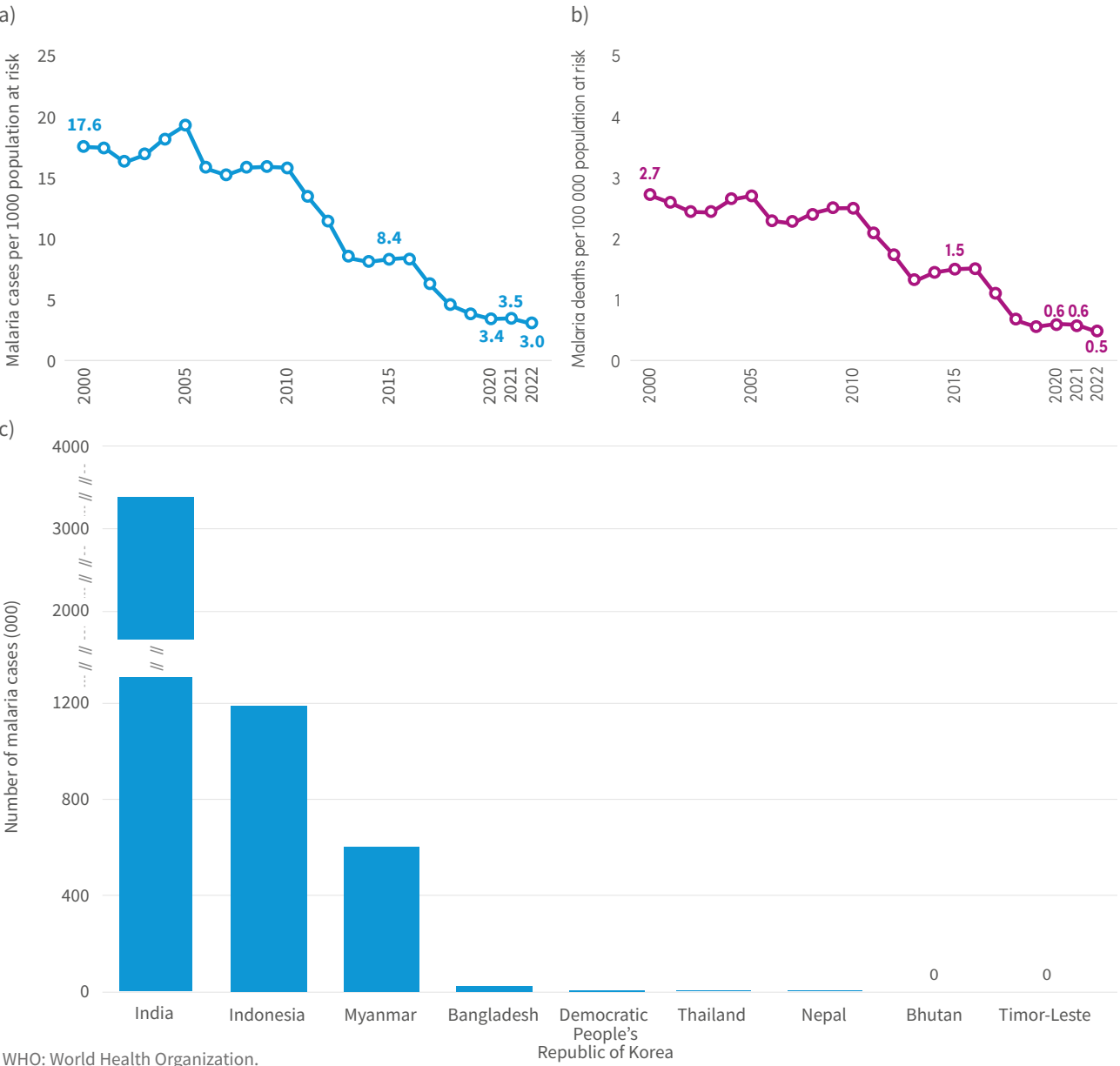
malaria mortality rate decreased by 82.7%, from 2.7 to 0.5 per 100 000 population at risk (**Fig. 3.5b**). India and Indonesia accounted for about 94% of all malaria deaths in this region in 2022. Between 2020 and 2022, all countries in the region in which malaria deaths occurred reported an increase in the malaria mortality rate, except for India. The mortality rate in Myanmar experienced a near sixfold increase, from 0.17 to 0.99 per 100 000 population at risk. Bhutan and Timor-Leste have reported zero malaria deaths since 2013 and 2015, respectively. In 2021, Thailand reported zero indigenous deaths for the first time; also, in 2022, the one reported death from malaria in the country was due to a *P. knowlesi* infection. In 2022, Nepal reported zero indigenous deaths for the first time.

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% <i>P. vivax</i>	Point	Lower bound	Upper bound
2000	22 800	18 400	28 800	47.6%	35 000	20 000	54 000
2001	23 100	18 800	28 800	50.4%	34 000	20 000	52 000
2002	21 900	17 600	27 700	49.8%	33 000	19 000	51 000
2003	23 100	18 600	28 900	52.2%	33 000	19 000	51 000
2004	25 300	20 200	32 500	51.9%	37 000	20 000	57 000
2005	27 200	21 000	35 900	53.7%	38 000	21 000	61 000
2006	22 500	17 500	30 300	51.4%	33 000	18 000	53 000
2007	22 100	17 000	30 000	49.5%	33 000	18 000	53 000
2008	23 300	17 700	32 300	47.4%	35 000	19 000	58 000
2009	23 700	17 700	33 000	45.2%	37 000	20 000	61 000
2010	23 900	18 700	32 400	44.7%	38 000	21 000	60 000
2011	20 600	16 000	27 600	45.9%	32 000	18 000	51 000
2012	17 700	14 000	23 500	47.7%	27 000	16 000	42 000
2013	13 200	10 400	17 200	46.1%	20 000	11 000	32 000
2014	12 800	10 000	17 000	35.0%	23 000	12 000	37 000
2015	13 300	10 400	17 900	34.3%	24 000	12 000	40 000
2016	13 700	10 200	19 300	34.9%	25 000	12 000	42 000
2017	10 300	7 700	14 100	37.3%	18 000	9 000	30 000
2018	7 500	5 500	10 300	50.5%	11 000	6 000	18 000
2019	6 400	4 600	8 800	51.3%	9 000	5 000	15 000
2020	5 800	4 000	7 900	36.3%	10 000	5 000	17 000
2021	5 900	4 100	8 300	39.5%	10 000	5 000	17 000
2022	5 200	4 300	7 400	45.7%	8 000	5 000	13 000

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

^a Estimated cases and deaths are shown with 95% upper and lower confidence intervals.

Fig. 3.5.
Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO South-East Asia Region, 2022 Source: WHO estimates.



3.4 Estimated malaria cases and deaths in the WHO Eastern Mediterranean Region, 2000–2022

Estimated malaria cases in the WHO Eastern Mediterranean Region decreased by 38.0% between 2000 and 2015, from 6.9 million to 4.3 million, before increasing by 92% between 2015 and 2022 to reach 8.3 million cases (Table 3.4). Between 2021 and 2022, there was an increase of 34%; this was mainly due to a large increase of 2.1 million malaria cases in Pakistan owing to a malaria outbreak following the catastrophic flooding that affected more than 30 million people. Significant increases were also seen in Afghanistan and Sudan, with an additional 94 000 and 35 000 cases, respectively. In 2022, 29.4% of the cases in the region were due to *P. vivax*, with the cases being mainly in Afghanistan and Pakistan. Owing to instabilities in Afghanistan, Somalia, Sudan and Yemen that have led to closure of facilities and other disruptions, obtaining sufficiently reliable data to estimate the recent

trends in the burden of malaria in these countries has been difficult. Hence, current estimates should be interpreted with caution. WHO is supporting subnational burden estimation analyses in these countries for improved decision-making for malaria control.

Estimated malaria deaths decreased by about 45%, from 13 600 in 2000 to 7500 in 2014, and then more than doubled between 2014 and 2022 to reach 15 900 deaths (Table 3.4). This increase in deaths was due to increases in Djibouti, Pakistan, Somalia, Sudan and Yemen. Most of the estimated deaths were observed in Sudan, where around 90% of cases are due to *P. falciparum*, which is responsible for almost all malaria-related fatalities. In Pakistan, the largest increase in deaths was between 2021 and 2022 because of the flooding that damaged more than 1000 health facilities in the country,

resulting in millions with lack of access to health care in affected districts (20).

Over the period 2000–2015, malaria case incidence declined from 20.2 to 9.0 cases per 1000 population at risk, and the mortality rate declined from 4.0 to 1.7 deaths per 100 000 population at risk (Fig. 3.6a–b). Following an increase in both incidence and mortality rates in 2016, trends remained stable until 2021. In 2022, however, there was an increase of 31% in estimated incidence from 11.5 to 15.2 per 1000 population at risk and an increase of 16% in mortality rate from 2.5 to 2.9 per 100 000 population at risk.

In 2022, Sudan accounted for most of the estimated malaria cases in this region (41%), followed by Pakistan, Somalia, Yemen, Afghanistan and Djibouti (Fig. 3.6c). In 2022, the Islamic Republic of Iran reported 1439 locally acquired cases, which included indigenous cases, despite reporting zero indigenous cases for 4 consecutive years between 2018 and 2021. The upsurge in cases in neighbouring Pakistan

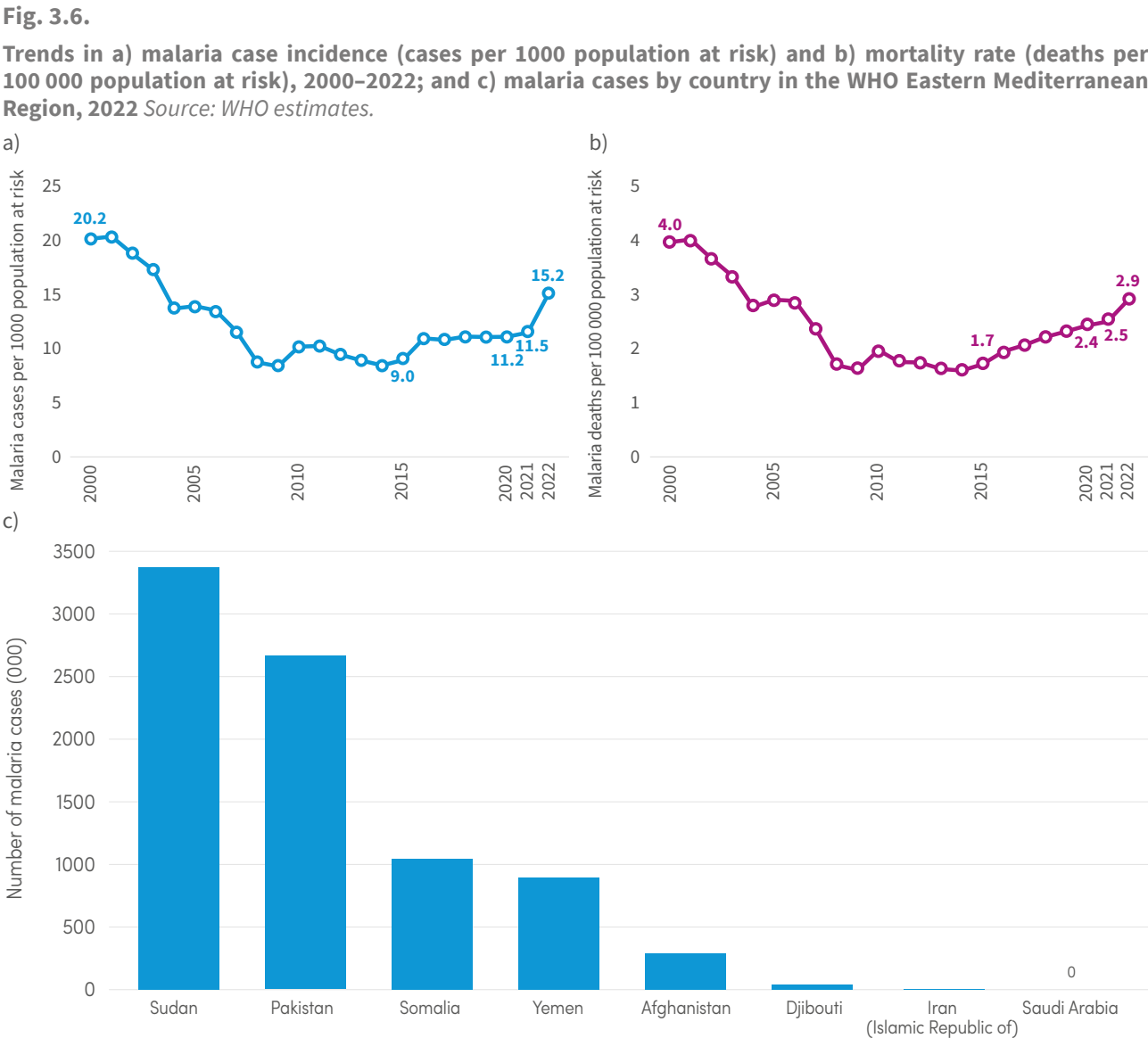
was a major contributing factor to the increase in cases in the Islamic Republic of Iran, particularly along the border area, where there is frequent movement of people. Other contributing factors include flash flooding, the emergence and spread of *Aedes aegypti* (which has diverted some control efforts and resources), and insufficient funding and difficulties in procuring essential malaria commodities due to sanctions. Reduced resources resulted in a lack of, or delays in, diagnosis and treatment, in addition to difficulties in effectively carrying out case investigation and classification. As a result, it was not possible to distinguish accurately between indigenous and introduced cases.

In 2022, Saudi Arabia reported zero indigenous malaria cases for the second consecutive year. Iraq, Morocco, Oman and the Syrian Arab Republic last reported indigenous malaria cases in 2008, 2004, 2007 and 2004, respectively (Annex 4-I). In 2022, all countries in the region reported zero malaria deaths apart from Djibouti, Pakistan, Sudan and Yemen.

Table 3.4.
Estimated malaria cases and deaths in the WHO Eastern Mediterranean Region, 2000–2022^a
Source: WHO estimates.

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% <i>P. vivax</i>	Point	Lower bound	Upper bound
2000	6 900	5 400	11 300	27.3%	13 600	8 600	24 700
2001	7 200	5 600	11 700	27.2%	14 100	8 900	26 500
2002	6 800	5 300	12 000	28.1%	13 200	8 400	26 400
2003	6 400	5 000	11 200	29.0%	12 300	7 800	24 200
2004	5 200	4 200	8 900	25.1%	10 500	6 500	20 400
2005	5 400	4 300	9 500	22.3%	11 200	7 100	22 300
2006	5 400	4 200	10 200	20.4%	11 400	7 100	23 600
2007	4 700	3 800	6 500	24.4%	9 600	6 000	14 600
2008	3 700	2 900	5 200	28.9%	7 100	4 500	10 700
2009	3 600	2 800	5 300	29.7%	6 900	4 400	10 800
2010	4 500	3 400	6 400	28.9%	8 600	5 500	13 200
2011	4 600	3 400	6 500	39.2%	7 800	5 100	11 500
2012	4 300	3 300	6 200	33.1%	7 900	5 100	11 500
2013	4 200	3 300	5 600	34.3%	7 500	4 900	10 700
2014	4 000	3 300	5 000	31.2%	7 500	4 800	10 800
2015	4 300	3 400	5 700	30.1%	8 200	5 100	12 200
2016	5 400	4 200	6 900	36.2%	9 500	5 800	14 600
2017	5 400	4 100	7 300	30.2%	10 200	5 900	16 700
2018	5 600	4 200	7 900	26.6%	11 200	6 400	18 900
2019	5 700	4 200	8 200	22.0%	11 900	6 800	20 100
2020	5 900	4 200	8 500	17.7%	12 700	7 000	21 800
2021	6 200	4 400	8 900	18.0%	13 400	7 500	22 700
2022	8 300	6 400	11 200	29.4%	15 900	9 700	25 700

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.
^a Estimated cases and deaths are shown with 95% upper and lower confidence intervals.





3.5 Estimated malaria cases and deaths in the WHO Western Pacific Region, 2000–2022

Malaria cases decreased by 48% in the WHO Western Pacific Region, from 2.6 million cases in 2000 to an estimated 1.4 million cases in 2021. An increase of 30% was observed between 2021 and 2022, to 1.9 million cases (**Table 3.5**). Malaria deaths also decreased significantly (by 56%) from about 6300 deaths in 2000 to 2600 deaths in 2021. Between 2021 and 2022, there was a 37% increase in deaths to 3600. Increases in cases and deaths between 2021 and 2022 were mainly due to increases in Papua New Guinea as a result of

stock-outs of commodities, human resource capacity and management constraints, and unstable sources of domestic and external funding. Between 2020 and 2022, significant increases in cases were observed in Solomon Islands and Vanuatu. The proportion of cases in the region due to *P. vivax* has increased over time, from about 17% in 2000 to 27% in 2022, with effective malaria prevention and treatment contributing to reductions in the burden of *P. falciparum*.

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% <i>P. vivax</i>	Point	Lower bound	Upper bound
2000	2 678	1 630	3 942	17.2%	6 300	3 600	10 200
2001	2 360	1 405	3 522	20.2%	5 400	3 000	9 100
2002	2 109	1 260	3 131	20.5%	4 600	2 400	7 800
2003	2 301	1 397	3 406	20.0%	5 000	2 700	8 400
2004	2 670	1 544	4 033	22.4%	5 600	2 800	9 800
2005	2 280	1 322	3 463	28.8%	4 500	2 300	7 900
2006	2 442	1 473	3 629	27.1%	4 800	2 500	8 200
2007	1 836	996	2 894	21.8%	3 800	1 800	7 200
2008	1 666	870	2 656	20.5%	3 500	1 600	6 600
2009	2 218	1 274	3 434	20.5%	4 700	2 200	8 500
2010	1 671	976	2 532	22.2%	3 500	1 700	6 200
2011	1 418	838	2 135	21.7%	3 000	1 400	5 400
2012	1 693	834	3 048	23.2%	3 500	1 400	7 300
2013	1 753	1 103	2 539	13.5%	4 000	1 800	7 300
2014	2 011	1 339	2 918	30.8%	3 800	1 900	6 700
2015	1 245	937	1 617	27.0%	2 400	1 300	4 000
2016	1 471	1 078	1 927	25.1%	3 000	1 400	5 000
2017	1 575	1 147	2 096	28.5%	3 000	1 500	5 200
2018	1 692	1 236	2 234	35.9%	3 000	1 500	5 100
2019	1 433	1 088	1 809	35.3%	2 600	1 300	4 300
2020	1 650	1 193	2 157	29.5%	3 200	1 400	5 500
2021	1 427	1 046	1 844	32.0%	2 600	1 200	4 600
2022	1 853	1 347	2 399	27.3%	3 600	1 700	6 300

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

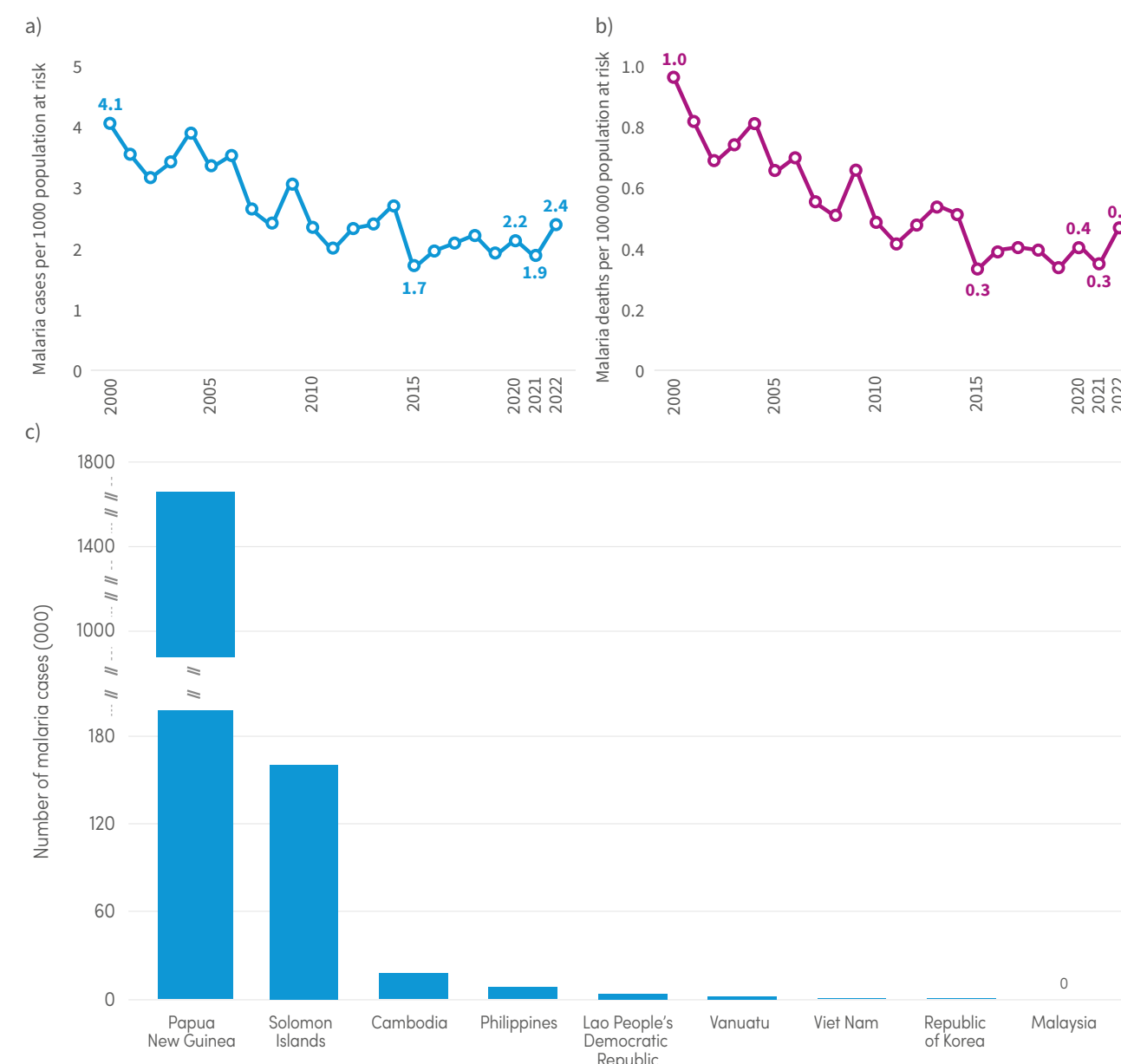
^a Estimated cases and deaths are shown with 95% upper and lower confidence intervals.

In the period 2000–2022, malaria case incidence decreased from 4.1 to 2.4 cases per 1000 population at risk (**Fig. 3.7a**), and the malaria mortality rate decreased from 1.0 to 0.5 deaths per 100 000 population at risk (**Fig. 3.7b**). Papua New Guinea accounted for 90% of all cases in this region in 2022, followed by Solomon Islands, Cambodia and the Philippines (**Fig. 3.7c**). China was certified malaria free in 2021. Malaysia has had no cases of human malaria for 5 consecutive years, but for the past 6 years has had an increase in the number of indigenous zoonotic *P. knowlesi* malaria cases, with 2500 cases reported in 2022.

Five countries had fewer than 10 000 estimated cases in 2022: the Lao People's Democratic Republic (3713), the Philippines (8160), the Republic of Korea (382), Vanuatu (2035) and Viet Nam (412). Papua New Guinea accounted for 94% of all deaths in the region. There have been zero reported malaria deaths in the Republic of Korea and Vanuatu since 2012, Cambodia since 2018 and Viet Nam since 2019. No indigenous deaths due to human malaria have been reported in Malaysia since 2018; however, a small number of *P. knowlesi* malaria deaths have been reported every year since then, with nine deaths occurring in 2022.

Fig. 3.7.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO Western Pacific Region, 2022 Source: WHO estimates.



WHO: World Health Organization.



3.6 Estimated malaria cases and deaths in the WHO Region of the Americas, 2000–2022

Between 2000 and 2022, in the WHO Region of the Americas, malaria cases and incidence declined by 64.0% (from 1.5 million to 0.55 million) and 72.5% (from 13.1 to 3.6 cases per 1000 population at risk), respectively (**Table 3.6, Fig. 3.8a**). Over the same period, malaria deaths and the mortality rate decreased by 60% (from 850 to 343) and 70% (from 0.7 to 0.2 deaths per 100 000 population at risk), respectively (**Table 3.6, Fig. 3.8b**). The Bolivarian Republic of Venezuela, Brazil and Colombia accounted for 73% of

all cases in this region (**Fig. 3.8c**). Most of the cases in this region are due to *P. vivax* (72% in 2022).

Progress in this region has suffered in recent years because of a major increase in malaria in the Bolivarian Republic of Venezuela, which had about 35 500 cases in 2000, rising to over 483 000 by 2017. In 2020, however, cases decreased by more than half compared with 2019 to 223 000 cases, and further in 2021 and 2022, to 205 000 and 154 000 cases, respectively. Factors contributing to this reduction were the

low levels of population mobility resulting from COVID-19 pandemic restrictions, and an increase in malaria diagnosis and treatment commodities.

In 2022, three additional countries saw substantial reductions in case burden compared with 2019 – Brazil (–28 000), Colombia (–21 000) and Peru (–9000) – with more modest reductions seen in the Dominican Republic, Ecuador, French Guiana, Guatemala, Mexico and Suriname. During the same period, estimated cases increased in Costa Rica (311), the Plurinational State of Bolivia (1333), Guyana (428), Haiti (17 272), Honduras (3100), Nicaragua (3683) and Panama (4826). Suriname reported zero indigenous cases

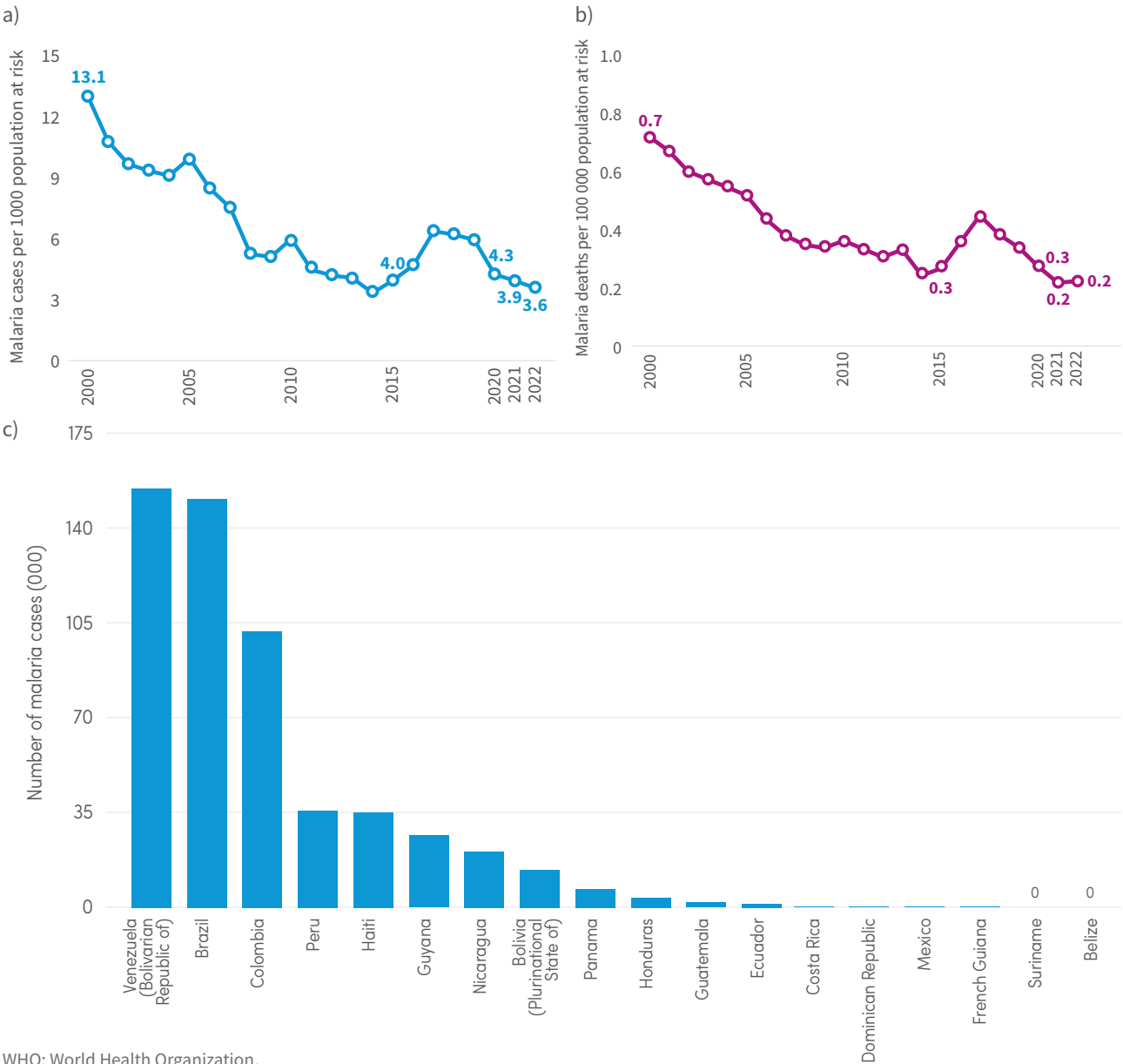
for the first time in 2022. In Costa Rica, the increase was due to an outbreak of *P. falciparum* cases, which resulted in more than 80% of all cases being due to *P. falciparum* infection since 2021, whereas in previous years most cases were due to *P. vivax*.

Four countries – Argentina, Belize, El Salvador and Paraguay – were certified as malaria free in 2019, 2023, 2021 and 2018, respectively. There are few malaria-related deaths in the region, with an estimated 343 deaths in 2022, most being in adults (78%).

Table 3.6. Estimated malaria cases and deaths in the WHO Region of the Americas, 2000–2022 ^a Source: WHO estimates.							
Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% <i>P. vivax</i>	Point	Lower bound	Upper bound
2000	1540	1389	1702	71.5%	850	714	1049
2001	1297	1170	1432	67.3%	806	670	1006
2002	1183	1076	1299	67.9%	732	593	938
2003	1159	1065	1259	68.5%	709	569	918
2004	1147	1068	1237	69.5%	686	540	892
2005	1273	1201	1357	70.3%	659	515	877
2006	1097	1031	1174	68.3%	563	423	777
2007	989	907	1072	70.2%	496	371	682
2008	696	643	761	71.1%	461	316	688
2009	688	634	753	70.5%	452	310	677
2010	818	743	902	70.9%	492	344	715
2011	615	570	672	68.9%	459	315	670
2012	585	545	634	68.9%	425	304	600
2013	576	531	630	64.1%	467	334	649
2014	475	444	510	69.8%	346	258	446
2015	573	531	620	70.1%	385	282	497
2016	688	638	748	67.3%	523	375	685
2017	946	878	1032	73.9%	665	450	900
2018	929	861	1014	78.1%	572	387	774
2019	897	827	985	77.2%	510	336	696
2020	646	598	700	68.4%	415	291	553
2021	603	558	656	71.2%	331	244	434
2022	552	511	600	72.0%	343	252	451

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.
^a Estimated cases and deaths are shown with 95% upper and lower confidence intervals.

Fig. 3.8.
Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO Region of the Americas, 2022 Source: WHO estimates.



WHO: World Health Organization.

3.7 Estimated malaria cases and deaths in the WHO European Region, 2000–2022

Since 2015, the WHO European Region has been free of malaria. The last country to report an indigenous malaria case was Tajikistan in 2014. Throughout the period

2000–2022, no malaria deaths were reported in the WHO European Region.

3.8 Cases and deaths averted since 2000, globally and by WHO region

Cases and deaths averted over the period 2000–2022 were calculated by comparing the current annual estimated burden of malaria with the malaria case incidence and

mortality rates from 2000, assuming that they remained constant throughout the same period (as a comparison) but accounting for population growth (**Annex 1**). The

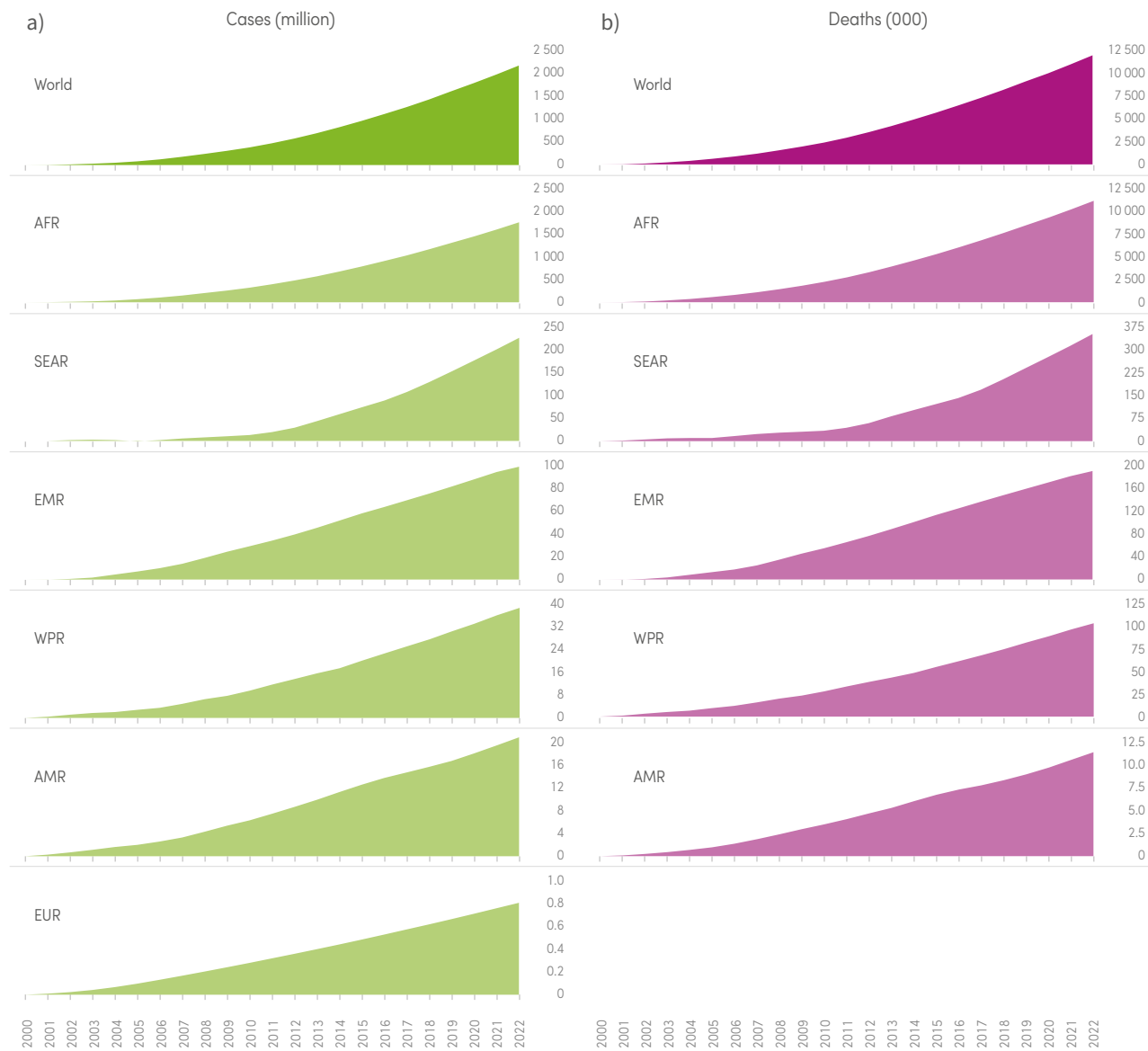
analysis showed that 2.1 billion malaria cases and 11.7 million malaria deaths were averted globally in the period 2000–2022. Most of the cases (82%) and deaths (94%) averted were in the WHO African Region, followed by the South-East Asia Region (cases averted 10% and deaths averted 3%) (**Fig. 3.9** and **Fig. 3.10**). In addition to malaria interventions, cases and deaths could also have been averted by other factors that modify malaria transmission or disease, such as improvements in socioeconomic status, malnutrition, infrastructure, housing and urbanization.

Globally, the pace at which cases and deaths were averted was slower in the COVID-19 pandemic years than in other

years, adding to the many challenges that led to a reduced pace of burden reduction in the 4 years preceding the pandemic.

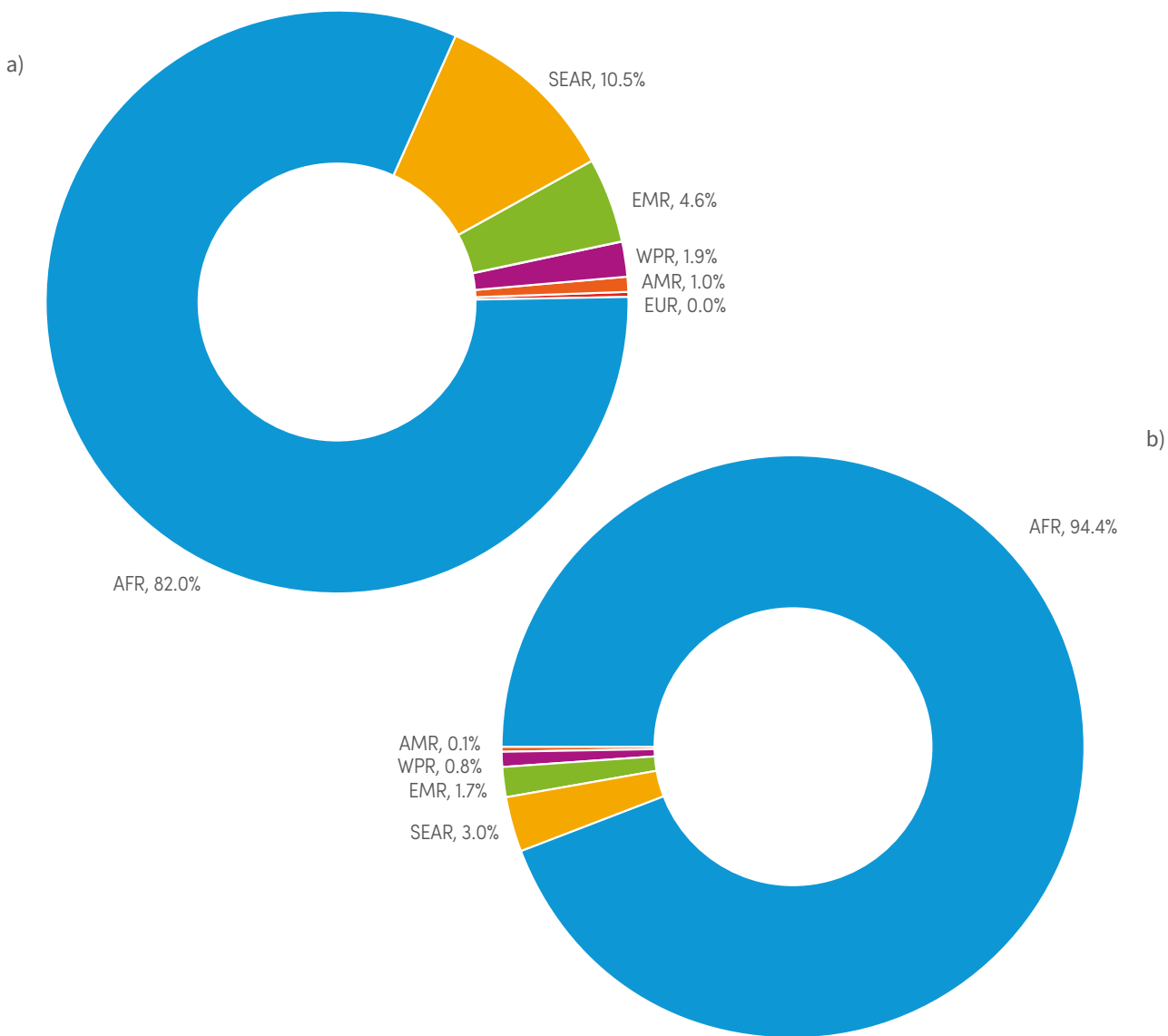
Despite considerable disruptions to malaria services during the COVID-19 pandemic, it is estimated that 174 million cases and 886 000 deaths were averted in 2020, and a further 184 million and 191 million cases and 948 000 and 991 000 deaths in 2021 and 2022, respectively, compared with the estimated burden if case incidence and mortality rates had remained at the levels of 2000.

Fig. 3.9. Cumulative number of a) cases and b) deaths averted, globally and by WHO region, 2000–2022 *Source: WHO estimates.*



AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; EUR: WHO European Region; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

Fig. 3.10. Percentage of a) cases and b) deaths averted, by WHO region, 2000–2022 *Source: WHO estimates.*



AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; EUR: WHO European Region; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

3.9 Burden of malaria in pregnancy

Malaria infection during pregnancy has substantial risks for the pregnant woman, her fetus and the newborn child. For the pregnant woman, malaria infection can lead to severe disease and death, and placental sequestration of the parasite, which can lead to maternal anaemia; it also puts the mother at increased risk of death before and after childbirth, and is an important contributor to stillbirth and preterm birth. Placental infection can also lead to poor fetal growth and low birthweight, which in turn can lead to retardation of child growth and poor cognitive outcomes; it can also be a major risk factor for perinatal, neonatal and infant mortality (21–23). To avert the consequences to women and children of malaria infection, WHO recommends – in combination with vector control, and prompt diagnosis and effective treatment of malaria – the use of IPTp with sulfadoxine-pyrimethamine (SP) as part of antenatal care (ANC) (Section 7.4) in malaria endemic areas.

The analysis in this section is restricted to moderate to high transmission countries in the WHO African Region, where the burden of malaria in pregnancy is most pronounced (Section 3.2, Section 7.4).

3.9.1 Prevalence of exposure to malaria infection during pregnancy

Data on malaria in pregnancy vary in availability and quality across countries and require improvements if the data are to be used to estimate the burden of malaria infections during pregnancy. The methods used to estimate country-specific malaria infection exposure during pregnancy (measured as cumulative prevalence over 40 weeks) are presented in Annex 1.

In 2022, in 33 moderate to high transmission countries¹ in the WHO African Region, there were an estimated 35.4 million

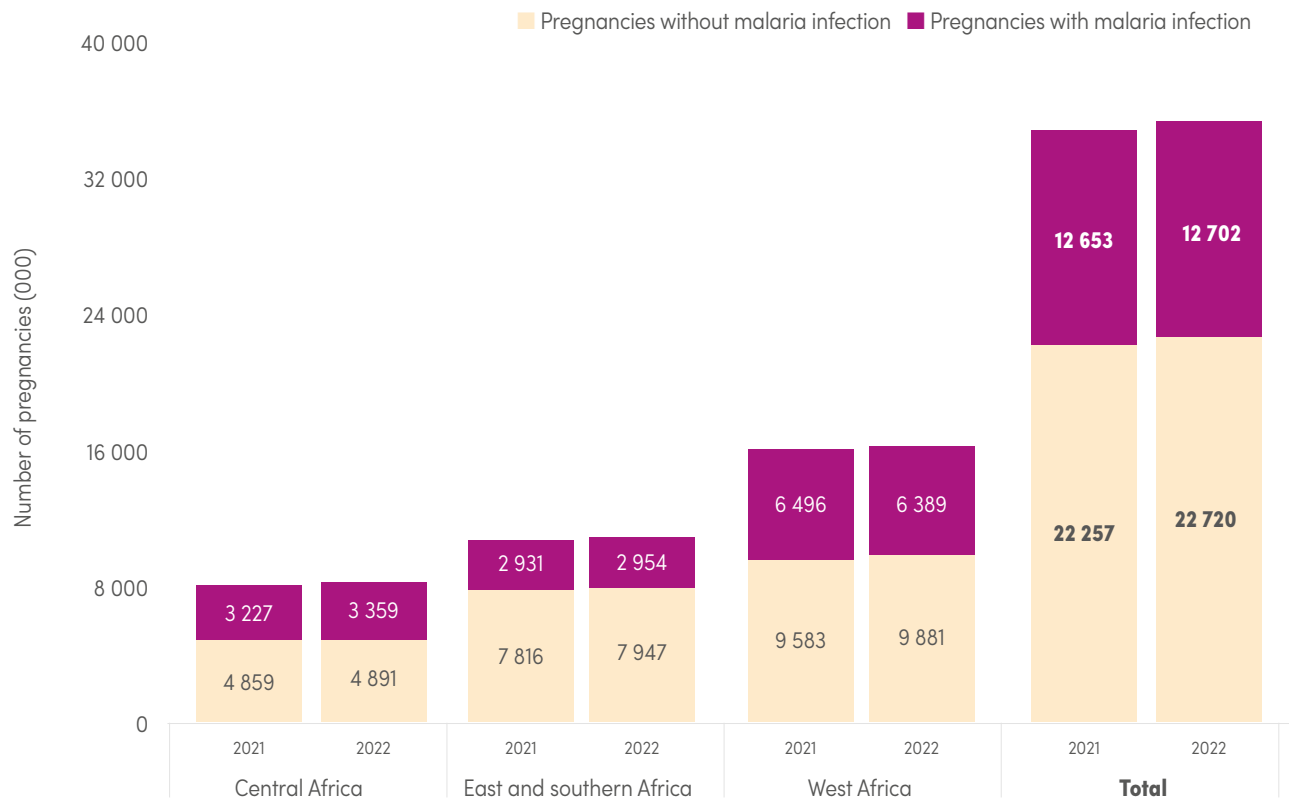
pregnancies (Annex 1, Fig. 7.5), of which 12.7 million (36%) were exposed to malaria infection (Fig. 3.11). The estimate for the number of pregnant women infected with malaria in 2021 was similar to that in 2022.

By WHO subregion, prevalence of exposure to malaria during pregnancy in 2022 was highest in west Africa, where about 6.4 million (39.3%) of an estimated 16.2 million pregnant women had malaria infections, and in central Africa, where about 3.4 million (40.1%) of the 8.3 million pregnant women were infected with malaria. The prevalence of malaria infection in pregnant women was lower in the subregion of east and southern Africa (27%) than in other subregions in 2022; however, the number of infected women in east and southern Africa (2.9 million) was similar to that in central Africa (3.4 million).

3.9.2 Prevalence of low birthweight in neonates due to malaria infection during pregnancy

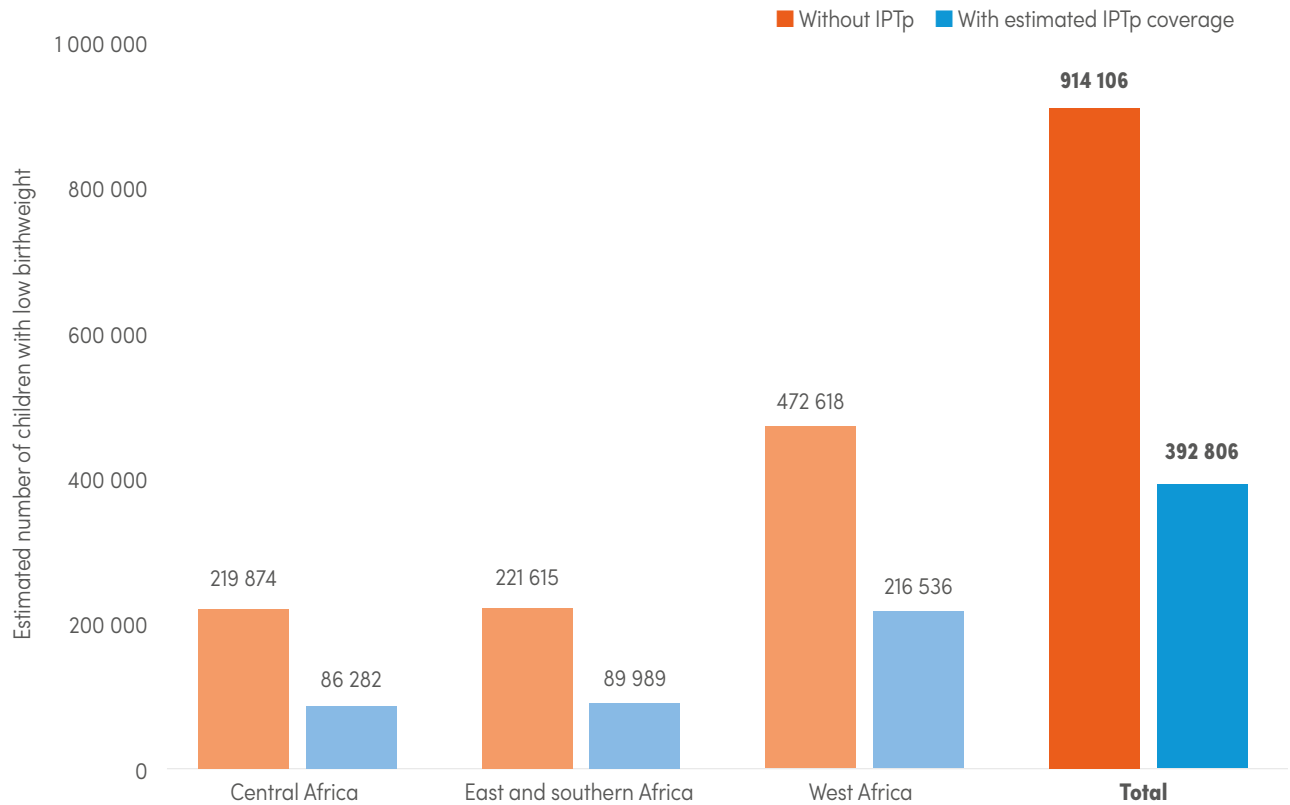
Between 2021 and 2022, exposure to malaria in pregnancy in the WHO African Region has remained stable, as outlined in Section 3.9.1. Low birthweight is a strong risk factor for neonatal and childhood mortality, and averting a substantial number of low birthweights will have a considerable impact on all-cause mortality in children. If there had been no pregnancy-specific malaria chemoprevention, it is estimated that exposure to malaria infection would have resulted in 914 000 neonates with low birthweight in 2022 compared with about 393 000 neonates with low birthweight estimated at the current IPTp coverage levels in the three subregions. The subregion of west Africa carries about half (55.1%) of the burden of low birthweight neonates due to malaria infection during pregnancy (Fig. 3.12).

Fig. 3.11.
Estimated prevalence of exposure to malaria infection during pregnancy, overall and by subregion in 2022, in moderate to high transmission countries in the WHO African Region Sources: Imperial College and WHO estimates.



WHO: World Health Organization.

Fig. 3.12.
Estimated number of LBWs due to exposure to malaria infection during pregnancy (without IPTp versus at estimated levels of IPTp coverage), overall and by subregion in 2022, in moderate to high transmission countries in sub-Saharan Africa Sources: Imperial College and WHO estimates.

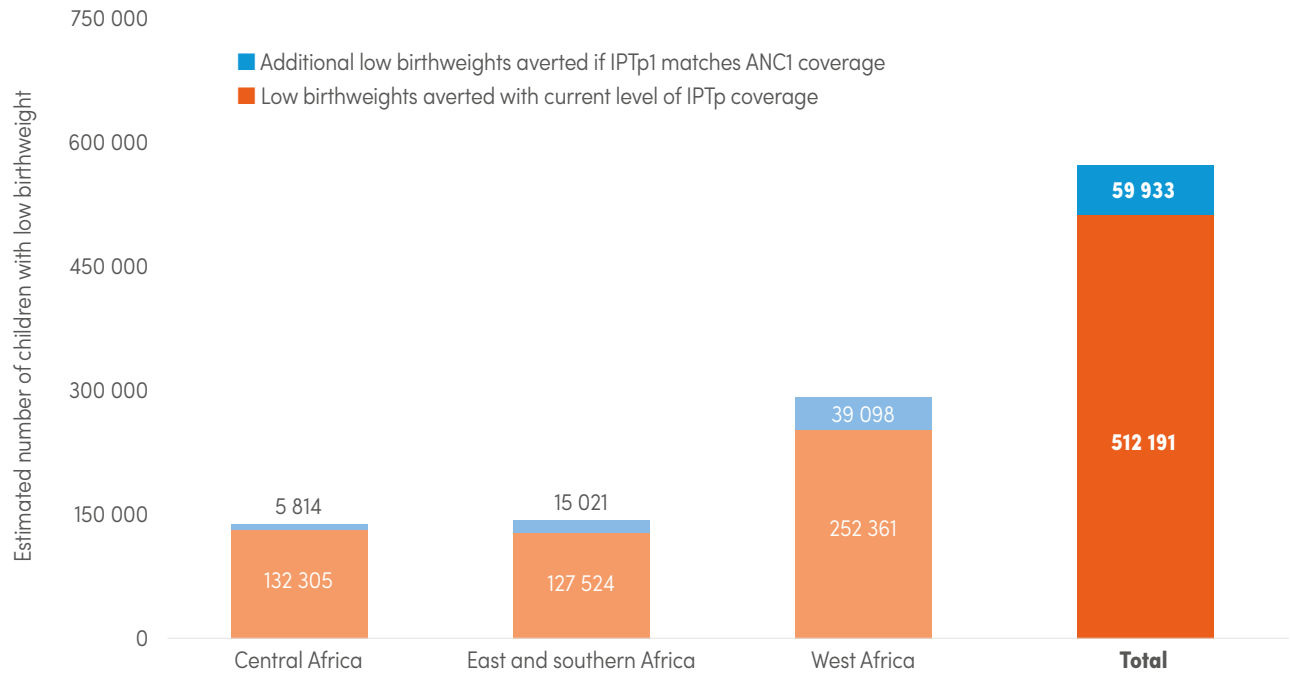


IPTp: intermittent preventive treatment of malaria in pregnancy; LBW: low birthweight; WHO: World Health Organization.

Accounting for the current impact of IPTp, it is estimated that low birthweight was averted in about 512 000 neonates. If all pregnant women visiting ANC clinics at least once during pregnancy received a single dose of IPTp – assuming that they were all eligible, and that the levels of IPTp2 and IPTp3 coverage remained the same – an additional 60 000 low birthweights would be averted (Fig. 3.13), reducing the remaining residual low birthweight burden of malaria in pregnancy to 332 000. If IPTp3 coverage matched the levels

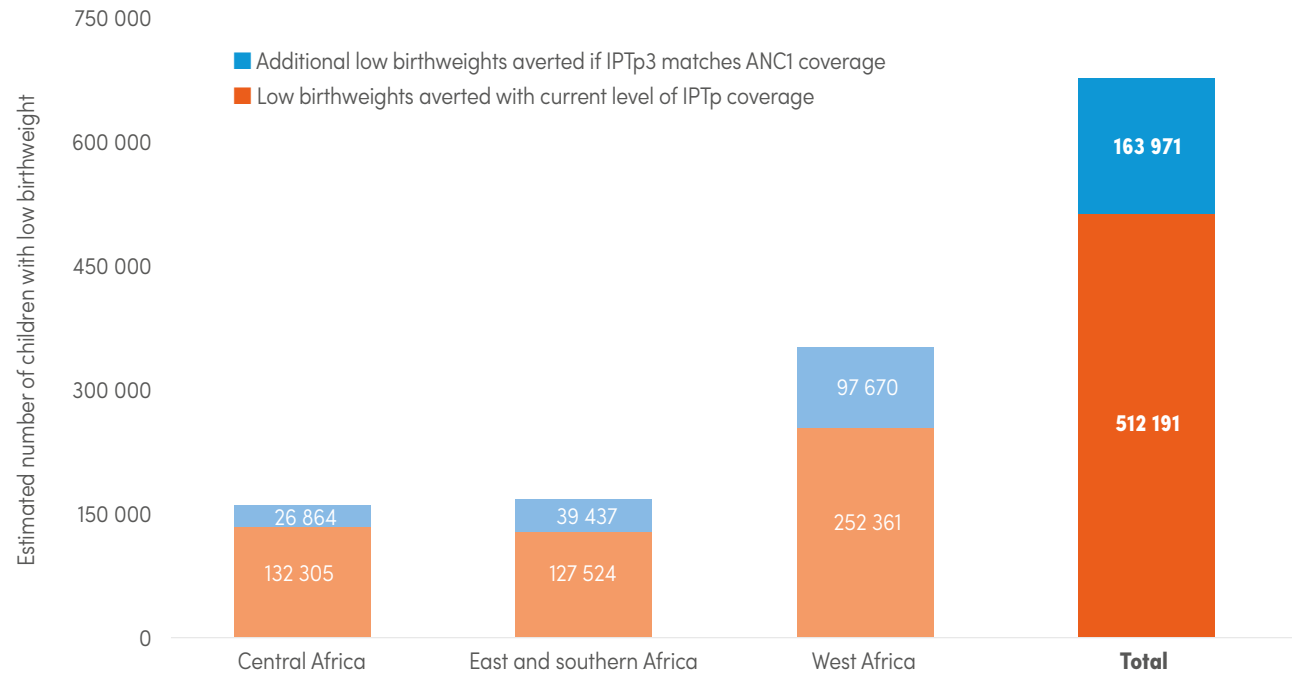
of ANC1 coverage, assuming that subsequent ANC visits were just as high, then an additional 164 000 low birthweights would be averted (Fig. 3.14), reducing the remaining residual low birthweight burden of malaria in pregnancy to 229 000. Finally, if IPTp3 coverage increased to 90% of all pregnant women, an additional 221 000 low birthweights would be averted (Fig. 3.15), reducing the remaining residual low birthweight burden of malaria in pregnancy to 172 000.

Fig. 3.13.
Estimated number of LBWs averted if current levels of IPTp coverage are maintained, and additional number averted if coverage of IPTp1 was optimized to match levels of coverage of ANC1 in 2022 while maintaining IPTp2 and IPTp3 at current levels, in moderate to high transmission countries in the WHO African Region
Sources: Imperial College and WHO estimates.



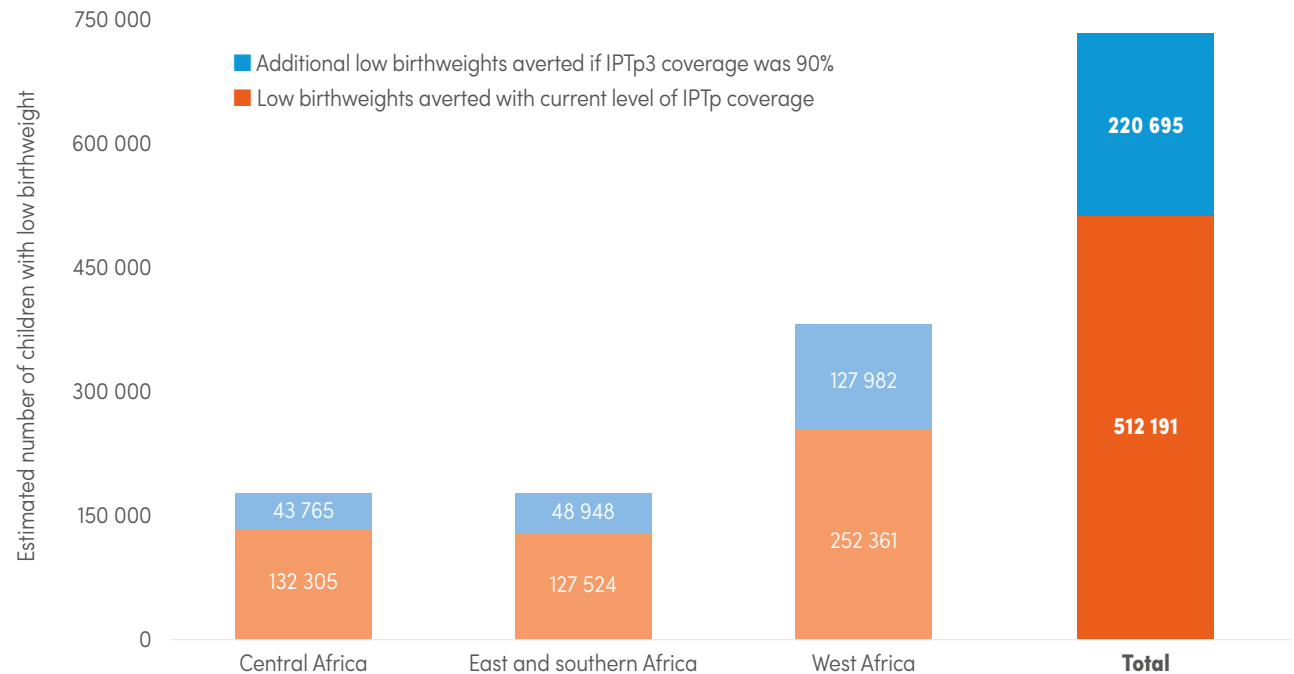
ANC: antenatal care; ANC1: first ANC visit; IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp1: first dose of IPTp; IPTp2: second dose of IPTp; IPTp3: third dose of IPTp; LBW: low birthweight; WHO: World Health Organization.

Fig. 3.14.
Estimated number of LBWs averted if levels of IPTp3 coverage were optimized to match levels of coverage of ANC1 in 2022, in moderate to high transmission countries in the WHO African Region
Sources: Imperial College and WHO estimates.



ANC: antenatal care; ANC1: first ANC visit; IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp3: third dose of IPTp; LBW: low birthweight; WHO: World Health Organization.

Fig. 3.15.
Estimated number of LBWs averted if levels of IPTp3 were optimized to achieve 90% coverage in 2022, in moderate to high transmission countries in the WHO African Region
Sources: Imperial College and WHO estimates.



IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp3: third dose of IPTp; LBW: low birthweight; WHO: World Health Organization.



4 Elimination

This section presents the latest results on progress towards the elimination of malaria globally. It focuses on trends in E-2025 countries, the Greater Mekong subregion (GMS) and countries that are malaria free or have received certification.

4.1 Nearing elimination

Over time, the elimination of malaria has gained momentum in numerous countries as they approach the milestone of zero indigenous malaria cases. In 2022, a total of 85 countries (including the territory of French Guiana) were malaria endemic, compared with 84 in 2021. Globally, the number of countries that were malaria endemic in 2000 and reported fewer than 10 000 malaria cases saw a 70% increase from 27 in 2000 to 46 in 2022 (Fig. 4.1). During the same period, the number of countries that reported

fewer than 100 indigenous cases increased from 6 to 27. Yet, when comparing 2021 and 2022, there has been a slight decrease from 28 to 27 countries because of the increase in indigenous cases reported by the Islamic Republic of Iran, which reported more than 1000 cases in 2022. Between 2000 and 2022, countries that reported fewer than 10 cases increased from four to 25, but the number of countries remained unchanged when comparing 2021 and 2022.

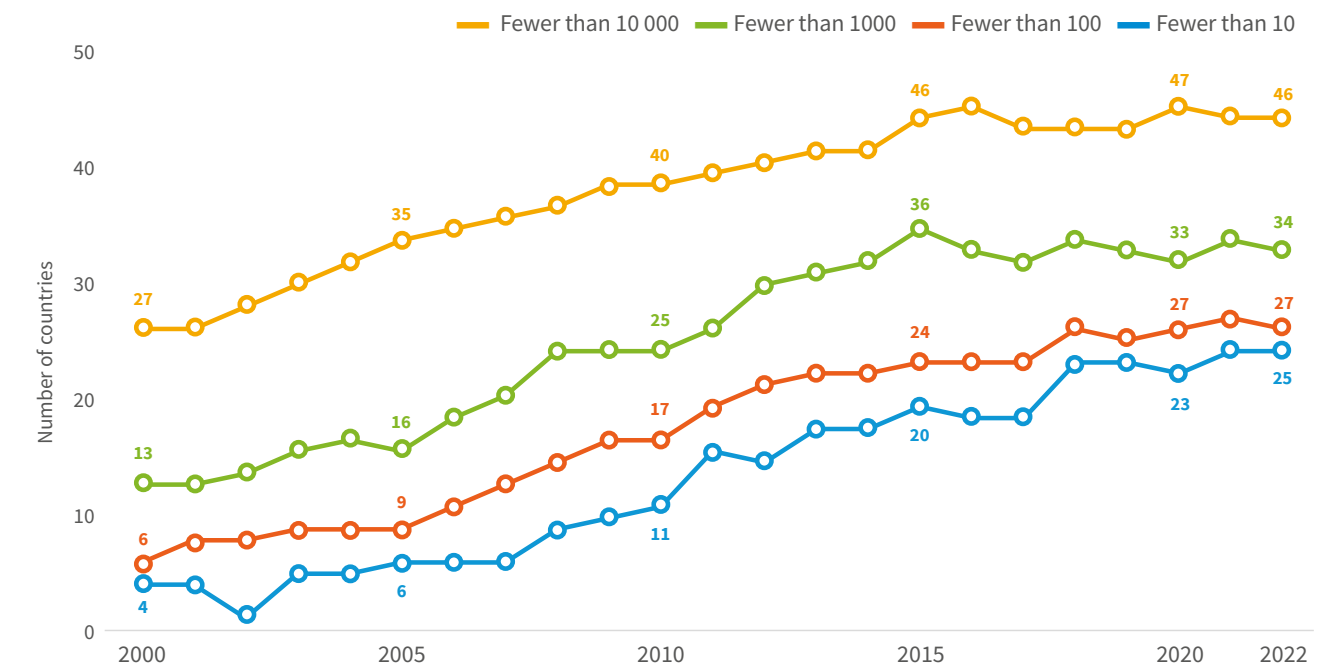
4.2 Malaria elimination certification

Between 2000 and 2023, 25 countries that were malaria endemic in 2000 achieved 3 consecutive years of zero indigenous malaria cases; 15 of these countries were certified malaria free by WHO. Certification of malaria elimination requires the elimination of the four main human parasite species: *P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*. A country or area is granted certification once it has been proven, beyond a reasonable doubt, that the

chain of mosquito-borne transmission has been interrupted nationwide, resulting in zero indigenous malaria cases for at least the past 3 consecutive years. Additionally, there must be a programme in place for preventing the re-establishment of transmission (24). No countries were certified malaria free in 2022, but three countries – Azerbaijan, Belize and Tajikistan – were granted certification in 2023 (Fig. 4.2).

Fig. 4.1.

Number of countries that were malaria endemic in 2000 and had fewer than 10, 100, 1000 and 10 000 indigenous malaria cases, 2000–2022^a Sources: NMP reports and WHO estimates.

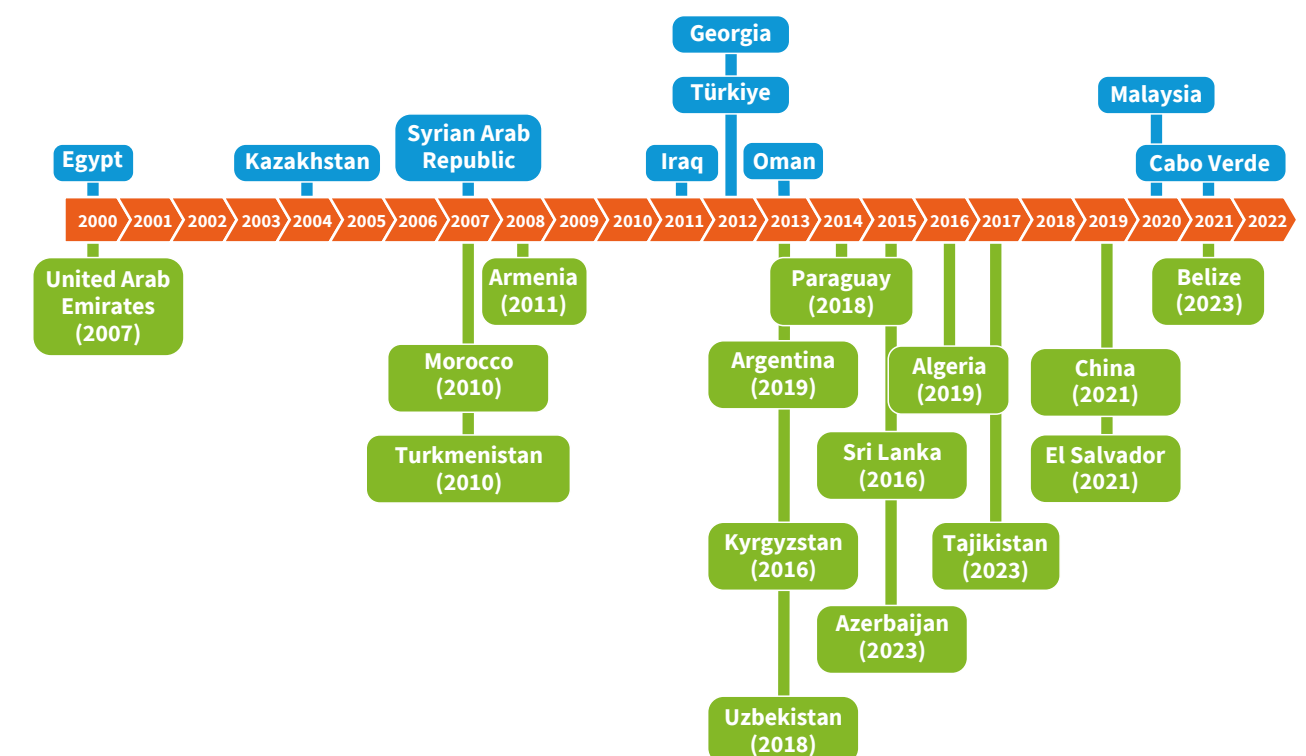


NMP: national malaria programme; *P. knowlesi*: *Plasmodium knowlesi*; WHO: World Health Organization.

^a *P. knowlesi* and introduced cases are not included.

Fig. 4.2.

Countries eliminating malaria since 2000^{a,b} Sources: Country reports and WHO.



WHO: World Health Organization.

^a Countries are placed on the year that they attained 3 consecutive years of zero indigenous cases. Blue represents countries with zero indigenous cases but not yet certified. Green represents countries that have been certified as malaria free, with the year of certification in parentheses.

^b Maldives was certified in 2015; however, it was already malaria free before 2000 and thus is not listed here.



4.2.1 Azerbaijan

Azerbaijan's journey to certification began with the systematic organization of malaria activities in 1920, through the establishment of an antimalaria network comprising specialized tropical disease stations, and therapeutic and preventive health services. Using a malariogenic zoning approach, by 1960, local transmission of *P. falciparum* and *P. malariae* was interrupted, with only about 100 cases of *P. vivax* in that year (25). Following the implementation of malaria interventions, transmission was interrupted in 2012, when the last indigenous case was recorded. The success of malaria elimination in Azerbaijan is attributed to the hard work of health staff and sustained investment to support targeted malaria interventions (e.g. early detection and treatment of all cases and vector control), and maintain the skills and capacities of all malaria staff through training. Timely detection and response to cases are achieved through an efficient system used to collect specimens, a network of laboratory services and clinical services, and an electronic data management system. In addition, collaboration with other sectors (e.g. the Amelioration and Water Management group) helped to reduce mosquito breeding and thus reduce the risk of malaria.

4.2.2 Tajikistan

Tajikistan eliminated malaria as a mass disease in the country through large-scale antimalaria measures, including the launch of an eradication programme in 1954 and a large-scale antimalaria campaign (25); by 1960, only isolated foci remained in the areas bordering Afghanistan. Since then, the government has dealt with sporadic outbreaks and increases in cases by taking all necessary measures in every affected region. Measures include actively identifying patients and treating them in a timely manner, treating foci, conducting proper epidemiological surveillance, and carrying out information and education activities. These actions resulted in a sharp decrease in malaria incidence over time, which helped to contain the spread of the disease and facilitate its complete elimination; the last reported local malaria case was in 2014. Tajikistan's success in containing a malaria

epidemic in the 1990s and eventually eliminating the disease highlights the importance of having trained and experienced malaria control staff who can organize and carry out malaria activities at the local level. Contributing to the country's success was universal access to quality medical care delivered to the entire national population through primary health care and public and private facilities, and effective actions targeted to particular types of malaria landscape, with various sanitary and water management activities used to reduce mosquito breeding.

4.2.3 Belize and El Salvador

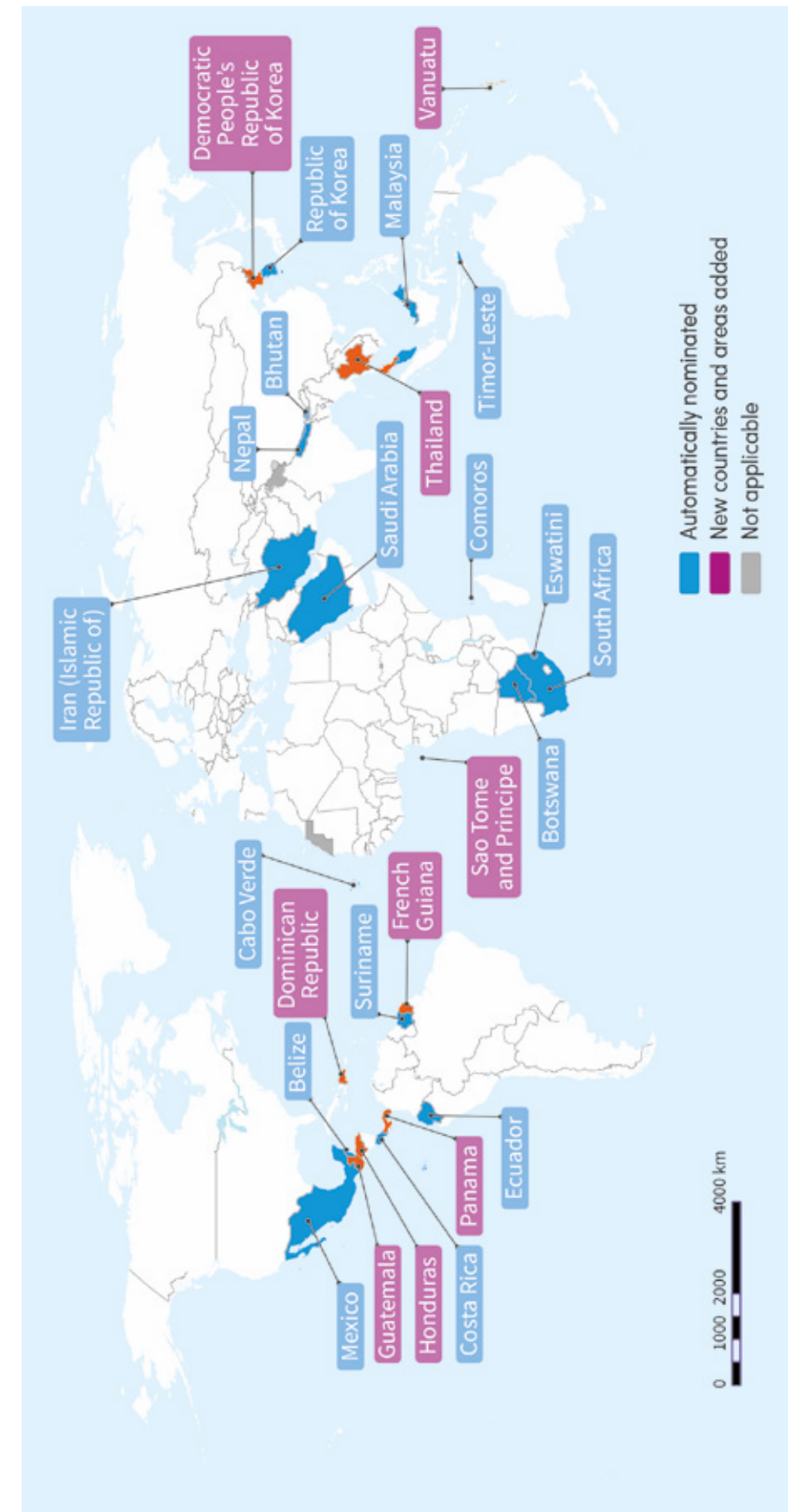
After more than 70 years in the fight against malaria, Belize was certified malaria free in 2023. This marked Belize as the fourth country in the WHO Region of the Americas, and the second in Central America, to achieve this status in the past 5 years, following the achievements of Argentina (2019), El Salvador (2021) and Paraguay (2018). In 1950, Belize launched a targeted programme aimed at eliminating malaria nationwide. The country experienced a significant decline in malaria cases over 30 years, with cases dropping from 10 000 in 1994 to zero by the end of 2019. In 2015, the country changed its approach and prioritized surveillance in high-risk groups, with targeted interventions and resources allocated to the most affected areas. Remarkably, Belize managed to maintain its malaria surveillance efforts during the COVID-19 pandemic, and succeeded in merging its surveillance systems for malaria and COVID-19 (26). Several key strategies contributed to the country being certified malaria free, including a robust surveillance system, widespread access to diagnosis (with a notable contribution from trained community workers) and access to vector-control interventions such as ITNs and effective indoor residual spraying (IRS).

By 2023, Belize and El Salvador became the first two Central American countries to achieve malaria free status (**Fig. 4.2**). Two countries, Egypt and Timor-Leste, submitted official requests for certification in 2023. Cabo Verde has reported zero indigenous cases for 4 years and has reached the final stage of the certification process.

the Republic of Korea, Sao Tome and Principe, Saudi Arabia, South Africa, Suriname, Thailand, Timor-Leste and Vanuatu (**Fig. 4.3**). The selection of the E-2025 countries was based on criteria such as having a government-endorsed elimination plan, meeting a defined threshold of malaria case reductions in recent years, meeting pre-defined programme requirements, and expert opinions (including from WHO) (27).

Fig. 4.3.

Countries and areas selected for the E-2025 initiative Source: WHO estimates.



E-2025; malaria eliminating countries for 2025; WHO; World Health Organization.



From 2010 to 2022, there was a 72.3% reduction in indigenous malaria cases across the E-2025 countries and one area, with increases observed in 2017–2018 and then again since 2021. The reduction in cases is illustrated in **Fig. 4.4**.

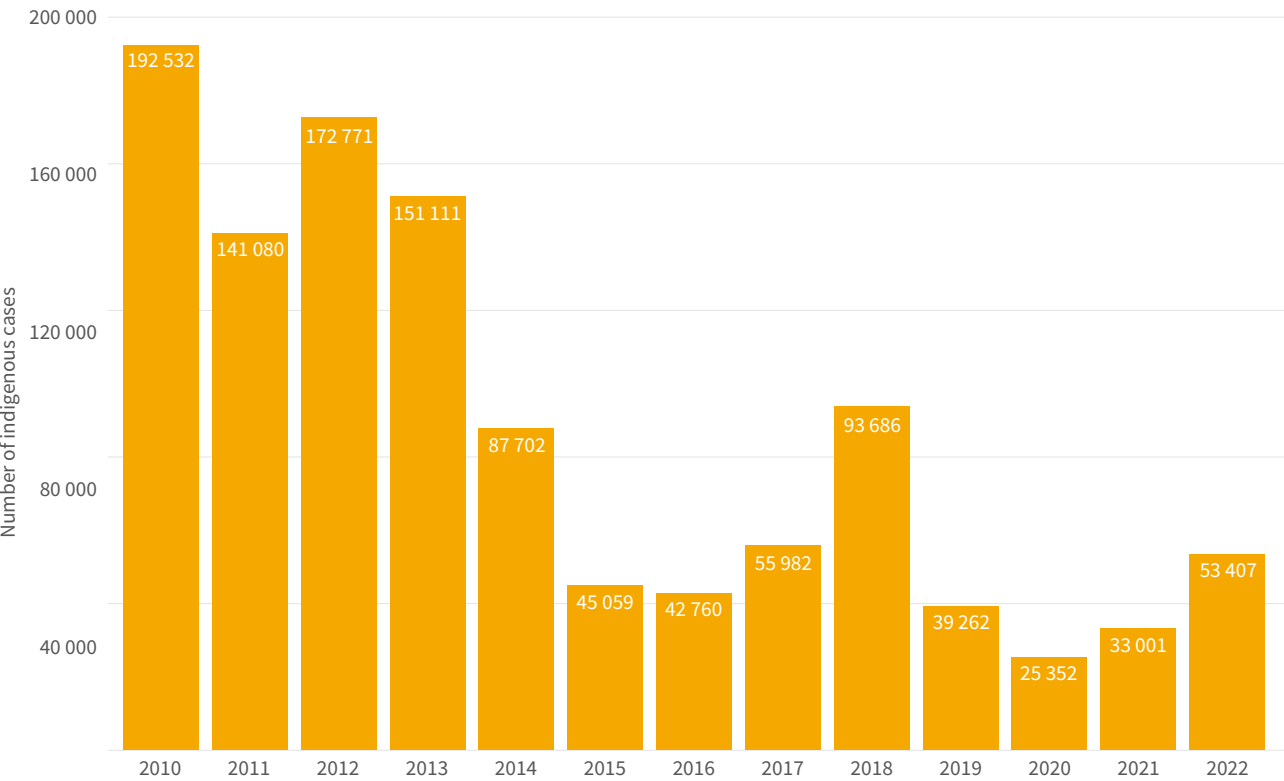
In 2022, the E-2025 countries and area reported 53 407 indigenous cases, marking an overall increase of 61.8% from 33 001 cases in 2021 (**Fig. 4.4, Table 4.1**). This increase was largely due to an alarming surge in cases in the Comoros, which almost doubled its cases from 10 537 in 2021 to 20 675 in 2022. Other countries also experienced substantial increases during this period: Costa Rica more than doubled its caseload, from 189 in 2021 to 409 in 2022; Panama saw an increase from 4354 in 2021 to 7102 in 2022; Thailand reported a significant increase, from 2426 in 2021 to 6263 in 2022; Honduras more than doubled its cases, from 1542 in 2021 to 3534 in 2022; and Vanuatu had an almost fourfold increase, from 312 in 2021 to 1102 in 2022. Additional countries that reported varying levels of increase in cases for the same period were the Dominican Republic (12.6%), Guatemala (45.7%), Nepal (12.5%), the Republic of Korea (39.4%) and Sao Tome and Principe (46.0%) (**Table 4.1**).

For the second consecutive year, Nepal continued to report presumed cases; the country still treats patients based solely on clinical symptoms, in accordance with national

guidelines, even when diagnostic tests are negative. This approach remains a concern; revisions to the country’s case management guidelines could address the issue but currently have not been implemented. Additionally, the resurgence of indigenous cases in the Islamic Republic of Iran is a concern, with 1439 locally acquired cases reported in 2022 after 4 consecutive years of zero indigenous cases (**Table 4.1**).

Despite the setbacks, several countries and one area observed notable reductions in indigenous transmission: Botswana (43.5%), the Democratic People’s Republic of Korea (9.3%), Ecuador (38.0%), Eswatini (57.6%), French Guiana (71.6%), Mexico (32.6%) and South Africa (31.3%). Also, Belize was recently certified malaria free, and Cabo Verde reported zero malaria cases for the fourth consecutive year (**Table 4.1**). Malaysia reported zero indigenous cases of human *Plasmodium* species for the fifth consecutive year. After an outbreak of three cases in Timor-Leste in 2020, the country managed to realign its efforts, achieving 2 consecutive years with zero indigenous cases in 2021 and 2022 (in fact, for 36 consecutive months if 2023 is taken into consideration). Saudi Arabia also achieved 2 consecutive years with zero indigenous cases in 2021 and 2022; in addition, for the first time, both Bhutan and Suriname reported zero indigenous cases in their efforts to reach the certification milestone.

Fig. 4.4.
Total number of indigenous cases in E-2025 countries and areas, 2010–2022 *Source: NMP reports.*



E-2025: malaria eliminating countries for 2025; NMP: national malaria programme.

Table 4.1. Number of indigenous malaria cases in E-2025 countries and areas, 2010–2022 ^a <i>Source: NMP reports.</i>													
Country/ area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Belize	150	72	33	20	19	9	4	7	3	0	0	0	0
Bhutan	436	194	82	15	19	34	15	11	6	2	22	9	0
Botswana	1 046	432	193	456	1 346	284	659	1 847	534	169	884	703	397
Cabo Verde	47	7	1	22	26	7	49	423	2	0	0	0	0
Comoros	36 538	24 856	49 840	53 156	2 203	1 884	1 467	3 896	15 613	17 599	4 546	10 537	20 675
Costa Rica	110	10	6	0	0	0	4	12	70	95	90	189	406
Democratic People's Republic of Korea	13 520	16 760	21 850	14 407	10 535	7 022	5 033	4 603	3 698	1 869	1 819	2 357	2 136
Dominican Republic	2 482	1 616	952	473	459	631	690	341	433	1 291	826	284	320
Ecuador	1 888	1 219	544	368	242	618	1 191	1 275	1 653	1 803	1 934	2 175	1 348
Eswatini	268	379	409	728	389	318	250	440	686	235	233	505	214
French Guiana	1 632	1 209	900	875	448	374	217	554	546	212	140	74	21
Guatemala	7 384	6 817	5 346	6 214	4 929	5 538	5 000	4 121	3 018	2 069	1 058	1 273	1 856
Honduras	9 745	7 618	6 439	5 364	3 378	3 555	4 094	1 273	632	330	815	1 542	3 534
Iran (Islamic Republic of) ^b	1 847	1 632	756	480	358	167	81	57	0	0	0	0	1 439
Malaysia	5 194	3 954	3 662	1 028	596	242	266	85	0	0	0	0	0
Mexico	1 226	1 124	833	495	656	517	551	736	803	618	356	242	163
Nepal	3 894	2 335	3 230	1 974	832	591	507	623	493	127	73	32	36
Panama	418	354	844	696	864	546	769	649	684	1 756	1 946	4 354	7 102
Republic of Korea	1 267	505	394	383	557	627	602	436	501	485	356	274	382
Sao Tome and Principe	3 146	8 442	12 550	9 243	1 754	2 056	2 238	2 239	2 937	2 732	1 933	2 719	3 970
Saudi Arabia	29	69	82	34	30	83	272	177	61	38	83	0	0
South Africa	8 060	9 866	6 621	8 645	11 705	4 959	4 323	23 381	9 540	3 096	4 463	2 972	2 043
Suriname	1 771	795	569	525	401	81	78	137	37	104	156	22	0
Thailand	32 480	24 897	46 895	41 602	41 218	14 265	12 076	7 416	51 104	4 065	3 123	2 426	6 263
Timor-Leste	48 137	19 739	5 208	1 025	3 424	80	81	16	0	0	3	0	0
Vanuatu	9 817	6 179	4 532	2 883	1 314	571	2 243	1 227	632	567	493	312	1 102
Total	192 532	141 080	172 771	151 111	87 702	45 059	42 760	55 982	93 686	39 262	25 352	33 001	53 407

E-2025: malaria eliminating countries for 2025; NMP: national malaria programme.
^a Entries in red indicate that cases in E-2025 countries were higher in 2021 or 2022 than in the previous year.
^b In 2022, the Islamic Republic of Iran reported 1439 locally acquired cases, including indigenous cases.



4.4 *P. knowlesi* disease burden and transmission

Over recent years, *P. knowlesi* has emerged as a notable concern in malaria cases, especially in the WHO South-East Asia Region countries of Indonesia, Malaysia and Thailand.

In 2022, a total of 2768 *P. knowlesi* cases were reported globally, a decrease of 24.2% compared with 2021 (3651 cases). Indigenous *P. knowlesi* cases also saw a decrease of 26%, from 3629 cases in 2021 to 2682 cases in 2022. Malaysia continues to be the predominant source of *P. knowlesi* cases, followed by Thailand and Indonesia, which contributed 90.5%, 3.1% and 0.1%, respectively, in 2022. In 2022, all the indigenous malaria deaths in Malaysia (9) and Thailand (1) were attributed to *P. knowlesi*.

Malaysia experienced a 30% decline in total *P. knowlesi* cases, from 3575 in 2021 to 2505 in 2022. Most (99.9%) of the *P. knowlesi* cases detected in 2022 were classified as indigenous. The total number of *P. knowlesi* cases rose

from five reported cases in 2021 to 87 in 2022 in Indonesia, and 71 cases in 2021 to 176 in 2022 in Thailand. Although Malaysia reported the highest absolute numbers of *P. knowlesi* cases, the rate of increase in 2022 was most pronounced in Indonesia and Thailand (Fig. 4.5).

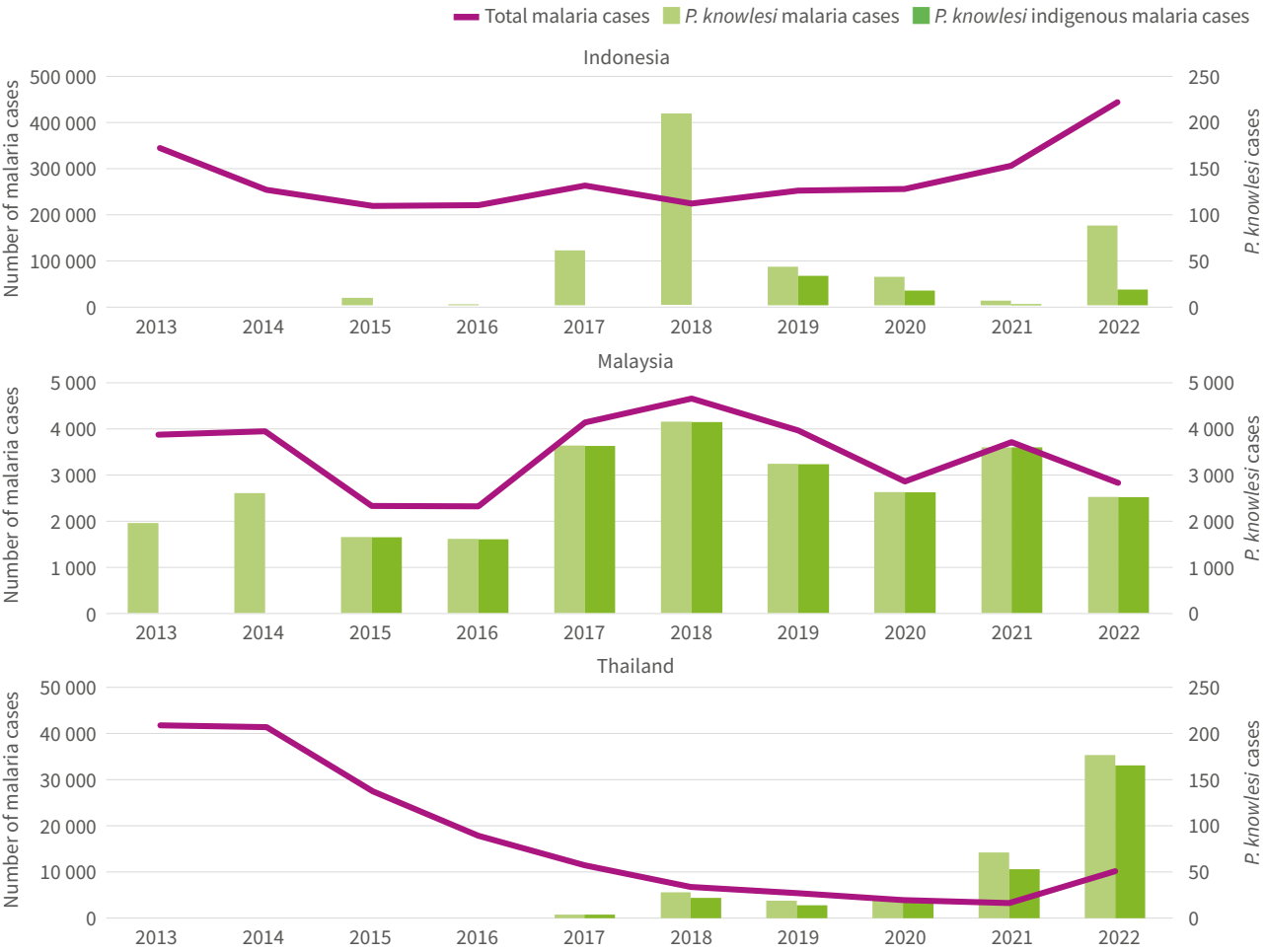
The increase in the burden and transmission of *P. knowlesi* poses unique challenges for malaria elimination; it also has implications for malaria free certification (24). Until now, certification has been awarded exclusively to countries where only the four species of human *Plasmodium* were transmitted. Given the emerging *P. knowlesi* transmission context, WHO has convened its advisory groups to discuss the implications of *P. knowlesi* for certification. If a country was able to eliminate the transmission of the four main human species but other species were still being transmitted, certification might be granted if the risk of infection was assessed as negligible.

4.5 The GMS

Antimalarial drug resistance of *P. falciparum*, the parasite responsible for the most severe form of malaria, is a major public health concern, especially in the GMS, which historically has been the epicentre of the emergence of drug-resistant malaria that has now spread to Africa (28). Between 2000 and 2022, the GMS countries – Cambodia, China (Yunnan Province), the Lao People’s Democratic Republic, Myanmar, Thailand and Viet Nam – reported a 55.5% decrease in indigenous malaria cases and an 89.1% decline in indigenous *P. falciparum* malaria cases (Fig. 4.6). Of these, China stands out as the only country within the subregion to consecutively report zero indigenous cases and be certified malaria free.

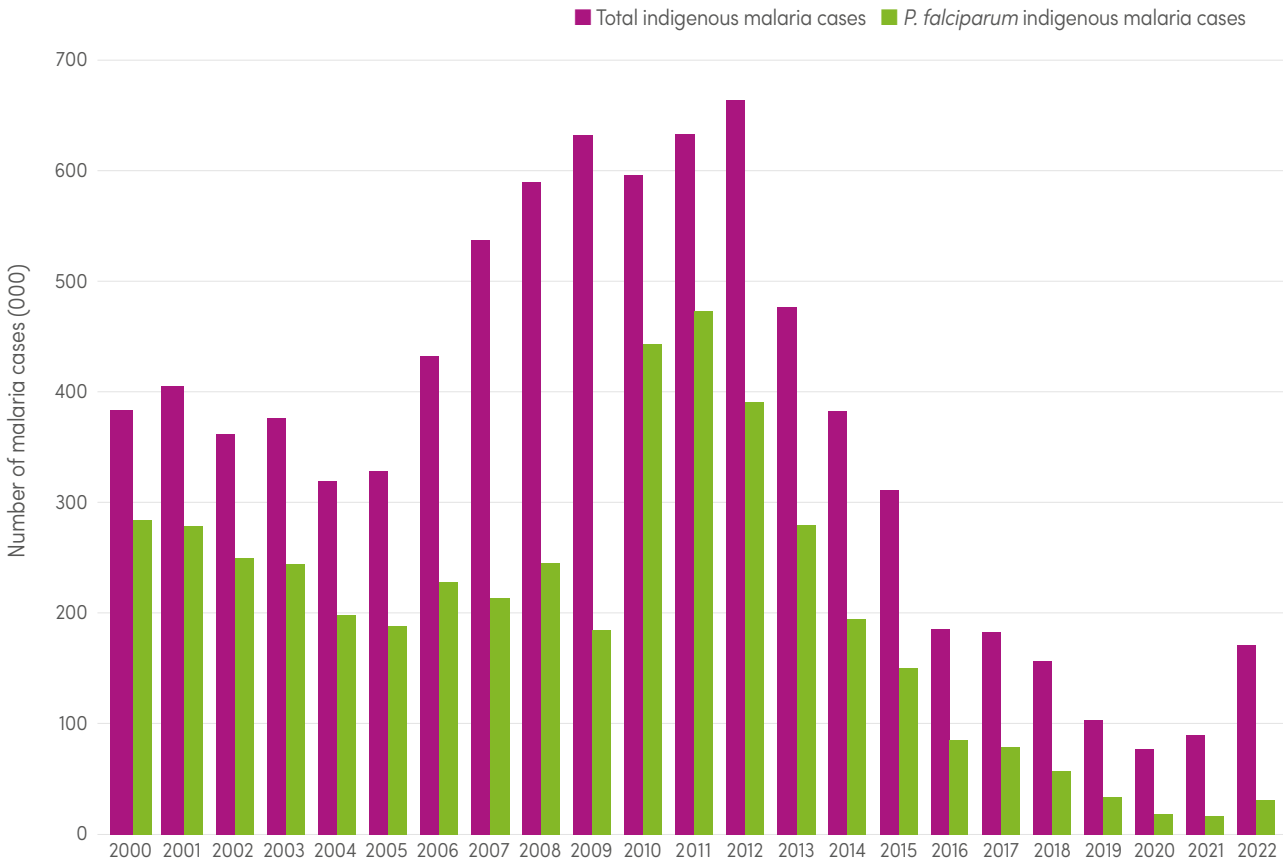
In 2013, in response to a peak of malaria cases in the region in 2012, WHO launched the Emergency Response to Artemisinin Resistance in the GMS initiative (29); by 2017, the initiative had transitioned into the Mekong Malaria Elimination Programme (30). Between 2012 and 2021, the GMS witnessed a significant decrease in indigenous malaria cases (86.4%) and in indigenous *P. falciparum* malaria cases (95.7%). However, in the span of a single year, the GMS has experienced a concerning resurgence in malaria, with cases nearly doubling between 2021 and 2022. The number of indigenous cases increased from 90 082 in 2021 to 170 527 in 2022. Similarly, the number of indigenous *P. falciparum* cases nearly doubled, increasing from 16 490 in 2021 to 30 789 cases in 2022 (Fig. 4.6).

Fig. 4.5. Number of total *P. knowlesi*, indigenous *P. knowlesi* and total malaria cases in Indonesia, Malaysia and Thailand, 2013–2022 Source: NMP data.



NMP: national malaria programme; *P. knowlesi*: *Plasmodium knowlesi*.

Fig. 4.6. Total indigenous malaria and *P. falciparum* cases in the GMS, 2000–2022^a Source: WHO database.



GMS: Greater Mekong subregion; *P. falciparum*: *Plasmodium falciparum*; WHO: World Health Organization.
^a For the following countries and years, species breakdown does not add up to the total confirmed cases, and therefore the numbers of *P. falciparum* cases are likely to be underreported: Cambodia 2000–2006 and 2010–2013; Myanmar 2000–2006 and 2010–2011; Thailand 2005, 2006 and 2010–2011; and Viet Nam 2000 and 2007–2009. Before the implementation of case investigation and classification in countries, all confirmed cases were considered to be indigenous. This uncertainty should be noted in the interpretation of the trends. The year of implementation of these activities varies by country. For further details of species breakdown from 2010 onwards, see Annex 4-I.

Myanmar remains the largest contributor to the region's malaria burden, accounting for 92.4% of indigenous malaria cases and 95.0% of indigenous *P. falciparum* malaria cases. It is followed by Thailand, with 3.7% of indigenous cases and 0.5% of indigenous *P. falciparum* cases, while Cambodia accounts for 2.4% and 1.3%, respectively (**Fig. 4.7**).

Indigenous *P. falciparum* cases are on the rise in Thailand, which borders Myanmar (a country reporting a significant number of *P. falciparum* cases) in the west. The frequent cross-border movement, especially from Myanmar to Thailand, highlights how importation is likely to fuel local transmission. Resources are limited in Myanmar due to

the current political situation; thus, Thailand is burdened with cross-border movement of individuals entering the country to seek medical care, and there is a need to increase investments and resources for diagnostics, treatment and long-lasting insecticidal nets in Thailand, to cater to the growing number of cases. There is also a need to tackle the cross-border transmission challenges to control onward transmission from imported cases, particularly in the north. China's malaria free status provides important lessons for the subregion. All GMS countries other than Myanmar have increasingly adopted subnational verification in low-burden settings, in preparation for malaria certification.

4.6 Prevention of re-establishment

Once malaria has been eliminated, countries should remain vigilant and implement the necessary activities

to prevent re-establishment in areas with malariogenic potential (i.e. the risk of importation in areas receptive

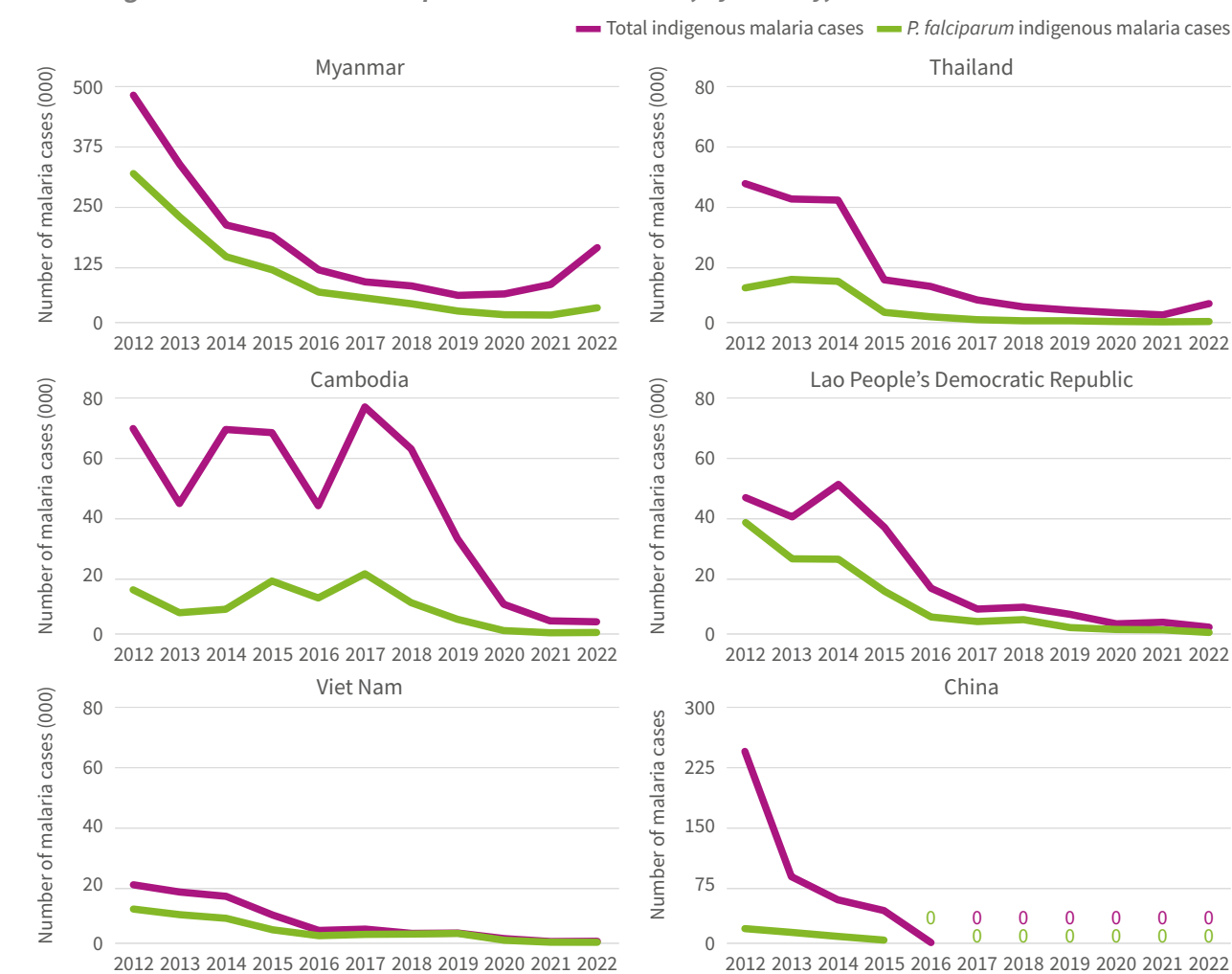
to transmission). Countries should maintain vigilance to rapidly detect imported cases that might occur at any time and place. Detection of introduced or indigenous cases should trigger a rapid response and a thorough investigation to prevent further transmission. Several E-2025 countries that achieved zero indigenous cases recently face challenges in maintaining that achievement and preventing re-establishment. Many of the challenges are related to migrants and occur in border areas; hence, WHO is developing guidance for border malaria (31). Additionally, decreased funding for malaria poses a threat to countries that report zero or low numbers of indigenous cases. There is a need to advocate and ensure that malaria programmes remain adequately funded to sustain progress by responding to cases in a timely way and prevent re-establishment of transmission.

The minimum indication of re-establishment is defined as at least three indigenous malaria cases of the same species in the same focus for 3 consecutive years; such re-establishment may trigger a de-certification process. Between 2000 and 2022, no country that was certified malaria free was found to have malaria transmission re-established.

Saudi Arabia, which reported zero indigenous cases for 2 consecutive years, and Bhutan and Suriname, which recently celebrated their first year of reporting zero indigenous cases, are proactively implementing strategies to prevent the reintroduction of indigenous malaria cases (**Fig. 4.8**). Achieving zero indigenous cases is an important milestone, but continuous investments, rigorous deployment of interventions, and sensitivity and robust surveillance remain the key to safeguarding the achievement and maintaining malaria free status.

Fig. 4.7.

Total indigenous malaria and *P. falciparum* cases in the GMS, by country, 2012–2022^a Source: WHO database.

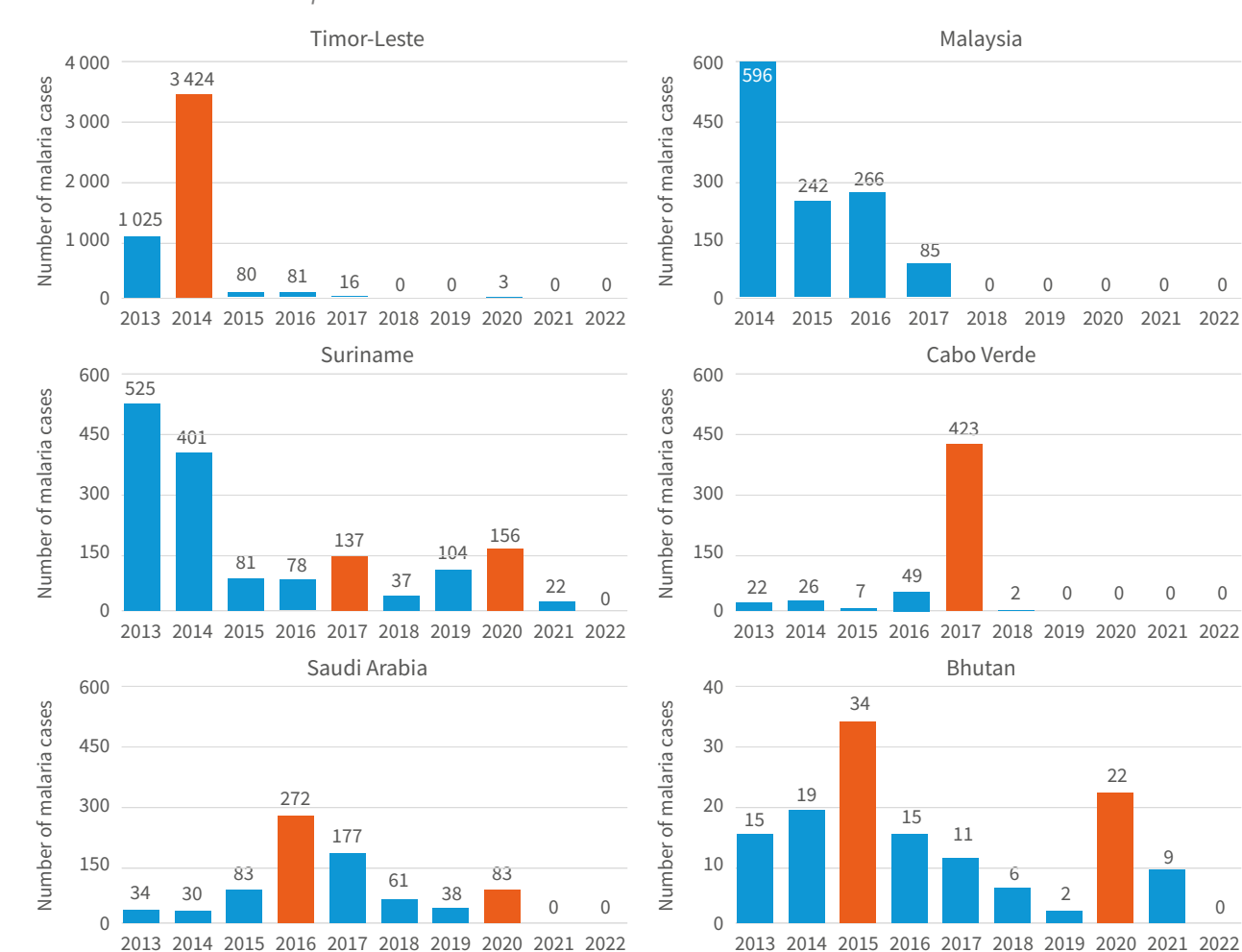


GMS: Greater Mekong subregion; *P. falciparum*: *Plasmodium falciparum*; WHO: World Health Organization.

^a Countries are shown from the highest number of total indigenous malaria cases in 2022 to the lowest.

Fig. 4.8.

Number of annual indigenous malaria cases between 2013 and 2022 in E-2025 countries that recently reported zero cases^a Source: NMP reports.

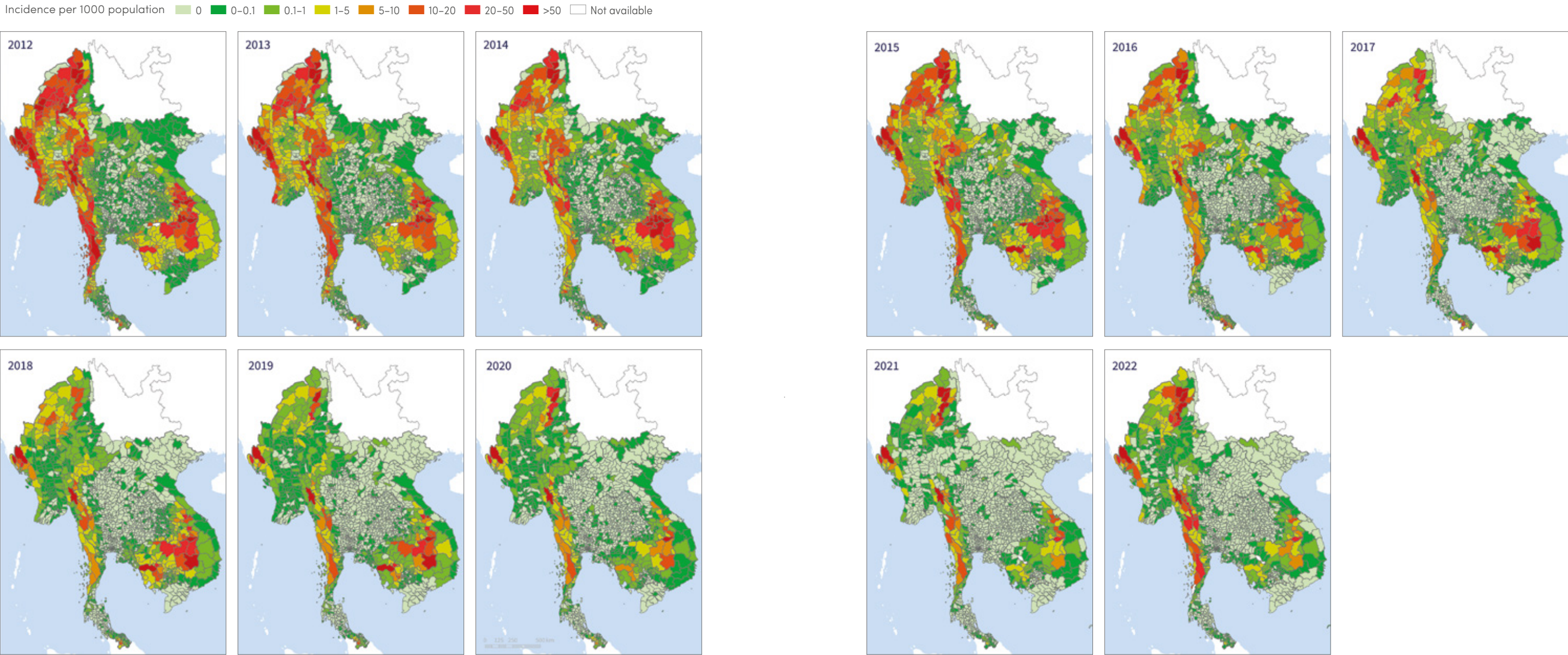


E-2025: malaria eliminating countries for 2025; NMP: national malaria programme.

^a Countries are shown from the highest number of indigenous malaria cases in any year between 2013 and 2016 to the lowest. Orange bars represent substantial increases in cases or outbreaks in comparison with the previous year of the time series.



Fig. 4.9.
Regional map of malaria incidence in the GMS, by area, 2012–2022 Source: NMP reports to the GMS Malaria Elimination Database.



GMS: Greater Mekong subregion; NMP: national malaria programme.

After 5 years of zero local transmission, the Islamic Republic of Iran is currently facing an outbreak of indigenous malaria cases. A significant proportion of these cases are imported (mainly from neighbouring Pakistan, which experienced an outbreak of cases in 2022 due to heavy flooding). Frequent border movement of people, including individuals visiting relatives, contributed to the introduction of cases into the Islamic Republic of Iran, and to the further re-establishment of local transmission. This has heightened the potential for

disease spread, making the interruption of transmission even more challenging.

The significant increase in malaria cases in the Islamic Republic of Iran has made it almost impossible for authorities to conduct the thorough case investigations necessary for case classification; as a result, the country's malaria programme has struggled to distinguish between indigenous and introduced cases. Additional challenges within the country (e.g. flooding, an inadequate system

for procuring essential commodities, a rise in other vector-borne diseases such as dengue) have put pressure on the availability of malaria diagnostics and have further contributed to the current epidemiological situation in the Islamic Republic of Iran. This highlights the importance of a robust surveillance system and adequate human resources, which can detect and investigate cases early, facilitating a timely response that can interrupt transmission.

In recognition of the policy gap, WHO is developing guidance for the prevention of re-establishment. Given that malaria elimination is often first achieved in areas within a country, prevention of re-establishment should start at the subnational level, at the same time as countries are working on national interruption of transmission.

5 High burden to high impact countries

The high burden to high impact (HBHI) approach is built on four core pillars and two enabling environments. The four pillars are political will and commitment from national to community level to combat malaria; strategic use of information for action, focusing on the use of data to guide malaria control efforts; better technical and policy guidance at all levels; and effective coordination and leadership. The two enabling environments are strong health systems with integration of malaria control, and multisectoral action for malaria. The HBHI approach is guided by three principles: country led and country owned; tailored interventions, moving away from a one-size-fits-all approach to adapt interventions to specific needs and local contexts; and a swift reduction in malaria-related deaths through the use of existing tools and prevention methods.

In November 2018, WHO and the RBM Partnership to End Malaria launched the HBHI country-led approach (32) as a mechanism to support the 11 highest burden countries to get back on track to achieve the GTS 2025 targets (33). In 2017, these 11 countries (Burkina Faso, Cameroon, the Democratic Republic of the Congo, Ghana, India, Mali, Mozambique, Niger, Nigeria, Uganda and the United Republic of Tanzania) accounted for 70% of the global estimated case burden and 71% of global estimated deaths. In 2022, Sudan joined the first group of HBHI countries, at the request of the Sudanese Federal Ministry of Health. This inclusion expanded the official number of HBHI countries to 12. However, full implementation in Sudan was hindered due to conflict that erupted in early 2023.

5.1 Malaria burden in HBHI countries

During the period 2019–2022, malaria cases in the 11 original HBHI countries rose from 157 million cases in 2019 to 165 million in 2020, 166 million in 2021 and 167 million in 2022 (**Fig. 5.1**). The increase in 2020 was mainly due to the COVID-19 pandemic, after which estimated malaria cases increased by a small percentage in 2021 and 2022, in part due to population growth. Among the HBHI countries, India makes only a small overall contribution; however, it reported the highest relative reduction in cases among these countries (about 30%). Overall, the 11 HBHI countries accounted for 67% of cases globally in 2022.

By country, malaria deaths remained stable during the pandemic years of 2021–2022, despite an initial increase in

Mozambique, Niger, Nigeria, Uganda and the United Republic of Tanzania) accounted for 70% of the global estimated case burden and 71% of global estimated deaths. In 2022, Sudan joined the first group of HBHI countries, at the request of the Sudanese Federal Ministry of Health. This inclusion expanded the official number of HBHI countries to 12. However, full implementation in Sudan was hindered due to conflict that erupted in early 2023.

As a result of the positive outcomes observed in the initial HBHI countries, several additional countries in the WHO African and Eastern Mediterranean regions have begun implementing the second pillar of the HBHI approach. That pillar focuses on strategic use of information, with an emphasis on subnational tailoring of interventions (discussed in more detail in **Section 5.2**).

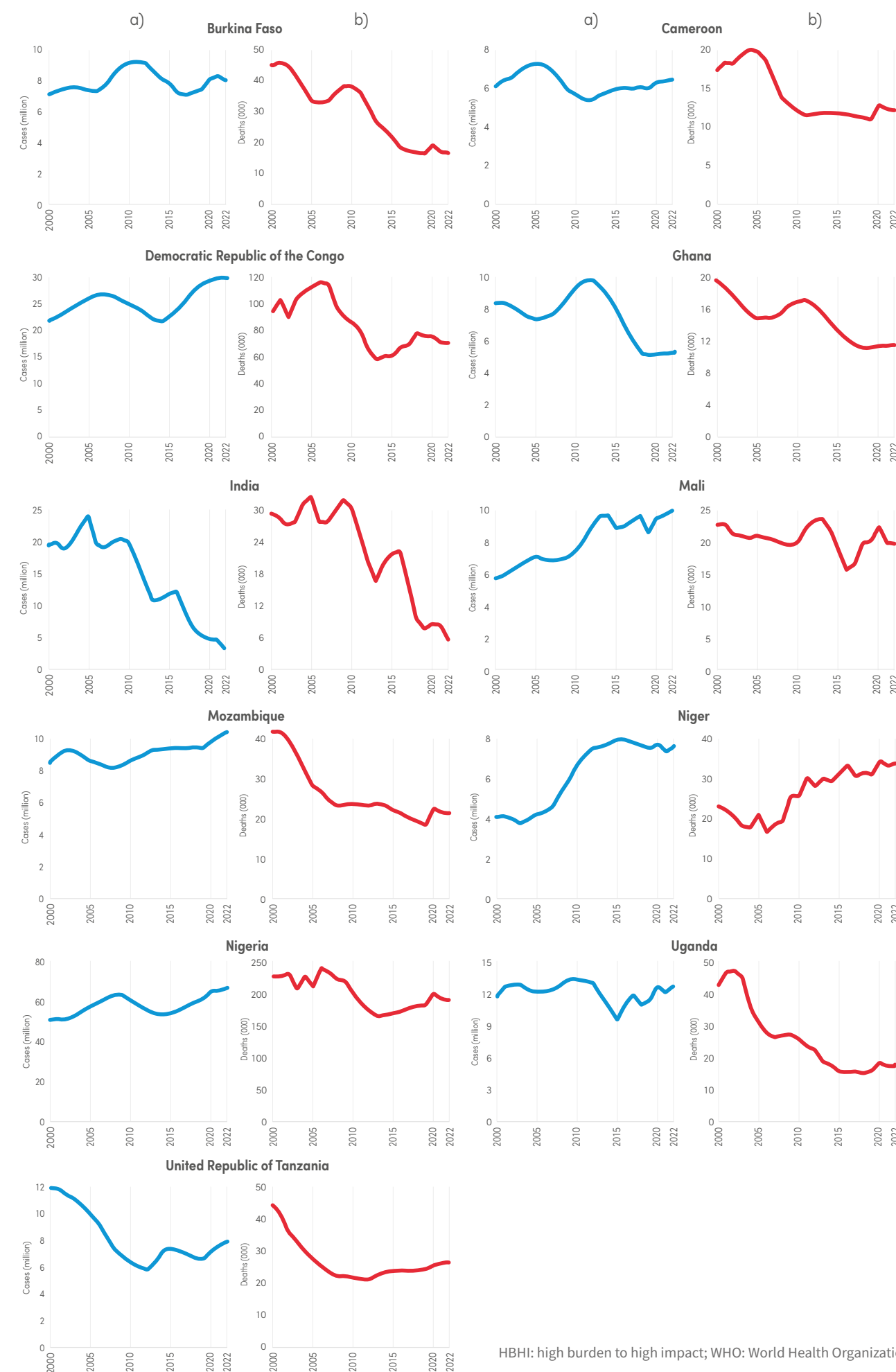
This chapter presents the progress made in reducing the burden of malaria and the consequences of disruptions during the COVID-19 pandemic in the HBHI countries.

2020 (**Fig. 5.1**). Overall, figures for malaria deaths in the HBHI countries in the period 2019–2022 were 414 000, 452 000, 430 000 and 426 000, with Nigeria accounting for 44% of all malaria deaths in the HBHI countries. In 2022, HBHI countries accounted for 73% of malaria deaths globally.

Given the observed incidence and mortality trajectories, it is unlikely that these countries will attain the GTS's target of reducing malaria incidence and mortality by 75% by 2025. The main causes for this stagnation are limited health care access, ongoing conflicts and emergencies, lingering effects of the COVID-19 pandemic on service delivery (at least until late 2022), inadequate funding and poor capacity for implementation.

Fig. 5.1.

Estimated malaria a) cases and b) deaths in the original HBHI countries, 2000–2022 Source: WHO estimates.



HBHI: high burden to high impact; WHO: World Health Organization.

5.2 Subnational tailoring support to countries

Subnational tailoring (SNT) is the use of local data and contextual information to determine the appropriate mix of interventions and strategies to be used for a given area, to achieve optimum impact on transmission and burden of disease at the strategic level or within a specific resource envelope. SNT can also be used to inform how new tools can be integrated most effectively within previously planned mixes of interventions, or for dynamic resource mobilization as additional funding opportunities become available.

SNT stems from a collective commitment to surveillance – a key pillar of the GTS (33) – and the use of local data for decision-making by malaria programmes and partners to achieve malaria elimination. It is also aligned with one of the HBHI response elements, which advocates for the use of strategic information to drive impact. This is anchored on the basic principles of good public health; that is, that health policies should be informed by the best possible evidence derived from the best available data and information.

Mixes of interventions and strategies that are considered in the local response include not only those aimed at diagnosis, treatment and prevention, but also other major programmatic and health system actions required to reach the goal of malaria elimination. The latter include actions required to strengthen the health workforce, improve access to and quality of care, strengthen surveillance systems,

achieve social and behaviour change, and expand the engagement of communities. As such, the process requires system-wide and multistakeholder participation, anchored on the broad principles of health sector priority setting. Analytically, mixed-methods approaches (qualitative and quantitative) are used – descriptive, statistical, geospatial and mathematical modelling approaches can all play a role.

The following are essential steps in the development and monitoring of prioritized malaria control and elimination programmes, as implemented under the SNT process (Fig. 5.2):

- **Step 1: Establish a national SNT team.** The team will be led by the national malaria programme (NMP) but should include other government departments, and national, regional and global partners, with consent from the NMP. This team is responsible for the entire process, from data assembly and analysis to strategy development, resource mobilization and prioritization, and implementation.
- **Step 2: Determine the criteria for tailoring interventions and strategies.** Possible interventions include LLINs, IRS, chemoprevention, diagnosis and treatment; and possible strategies include integrated community case management and the timing or number of rounds of seasonal malaria chemoprevention (SMC). The national team compiles all interventions and strategies under consideration, then develops the criteria to be used for tailoring each of them, building on WHO normative guidance and adapting to the local context as needed.

- **Step 3: Stratify malaria risk and its determinants into individual layers of information.** The various determinants – ecological, interventional, systemic, social and so on – are independently stratified at operational units of relevance and in ways that respond to the specific question at hand, based on the agreed-upon criteria from Step 2. Hence, the process of stratification depends on the specific intervention or strategy under discussion rather than the use of epidemiological metrics alone. Statistical and geospatial methods can be used to produce some of the analytical outputs required for stratification.
- **Step 4: Apply the criteria determined in Step 2 to each operational unit.** This process uses the relevant stratified layers obtained through Step 3. It identifies the areas eligible for each intervention according to the specified criteria, leading to the development of various scenarios of intervention mixes.
- **Step 5: Estimate the impact of these scenarios using mathematical models.** Depending on the outcomes of the estimations, the scenarios may be further refined at this point.
- **Step 6: Use a consensus-based approach, informed by the evidence, to select the final mix of interventions and strategies.** Once the interventions and strategies have been agreed, the strategic plan should be costed and used for resource mobilization.
- **Step 7: Use the costed strategic plan as the basis for rational prioritization of investments, to maximize impact if resources are insufficient.** This can be done once there is clarity on the available resources, and it is usually the most challenging part of the process.

Further stratification of determinants can be used to identify priority areas for one or several interventions, and additional prioritization scenarios may arise. Mathematical modelling can be helpful at this point to guide and assess the impact of the various prioritization decisions.

- **Step 8: Set aside sufficient capacity to monitor the impact of the deployed intervention packages.** This should be part of the budgeting process. Undertaking this type of monitoring means that the response can be honed over time and resources can be re-prioritized as needed.

Since 2018, WHO/GMP and WHO regional and country offices have worked collaboratively to provide support to the NMPs of more than 30 malaria endemic countries (Fig. 5.3) in the implementation of the SNT process. The process has been used to inform single or multiple intervention strategic planning, resource mobilization efforts, funding requests, budget negotiations or the optimization of intervention implementation. The support was provided in close collaboration with local and global analytical and implementing partners to NMPs, and included the engagement of funders and other relevant stakeholders. The application of SNT has sparked the integration of data as part of countries' regular decision-making processes; in turn, this has strengthened efforts to improve the collection, review and quality of data on a regular basis. It has also revealed variations in the capacity of countries to fully implement the SNT process locally; any gaps in capacity need to be collectively addressed by countries, their partners and donors.

Fig. 5.2. Essential steps for the development and monitoring of prioritized malaria control and elimination programmes as implemented under the SNT process *Source: WHO GMP SIR team.*

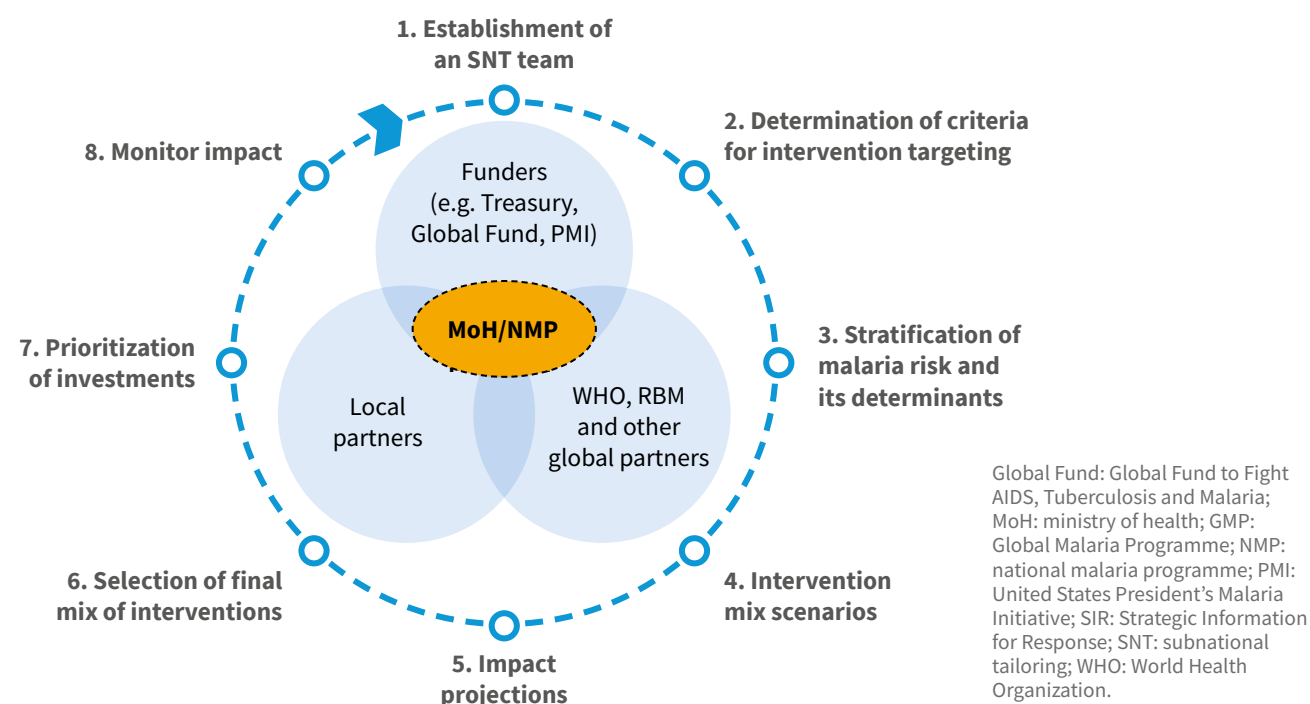
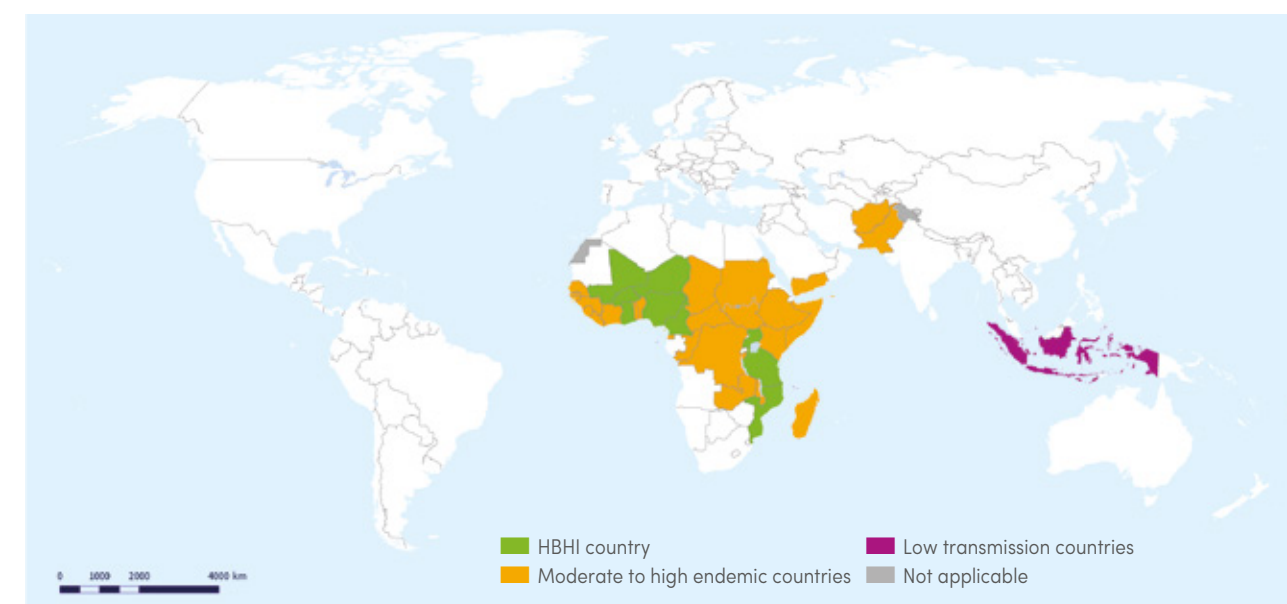


Fig. 5.3. Countries that conducted SNT and related analyses between 2018 and 2023 with support from WHO and technical partners and funders *Source: WHO GMP SIR team.*



GMP: Global Malaria Programme; HBHI: high burden to high impact; SIR: Strategic Information for Response; SNT: subnational tailoring; WHO: World Health Organization.

Investments in malaria programmes and research

In this chapter on investments in malaria programmes and research: **Section 6.1** presents the most up-to-date funding trends for malaria control and elimination, by source and channel of funding, for the periods 2000–2022 or 2010–2022 (where data are available), both globally and for major country groupings; **Section 6.2** presents the latest trends in real gross domestic product (GDP) growth from 2020–2022, and out-of-pocket expenditure as a percentage of current health expenditure in 2010 and 2020; and **Section 6.3** presents investments in malaria-related R&D for the period 2013–2022.

New initiatives and funding mechanisms for malaria programmes and research have increased in number since the 1990s. In 1998, the RBM Partnership to End Malaria was introduced, followed by the Bill & Melinda Gates Foundation in 2000, the Global Fund in 2001, the United States President's Malaria Initiative in 2005 and Unitaid in 2006. The SDGs were adopted in 2015, with malaria included in SDG Goal 3: Ensure healthy lives and promote well-being for all at all ages (34). WHO also launched the GTS in 2015 (2). These initiatives, combined with bilateral and multilateral investments and domestic spending, have been crucial in elevating awareness about malaria and establishing global benchmarks for the funding necessary to ensure that resources for malaria interventions are adequate.

The 2021 GTS update (33) estimated the funding required to achieve key targets in 2025 and 2030. To reach over 80% coverage of currently available interventions, investment

in malaria (both international and domestic) needs to increase substantially above the annual spending of about US\$ 3.3 billion over the past 5 years. Total annual resources needed were estimated at US\$ 6.8 billion in 2020, increasing by US\$ 0.5 billion per year to achieve the estimated US\$ 9.3 billion required by 2025, and then by US\$ 0.2 billion per year to reach US\$ 10.3 billion by 2030 (33). Additionally, funding of US\$ 8.5 billion is projected to be needed for R&D during the period 2021–2030, representing an average annual investment of US\$ 851 million (33). Total funding for malaria control and elimination as well as funding required for R&D continues to fall short of the GTS targets. Funding for malaria control and elimination in 2022 represents less than half of all funding required by 2025, and funding for R&D in 2022 was US\$ 248 million short of the annual target (**Fig. 6.1**). Increases in both domestic and international funding for malaria are urgently required.

6.1 Funding trends for malaria control and elimination

In 2022, 91 countries were included in the analysis of total funding for malaria control and elimination. The total of 91 countries comprised 84 endemic and seven non-endemic countries, three of which have been declared malaria free in the past 2 years. The seven non-endemic countries are included in this section because they contribute to important trends over the past 2 decades, and some of these countries continue to receive support for malaria. Throughout this section, the 91 countries are referred to as the “malaria endemic countries”.

Total funding in 2022 was estimated at US\$ 4.1 billion, marking a notable increase from US\$ 3.5 billion in 2021, US\$ 3.3 billion in 2020 and US\$ 3.0 billion in 2019. These figures are given in current year US dollars for the purposes

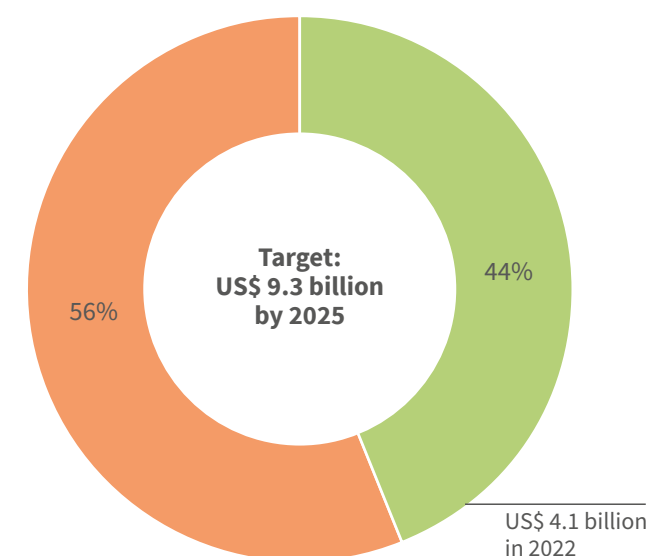
of comparison with previous world malaria reports. In the rest of the section, funding trends are reported in constant 2022 US\$, unless stated otherwise.

The amount invested in 2022 continues to fall short of the estimated US\$ 7.8 billion required globally to stay on track for the GTS targets. Moreover, the funding gap between the amount invested and the resources needed has continued to widen significantly, particularly over the past 5 years. This gap increased from US\$ 2.3 billion in 2018 to US\$ 3.7 billion in 2022, indicating that only 52% of targeted funding for 2022 was attained. Out-of-pocket expenditures on malaria are not included in the GTS targets; therefore, they are not included in the analysis on funding for malaria.

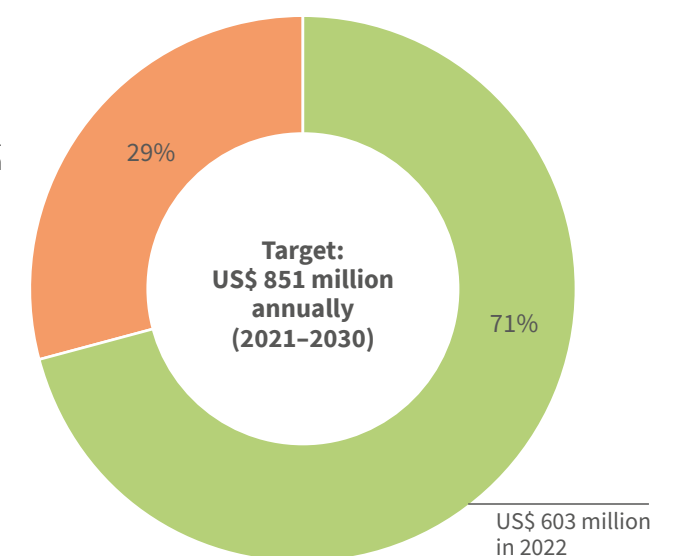
Fig. 6.1.

GTS funding targets for 2025 and 2030 (current 2022 US\$) Sources: GTS (2) and Policy Cures (35).

Funding target for malaria control and elimination



Annual funding target for malaria research and development



GTS: Global technical strategy for malaria 2016–2030.



Each year, the world malaria report describes funding that has been adjusted for inflation, and potential changes to data in cases where new information has become available from countries, donors and institutions. Therefore, the figures presented in this chapter reflect constant 2022 US\$ values and potential updates, which may vary from figures reported in previous reports. The sources of funding for malaria control and elimination are summarized in **Table 6.1**.

To assess the share of international funding by source of funds, malaria-related annual funding through multilateral

agencies was estimated from donors’ contributions to the Global Fund for 2010–2022, and from contributions from the Organisation for Economic Co-operation and Development (OECD) creditor reporting system (CRS) for 2011–2021. Annual OECD CRS funding data for 2010 and 2022 were estimated using 2011 and 2021 reported estimates, respectively. In addition, contributions from malaria endemic countries to multilateral agencies were allocated to governments of endemic countries for the years 2010–2022.

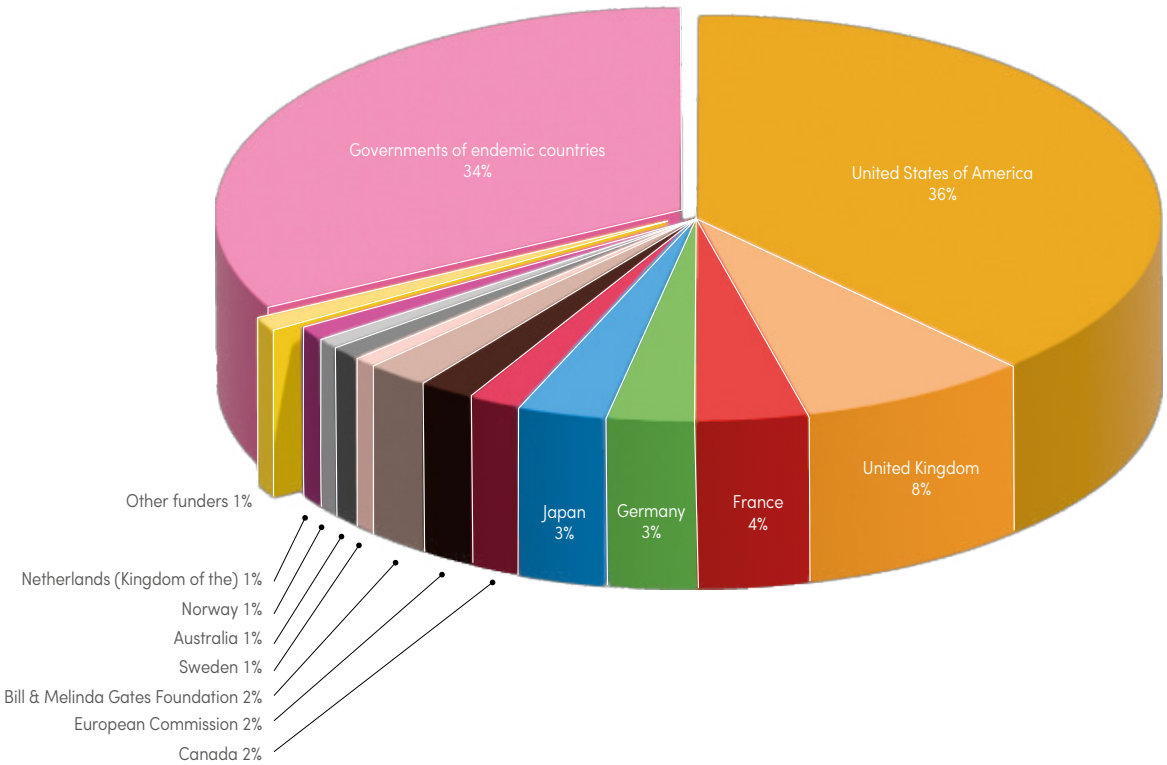
From 2010 to 2022, the funding distribution exhibited a consistent trend, mirroring the same breakdown as in previous years. International sources contributed 66%, and domestic contributions accounted for the remaining 34%, a pattern that held true from 2010 through 2021. However, in 2022, there was a shift in funding distribution, with international funding contributing 62% and the governments of malaria endemic countries increasing their share to 38% (a rise in domestic funding compared with the 33% reported in 2021).

Since 2010, the largest share of the contributions from international sources has come from the United States of America (USA), the United Kingdom of Great Britain and Northern Ireland (United Kingdom), France, Germany and Japan; other donors made contributions as shown in **Fig. 6.2**.

Table 6.1. Sources of data on funding for malaria		
Domestic funding	International funding	
	Multilateral	Bilateral
NMP reported domestic budget or expenditures when available, or estimates from WHO/GMP 2000–2022 Patient care delivery estimates, 2010–2022 from WHO/GMP	Donor contributions to the Global Fund 2010–2022 sourced from the Global Fund and WHO/GMP estimates	United Kingdom final aid spend 2017–2022 from the Foreign, Commonwealth and Development Office
	Global Fund disbursements to malaria endemic countries 2003–2022, sourced from the Global Fund	United States funding for malaria 2001–2022, by agency and recipient country sourced from KFF (formerly Kaiser Family Foundation)
	Donor disbursements to multilateral funders 2011–2021 sourced from OECD members’ total use of the multilateral system, and WHO/GMP estimates for 2010 and 2022	Donor disbursement to malaria endemic countries from OECD CRS (2002–2021, except for United Kingdom 2007–2016) and WHO/GMP estimates for 2022

CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO/GMP: World Health Organization Global Malaria Programme.

Fig. 6.2.
Funding for malaria control and elimination, 2010–2022 (% of total funding), by source of funds (constant 2022 US\$) Sources: US Government’s ForeignAssistance.gov, Global Fund, NMP reports, OECD CRS database, United Kingdom Department for International Development, WHO estimates and World Bank DataBank.



CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization.

Note: The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.



Fig. 6.3 shows the breakdown of total funding for each donor per year from 2010 to 2022. Most of the US\$ 4.1 billion invested in 2022 (nearly US\$ 2.6 billion) came from international funders. The highest contribution stemmed from the government of the USA – over US\$ 1.5 billion (US\$ 1.3 billion in 2021) in planned bilateral funding and malaria-adjusted share of multilateral contributions. However, the increase from the USA was largely due to the timing of disbursements to the Global Fund, rather than an actual increase in commitments in 2022. This was followed by bilateral and multilateral disbursements of over US\$ 0.4 billion from France, Germany and the United Kingdom combined; contributions of about US\$ 0.1 billion each from Australia, Canada and Japan; and a combined US\$ 0.4 billion from other countries that are members of the Development Assistance Committee (DAC) and from private sector contributors. Governments of malaria endemic countries contributed more than a third of total funding in 2022, with investments of over US\$ 1.5 billion, a significant increase from the US\$ 1.2 billion invested in 2021. Most of this increase stemmed from a US\$ 0.3 billion influx of domestic investments by the WHO African Region made

since 2021. Of the US\$ 1.5 billion, nearly US\$ 0.4 billion was spent on malaria case management in the public sector and over US\$ 1.1 billion on other malaria control activities.

To analyse malaria investment since 2000, international bilateral funding data were obtained from several sources, although the availability of historical data varied, depending on the donor. From the USA, data on total annual planned funding from the US Centers for Disease Control and Prevention (CDC), US Department of Defense (DoD) and United States Agency for International Development (USAID) were available from 2001 to 2022; planned country-level USAID data were available starting in 2006. Data on annual disbursements by the Global Fund to malaria endemic countries were available from 2003 to 2022. For the government of the United Kingdom, disbursement data were obtained through the OECD CRS on aid activity from 2007 to 2016; however, from 2017 to 2022, disbursement data were sourced from *Statistics on International Development: final UK aid spend 2022* (36). Overall, funding reported in this section for the United Kingdom has declined since 2017 because the estimates

based on the “final UK aid spend” do not capture all the spending that may affect malaria outcomes. The United Kingdom supports malaria control and elimination through a broad range of interventions (e.g. support to overall health systems in malaria endemic countries, to R&D and contributions to the Global Fund) that are not included in this estimate.

For all other donors, disbursement data were obtained from the OECD CRS database for the period 2002–2021, with 2022 estimates being derived from 2021 figures. For all international bilateral funding data, the country recipient has been labelled as “unspecified” for all years where country-specific data are not available. For years where no data are available for a particular funder, no imputation was conducted; hence, the trends presented in **Fig. 6.3** to **Fig. 6.8** should be interpreted carefully, particularly for the years preceding 2010.

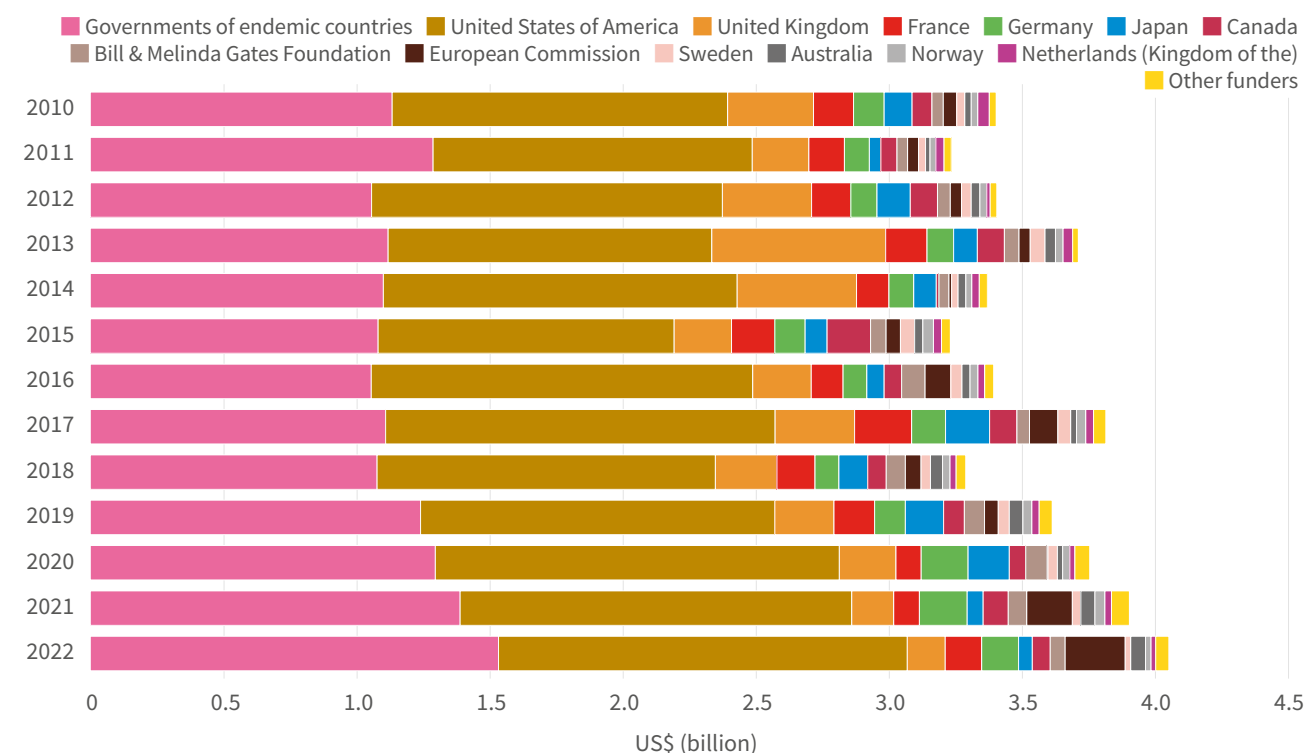
Contributions from governments of endemic countries were estimated as the sum of contributions reported by NMPs for the relevant year plus the estimated costs of patient care delivery services at public health facilities. From 2000 to

2022, where government expenditures were available, they were used to estimate contributions (if expenditures were unavailable, then government budgets or estimates were used). Patient care delivery costs were derived using unit cost estimates from WHO CHOosing Interventions that are Cost-Effective (WHO-CHOICE) (37). Where possible, patient care delivery costs per country were included for the years 2010–2022 because no unit cost estimates are available for the years before 2010.

Of the US\$ 4.1 billion invested in 2022, over US\$ 1.5 billion (38%) was contributed by governments of endemic countries. Of the total investments, nearly US\$ 1.6 billion (39%) was channelled through the Global Fund. Compared with previous years, the Global Fund’s disbursements to malaria endemic countries increased by about US\$ 0.1 billion since 2021 and US\$ 0.5 billion since 2018. Planned funding from the USA was US\$ 0.8 billion in 2022, essentially unchanged from the previous year. In 2022, the United Kingdom remained the second largest bilateral funder, alongside the World Bank and other DAC members (**Fig. 6.4**).

Fig. 6.3.

Funding for malaria control and elimination, 2010–2022, by source of funds (constant 2022 US\$) Sources: US Government’s ForeignAssistance.gov, United Kingdom Foreign, Commonwealth and Development Office, Global Fund, NMP reports, OECD CRS database, the World Bank DataBank and WHO estimates.

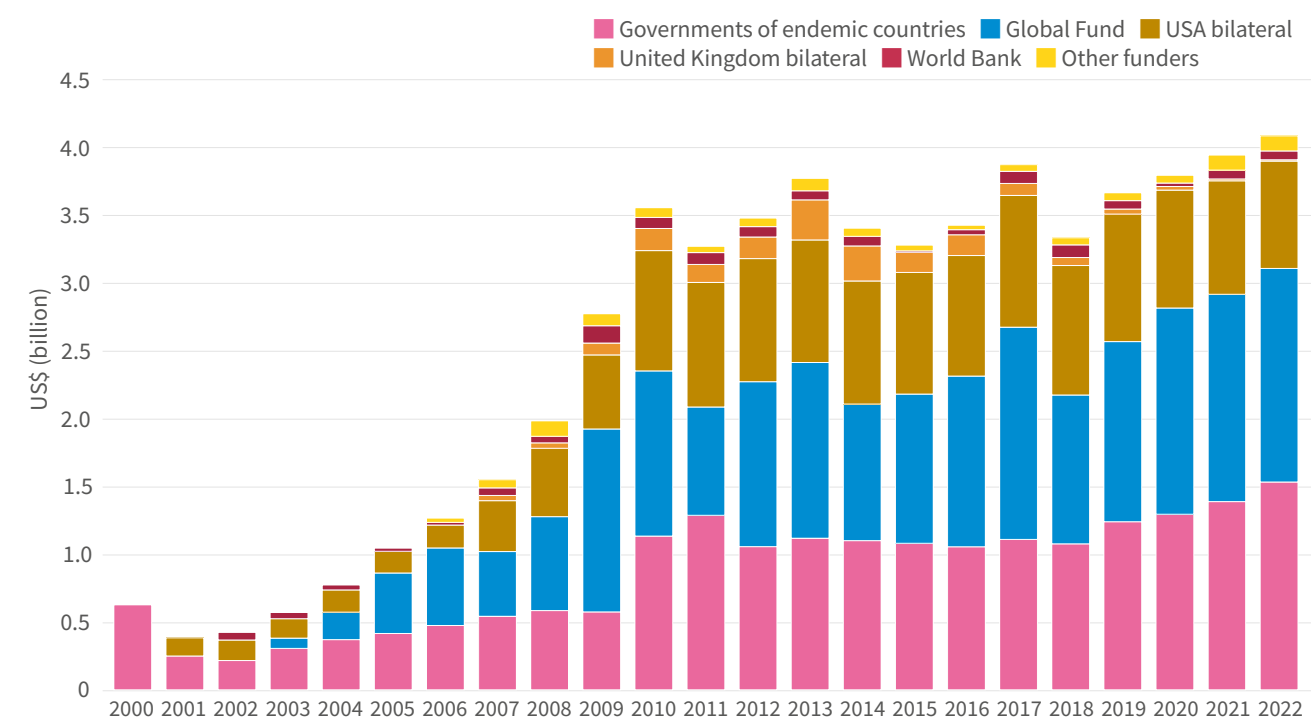


CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization.

Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.4.

Funding for malaria control and elimination, 2000–2022, by channel (constant 2022 US\$) Sources: US Government’s ForeignAssistance.gov, Global Fund, NMP reports, OECD CRS database, United Kingdom Department for International Development, WHO estimates and World Bank DataBank.



CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; USA: United States of America; WHO: World Health Organization.

Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.



Fig. 6.5 shows the substantial variation across income groups (as defined by the World Bank classifications published in July 2023) (38) in the share of funding received by countries within each income group from domestic and international sources. The World Bank's classifications by income group vary from year to year. In 2022, the low-income group category comprised 25 countries representing over 90% of global malaria cases and deaths. The low-income countries accounted for 44% of total malaria funding in 2022, which was similar to 2021. These countries have experienced a notable increase in funding since 2000; also, since 2010 they have had an overall increase in funding of more than 50% from both international and domestic sources, and are the group that receive the most funding of the different income categories. In this low-income group, 70% of the funding came from international sources and 30% from domestic sources. The share in funding that came from domestic sources rose from 22% in 2021 to 30% in 2022, reflecting an increase in domestic funding in the WHO African Region.

The 40 lower-middle-income countries accounted for 43% of total funding in 2022, with international sources accounting

for 57% of funding and domestic for 43%; this was similar to 2021, with a slight increase in international funding and a slight decrease in domestic funding. In contrast, the upper-middle-income group, comprising 20 countries and accounting for 6% of total funding in 2022, received 13% of their malaria funding from international sources and 87% from domestic public funding. Funding from domestic sources increased significantly in 2022, up from 4% in 2021. Finally, the four high-income countries accounted for 1% of total malaria funding, with 98% stemming from domestic sources compared with 100% in the previous 2 years. Malaria funding to regions with no geographical information on recipients and one country that was not classified into an income group this year represented the remaining 6% of malaria funding in 2022.

The assessment of funding for malaria control and elimination per capita by domestic and international sources highlights the variation in average funding per person at risk from year to year, within each WHO region. The calculation for the population at risk is further explained in **Annex 1**. The five graphs in **Fig. 6.6** depict the trends across the different regions in funding per person at risk.

The WHO African Region had the highest funding per person at risk in 2022, with international expenditure per capita of US\$ 2.00 and domestic expenditure per capita over US\$ 1.10, having more than doubled from US\$ 0.50 in 2010. However, the trend has remained relatively stable since 2010, when the total funding per person at risk was just below US\$ 3.00 per capita. Each of the other WHO regions has experienced sharp decreases in the total funding per capita since 2010.

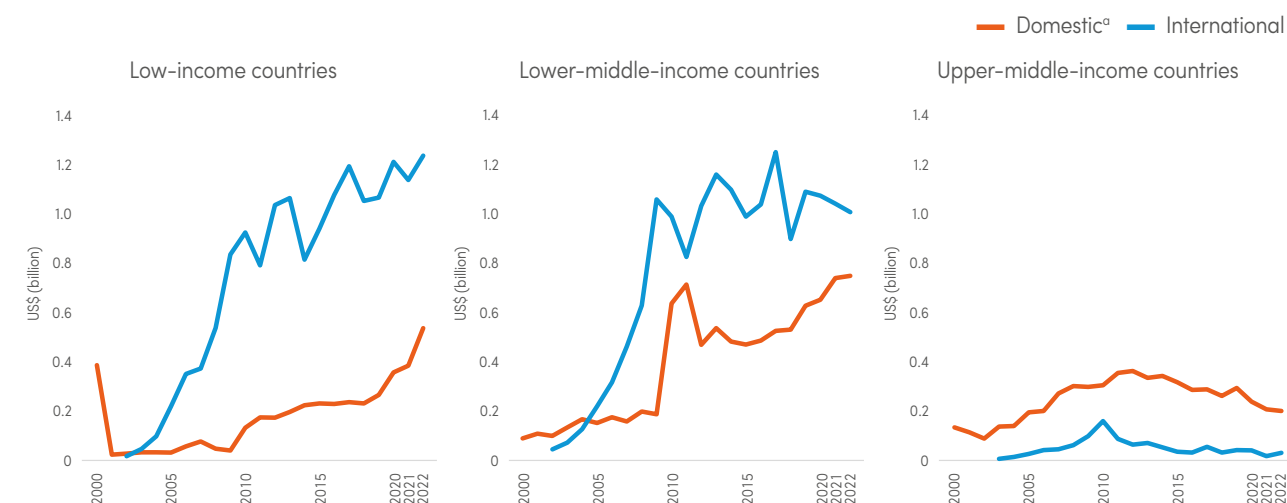
In the WHO Region of the Americas, since 2010, there has been an overall trend of a 50% decrease in total funding; during this period, international funding sources have remained relatively stable but domestic sources have reduced by over 50%. This trend was also observed in the WHO South-East Asia and Western Pacific regions; in both these regions, in 2022, funding per person at risk dropped to one third of the reported funding in 2010 – in both cases, from about US\$ 0.30 to US\$ 0.10 per person at risk – with domestic contributions being significantly higher than international contributions (which were essentially US\$ 0). The WHO Western Pacific Region experienced a

40% decrease in funding per person at risk in the past 2 years alone.

In the WHO Eastern Mediterranean Region, overall funding per person at risk has dropped slightly since 2010, with funding from domestic sources to international sources converging in 2022. Since 2021, a larger change has occurred, with the total funding per person at risk dropping by over one third – a significant fall over a single year. Most of the WHO regions, apart from the African Region, have shown volatility in overall funding over the past decade; also, they experienced lower total funding per person at risk in 2022 than in 2010, with similar trends also seen in comparison with 2021 (except for the WHO African and Eastern Mediterranean regions). Several countries in the regions that have been part of the E-2020 initiative (and now the E-2025 initiative) saw a decline in malaria funding; typically, these countries have higher economic growth than the highest burden countries and may be able to rely more sustainably on domestic, rather than international, funding throughout the elimination and certification process.

Fig. 6.5.

Funding for malaria control and elimination, 2000–2022, by World Bank 2023 income group and source of funding (constant 2022 US\$) Sources: US Government's ForeignAssistance.gov, Global Fund, NMP reports, OECD CRS database, United Kingdom Department for International Development, WHO estimates and World Bank DataBank.



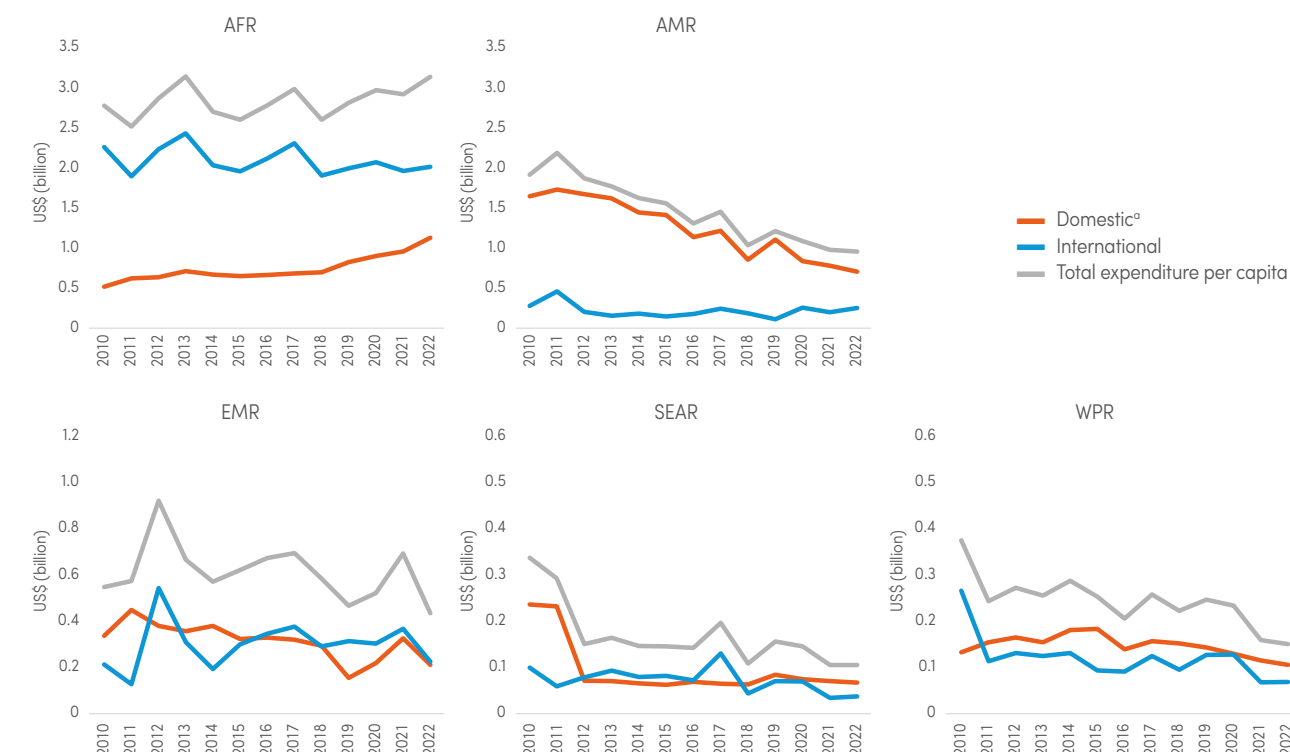
CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization.

^a Excludes out-of-pocket spending by households.

Note: The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.6.

Funding for malaria control and elimination per person at risk, 2010–2022, by WHO region (constant 2022 US\$) Sources: US Government's ForeignAssistance.gov, NMP reports, OECD CRS database, United Kingdom Department for International Development, WHO estimates and World Bank DataBank.



AFR: WHO African Region; AMR: WHO Region of the Americas; CRS: creditor reporting system; EMR: WHO Eastern Mediterranean Region; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; SEAR: WHO South-East Asia Region; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization; WPR: Western Pacific Region.

^a Excludes out-of-pocket spending by households.

Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.



A broader review of funding per person at risk on a global scale reveals a year-to-year increase, from US\$ 0.80 per person in 2020 to US\$ 1.00 in 2022; however, this amount is still only half of that needed to align with the GTS target of nearly US\$ 2.00 per person at risk. Comparing the projected at-risk population in 2025 and 2030 with the projected GTS targeted funds indicates that this gap will continue to widen, requiring a total investment per person at risk of over US\$ 2.20 for 2025 and US\$ 2.30 for 2030.

Fig. 6.7 provides a visual representation of the total funding per person at risk in previous years and the forecasted projections for 2025 and 2030. These projections are based on estimates from total funding in malaria control and elimination, and the population at risk, from 2020 to 2022. The targets stem from the 2015 GTS (2) and the 2021 update (33). The figure depicts the total funding and the GTS targeted funding required independent of the other; hence, it should not be interpreted as a combined total of both

sources. For instance, based on forecasted projections for 2030, there will only be US\$ 1.60 per person at risk, whereas the GTS sets out a target of US\$ 2.30 per person for that year. Thus, if the projected funding remains on the current trajectory, only 70% of the total funding per person at risk required will be achieved.

In the assessment of funding for malaria control and elimination by WHO region, more than three quarters

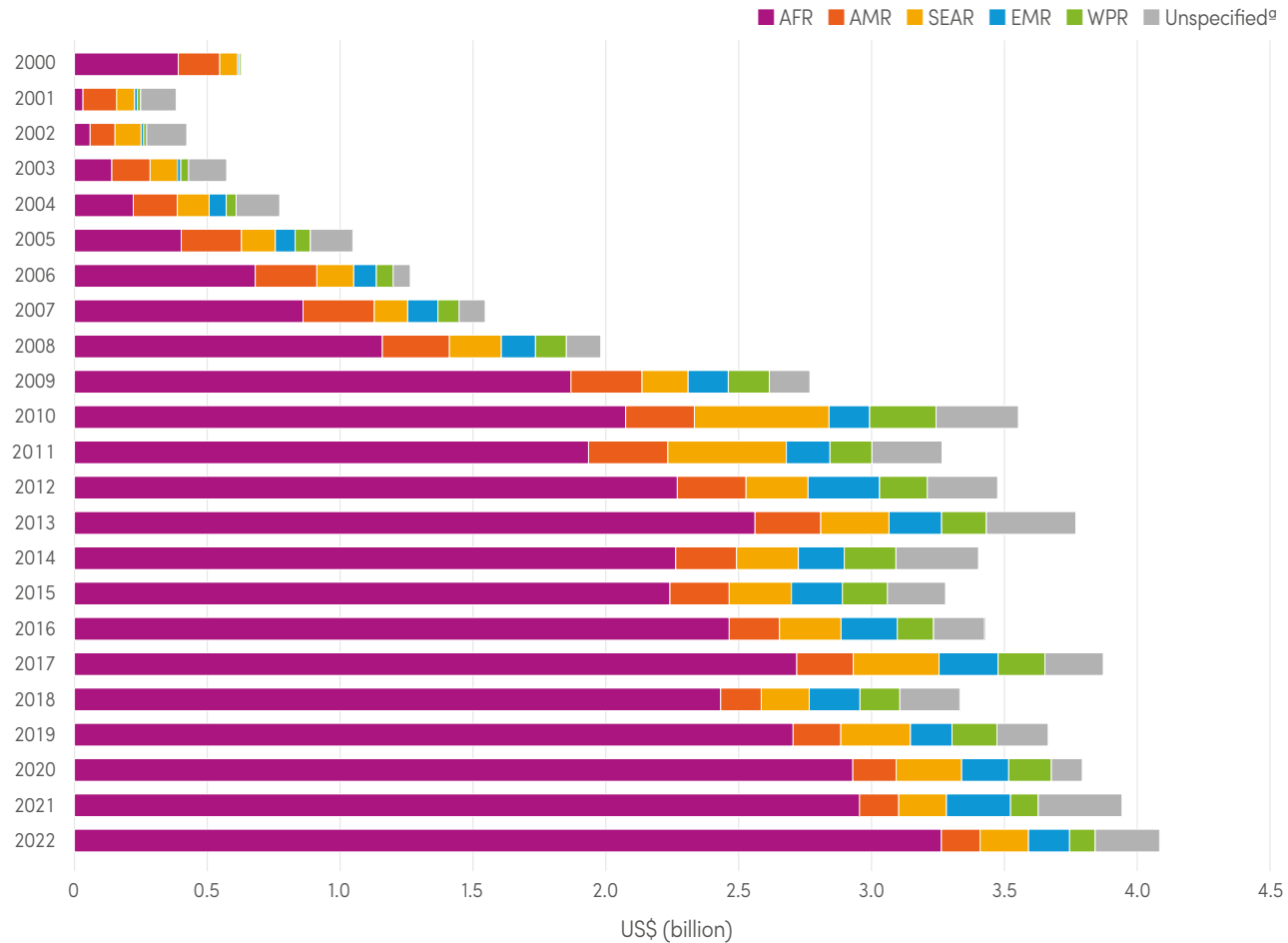
(80%) of the US\$ 4.1 billion invested in 2022 benefited the WHO African Region, an increase from 78% in 2021. Of the remaining funding, 4% each went to the WHO regions of the Eastern Mediterranean, South-East Asia and the Americas, and 2% to the Western Pacific. The remaining 6% of total funding in 2022 was allocated to unspecified regions where no geographical information on recipients was available (**Fig. 6.8**).

Fig. 6.7.
Funding for malaria control and elimination per person at risk, globally, and the 2025 and 2030 targets (current 2022 US\$) Sources: GTS (2, 33) and WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization.
Note: The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.8.
Funding for malaria control and elimination, 2000–2022, by WHO region (constant 2022 US\$) Sources: US Government’s ForeignAssistance.gov, United Kingdom Department for International Development, Global Fund, NMP reports, OECD CRS database, World Bank DataBank and WHO estimates.



AFR: WHO African Region; AMR: WHO Region of the Americas; CRS: creditor reporting system; EMR: WHO Eastern Mediterranean Region; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; SEAR: WHO South-East Asia Region; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization; WPR: WHO Western Pacific Region.
a “Unspecified” refers to funding flows, with no information on the geographical localization of their recipients.
Note: The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

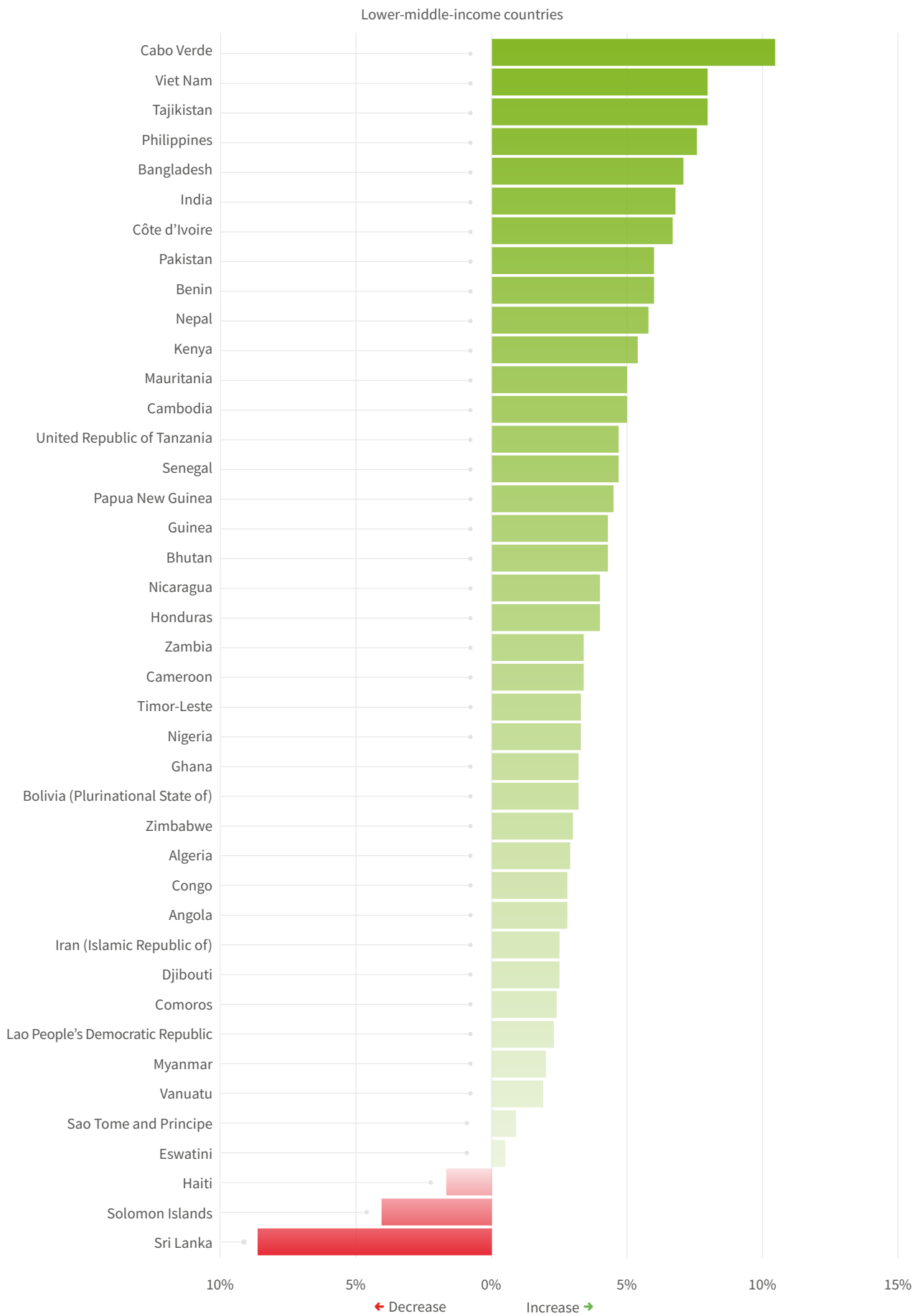
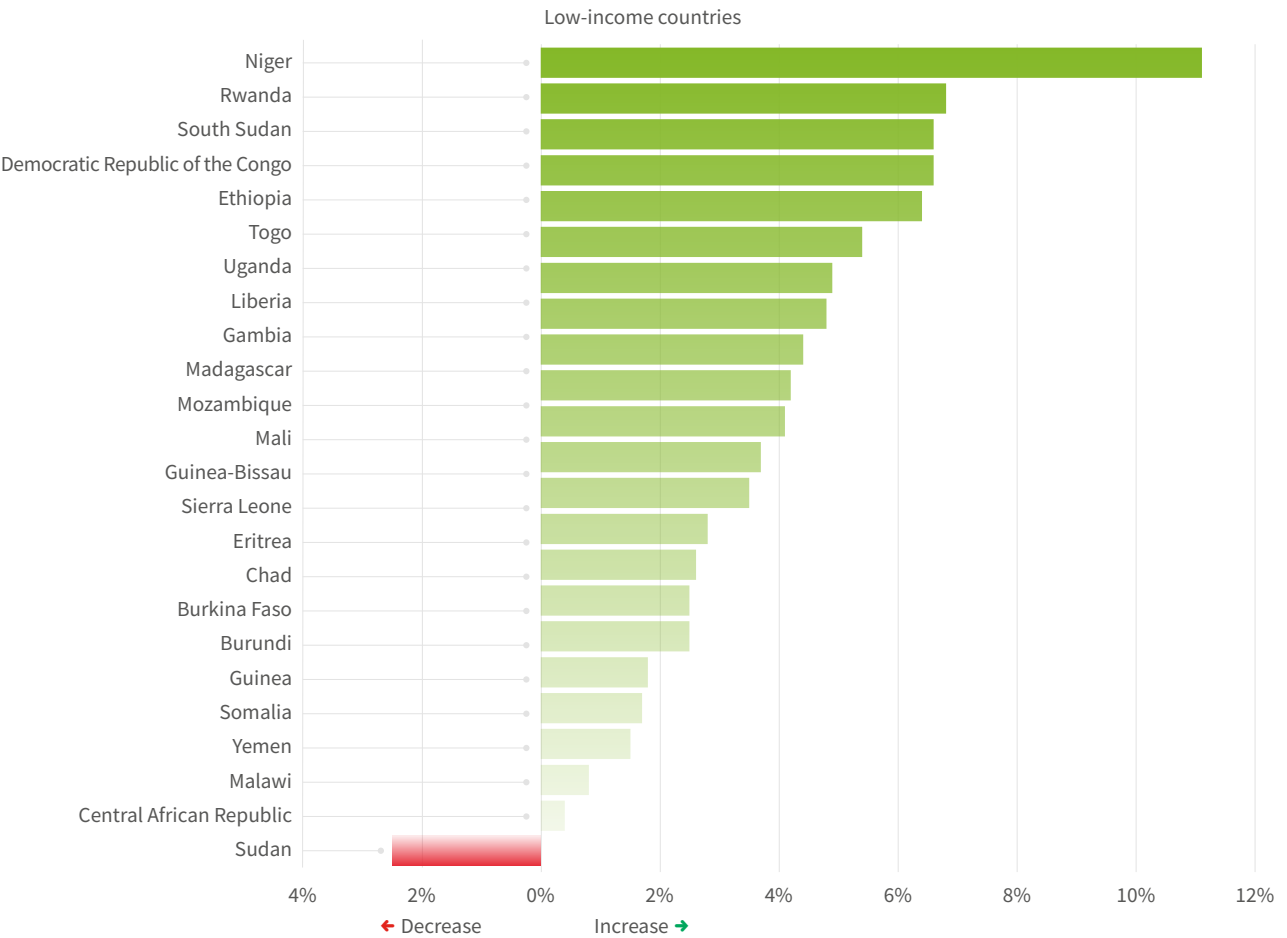


6.2 Global trends in real GDP growth and out-of-pocket health expenditure

Many nations have experienced economic shocks in their real GDP because of the COVID-19 pandemic and other global crises, including emerging infectious diseases (e.g. mpox), climate-related events and conflict. This is evident in the variation in real GDP across countries since the beginning of the pandemic. According to the 2022 *World economic situation and prospects* report from the UN Department of Economic and Social Affairs (39), the global economy showed signs of recovery in 2021, experiencing a growth rate of 5.5% – the highest in over 4 decades – following a 3.4% contraction in 2020. In 2022, there was a rebound effect, with a significant increase in real GDP growth observed and most countries experiencing growth compared with previous years. However, these are global outcomes and projections that do not capture differences across countries. In 2020, 70% of the malaria endemic countries categorized as low- and middle-income countries (LMIC) experienced a contraction in their annual real GDP (40). Of these countries, 34 shrunk by more than 1% (half of which came from the WHO African Region), as defined in the International

Monetary Fund (IMF) data mapper on real GDP annual growth percentage (40). In 2021, the proportion of countries that experienced a shock dropped slightly to 64%, with contractions ranging from 1% to 18%; in 2022, only four of the LMIC analysed experienced a shock (ranging from 1% to 9%) (**Fig. 6.9**), demonstrating that there was an upswing in economic growth worldwide when compared with the period during the pandemic. However, it is anticipated that high-income nations and other international funders will maintain their focus on COVID-19 efforts through 2024 (41). Although there have been significant economic advances, real GDP growth does not account for shifts in income distribution within a country, nor does it indicate whether a country's growth rate is sustainable. Hence, a high GDP growth rate does not necessarily imply an equitable distribution of well-being among the population. This is underscored by the fact that the countries bearing the heaviest disease burden tend to be LMIC, where malaria has the most significant impact.

Fig. 6.9.
Real GDP growth annual per cent change by World Bank income classification (constant 2022 US\$) Sources: IMF data mapper (40) and World Bank DataBank (38).





There is a continued shortfall in the funding necessary for achieving specific targets. Although countries have experienced an improvement in real GDP growth after the easing of the pandemic, the funding gap for individuals at risk of malaria is expanding annually and is expected to widen even further in the future. It is crucial to highlight that this funding gap does not take into consideration the significant financial strain that malaria puts on households, particularly those pronounced in LMIC, where the burden of malaria is most pronounced.

Malaria patients and their households experience out-of-pocket spending, funded by their income, savings and loans. This includes both formal and informal payments made at the time of using any health good or service, delivered by any type of provider; for any type of care; for

any kind of disease, illness or health condition; and in any type of setting. However, out-of-pocket spending excludes any per-payments (e.g. taxes, contributions or premiums), reimbursements from a third party, indirect expenses (e.g. transportation) and the opportunity cost of seeking care (e.g. lost income or missed schooling). **Fig. 6.10a-b** give the share of out-of-pocket health expenditure of total current health expenditure for each country in 2010 and 2020 (the most recent year with available data).

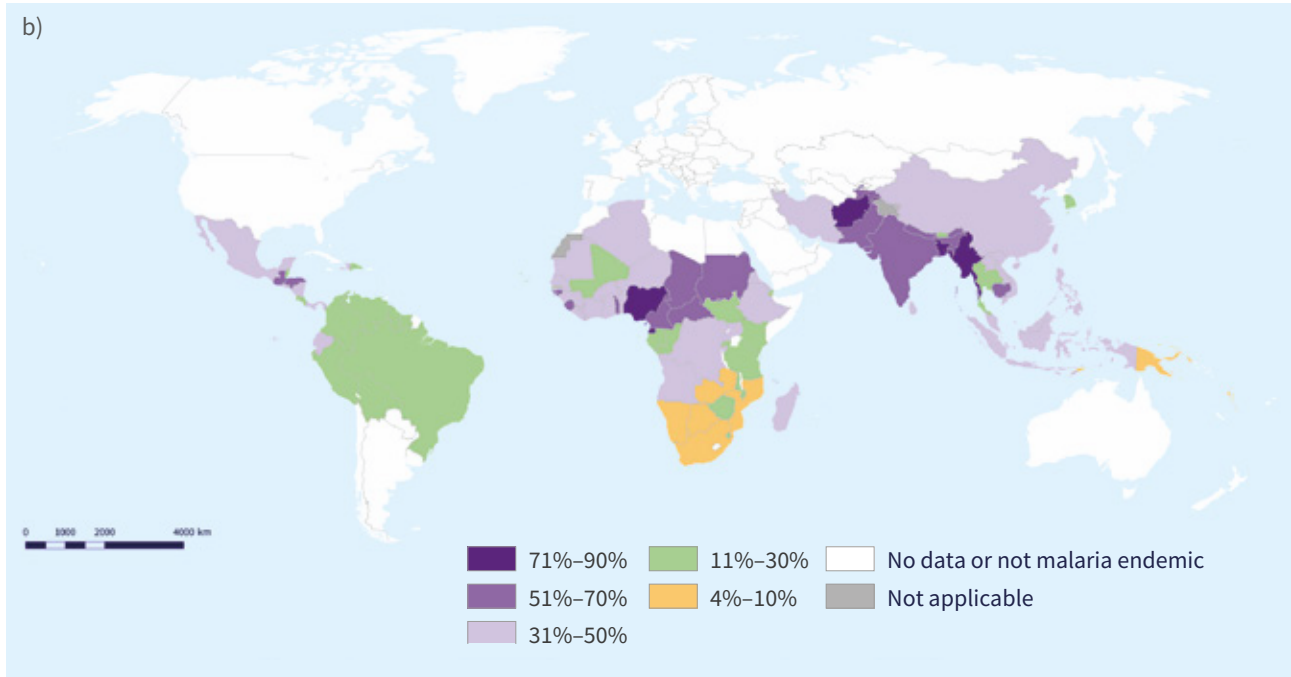
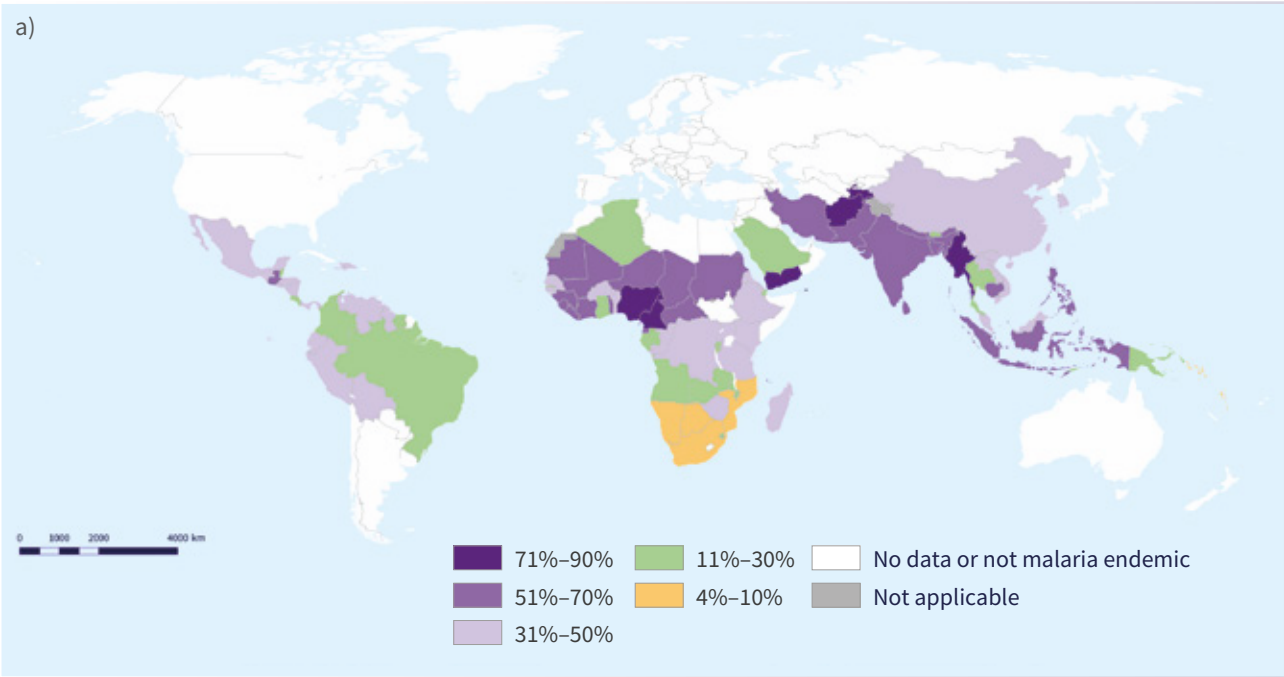
SDG Target 3.8 (42) sets out to achieve universal health coverage, including financial risk protection, access to quality essential health care services, and access to safe, effective, quality and affordable essential medicines and vaccines for all. Progress in health services coverage, as tracked by SDG Indicator 3.8.1, decelerated and

stagnated between 2019 and 2021, and in 2021, in total, 4.5 billion people were not fully covered by essential health services (43). Catastrophic out-of-pocket health spending (SDG Indicator 3.8.2) – defined as out-of-pocket health spending exceeding 10% or 25% of a household budget worsened continuously over time. Such spending reduces households’ abilities to consume other essential goods and services. In 2019, the proportion of the global population with out-of-pocket health spending exceeding 10% of the household budget surpassed 1 billion people (43) and 344 million people were put into extreme poverty due to out-of-pocket health spending. Financial protection is undermined when there is a heavy reliance on out-of-pocket health spending to fund health care use, and this can be alleviated by pre-paid pooled compulsory contributions

(43). Large inequalities persist, with higher service coverage observed among those living in richer households and urban areas, and among those with more education (43).

Malaria is a leading cause of health care spending in endemic and high-burden countries (44); without adequate financial protection, the costs involved may be sufficiently high to affect an individual’s decision to seek care (e.g. an individual may forgo care altogether or seek it from less qualified providers) (45). Elevated levels of out-of-pocket health care spending can result in reduced access to health care, heightened poverty levels and increased socioeconomic disparities – factors that further deepen the health and socioeconomic burden of malaria.

Fig. 6.10.
Out-of-pocket health expenditure as a percentage of total current health expenditure in a) 2010 and b) 2020
Source: *The Global Health Observatory* (46).





6.3 Investments in malaria-related R&D

6.3.1 Overarching trends

Global funding for basic malaria R&D dropped to US\$ 603 million in 2022 (**Fig. 6.11**). This represented its steepest fall yet – down more than 10% (–US\$ 73 million) from 2021 – leaving funding at its lowest recorded level in the past 15 years. However, about 8% of this decline reflects constant nominal funding in the face of the high global inflation experienced in 2022. The approach used here, of converting dollar amounts using headline inflation, may slightly overstate the short-term increase in R&D costs, specifically, which the US National Institutes of Health (NIH) estimates was closer to 5%.

Funding for R&D targets three separate categories: *P. vivax*, *P. falciparum* or a third residual category of “multiple/other malaria species”, with the latter primarily made up of R&D targeting both *P. vivax* and *P. falciparum*, but also R&D that may be intended for a particular species without enough evidence to make a clear assessment. In 2021, the fall in funding was driven by a significant decrease in R&D targeting multiple/other malaria species, while both *P. vivax*- and *P. falciparum*-specific R&D rose. In contrast, the fall in 2022

was spread more evenly across all three categories, with funding for *P. falciparum* falling 9% to US\$ 270 million (45% of the total), funding for *P. vivax* falling by 12% to US\$ 52 million (8.6%) and funding for multiple/other malaria species falling by 12% to US\$ 281 million (47%).

Overall funding for vaccines fell for the fifth consecutive year to a record low of US\$ 106 million in 2022 (a fall of a further US\$ 16 million, –13%) (**Fig. 6.12**). The Bill & Melinda Gates Foundation (BMGF) accounted for over 30% of this fall, with the foundation’s funding for PATH’s Malaria Vaccine Initiative having decreased over the same 5-year period, from US\$ 36 million in 2018 to US\$ 4.5 million in 2022 (reflecting declining funding for the clinical development of fractional-dose RTS,S for *P. falciparum* elimination). Alongside this change in funding from the BMGF, there were falls in funding from industry (down US\$ 3.6 million, –12%) and the European Commission (down US\$ 4.5 million, –79%), which concluded funding for two multiyear projects, OptiMalVax and MultiViVax.

Funding for basic research declined by one fifth to US\$ 155 million (down US\$ 38 million) between 2021

and 2022. Over 15% of this fall was artefactual, partially due to the absence of 2022 funding data from the DFG, German Research Foundation. However, there were also real reductions in basic research funding from multiple organizations, in particular from the US NIH (down US\$ 12 million, –11%), which remained the highest funder of malaria R&D.

Drugs continued to receive the largest share of funding, at US\$ 235 million (39% of total funding), despite a decrease in funding of US\$ 33 million (–12%) compared with 2021. The fall in funding for drugs was primarily due to decreased funding from the US DoD (down US\$ 21 million, –74%), as two of its long running malaria drug programmes concluded in 2021. The US DoD’s overall funding for malaria has fallen for 4 consecutive years, to US\$ 11 million in 2022 (representing one fifth of its peak in 2018). Unitaids’ drug funding also dropped (down US\$ 12 million, –47%) compared with 2021; however, in contrast to the US DoD, funding from Unitaids was at its second highest level ever, far above the organization’s long-term average.

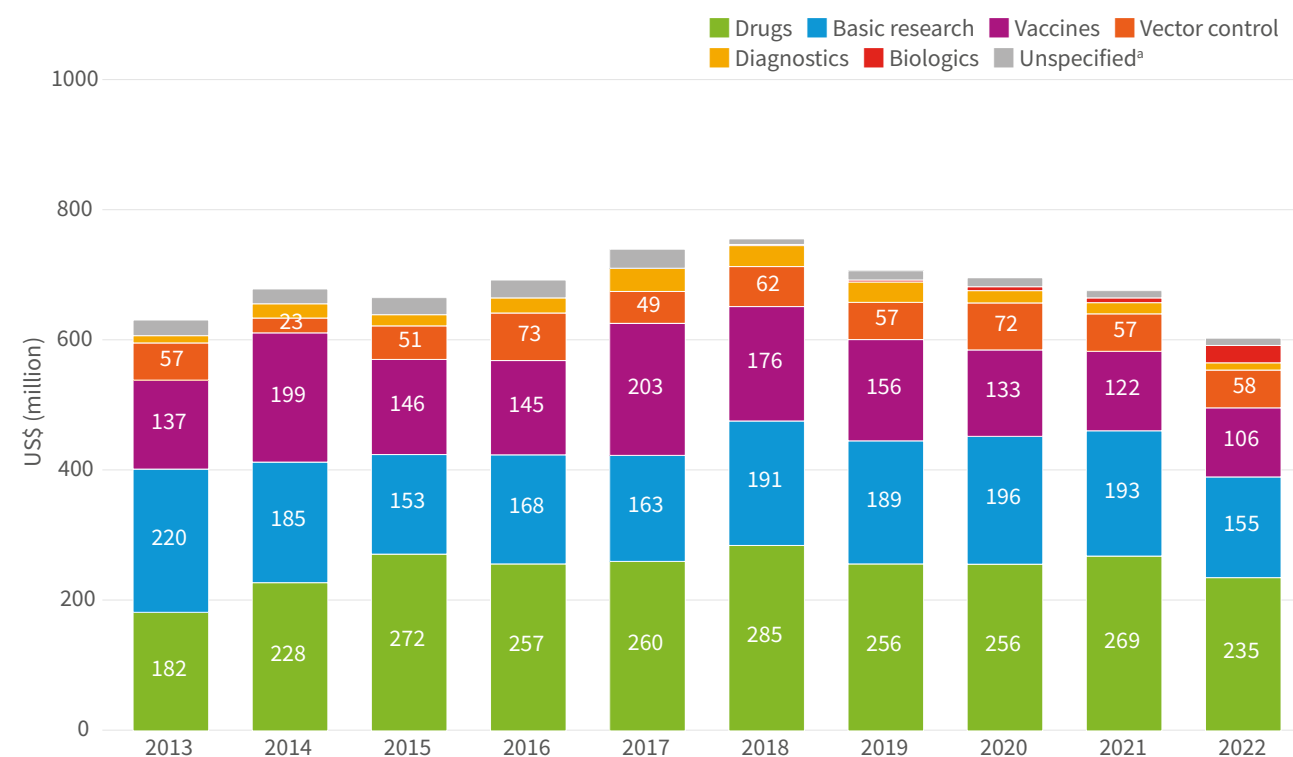
In contrast to the reductions in funding for vaccines, basic research and drugs, funding for biologics continued to rise for a fourth consecutive year, increasing more than 250% (up US\$ 19 million) to US\$ 27 million in 2022, nearly 14 times

its 2018 level. This was almost entirely driven by the BMGF, which was responsible for more than 80% of 2022 biologics funding. Most of this funding went to early-stage research, with the largest single disbursement going to the Bill & Melinda Gates Medical Research Institute for its development of malaria monoclonal antibodies. The BMGF also provided the first-ever biologics clinical development funding, in the form of a US\$ 3.9 million grant to the CDC Foundation.

Public funding from high-income countries fell heavily compared with 2021, to US\$ 281 million (down US\$ 63 million, –18%), causing their share of funding to drop to 47% – its lowest level in more than a decade; however, such countries remained the top funders of malaria R&D. Funding from philanthropic organizations, public multilaterals and public LMIC funders also fell by varying degrees, the latter almost halving, mainly because of cuts from two institutions in India – the Indian Council of Medical Research and the Council of Scientific & Industrial Research – and from FAPESP in Brazil. The only increase was in funding from the private sector, which rebounded by US\$ 10 million to US\$ 119 million, after a similarly sized fall in drug R&D funding from this sector in 2021; however, funding from this sector remained well below its long-term average.

Fig. 6.11.

Funding for malaria-related R&D, 2013–2022, by product type (constant 2022 US\$) Source: G-FINDER data portal (35).

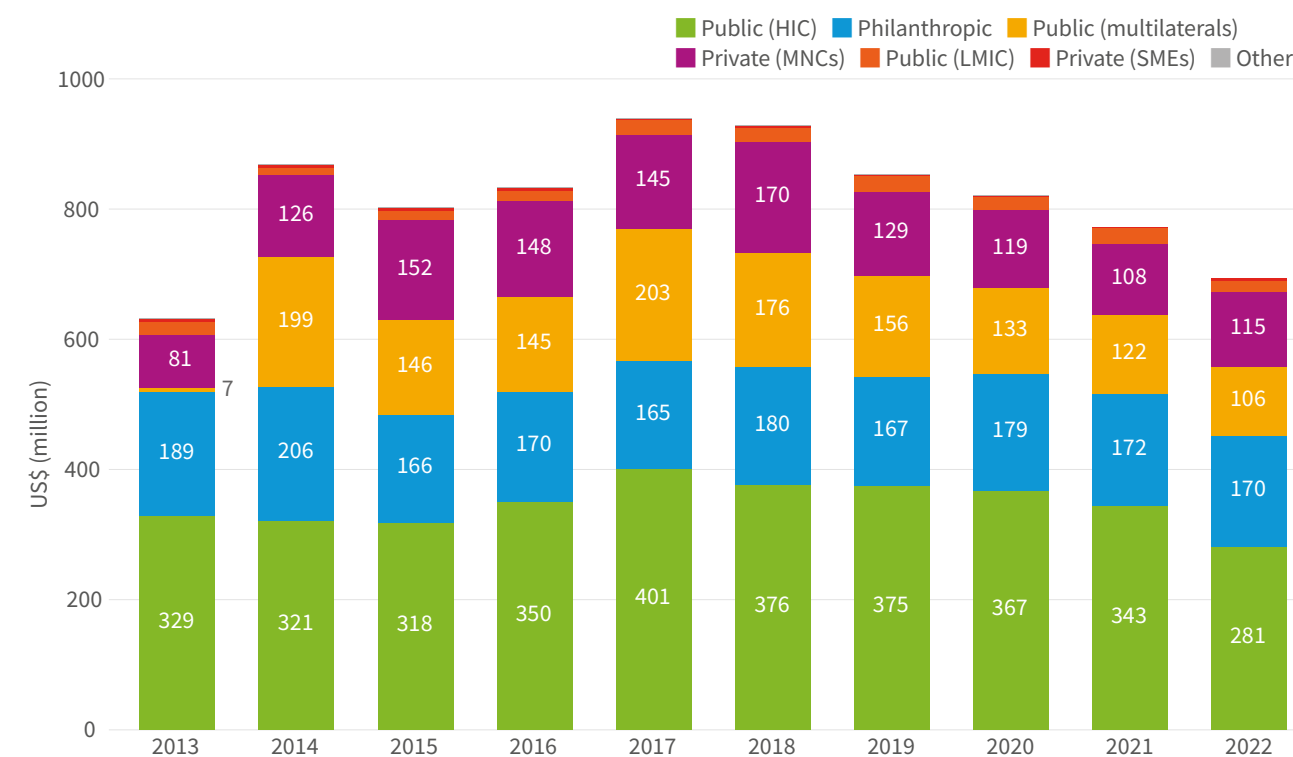


R&D: research and development.

^a “Unspecified” refers to funding flows, with no information on the product type.

Fig. 6.12.

Funding for malaria-related R&D, 2013–2022, by sector (constant 2022 US\$) Source: G-FINDER data portal (35).



HIC: high-income countries; LMIC: low- and middle-income countries; MNC: multinational corporation; R&D: research and development; SME: small and medium enterprise.



7 Distribution and coverage of malaria prevention, diagnosis and treatment

7.1 Distribution and coverage of ITNs

Manufacturers delivered about 282 million ITNs to malaria endemic countries in 2022, an increase of 28% compared with 2021 (**Fig. 7.1**). About 92% of all ITNs delivered by manufacturers went to countries in sub-Saharan Africa. Of the 260 million ITNs delivered to sub-Saharan Africa in 2022, 131.5 million (51%) were pyrethroid-PBO nets, an increase of 40% from 2021. Dual active ingredient ITNs made up 8% of the total ITNs delivered in 2022, compared with 9% in 2021. About half of the ITNs delivered to endemic countries in sub-Saharan Africa were received by six countries: the Democratic Republic of the Congo (33.6 million), Nigeria (28.4 million), Ethiopia (21.4 million), Sudan (18.9 million), Uganda (13.8 million) and Mali (12.5 million). Data from 2010–2022 are presented here; however, manufacturers' delivery data from 2004 and 2022 show that more than 2.9 billion ITNs were supplied globally, of which 2.5 billion (86%) were supplied to sub-Saharan Africa.

In 2022, a total of 254 million ITNs were distributed through all channels by NMPs in malaria endemic countries. Of these ITNs, 235 million (93%) were distributed in sub-Saharan Africa. About 147 million (58%) of these ITNs were distributed in seven countries: Nigeria (43.8 million), the Democratic Republic of the Congo (35.5 million), Sudan (18.8 million), Burkina Faso (15.7 million), Cameroon (11.8 million), Niger (11.0 million) and the United Republic of Tanzania (10.0 million). Outside sub-Saharan Africa, more than 18 million (7%) ITNs were distributed, with the largest number distributed in Pakistan (6.2 million), followed by Indonesia (2.6 million),

Afghanistan (2.1 million), India (1.2 million), Papua New Guinea (1.0 million) and the Lao People's Democratic Republic (1.0 million).

Data reported by countries, or assembled by the Alliance for Malaria Prevention, the RBM Partnership to End Malaria and the Global Fund indicated that 44 countries were planning mass ITN campaigns in 2022, with the aim of distributing about 241 million nets (**Annex 2**). By the end of 2022, 83% of the 241 million ITNs planned for mass distribution in 2022 had been distributed, including the 21 million carried over from 2021.

By the end of 2022, three countries (Nepal, South Sudan and Yemen) had distributed less than 60% of the ITNs planned for distribution in the mass ITN campaigns; Nepal distributed 29%, South Sudan 39% and Yemen 36% (**Annex 2**). Malawi was the only country that had planned a distribution campaign in 2022 but did not carry it out. Seven of the 11 countries supported under the first phase of the HBHI approach carried out a mass distribution campaign, with five countries distributing at least 90% of their nets: Mozambique (100%), the United Republic of Tanzania (100%), Nigeria (93%), India (91%) and Burkina Faso (90%). Cameroon distributed 67% of its nets, and the Democratic Republic of the Congo distributed 75%. In these seven countries, about 11 million of the nets distributed were the surplus from the 2021 campaign.

Indicators of population-level coverage of ITNs were estimated for sub-Saharan African countries in which ITNs are the main method of vector control. The following

indicators were estimated from household surveys, manufacturer deliveries and NMP distributions:

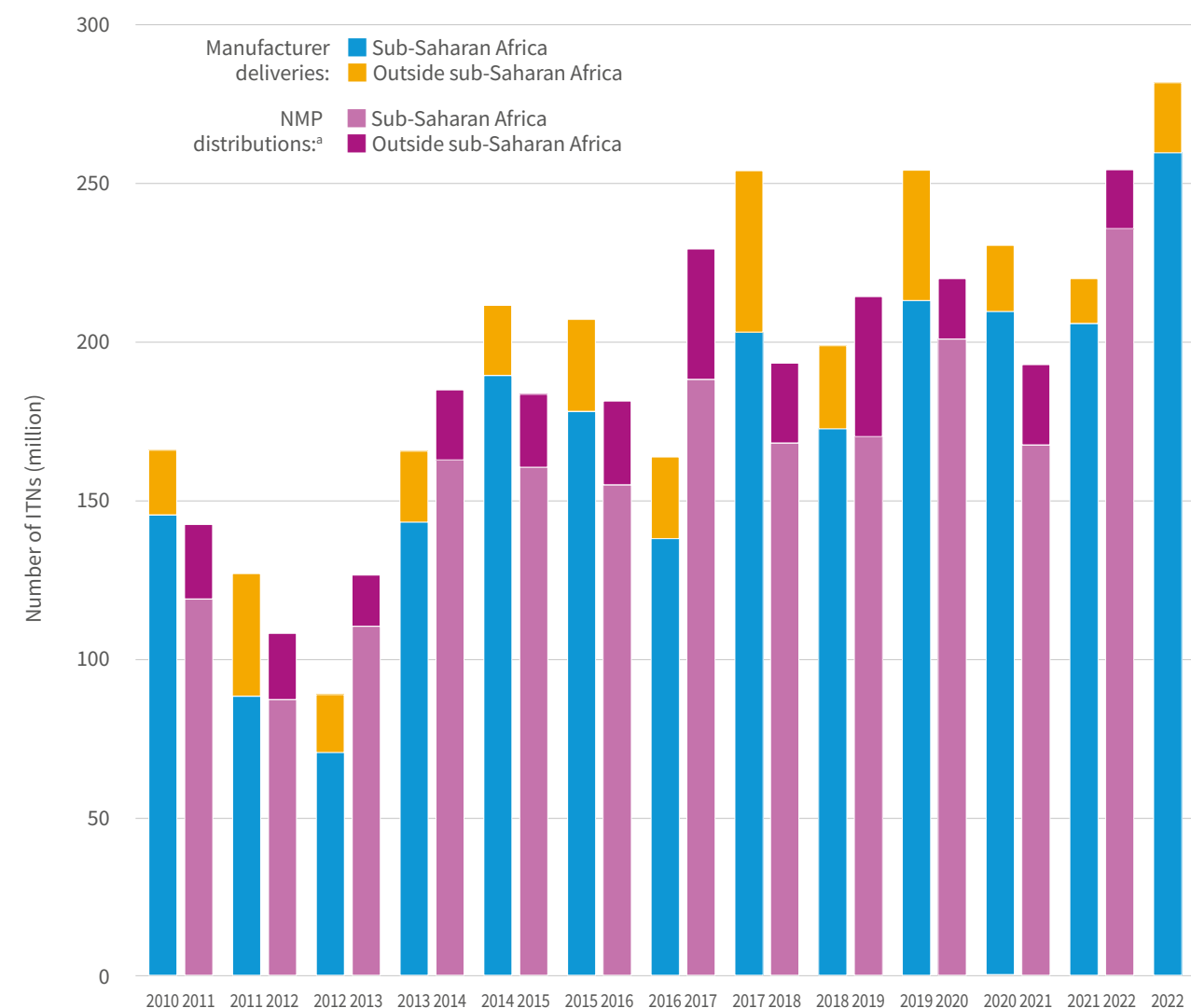
- ITN use (i.e. percentage of a given population group that slept under an ITN the night before the survey);
- ITN ownership (i.e. percentage of households that owned at least one ITN);

■ percentage of households with at least one ITN for every two people; and

■ percentage of the population with access to an ITN within their household (i.e. percentage of the population that could be protected by an ITN, if each ITN in a household could be used by two people).

Fig. 7.1.

Number of ITNs delivered by manufacturers and distributed^a by NMPs, 2010–2022 Sources: Milliner Global Associates and NMP reports.



ITN: insecticide-treated mosquito net; NMP: national malaria programme.

^a A lag between manufacturer deliveries to countries and NMP distributions of about 6–12 months is expected; thus, deliveries by manufacturers in a given year are often not reflected in distributions by NMPs in that year. Also, distributions of ITNs reported by NMPs do not always reflect all the nets that have been distributed to communities, depending on completeness of reporting. These issues should be considered when interpreting the relationship between manufacturer deliveries, NMP distributions and likely population coverage. Additional considerations include nets that are in storage in-country but have not yet been distributed by NMPs and those sold through the private sector that are not reported by programmes.



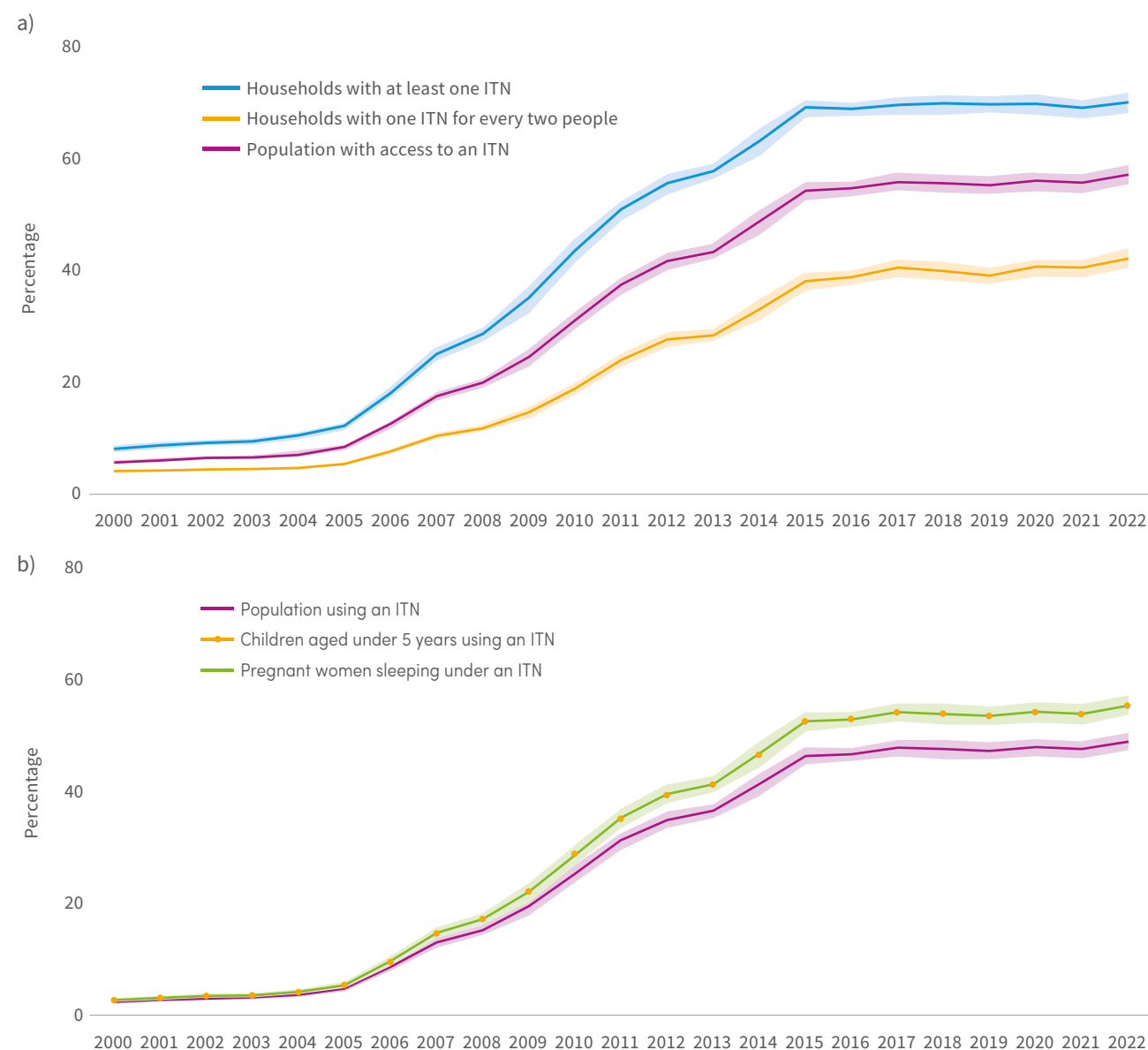
Coverage estimates are made by country, then aggregated to continental level. Years with household surveys are most precise; between survey years, the estimates rely on modelled rates of loss of nets from households, which can be highly variable. The modelling does not currently account for seasonal variation in ITN use, nor does it differentiate by type of net (**Annex 1**).

By 2022, 70% of households in sub-Saharan Africa had at least one ITN, increasing from about 5% in 2000. The percentage of households owning at least one ITN for every

two people increased from 1% in 2000 to 40% in 2022. In the same period, the percentage of the population with access to an ITN within their household increased from 3% to 56%. The percentage of the population sleeping under an ITN also increased between 2000 and 2022, for the whole population (from 2% to 49%), for children aged under 5 years (from 3% to 56%) and for pregnant women (from 3% to 56%). However, no significant increases in overall access to and use of ITNs have been observed since 2015 (**Fig. 7.2**). Survey results on key ITN coverage indicators, by country, are shown in **Annex 4-Ea**.

Fig. 7.2.

a) Indicators of population-level access to ITNs, sub-Saharan Africa, 2000–2022 and b) indicators of population-level use of ITNs, sub-Saharan Africa, 2000–2022 Source: ITN coverage model by the Malaria Atlas Project (47, 48).



ITN: insecticide-treated mosquito net.

7.2 Population protected with IRS

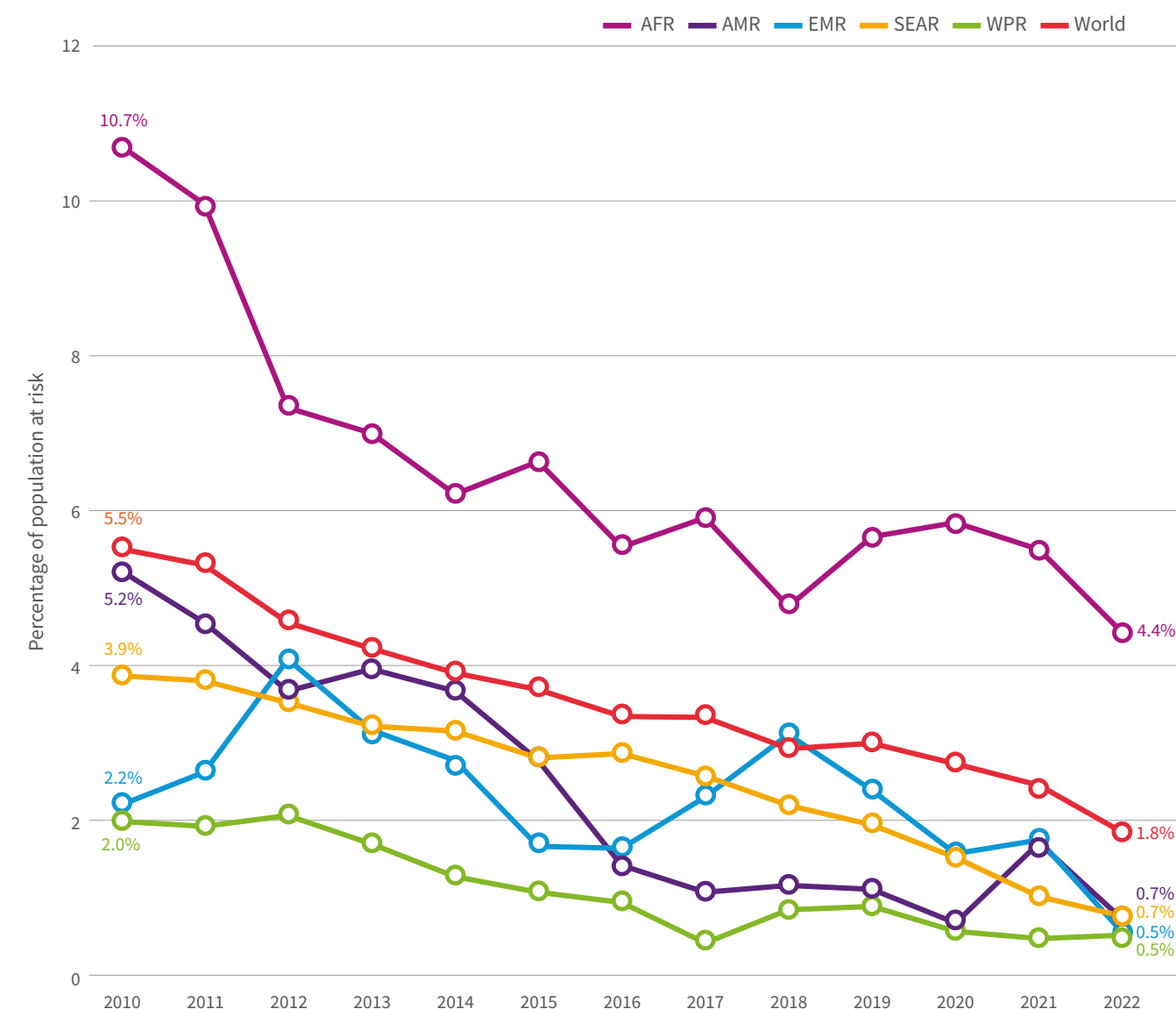
In 2022, 47 countries¹ implemented IRS to prevent malaria. Globally, the percentage of the population at risk protected by IRS in countries that are currently malaria endemic declined from 5.5% in 2010 to 1.8% in 2022. The percentage of the population at risk protected by IRS has declined slightly since 2016, with less than 6% of the population

protected in each WHO region (**Fig. 7.3**). Also, the number of people protected by IRS globally fell from 153 million in 2010 to 62 million in 2022. Between 2021 and 2022, more than 1 million fewer people were protected by IRS in Ecuador, India, Sudan, the United Republic of Tanzania and Zambia.

¹ The 47 countries that implemented IRS nationally in 2022, and have data available, are Angola, Bhutan, Bolivia (Plurinational State of), Brazil, Burundi, Chad, Costa Rica, Côte d'Ivoire, Djibouti, the Dominican Republic, Ecuador, Equatorial Guinea, Eritrea, Eswatini, the Gambia, Ghana, Honduras, India, Indonesia, Iran (Islamic Republic of), Kenya, the Lao People's Democratic Republic, Madagascar, Malawi, Mali, Mexico, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Panama, the Philippines, Rwanda, Saudi Arabia, Senegal, Sierra Leone, South Africa, Sudan, Thailand, Timor-Leste, Uganda, the United Republic of Tanzania, Viet Nam, Yemen, Zambia and Zimbabwe.

Fig. 7.3.

Percentage of the population at risk protected by IRS, by WHO region, 2010–2022^a Sources: IVCC data and NMP reports.



AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; IRS: indoor residual spraying; IVCC: Innovative Vector Control Consortium; NMP: national malaria programme; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

^a Among malaria endemic countries, 2022.



7.3 Scale-up of SMC

SMC has been implemented in 17 countries in the Sahel and other seasonal areas of sub-Saharan Africa. In 2022, Mauritania and South Sudan implemented SMC for the first time. The average number of children treated per cycle of SMC increased steadily, from about 0.2 million in 2012 to

about 49 million in 2022 (Table 7.1). In the 17 countries implementing SMC, more children were treated in 2022 than in 2021, with an additional 4 million children treated with SMC per cycle overall. Nigeria made the largest contribution to these figures, with 25.5 million children

treated on average per SMC cycle. In Mozambique, the number of children treated on average per cycle increased 12-fold between 2021 (0.1 million children treated per cycle on average) and 2022 (1.3 million children).

In 2022, more than 200 million treatment doses were delivered among countries implementing SMC compared with 180 million in 2021 (Table 7.2). Subnational areas in each country where SMC was delivered in 2022, together with the number of cycles in each district, are shown in Fig. 7.4.

Table 7.1.
Average number of children treated with at least one dose of SMC, by year, in countries implementing SMC, 2012–2022 Sources: LSHTM and MMV.

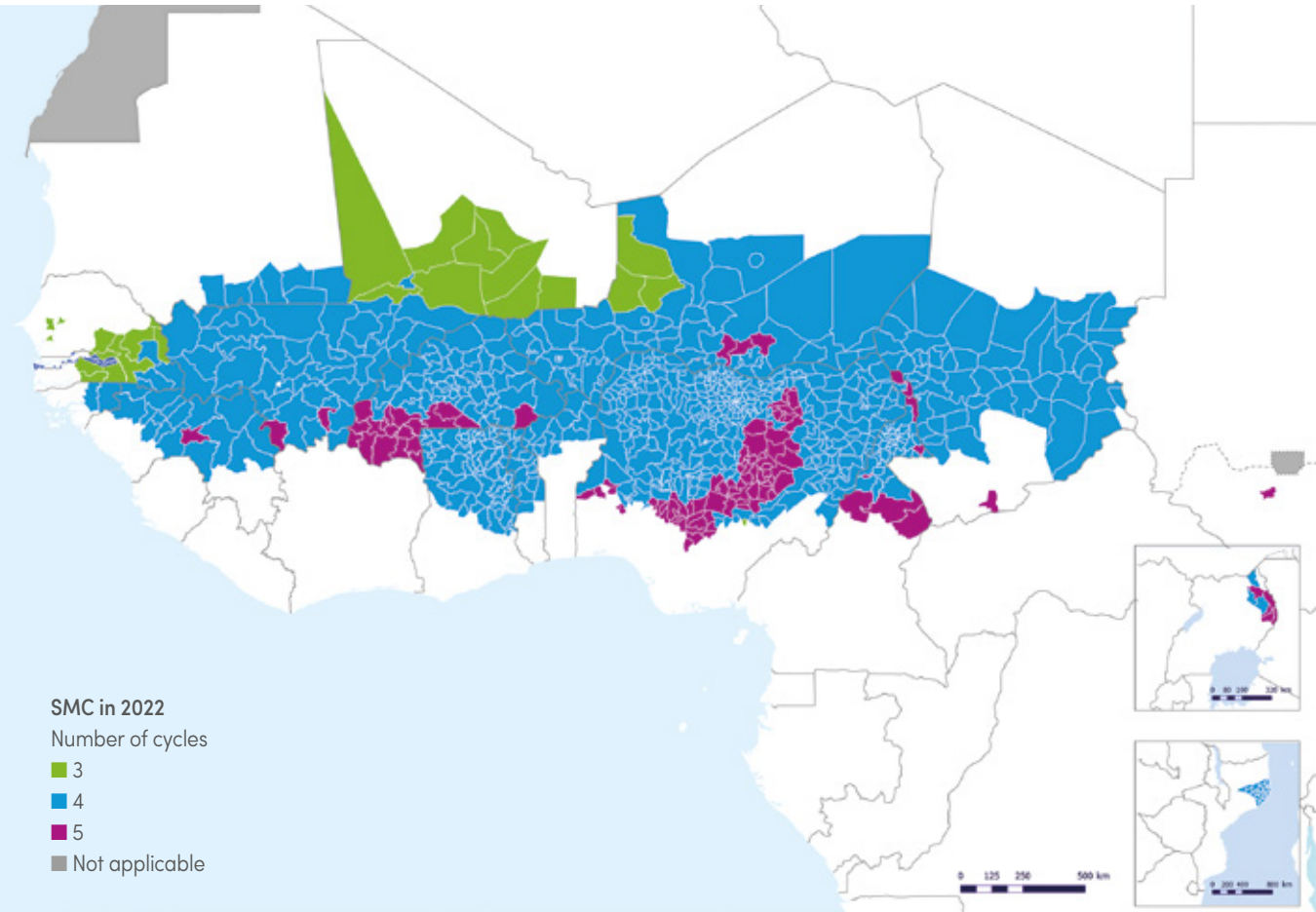
Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Benin	0	0	0	0	0	0	0	114 165	236 639	374 560	414 523
Burkina Faso	0	0	307 770	954 047	2 647 713	2 970 117	3 298 397	3 298 397	4 136 042	4 409 619	4 542 230
Cameroon	0	0	0	0	1 071 723	1 581 183	1 636 658	1 681 737	1 780 742	1 908 941	2 037 004
Chad	10 000	263 972	27 306	500 153	824 806	998 595	1 184 706	1 638 158	2 259 851	2 512 920	2 664 662
Gambia	0	0	65 271	76 450	73 710	76 601	112 841	110 870	121 834	76 045	79 205
Ghana	0	0	0	115 309	151 509	327 446	329 953	964 956	1 033 812	1 322 251	1 382 709
Guinea	0	0	0	201 283	442 177	575 927	840 120	841 090	1 088 194	1 122 434	1 163 812
Guinea-Bissau ^a	0	0	0	0	42 097	166 162	42 571	86 107	86 107	108 394	113 002
Mali	160 000	537 294	524 742	1 999 987	3 980 684	3 990 096	4 299 242	3 767 820	3 767 099	3 357 846	3 838 060
Mauritania	0	0	0	0	0	0	0	0	0	0	57 574
Mozambique	0	0	0	0	0	0	0	0	0	119 254	1 299 671
Niger	0	225 970	528 681	621 173	2 361 924	2 545 885	3 952 400	4 151 103	4 516 729	4 457 575	4 686 792
Nigeria	0	209 451	370 279	787 399	1 696 770	4 122 999	3 508 924	4 110 152	13 236 139	23 922 101	25 541 633
Senegal	0	55 709	595 745	614 581	621 503	631 897	0	879 652	687 959	748 116	801 729
South Sudan	0	0	0	0	0	0	0	0	0	0	18 000
Togo	0	119 222	170 165	0	411 811	420 451	434 161	453 907	486 716	475 997	519 141
Uganda	0	0	0	0	0	0	0	0	0	81 899	212 158
Total	170 000	1 411 618	2 589 959	5 870 382	14 326 427	18 407 359	19 639 973	22 098 114	33 437 863	44 997 952	49 371 905

Table 7.2.
Number of treatment doses delivered, by year, in countries implementing SMC, 2014–2022 Sources: LSHTM and MMV.

Country	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Benin	0	0	0	0	0	456 661	856 491	1 498 240	1 658 092	4 469 484
Burkina Faso	1 231 081	3 816 187	10 590 851	11 799 603	13 193 588	13 193 588	16 544 168	18 603 883	19 174 212	108 147 161
Cameroon	0	0	4 286 893	6 324 731	6 546 632	6 726 947	7 122 967	7 635 762	8 855 199	47 499 131
Chad	109 226	1 850 623	3 299 222	3 658 347	4 738 823	5 967 618	9 039 406	10 142 392	10 772 891	50 674 436
Gambia	195 812	305 800	294 839	306 405	406 044	443 478	487 334	304 180	316 821	3 060 713
Ghana	0	461 236	606 037	1 309 782	1 319 813	3 859 822	4 135 249	4 803 223	5 530 837	22 025 999
Guinea	0	805 131	1 768 708	2 303 709	3 360 479	3 003 612	4 352 774	4 533 292	4 703 712	24 831 417
Guinea-Bissau ^a	0	0	146 718	664 647	170 284	344 429	344 429	433 574	452 008	2 556 089
Mali	2 098 969	7 999 948	15 398 687	15 960 382	17 113 604	15 068 821	14 956 952	12 906 775	15 016 899	119 310 213
Mauritania	0	0	0	0	0	0	0	0	230 297	230 297
Mozambique	0	0	0	0	0	0	0	477 016	5 198 685	5 675 701
Niger	2 072 438	2 484 692	7 977 379	10 183 541	15 243 535	16 604 412	18 066 916	17 830 299	19 099 419	110 466 511
Nigeria	1 481 118	3 149 597	6 316 916	9 298 163	13 842 931	16 440 609	52 944 556	96 002 997	107 414 919	307 729 610
Senegal	1 787 236	1 887 211	1 910 656	1 942 868		2 684 527	2 107 303	2 290 288	2 467 495	17 300 420
South Sudan	0	0	0	0	0	0	0	0	90 000	90 000
Togo	510 494	0	1 235 433	1 529 275	1 302 483	1 185 327	1 946 863	1 903 986	2 076 563	12 167 312
Uganda	0	0	0	0	0	0	0	409 495	1 000 206	1 409 701
Total	9 486 374	22 760 425	53 832 339	65 281 453	77 238 216	85 979 851	132 905 408	179 775 402	204 058 255	837 644 195

LSHTM: London School of Hygiene & Tropical Medicine; MMV: Medicines for Malaria Venture; SMC: seasonal malaria chemoprevention.
^a Values for 2020 were imputed from 2019.

Fig. 7.4.
Subnational areas where SMC was delivered, and number of treatment cycles per district, in implementing countries in sub-Saharan Africa, 2022 Source: LSHTM.



LSHTM: London School of Hygiene & Tropical Medicine; SMC: seasonal malaria chemoprevention.



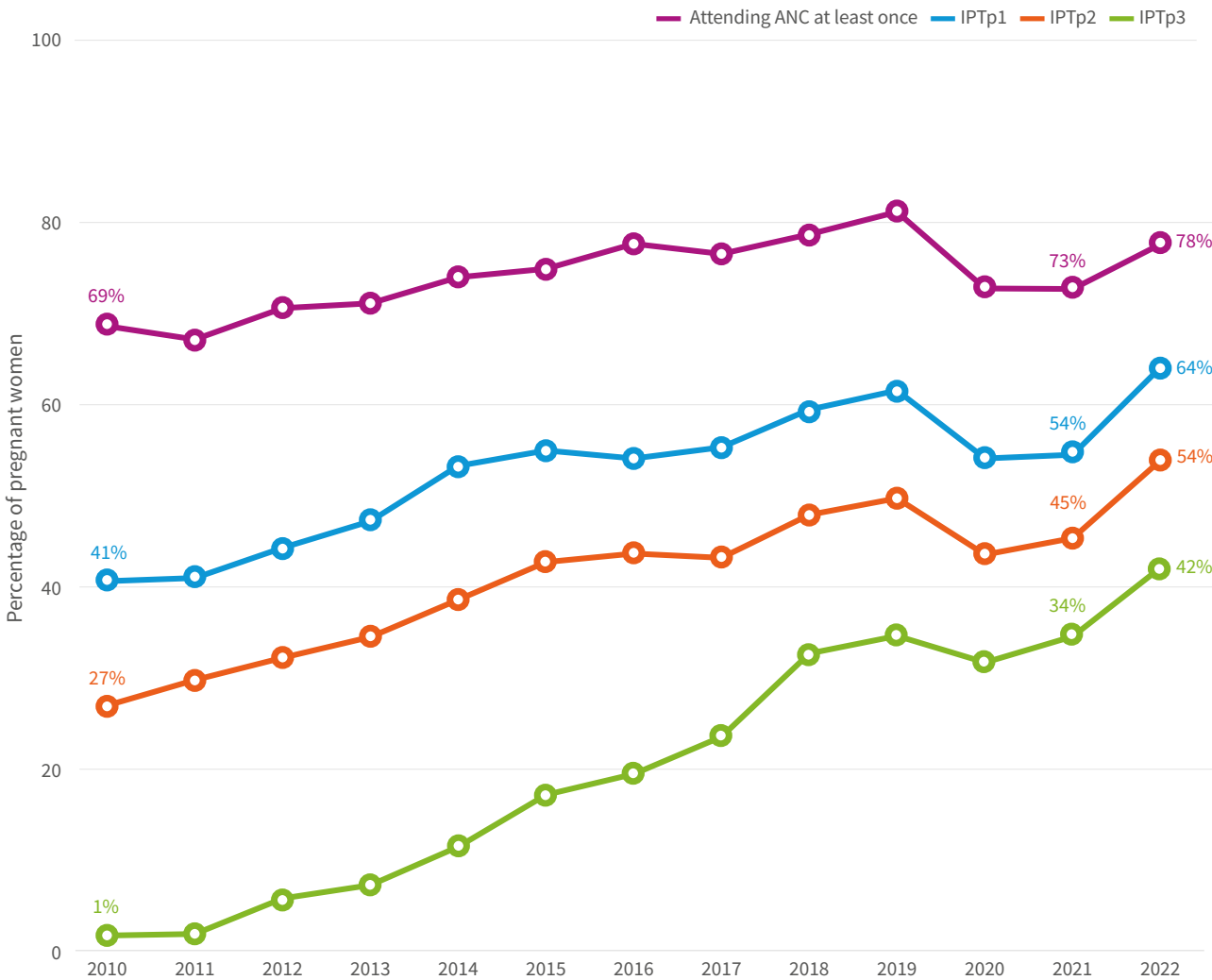
7.4 Coverage of IPTp use by dose

To date, 35 countries in the WHO African Region¹ have adopted IPTp to reduce the burden of malaria during pregnancy. Of these, 33 countries² with moderate to high malaria transmission reported routine data from health facilities in the public sector on the number of women visiting antenatal clinics, and the number receiving the first, second, third and fourth doses of IPTp (i.e. IPTp1, IPTp2, IPTp3 and IPTp4). Using annual expected pregnancies as the denominator (adjusted for fetal loss and stillbirths), the

percentage of IPTp use by dose was computed. ANC and IPTp coverages reported for 2020 and 2021 were adjusted for disruptions in ANC services, as explained in **Annex 1**. Overall, the coverage of women attending ANC at least once increased from 73% in 2021 to 78% in 2022 (**Fig. 7.5**). The coverage of IPTp1, IPTp2 and IPTp3 also increased, from 54%, 45% and 34% in 2021, to 64%, 54% and 42% in 2022, respectively. Although coverage of IPTp1, IPTp2 and IPTp3 was the highest ever recorded, it remains well below the target of 80%.

¹ The 35 countries that implement IPTp nationally are Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, the Comoros, Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, South Sudan, Togo, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe.
² The Comoros and Sao Tome and Principe are not included owing to their low malaria burden.

Fig. 7.5.
Percentage of pregnant women attending an ANC clinic at least once and receiving IPTp, by number of SP doses, sub-Saharan Africa, 2010–2022 Sources: NMP reports, CDC and WHO estimates.



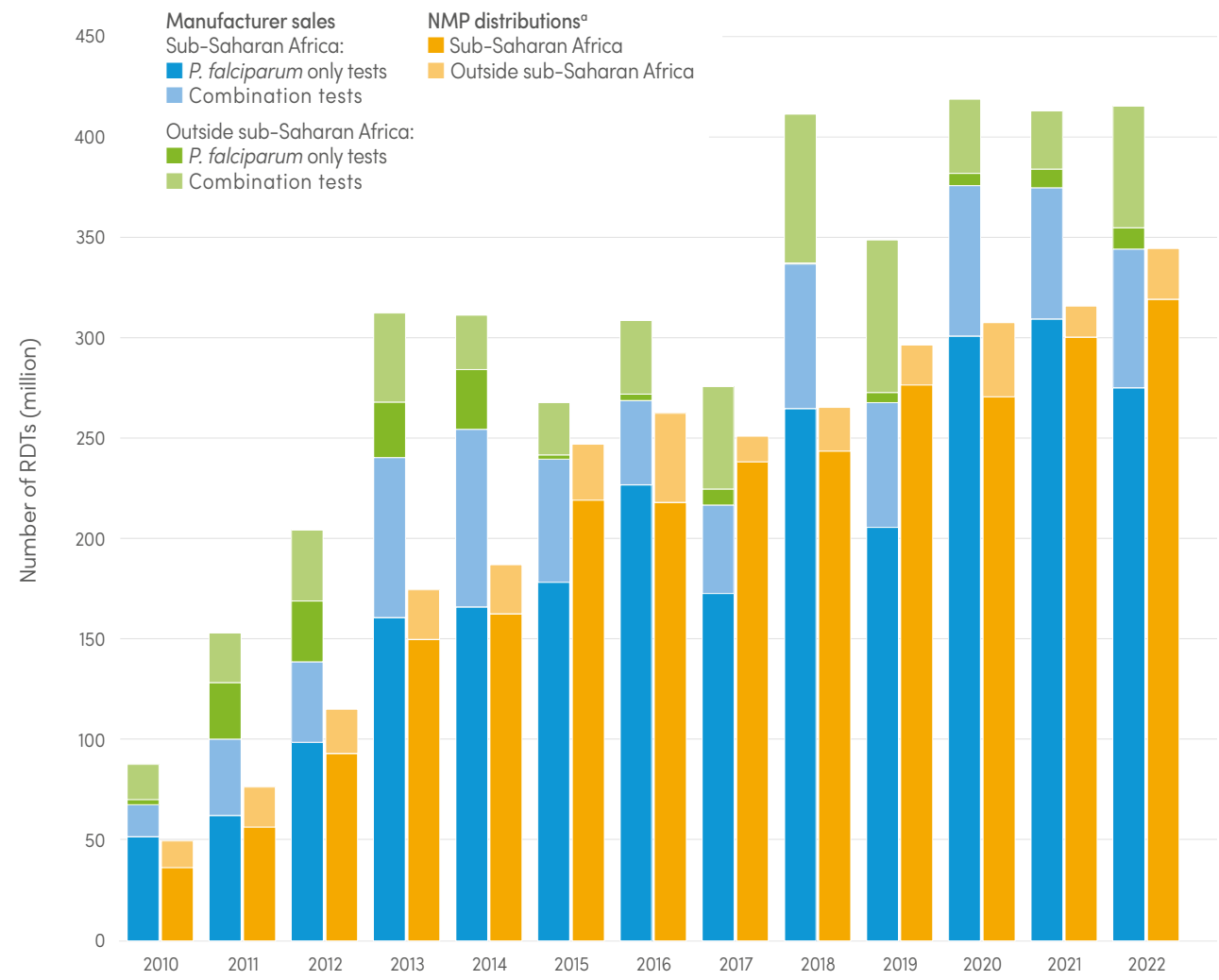
ANC: antenatal care; CDC: United States Centers for Disease Control and Prevention; IPTp: intermittent preventive treatment in pregnancy; IPTp1: first dose of IPTp; IPTp2: second dose of IPTp; IPTp3: third dose of IPTp; NMP: national malaria programme; SP: sulfadoxine-pyrimethamine; WHO: World Health Organization.

7.5 Malaria diagnosis and treatment

This section presents information on manufacturer sales and deliveries and national distribution of rapid diagnostic tests (RDTs) and artemisinin-based combination therapies (ACTs), treatment seeking for fever in children aged under 5 years, and population-level coverage of malaria diagnosis and treatment with ACTs. Data reflect RDT sales by manufacturers eligible for procurement (i.e. under the Malaria RDT Product Testing Programme) from 2010 to 2017; RDTs eligible for WHO prequalification since 2018; and NMP distributions of RDTs. Manufacturer data on ACTs have been provided by eligible companies for WHO-prequalified products.

Globally, 3.9 billion RDTs for malaria were sold by manufacturers between 2010 and 2022, with more than 82% of sales being in sub-Saharan African countries. In the same period, NMPs distributed 2.9 billion RDTs, with 90% of these being in sub-Saharan Africa (**Fig. 7.6**). This difference between sales and distribution may be because RDTs that are yet to be distributed to health facilities are not reported, or because of inadequate reporting of RDT use by the private sector. In 2022, manufacturers reported about 415.5 million RDT sales; all 10 eligible manufacturers reported figures for 2022; and NMPs distributed 345 million RDTs in 2022, about 30 million more than in 2021.

Fig. 7.6.
Number of RDTs sold by manufacturers and distributed by NMPs for use in testing suspected malaria cases, 2010–2022^a Sources: NMP reports and sales data from manufacturers eligible for the WHO Malaria RDT Product Testing Programme.



NMP: national malaria programme; *P. falciparum*: *Plasmodium falciparum*; RDT: rapid diagnostic test; WHO: World Health Organization.
^a NMP distributions do not reflect RDTs that are still in storage and are yet to be delivered to health facilities and to community health workers.



More than 4 billion treatment courses of ACT were delivered globally by manufacturers between 2010 and 2022 (**Fig. 7.7**). About 2.7 billion (66.7%) of these deliveries were to the public sector in malaria endemic countries, and the rest were either public or private sector deliveries through the Affordable Medicines Facility for malaria (AMFm) or the Global Fund co-payment mechanism (24.7%), or through private sector deliveries outside the Global Fund co-payment mechanism (8.6%). National data reported by NMPs show that, in the same period, 2.5 billion ACTs were delivered to health service providers to treat people with malaria in the public health sector. In 2022, some 210 million ACTs were delivered by

manufacturers to the public health sector. NMPs distributed 217 million ACTs in 2022, of which 97% were in sub-Saharan Africa, where about 113 million ACTs were distributed in five countries: Uganda (32 million), the Democratic Republic of the Congo (24 million), Zambia (21 million), Nigeria (19 million) and Mozambique (17 million).

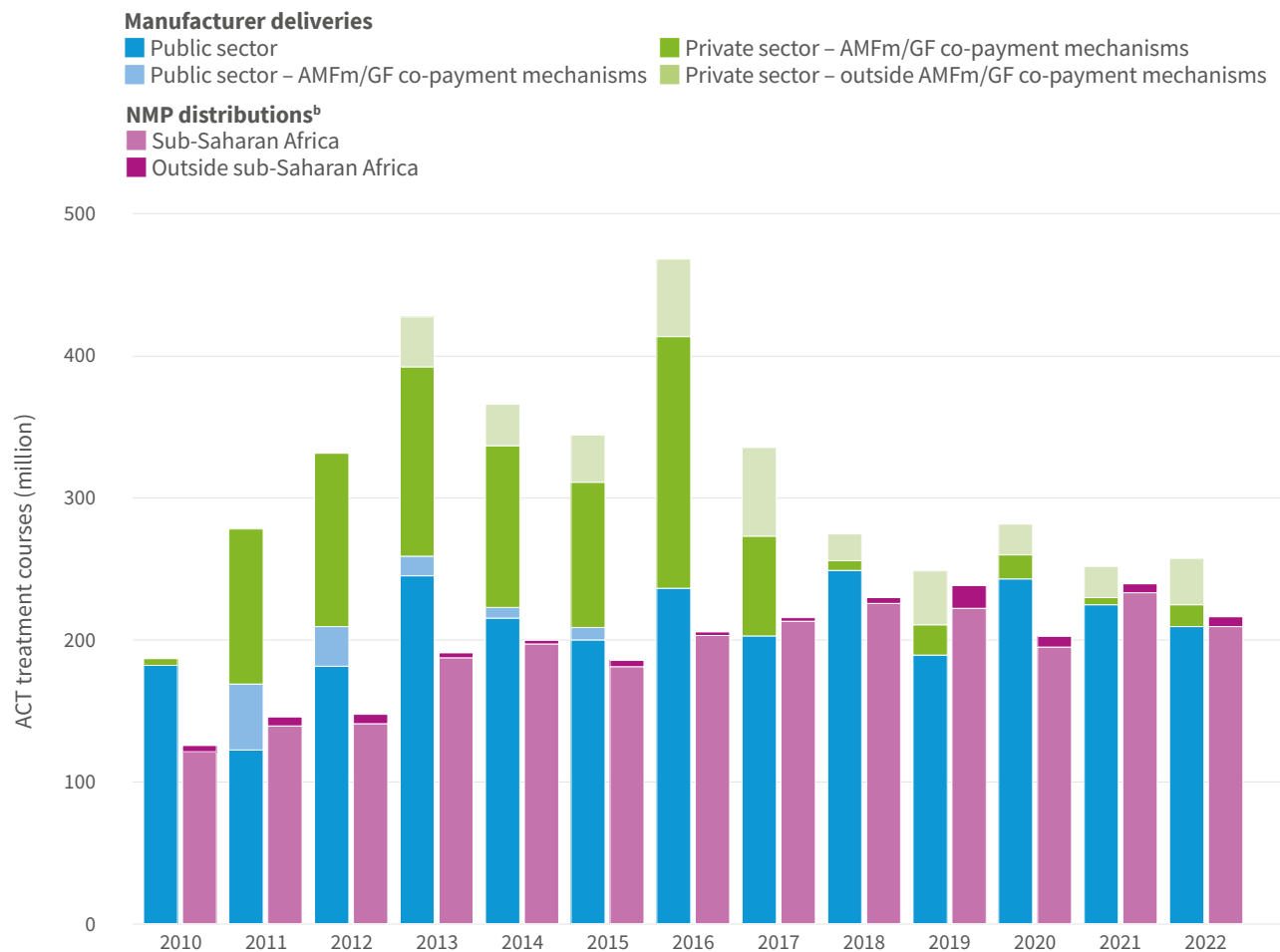
Aggregated data from household surveys conducted in sub-Saharan Africa between 2005 and 2022 were used to analyse coverage of treatment seeking, diagnosis and use of ACTs by children aged under 5 years (**Table 7.3**). Data were included from 22 countries^{1,2} that undertook

at least two surveys – either demographic and health surveys (DHS) or malaria indicator surveys (MIS) – in this period (baseline, 2005–2011 and most recent, 2015–2022). Comparing the baseline and latest surveys, there was little change in the prevalence of fever within the 2 weeks preceding the survey (median 26% versus 23%) or in treatment seeking for fever (median 65% versus 66%). Comparing the source of treatment for fever between the baseline and most recent surveys, the proportion of people who received care from public health facilities increased from a median of 58% to 69%. Use of community health workers was low in both periods, with a median of 2% in both the baseline and more recent surveys. The proportion of children aged under 5 years who received care from the private sector fell from a median of 40% at baseline to 28% in the more recent surveys, indicating an increase in population access to the public health sector

and consequently to the associated public surveillance system. Increases in reported cases may be detected as a consequence of more patients using the public sector; this has implications for commodities planning and for the estimation of burden trends using routine data (which are primarily collected from the public sector in all countries).

The proportion of children aged under 5 years who sought care for a fever and who received a diagnosis with a finger or heel prick increased from a median of 30% at baseline to 54% in the latest surveys, indicating an improvement in case management, despite evidence of inadequate levels of diagnostic services. Use of ACTs among those who sought care increased from a median of 13% at baseline to 24% in the latest surveys. Among those who received a finger or heel prick, the use of ACTs increased from a median of 21% at baseline to 34% in the latest surveys.

Fig. 7.7.
Number of ACT treatment courses delivered by manufacturers and distributed by NMPs to people with malaria, 2010–2022^{a,b} Sources: Companies eligible for procurement by WHO/UNICEF and NMP reports.



ACT: artemisinin-based combination therapy; AMFm: Affordable Medicines Facility–malaria; GF: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; UNICEF: United Nations Children’s Fund; WHO: World Health Organization.
^a NMP deliveries to patients reflect consumption reported in the public health sector.
^b AMFm/GF indicates that the AMFm operated from 2010 to 2013, with the GF co-payment mechanism operating from 2014.

Table 7.3.
Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years, from household surveys in sub-Saharan Africa, at baseline (2005–2011) and most recently (2015–2022) Source: Household surveys.

Children aged under 5 years		Baseline (2005–2011)			Most recent surveys (2015–2022)		
Indicator		Median estimate	Lower bound	Upper bound	Median estimate	Lower bound	Upper bound
Prevalence of fever							
With fever in past 2 weeks		25.9%	20.1%	34.3%	22.7%	17.3%	29.9%
Treatment seeking for fever							
With fever in past 2 weeks for whom treatment was sought		65.1%	59.2%	71.6%	66.4%	62.9%	74.0%
Source of treatment for fever among those who were treated							
Public sector (health facility)		57.7%	47.2%	78.1%	68.8%	50.3%	80.7%
Public sector (community health worker)		2.0%	0.2%	3.4%	1.6%	0.3%	5.1%
Private sector (formal and informal)		40.5%	21.6%	53.2%	27.5%	17.5%	49.9%
Diagnosis among those with fever and for whom care was sought							
Received a finger or heel prick		29.8%	12.2%	38.4%	53.8%	40.7%	63.8%
Use of ACTs among those for whom care was sought							
Received treatment with ACTs		12.8%	6.9%	30.7%	24.0%	14.2%	42.7%
Use of ACTs among those for whom care was sought and who received a finger or heel prick							
Received ACTs		20.6%	16.3%	41.7%	33.6%	21.3%	53.2%
Use of ACTs among those for whom care was sought and who were treated with an antimalarial drug							
Received ACTs		38.0%	19.7%	67.9%	64.7%	38.7%	87.6%

ACT: artemisinin-based combination therapy.

These results could indicate either an improvement in treatment rates or an increase in test positivity rates among the people tested; hence, this indicator should be interpreted according to individual country context, given a lack of information on the type of diagnostic test performed or the result of the test. ACT use among people who sought care and who were treated with an antimalarial drug increased from 38% at baseline to 65% in the latest surveys, suggesting an increase in the use of the recommended first-line treatment for *P. falciparum* in the countries included in the analysis.

Data from the most recent household surveys, conducted between 2015 and 2022, were used to analyse coverage of treatment seeking, diagnosis and use of ACTs by children aged under 5 years, by country (**Table 7.4**). The percentage of children with fever for whom care was sought ranged from 32.3% in Mauritania to 86.9% in Uganda, indicating varying levels of access to care between countries. Further disaggregation of data subnationally can be used to inform health service planning, tailor the malaria response and inform estimation of community-level malaria burden (given the evidence it provides about the coverage of the surveillance system used).

The percentage of people with fever for whom care was sought and who received a diagnosis ranged from 12.1% in Mauritania to 83.8% in Burundi. This finding highlights the varying levels of adherence to the recommended malaria diagnosis guidelines between countries, and the challenges in adequately identifying all malaria cases among those with fever who seek care. Information on the

percentage of people with fever for whom care was sought can be coupled with an evaluation of the testing ratios measured through routine data to inform a subnationally targeted approach, to optimize case management. The information can also be used to inform burden estimation.

Among those for whom care was sought, the percentage who received ACTs ranged from 3% in the Gambia to 61.8% in Uganda; and the proportion who received ACTs and received a finger or heel prick ranged from 5% in the Gambia to 64.9% in Uganda. The differences in the levels of ACT treatment after testing reflect the varying levels of transmission in the countries included in **Table 7.4**. However, by its nature, this indicator (i.e. use of ACTs among those for whom care was sought and who received a finger or heel prick) includes factors that cannot be independently evaluated through the survey data (e.g. treatment rates among people infected with malaria and variations in the quality of diagnostic results); hence, it needs to be investigated further (e.g. by evaluating routine malaria data).

The percentage of antimalarial drugs prescribed that were ACTs ranged from 11.6% in Burundi to 98.4% in Mozambique, although this indicator is likely to be affected by recall bias. The differences seen between countries indicate different levels of use of the recommended first-line treatment, and highlights that countries experience challenges in distributing ACTs, depending on the country context; these challenges include stock-outs, inadequate training and supervision of health staff, and alternative markets for antimalarial drugs.



Table 7.4.
Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years from the most recent household survey for countries in sub-Saharan Africa^a *Source: Household surveys.*

Country	Latest survey	Treatment seeking for fever	Diagnosis among those with fever and for whom care was sought	Use of ACTs among those for whom care was sought	Use of ACTs among those for whom care was sought and who received a finger or heel prick	Use of ACTs among those for whom care was sought and who were treated with an antimalarial
		Median (lower bound–upper bound)	Median (lower bound–upper bound)	Median (lower bound–upper bound)	Median (lower bound–upper bound)	Median (lower bound–upper bound)
Angola	DHS 2015	55.1 (51.8–58.4)	58.2 (53.9–62.4)	20.8 (17.4–24.7)	27.0 (22.1–32.4)	75.7 (69.1–81.3)
Benin	DHS 2017	53.9 (50.7–57.0)	29.3 (26.4–32.4)	10.9 (9.1–12.9)	18.7 (14.7–23.4)	38.3 (32.8–44.0)
Burkina Faso	DHS 2021	75.7 (73.4–78.0)	81.7 (79.1–84.0)	36.2 (33.0–39.6)	39.8 (36.2–43.5)	49.4 (45.5–53.4)
Burundi	DHS 2016	69.7 (67.8–71.6)	83.8 (82.1–85.3)	7.6 (6.3–9.1)	8.3 (6.9–10.0)	11.6 (9.7–13.8)
Cameroon	DHS 2018	63.0 (58.7–67.1)	31.0 (26.6–35.9)	10.6 (8.3–13.5)	17.1 (11.5–24.7)	22.4 (17.6–28.2)
Côte d’Ivoire	DHS 2021	65.4 (61.9–68.7)	52.7 (48.3–57.0)	16.9 (13.7–20.7)	22.7 (17.8–28.5)	40.2 (33.7–47.0)
Gambia	DHS 2019	64.8 (60.8–68.6)	39.4 (34.7–44.2)	3.0 (1.7–5.2)	5.2 (2.5–10.5)	59.9 (36.2–79.7)
Ghana	MIS 2019	69.5 (64.9–73.8)	47.9 (42.8–53.0)	51.4 (45.9–56.9)	58.7 (51.4–65.6)	86.8 (81.2–90.9)
Guinea	MIS 2021	62.2 (57.3–66.9)	43.1 (38.0–48.3)	25.2 (21.3–29.6)	36.6 (29.6–44.2)	53.1 (46.5–59.6)
Kenya	DHS 2022	69.8 (67.3–72.2)	42.9 (40.0–45.9)	22.8 (20.8–25.0)	38.2 (34.7–41.8)	83.5 (79.2–87.1)
Liberia	DHS 2019	81.4 (78.0–84.4)	58.0 (53.3–62.6)	26.1 (22.6–29.9)	30.5 (26.3–35.2)	43.1 (37.4–49.1)
Madagascar	DHS 2021	45.4 (41.8–49.1)	40.0 (35.8–44.4)	15.0 (12.0–18.6)	26.9 (20.9–33.8)	55.1 (46.9–63.0)
Malawi	MIS 2017	54.1 (49.0–59.2)	64.8 (58.2–70.8)	49.0 (42.4–55.7)	61.0 (53.7–67.9)	97.4 (94.2–98.9)
Mali	MIS 2021	64.8 (61.8–67.7)	34.8 (31.1–38.8)	14.2 (11.9–16.9)	20.8 (16.5–25.8)	30.3 (25.9–35.2)
Mauritania	DHS 2020	32.2 (29.3–35.2)	12.1 (9.2–15.8)	9.6 (6.9–13.3)	9.3 (3.6–22.2)	19.7 (14.3–26.6)
Mozambique	MIS 2018	69.1 (63.5–74.2)	68.3 (63.2–73.1)	46.2 (40.4–52.0)	57.9 (50.2–65.2)	98.4 (96.6–99.3)
Niger	MIS 2021	67.5 (62.3–72.3)	47.1 (41.8–52.5)	43.1 (37.6–48.8)	53.7 (46.9–60.3)	78.3 (72.8–82.9)
Nigeria	MIS 2021	64.0 (61.1–66.7)	31.2 (28.1–34.4)	39.1 (34.8–43.6)	56.1 (47.7–64.2)	74.4 (69.4–78.8)
Rwanda	DHS 2019	62.9 (60.0–65.7)	60.9 (57.2–64.6)	12.2 (9.5–15.7)	18.9 (14.8–23.8)	92.3 (84.7–96.3)
Senegal	MIS 2020	64.9 (58.8–70.6)	31.7 (25.3–38.8)	–	–	–
Sierra Leone	DHS 2019	75.5 (72.7–78.1)	71.9 (68.2–75.3)	22.5 (19.2–26.2)	22.9 (19.2–27.0)	31.7 (27.4–36.4)
Togo	MIS 2017	57.1 (51.4–62.7)	49.4 (43.8–55.1)	39.4 (33.2–45.9)	62.6 (53.4–71.0)	76.4 (68.2–83.0)
Uganda	MIS 2018	86.9 (84.7–88.8)	58.0 (53.8–62.2)	61.8 (56.9–66.5)	64.9 (59.0–70.3)	87.9 (83.9–91.0)
United Republic of Tanzania	MIS 2017	75.4 (72.2–78.3)	55.0 (50.4–59.5)	36.8 (31.3–42.6)	43.7 (36.6–51.1)	89.0 (82.7–93.2)
Zambia	DHS 2018	77.2 (74.2–79.9)	76.9 (72.5–80.7)	42.7 (38.2–47.4)	51.7 (46.8–56.5)	96.9 (94.8–98.2)

ACT: artemisinin-based combination therapy; DHS: demographic and health survey; MIS: malaria indicator survey.
^a Surveys underpowered to provide reliable estimates for specific indicators were left blank (–).



8 Global progress towards the GTS milestones

The GTS calls for a reduction in malaria case incidence and mortality rates (compared with a 2015 baseline) of at least 40% by 2020, 75% by 2025 and 90% by 2030 (2). Projections for beyond 2022, if current malaria trends are sustained, were informed by the trends observed between 2013 and 2022.

Trends in estimated malaria cases and deaths were used to make annual projections from 2023 to 2030, to track progress towards the future GTS milestones and targets for 2025 and 2030, as mandated to WHO by the World Health Assembly (2) (**Section 3.1**).

8.1 Global progress

In 2022, the morbidity and mortality levels expected for that year to meet the GTS 2025 targets, based on the 2015 baseline, were not achieved globally, despite the considerable progress made since 2000 (**Fig. 8.1**). The GTS and SDG 2030 targets for malaria morbidity and mortality will also not be met unless urgent actions are taken (**Fig. 8.1**). A malaria case incidence of 58 cases per 1000 population at risk in 2022 (instead of the expected 26 cases per 1000) means that, globally, we are now off track by 55% (i.e. the level of morbidity for 2022 required to meet the GTS 2025 target is 55% lower than the current case incidence). At the current trajectory, by 2030 the world could be off track by 89% (**Fig. 8.1a**). Malaria deaths per 100 000 population at risk decreased from 15 in 2015 to 14.3 in 2022. Globally, the world is off track by 53% (**Fig. 8.1b**); if this trajectory continues, by 2030 it will be off track by 88%.

Fig. 8.2 and **Fig. 8.3** present progress in all countries considered to be malaria endemic in 2015. Countries were ranked into eight categories to assess progress towards malaria case incidence and the mortality rate milestone in 2025 from the 2015 baseline:

- on track (zero malaria cases);

- on track (a decrease of 55% or more), where 55% represents the estimated expected reduction for 2022 between the GTS targets of 2020 (40%) and 2025 (75%);
- a decrease of between 25% and less than 55%;
- a decrease of less than 25%;
- no increase or decrease since 2015 (an increase or decrease of less than 5% in case incidence or mortality rate);
- an increase of less than 25%;
- an increase of between 25% and less than 55%; and
- an increase of 55% or more.

Of the 93 countries that were malaria endemic (including the territory of French Guiana) in 2015, seven countries have been certified malaria free since 2015; Algeria, Azerbaijan, Belize, China, El Salvador, Sri Lanka and Tajikistan. Twenty-three countries (24.7%) are on track to meet the GTS morbidity milestone for 2025, having achieved a reduction of 55% or more in case incidence or reported zero malaria cases in 2022. Twenty-four countries (25.8%) had made progress in reducing malaria case incidence by less than the expected target. Twenty-five countries (26.9%) had experienced increased case incidence, with 15 countries (16.2%) experiencing an increase of 55% or more in 2022

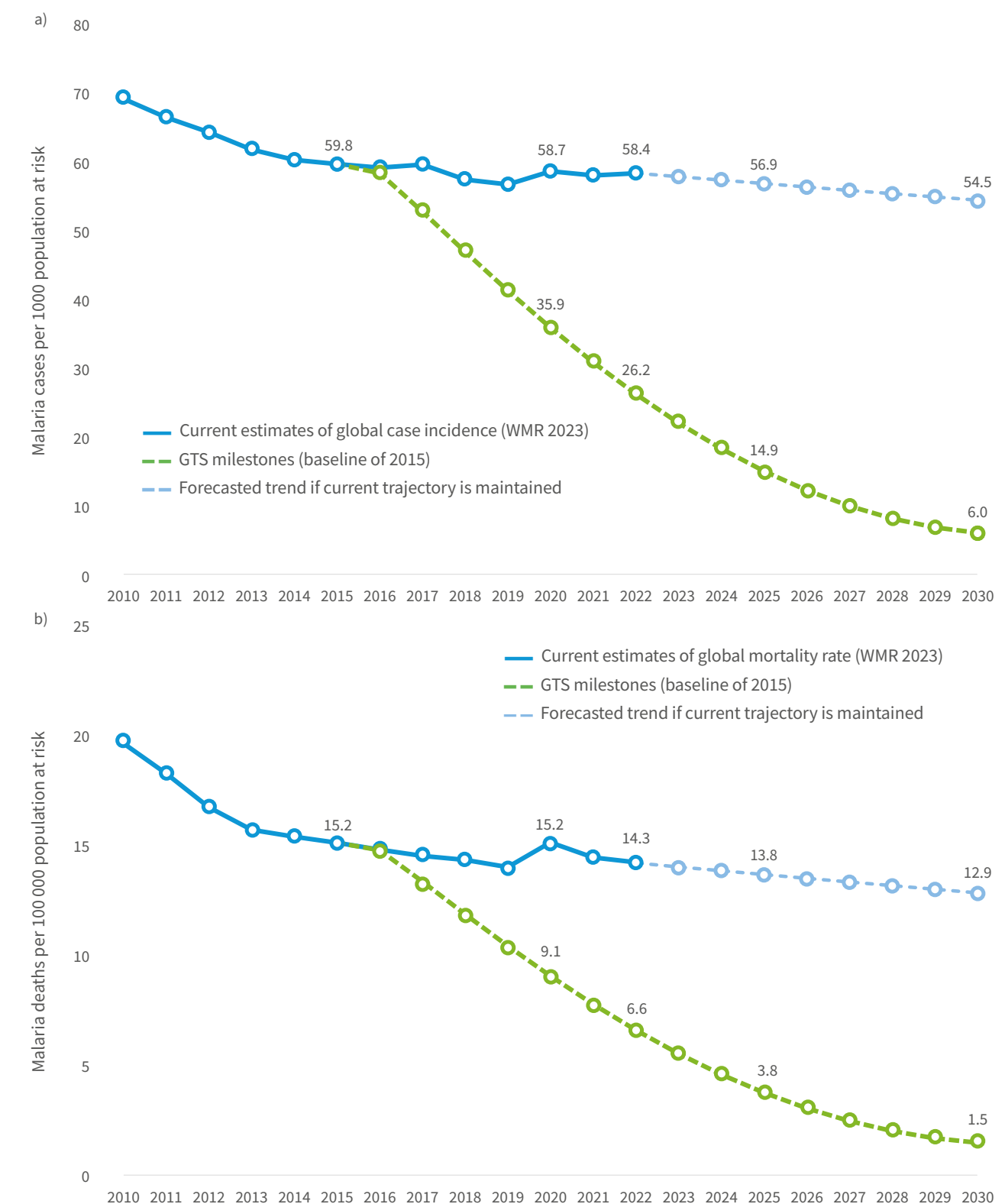
compared with 2015. In 14 countries (15.1%), malaria case incidence in 2022 was similar to that of 2015.

Thirty-one countries (33.3%) that were malaria endemic in 2015 are on track to meet the GTS mortality milestone for 2025, with 22 of those countries reporting zero malaria

deaths. An additional 31 countries (33.3%) achieved reductions in the mortality rate, but progress was below the expected 55% target for 2022. In seven countries, malaria mortality rates remained at the same level in 2022 as in 2015 (7.5%), whereas rates increased in 17 countries (18.3%), among which eight countries had increases of 55% or more.

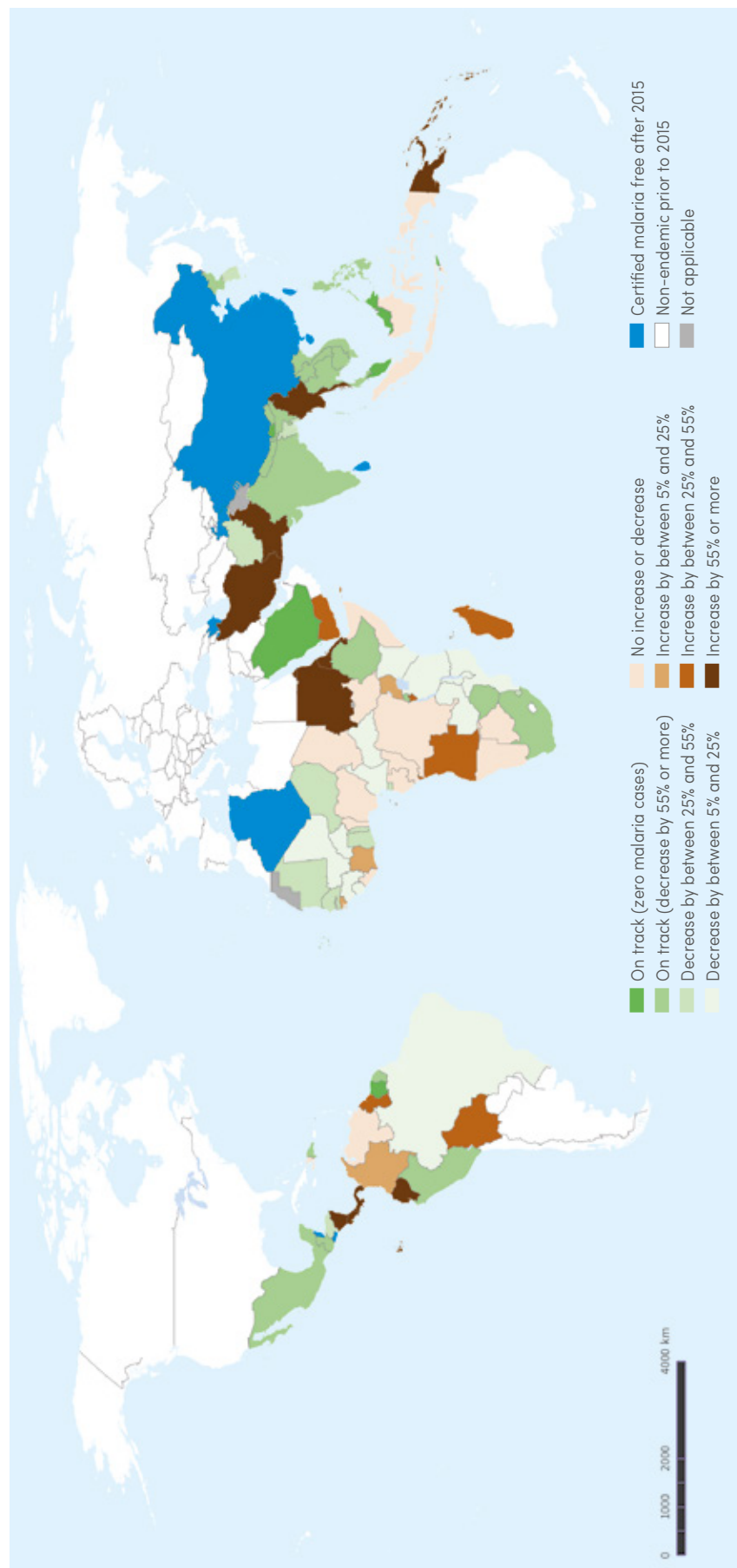
Fig. 8.1.

Comparison of global progress in malaria a) case incidence and b) mortality rate, considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) Source: WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.

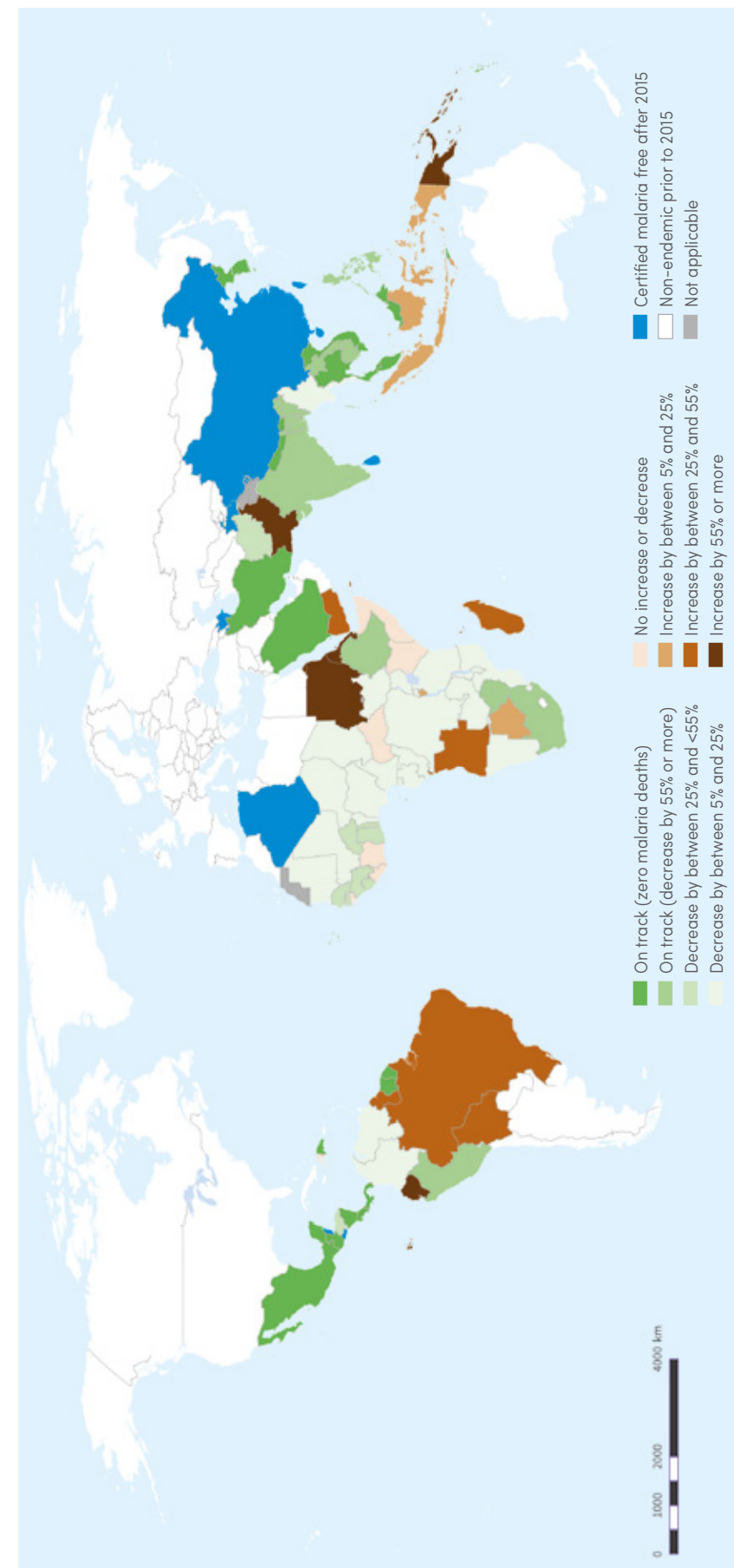
Fig. 8.2.
Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2025 malaria case incidence milestone of at least 75% reduction from a 2015 baseline^a Source: WHO estimates.



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization.
^a Countries that have experienced reductions of 55% or more in 2022 are considered to be on track to meet the GTS 2025 targets because 55% represents the estimated expected reduction for 2022 between the GTS targets of 2020 (40%) and 2025 (75%).



Fig. 8.3.
Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2025 malaria mortality rate milestone of at least 75% reduction from a 2015 baseline^a Source: WHO estimates.



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization.
^a Countries that have experienced reductions of 55% or more in 2022 are considered to be on track to meet the GTS 2025 targets because 55% represents the estimated expected reduction for 2022 between the GTS targets of 2020 (40%) and 2025 (75%).



8.2 WHO African Region

Analysis of the trends by region shows that, in 2022, the WHO African Region was off track for both the malaria morbidity and mortality GTS 2025 milestones, by 52% and 50%, respectively (Fig. 8.4). In 2020, only Cabo Verde, Ethiopia, the Gambia and Ghana met the GTS 2020 target. In 2022, the countries that continued to be on track to meet the GTS 2025 target, with at least a 55% reduction in malaria case incidence, were Cabo Verde, Ethiopia, Rwanda, South Africa and Zimbabwe. In 2022, the Gambia and Ghana were no longer on track to meet the GTS 2025 target, although they were still reporting decreases of between 25% and 55%. Algeria has already been certified malaria free.

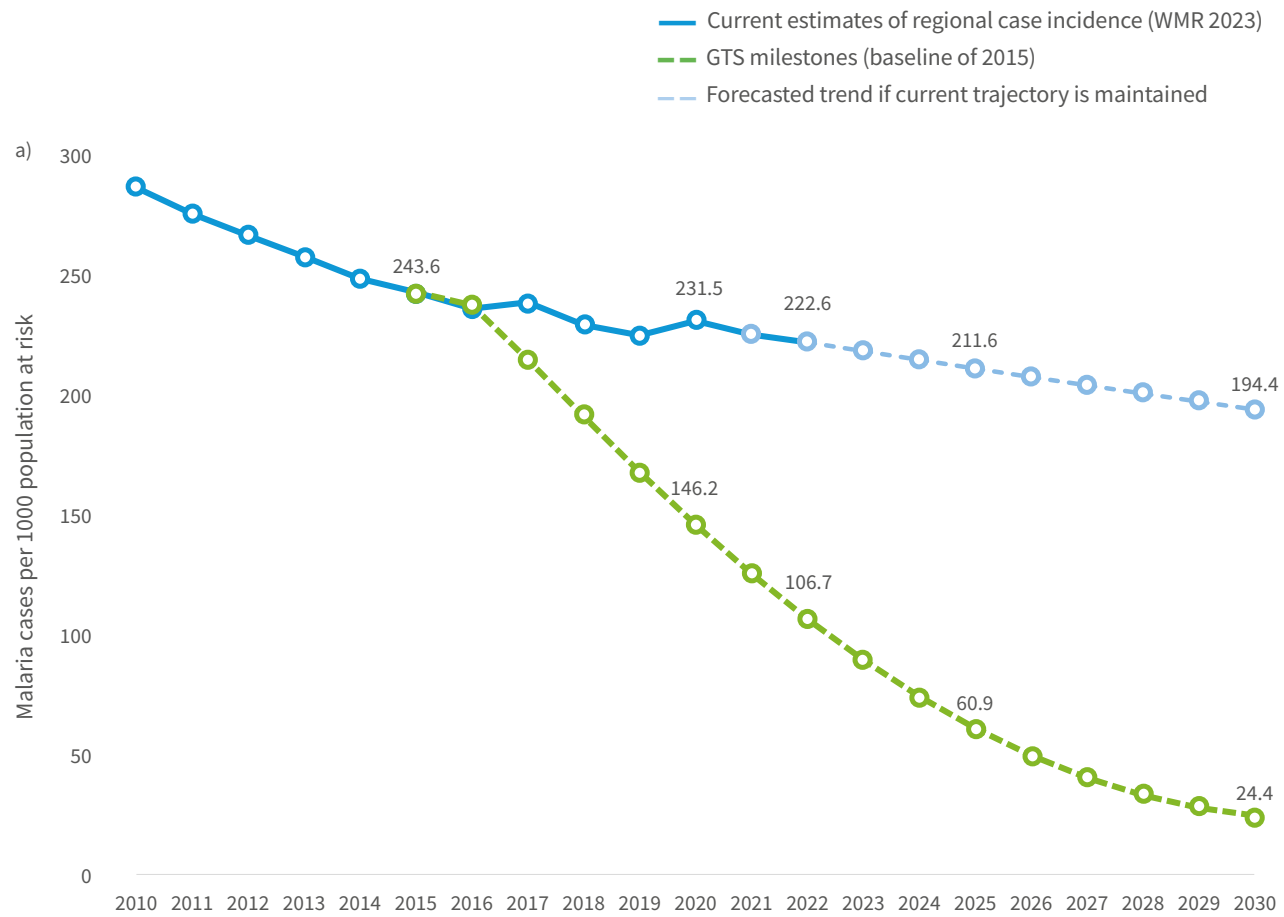
Although not on track, 19 countries (Burkina Faso, Cameroon, the Central African Republic, Equatorial Guinea, Eswatini, the Gambia, Ghana, Guinea, Kenya, Malawi, Mali, Mauritania, Mozambique, Niger, Senegal, Sierra Leone, Togo, the United Republic of Tanzania and Zambia) achieved reductions in malaria case incidence by 2022 compared with 2015 (Fig. 8.2). There was no difference (<5% increase or decrease) in case incidence in 2022 compared with 2015 in 10 countries (Benin, Botswana, Chad, Congo, the Democratic Republic of the Congo, Gabon, Liberia, Namibia, Nigeria and South Sudan). Case incidence was higher in 2022 than in 2015 by less than 25% in Côte d'Ivoire, Guinea-Bissau

and Uganda; increased by 25–55% in Angola, Burundi and Madagascar; and increased by 55% or more in the Comoros, Eritrea and Sao Tome and Principe.

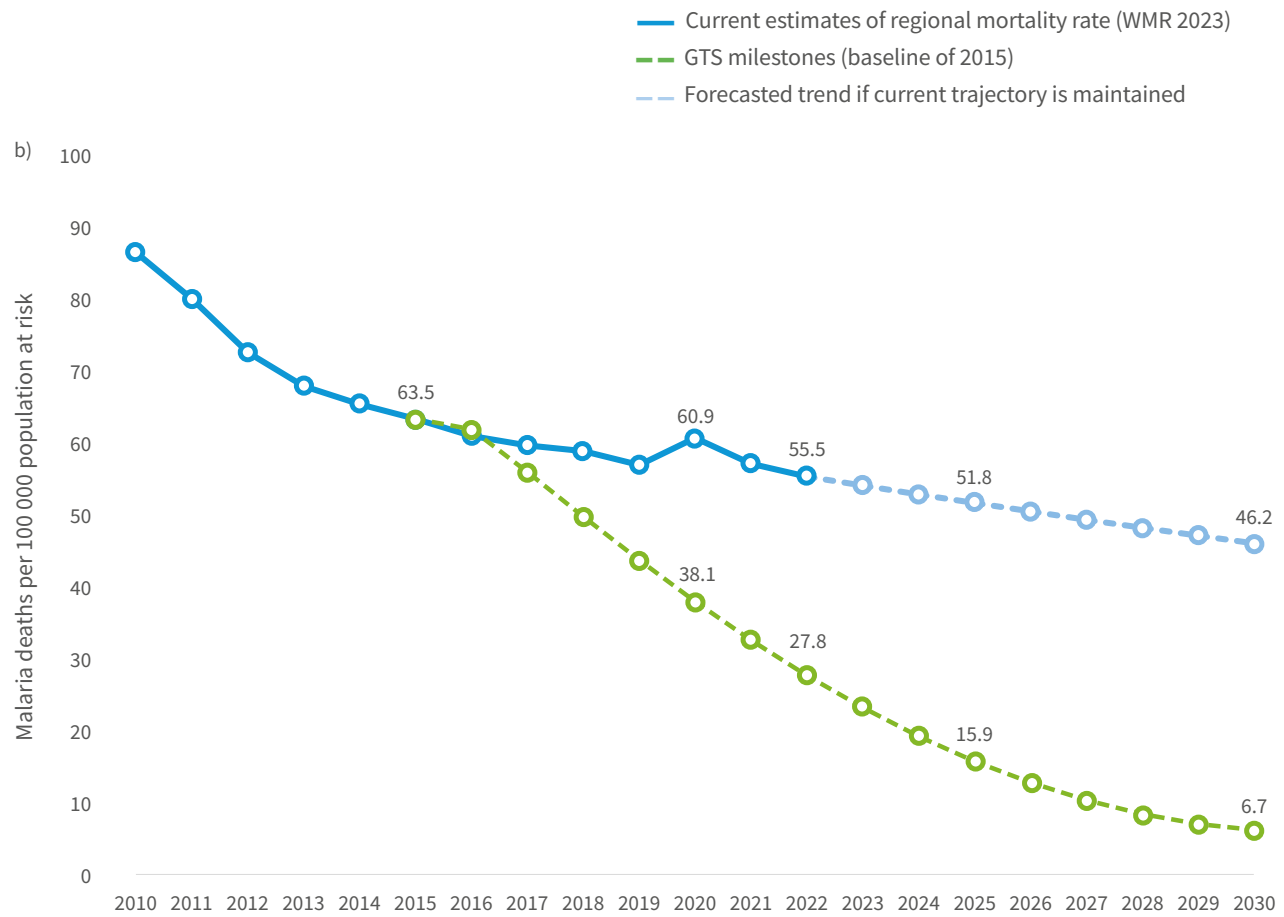
Cabo Verde and Sao Tome and Principe had zero estimated malaria deaths in 2022 (Fig. 8.3), and Ethiopia, South Africa and Zimbabwe achieved a reduction in mortality rate of 55% or more. Although 27 countries are off track to meet the GTS 2025 mortality milestones (Benin, Burkina Faso, Cameroon, Chad, Congo, the Democratic Republic of the Congo, Equatorial Guinea, Eswatini, Gabon, the Gambia, Ghana, Guinea, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Sudan, Togo, Uganda, the United Republic of Tanzania

and Zambia), these countries did achieve mortality rate reductions of less than 55%. Five countries (the Central African Republic, Côte d'Ivoire, Guinea-Bissau, Kenya and Liberia) showed no change (<5% increase or decrease) in mortality rate in 2022 compared with 2015, whereas increases in mortality rate of between 5% and 25% were seen in two countries (Botswana and Burundi); increases of between 25% and 55% were seen in Angola and Madagascar; and increases of 55% or more were reported in the Comoros and Eritrea. Despite being offtrack, caution is required when interpreting the trends in Botswana and the Comoros, because the increases experienced in both countries are associated with low numbers of deaths relative to the regional estimates.

Fig. 8.4.
Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO African Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) Source: WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.



8.3 WHO Region of the Americas

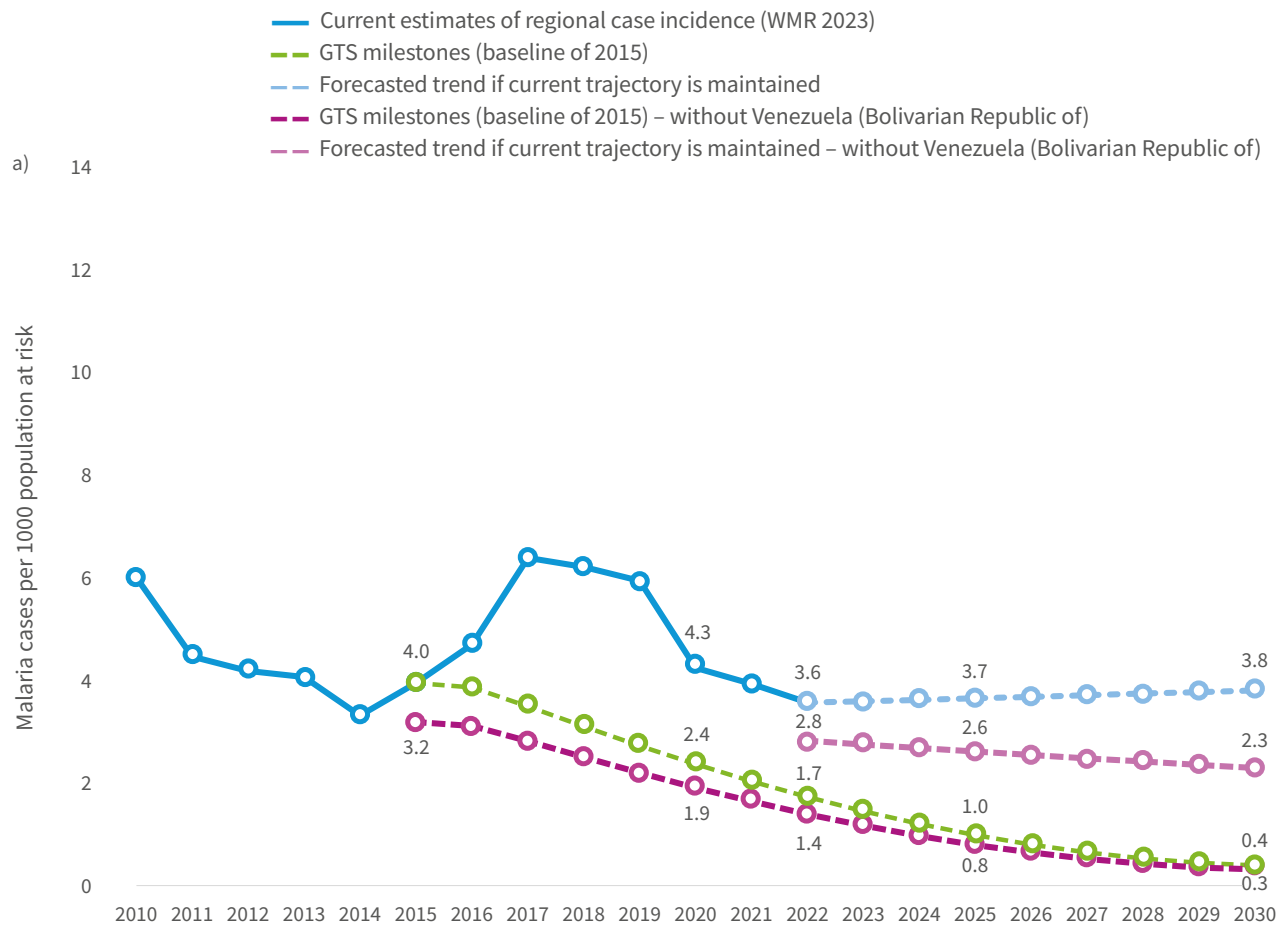
In the WHO Region of the Americas, El Salvador and Belize were certified malaria free in 2021 and 2023, respectively. The Dominican Republic, French Guiana, Guatemala, Mexico and Peru all had a reduction of more than 55% in case incidence in 2022 compared with 2015 (**Fig. 8.5**), with Suriname reporting zero indigenous cases for the first time. Over the same period, Honduras was estimated to have reduced malaria case incidence by between 25% and 55%, and Brazil by less than 25%. In Colombia, the estimated increase in case incidence was less than 25%, and in the Plurinational State of Bolivia and Guyana, estimated increases were between 25% and 55%. In Costa

Rica, Ecuador, Nicaragua and Panama, case incidence increased by 55% or more in 2022 compared with 2015. In the Bolivarian Republic of Venezuela and Haiti, there was no change in incidence in 2022 compared with 2015. Analysis of progress towards the GTS 2025 malaria case incidence milestones in the WHO Region of the Americas shows that the region is currently off track by 52%. On the current 10-year trajectory, by 2030 the region could be off track by 90%. At the regional level, most of the fluctuation in the trend is attributable to the epidemic experienced by the Bolivarian Republic of Venezuela

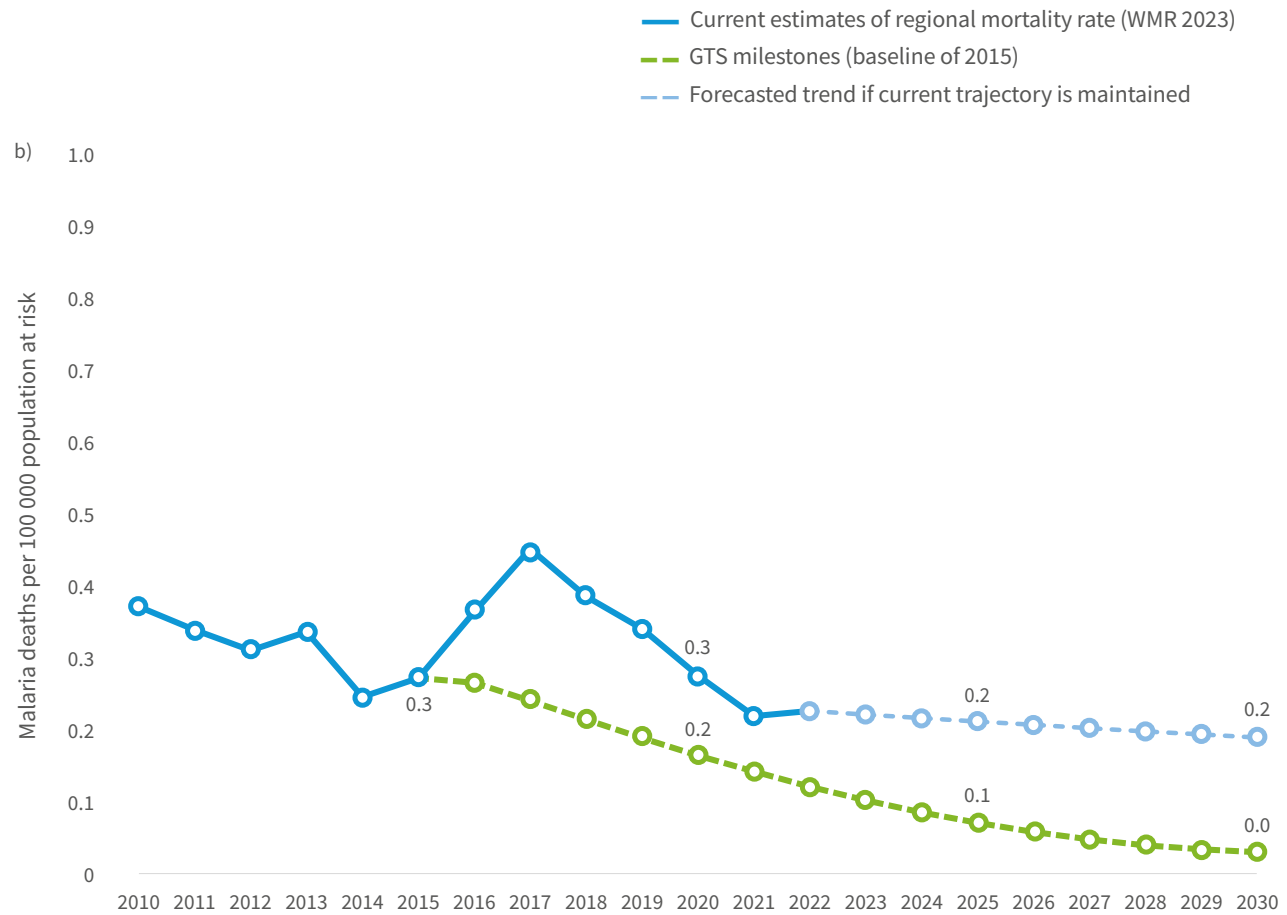
between 2017 and 2019. When the estimated cases from the Bolivarian Republic of Venezuela are excluded from the analysis, the trend is slightly reversed, although the region is still off track by 86% (**Fig. 8.5a**). The number of cases in the Bolivarian Republic of Venezuela more than halved in 2020 and reduced further in 2021 and 2022. Control measures must be strengthened in high-risk and migrant and mobile populations in the WHO Region of the Americas. To get the region back on track, the increasing trend in case incidence observed in several countries needs to be reversed. There were few malaria deaths in the WHO Region of the Americas (**Fig. 8.5b**), and changes in 2022 relative to the

GTS 2015 baseline should be interpreted with caution. For example, although the mortality rate in Ecuador and the Plurinational State of Bolivia increased by 55% or more (**Fig. 8.3**), it is estimated that the actual number of deaths would be one and five (reported), respectively. An estimated additional 81 deaths were from Brazil and Guyana, where there were increases of 25–55% in the mortality rate. Nevertheless, the region is currently off track for achieving all current and future GTS mortality rate milestones, with no change in trend projected between 2022 and 2030.

Fig. 8.5. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Region of the Americas considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) Source: WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.



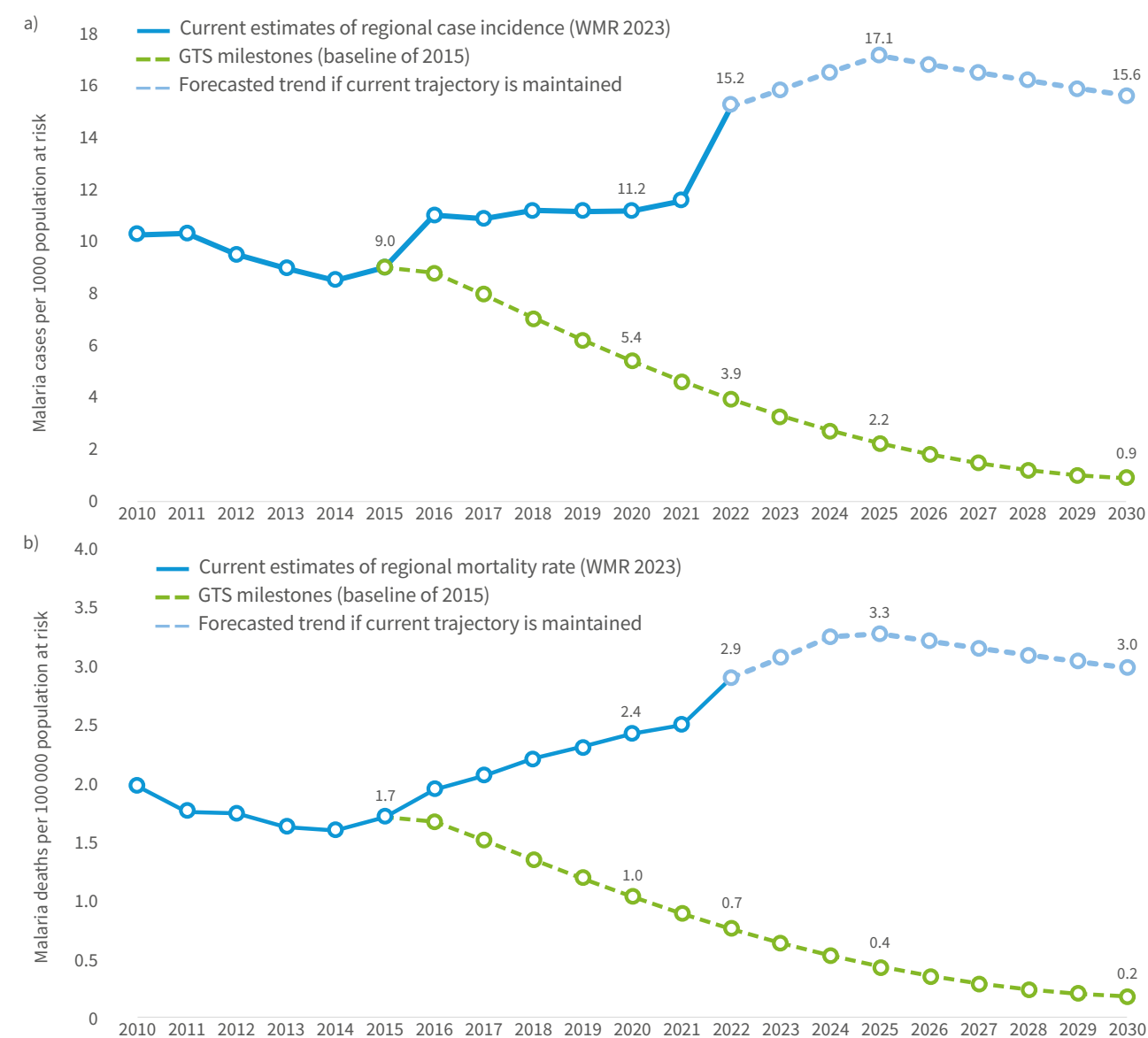
8.4 WHO Eastern Mediterranean Region

Since 2015, there has been an increase in case incidence and mortality rates in the WHO Eastern Mediterranean Region, both of which are now off track to meet the GTS 2025 morbidity target by 74% (**Fig. 8.6**). Saudi Arabia reported zero indigenous malaria cases for the second consecutive year in 2022. It is estimated that Afghanistan reduced case incidence by 25–55% in 2022 compared with 2015, although these estimates need to be verified through ongoing subnational analysis.

Djibouti, the Islamic Republic of Iran, Pakistan, Sudan and Yemen were off track, with malaria case incidence higher by

55% or more. It is estimated that case incidence in Somalia in 2022 was the same as in 2015 (**Fig. 8.2**). Malaria mortality rates decreased by 25–40% in Afghanistan in 2022 compared with 2015. Deaths increased by 55% or more in Djibouti, Pakistan and Sudan; and by 25–55% in Yemen; also, it is estimated that there was no change in malaria mortality in Somalia. Zero malaria deaths have been reported in Saudi Arabia since 2000, and zero indigenous malaria deaths have been reported in the Islamic Republic of Iran since 2009. In 2022, Afghanistan also reported zero malaria deaths.

Fig. 8.6.
Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Eastern Mediterranean Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)
Source: WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.

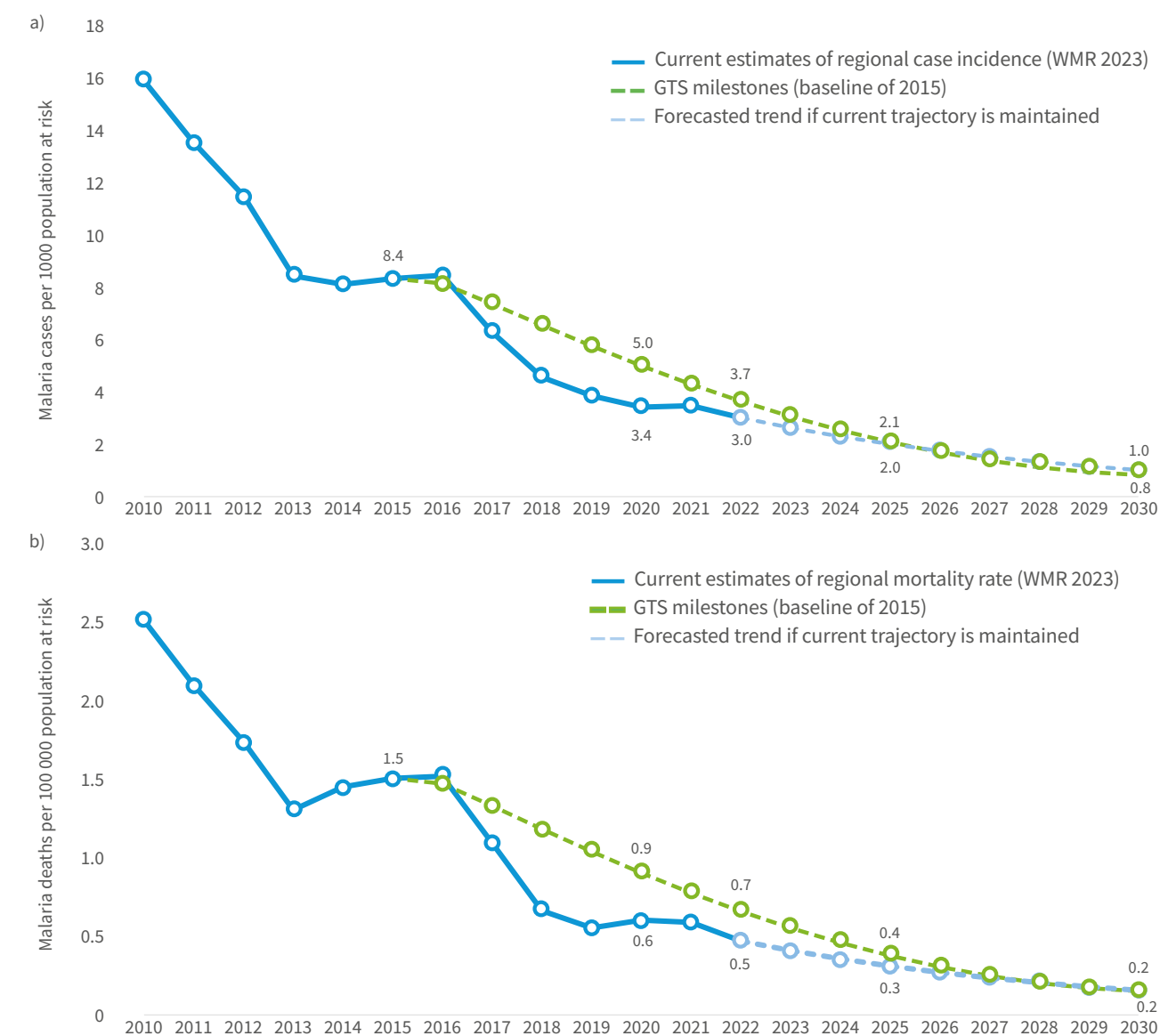
8.5 WHO South-East Asia Region

The WHO South-East Asia Region met the GTS 2020 milestones for both mortality and morbidity (**Fig. 8.7**), and the region remains on track to meet the GTS 2025 and 2030 targets. Sri Lanka was certified malaria free in 2016 and remains malaria free. Seven of the nine endemic countries in the region – Bangladesh, Bhutan, the Democratic People's Republic of Korea, India, Nepal, Thailand and Timor-Leste – reduced malaria case incidence by more than 55% in 2022 compared with 2015, with Timor-Leste reporting zero malaria cases in 2021 and 2022, and Bhutan reporting zero cases for the first time in 2022. There was no difference in

case incidence in Indonesia in 2022 compared with 2015. In Myanmar, case incidence increased by more than 55% over the same period (**Fig. 8.2**).

Zero malaria deaths were reported in Bhutan, the Democratic People's Republic of Korea, Nepal, Thailand and Timor-Leste. Bangladesh and India had reductions in mortality rate of 55% or more, and Myanmar had a reduction of less than 25%. Indonesia was the only country in the region with an increase in mortality rate (less than 25%) (**Fig. 8.3**).

Fig. 8.7.
Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO South-East Asia Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)
Source: WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.



8.6 WHO Western Pacific Region

The WHO Western Pacific Region did not achieve the GTS 2020 milestones for malaria morbidity or mortality; also, in 2022, case incidence and the mortality rate were off the GTS target for 2025 by 69% and 74%, respectively (Fig. 8.8). Between 2015 and 2022, case incidence and mortality rate increased by 30%. At the current trajectory, the burden and mortality rate are predicted to reduce by 9% and 16%, respectively, by 2030 (Fig. 8.8b).

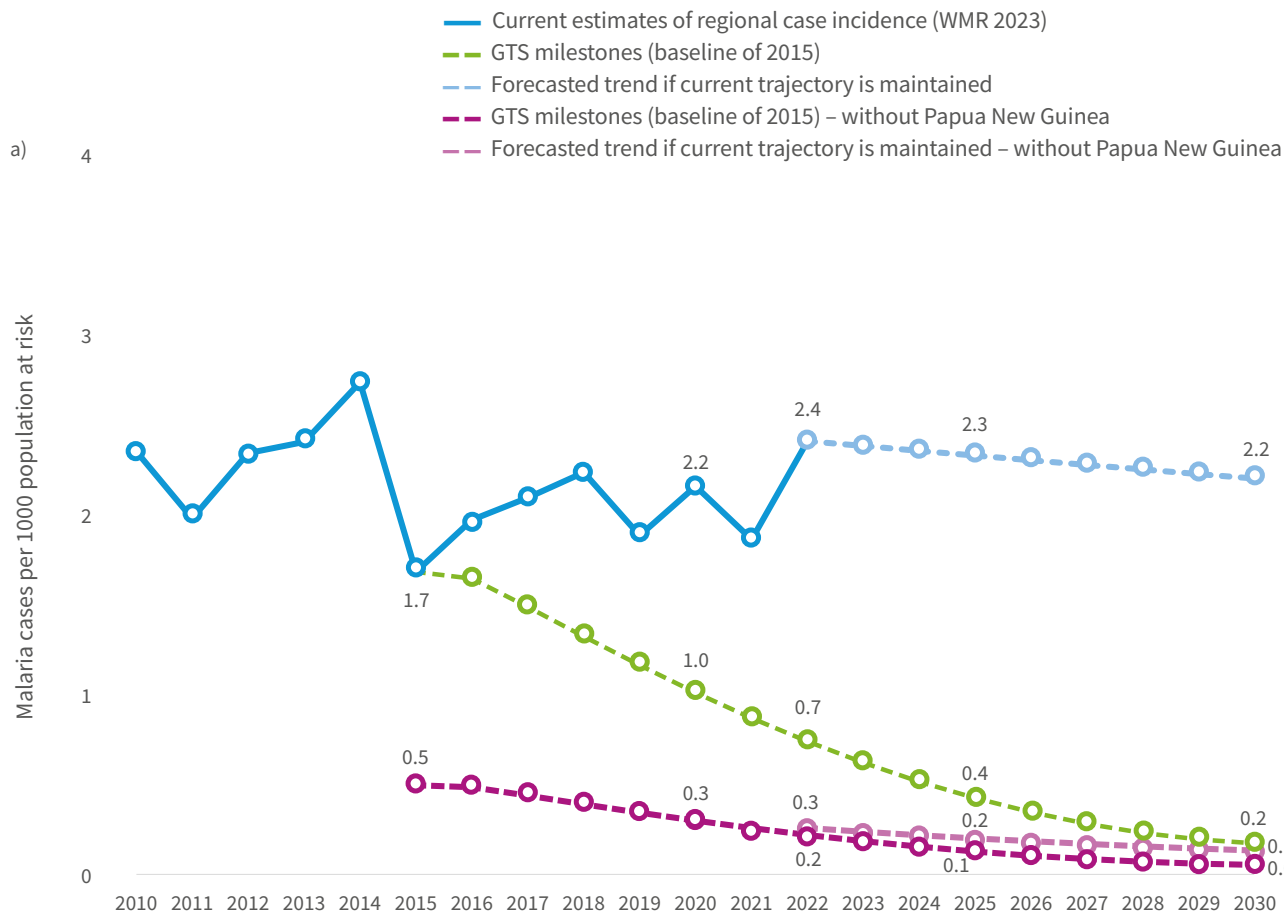
The lack of reduction in malaria case incidence and mortality rates is mainly due to increases of more than 55% in cases and deaths in Papua New Guinea, which accounts for about 90% of the burden of malaria in the region. If cases from Papua New Guinea are excluded from the analysis, then it is estimated that by 2030 the GTS case incidence milestone will be off track by 62%, whereas it will be off track by 92% if cases from Papua New Guinea are included in the projections (Fig. 8.8a). Increases of 55% or

more in case incidence were seen in Solomon Islands, which also accounts for a large proportion of cases in the region, and in Vanuatu, for which trends should be interpreted with caution because of the low number of cases.

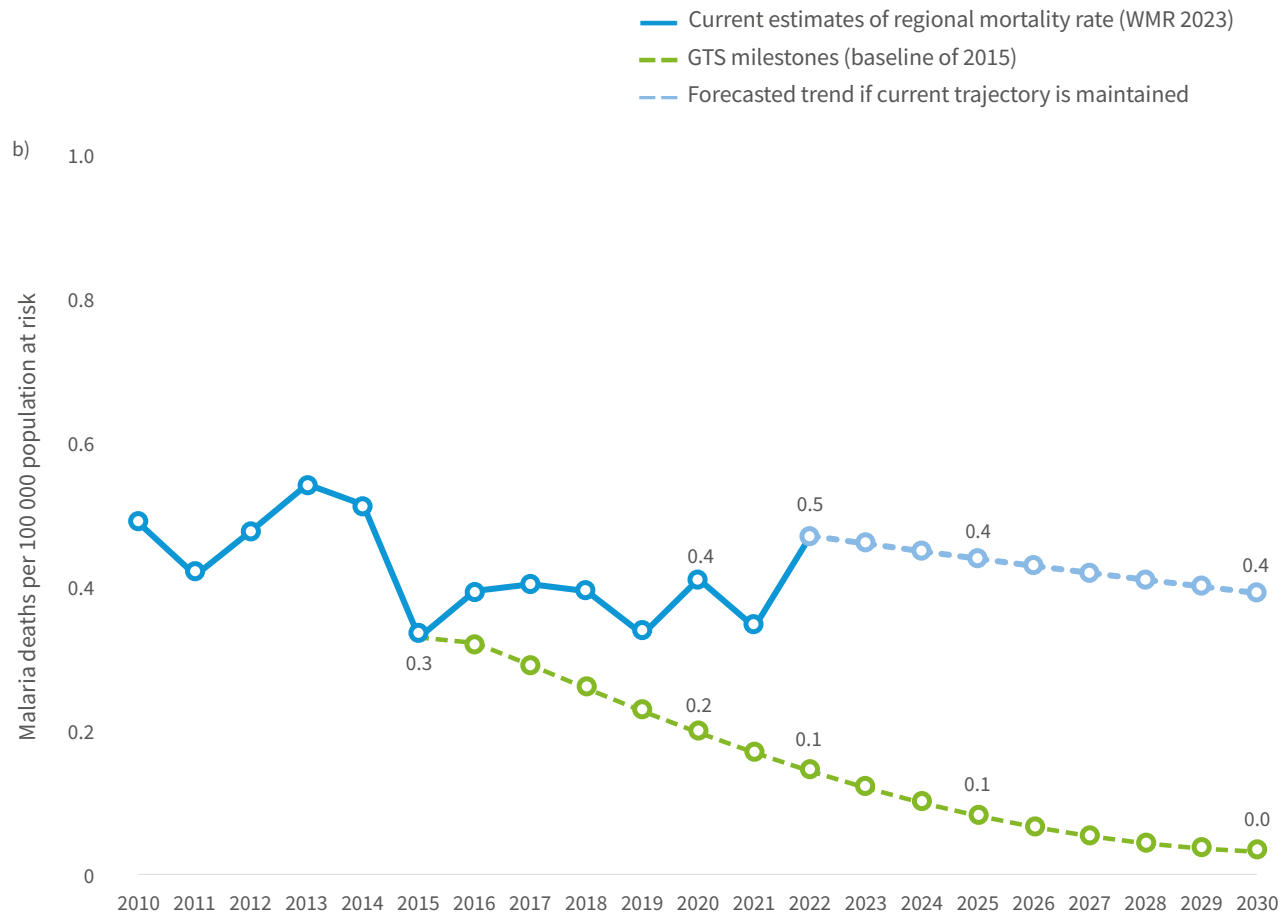
China was certified malaria free in 2021, and Malaysia reported zero malaria cases caused by human *Plasmodium* species for the fifth consecutive year in 2022. Decreases in case incidence of 55% or more occurred in all other countries in the region (Fig. 8.2). In 2015, Vanuatu was affected by a major cyclone that severely disrupted malaria diagnostic services and care seeking. As a result, it is likely

that malaria cases in 2015 were underestimated, which confounds assessment of progress towards the GTS targets relative to a 2015 baseline for Vanuatu. Cambodia, the Philippines, the Republic of Korea, Vanuatu and Viet Nam all reported zero malaria deaths. In Malaysia, there were zero indigenous deaths from human malaria, but nine deaths occurred due to zoonotic *P. knowlesi* infection. All other countries in the region apart from Papua New Guinea reported fewer than 15 deaths.

Fig. 8.8.
Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Western Pacific Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) Source: WHO estimates.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.



GTS: Global technical strategy for malaria 2016–2030; WHO: World Health Organization; WMR: world malaria report.

9 Biological threats to malaria interventions

9.1 Deletions in *P. falciparum* histidine-rich protein 2 and protein 3 genes

Most of the RDTs used to detect *P. falciparum* malaria target the histidine-rich protein 2 (HRP2) antigen; thus, *P. falciparum* parasites that do not express HRP2 may escape detection by RDTs that are based on detection of HRP2. At high parasite densities, histidine-rich protein 3 (HRP3), a homologue of HRP2 (i.e. with a common evolutionary origin), can cross-react with the monoclonal antibodies that detect HRP2. *P. falciparum* parasites that express neither HRP2 nor HRP3 will completely evade detection by these RDTs, about 415.5 million of which were sold in 2022 (according to data provided by manufacturers).

Deletions in the *P. falciparum* genes for HRP2 (encoded by the *Pfhrp2* gene) and HRP3 (*Pfhrp3*) were first reported in 2010 in the Peruvian Amazon basin, by researchers characterizing blood samples that were negative by HRP2-based RDTs but positive by microscopy (49). In recent years, *Pfhrp2/3*-deleted parasites have been documented outside of South America, including in Africa, Asia and the Middle East. Prevalence estimates vary widely, both within and between countries. In Djibouti, Eritrea and Peru, the prevalence of dual *Pfhrp2*- and *Pfhrp3*-deleted parasites among symptomatic patients was as high as 80% in some areas; this finding demonstrates that these parasites can become dominant in the population, posing a serious global threat to people with malaria and increasing the risk that missed cases will progress to severe disease or death (50).

WHO has published guidance on investigating suspected *Pfhrp2/3* deletions (51), and recommends that countries

with reports of *Pfhrp2/3* deletions, and neighbouring countries, should conduct representative baseline surveys among suspected malaria cases, to determine whether the prevalence of *Pfhrp2/3* deletions causing false negative RDT results exceeds the threshold that requires a change of RDT. This threshold is currently set at more than 5% *Pfhrp2* deletions causing false negative RDT results. Alternative RDT options (e.g. based on detection of *Plasmodium* lactate dehydrogenase) are limited; in particular, there are currently no WHO-prequalified non-HRP2 combination tests that can detect and distinguish between *P. falciparum* and *P. vivax*.

WHO is tracking published reports of *Pfhrp2/3* deletions using the Malaria Threats Map application (52) and is encouraging a harmonized approach to mapping and reporting of *Pfhrp2/3* deletions through publicly available survey protocols (53).

Based on literature searches informing the Malaria Threats Map, 16 new articles with information on *Pfhrp2* deletions were published in 2022 (52). These publications included data from 12 countries within the WHO African Region (Burundi, Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Ethiopia, Ghana, Kenya, Madagascar, Rwanda, Sierra Leone, South Sudan and the United Republic of Tanzania); three countries from the Region of the Americas (Brazil, Ecuador and Peru), two countries from the Western Pacific Region (Cambodia and Viet Nam) and one country from the South-East Asia Region (India). Studies from six countries (Burundi, Cambodia, Cameroon,

Sierra Leone, South Sudan and Viet Nam) were the first *Pfhrp2* papers published from these countries; among these studies, those from Burundi and Viet Nam did not detect any *Pfhrp2* deletions. The studies in Ecuador, Equatorial Guinea, Kenya and Rwanda did not identify any *Pfhrp2* deletions, although deletions in these countries have been reported previously. Based on data from publications included in the Malaria Threats Map (52), some form of investigation for *Pfhrp2/3* deletions has been conducted in 50 countries. The estimated prevalence of *Pfhrp2* gene deletions globally is shown in Fig. 9.1.

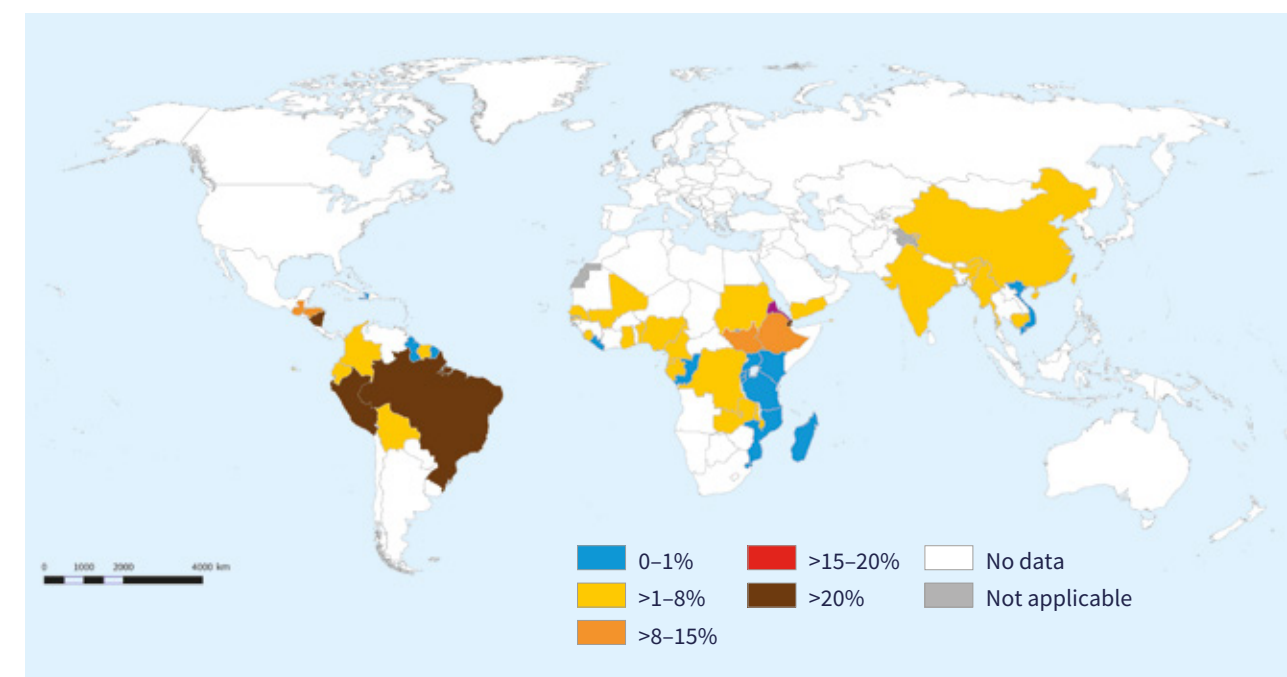
In December 2022, WHO launched an online survey to monitor the countries in which studies of *Pfhrp2/3* deletions were planned or ongoing, or had recently been completed (54), to support countries and donors to plan and allocate resources. Survey responses were received from 17 countries between December 2022 and June 2023; the results indicated that studies are being planned in six countries in the WHO African Region (Ghana, Malawi,

Mozambique, Nigeria, Uganda and the United Republic of Tanzania) and two countries in the Eastern Mediterranean Region (Libya and Somalia). Ongoing studies were reported in 10 countries in the WHO African Region (Burkina Faso, Cameroon, the Democratic Republic of the Congo, Ghana, Kenya, Mozambique, Nigeria, Rwanda, South Africa and Uganda) and two countries in the Region of the Americas (Brazil and Guyana). Ethiopia and Guyana reported studies as “completed but not yet published”. More detailed information is available through the Malaria Threats Map (52).

The WHO response plan for *Pfhrp2/3* deletions outlines several areas for action beyond scaling up of surveillance (55). Areas for action include identifying new biomarkers; improving the performance of non-HRP2 RDTs; undertaking market forecasting; and strengthening of laboratory networks, to support the demand for using molecular characterization to determine the presence or absence of these gene deletions.

Fig. 9.1.

Estimated prevalence of *Pfhrp2* gene deletions, 2022 Source: Review of published literature included in the Malaria Threats Map (52).



9.2 Status of antimalarial drug efficacy and resistance (2015–2022)

Effective treatment for malaria is a key component in the fight against this disease. The emergence of resistance to artemisinin and partner drugs is a significant risk to the global effort to reduce the burden of malaria (2). Artemisinin partial resistance in *P. falciparum* has been detected in four countries in the WHO African Region. The spread of artemisinin partial resistance in Africa is of great concern, requiring an urgent response. In November 2022, WHO launched the *Strategy to respond to antimalarial drug resistance in Africa* (56). To support the operationalization of this strategy, WHO organized two meetings in Uganda in November 2023: a regional stakeholder meeting on the response to resistance in Africa, and a meeting of the antimalarial drug efficacy and resistance surveillance networks for countries in eastern Africa and the Horn of Africa.

Artemisinin partial resistance continues to be a threat in other parts of the world, including the GMS and South America, and in Papua New Guinea. Resistance to ACT partner drugs has prompted changes in first-line treatment of *P. falciparum* in countries in the GMS, the Horn of Africa and south Asia. As part of the response to counter the threat of antimalarial drug resistance, WHO has called on malaria endemic countries and global malaria partners to strengthen the surveillance of antimalarial drug efficacy and resistance, and to ensure that the most effective treatments are selected for national treatment policy.

Antimalarial drug efficacy is monitored through therapeutic efficacy studies (TES), which track clinical and parasitological outcomes among patients receiving antimalarial treatment. Studies conducted according to the criteria established in the WHO protocol (57) help to detect changes in treatment efficacy over time. Polymerase chain reaction (PCR) correction is required to distinguish between cases with treatment failure caused by reinfection and those due to recrudescence. WHO recently updated its guidance on the methodology used to distinguish reinfection from recrudescence in areas of high malaria transmission (58). TES are considered the gold standard by which NMPs can best determine their national treatment policies. In countries where malaria transmission is low and in countries pursuing elimination, surveillance systems for case management have been strengthened so that all malaria cases are detected, treated and followed up to ensure cure. In this context, drug efficacy monitoring can be conducted by integrated drug efficacy surveillance (iDES) as part of the routine case-based surveillance and response system.

Antimalarial drug resistance can be assessed using several tools. For some drugs, genetic changes associated with reduced drug sensitivity have been identified. For example,

several *P. falciparum* *Kelch13* (*PfKelch13*) mutations are associated with delayed parasite clearance after a treatment containing artemisinin; hence, surveys of these mutations can provide information on the emergence and spread of artemisinin partial resistance (defined as delayed clearance after treatment with a drug containing an artemisinin). Resistance to sulfadoxine-pyrimethamine (SP) (an ACT partner and chemoprevention drug) can be monitored by the detection of mutations in the dihydrofolate reductase (*dhfr*) and dihydropteroate synthase (*dhps*) genes of *P. falciparum*. Resistance to mefloquine is associated with an increase in *Pfmdr1* copy numbers, and resistance to piperaquine is associated with an increase in *Pfplasmepsin 2/3* copy numbers and mutations in the *P. falciparum* chloroquine resistance transporter (*PfCRT*) (59). Some mutations have only been validated as markers associated with resistance in parasite strains from specific regions.

This section of the report summarizes the status of antimalarial drug efficacy and resistance in malaria endemic countries, focusing on studies that found high proportions of treatment failures. Key results are presented for each WHO region for TES for *P. falciparum* and *P. vivax* from 2015 to 2022. Treatment failure rates were calculated using the per protocol method unless otherwise indicated. A minimum sample size of 20 patients was applied to the analysis. Details of studies referenced here can be found in the Malaria Threats Map (52).

9.2.1 WHO African Region

In the WHO African Region, the first-line treatments for *P. falciparum* infection include artemether-lumefantrine (AL), artesunate-amodiaquine (AS-AQ), artesunate-pyronaridine (AS-PY) and dihydroartemisinin-piperaquine (DHA-PPQ). Most TES conducted according to the WHO standard protocol have demonstrated good efficacy (**Fig. 9.2**). Some studies in the WHO African Region have shown higher levels of treatment failure; these results warrant further investigation and could be a sign of emergence of resistance to ACT partner drugs, but the studies should be treated with caution because of significant deviations from the WHO standard protocol.

Fig. 9.2 shows five studies reporting treatment failure rates greater than 10% after treatment with AL using the WHO-recommended methodology for PCR correction in the WHO African Region in the period 2015–2022: a study conducted at three sites in Burkina Faso (60), one small study in Uganda (61) and one study in Kenya (62). Two of the study sites in Burkina Faso (both reporting high failure rates with AL) reported treatment failure rates greater than

10% after treatment with DHA-PPQ (60); however, concern has been raised about the quality of microscopy in Burkina Faso (63). In Kenya, evening doses of AL were not provided as supervised treatment (62).

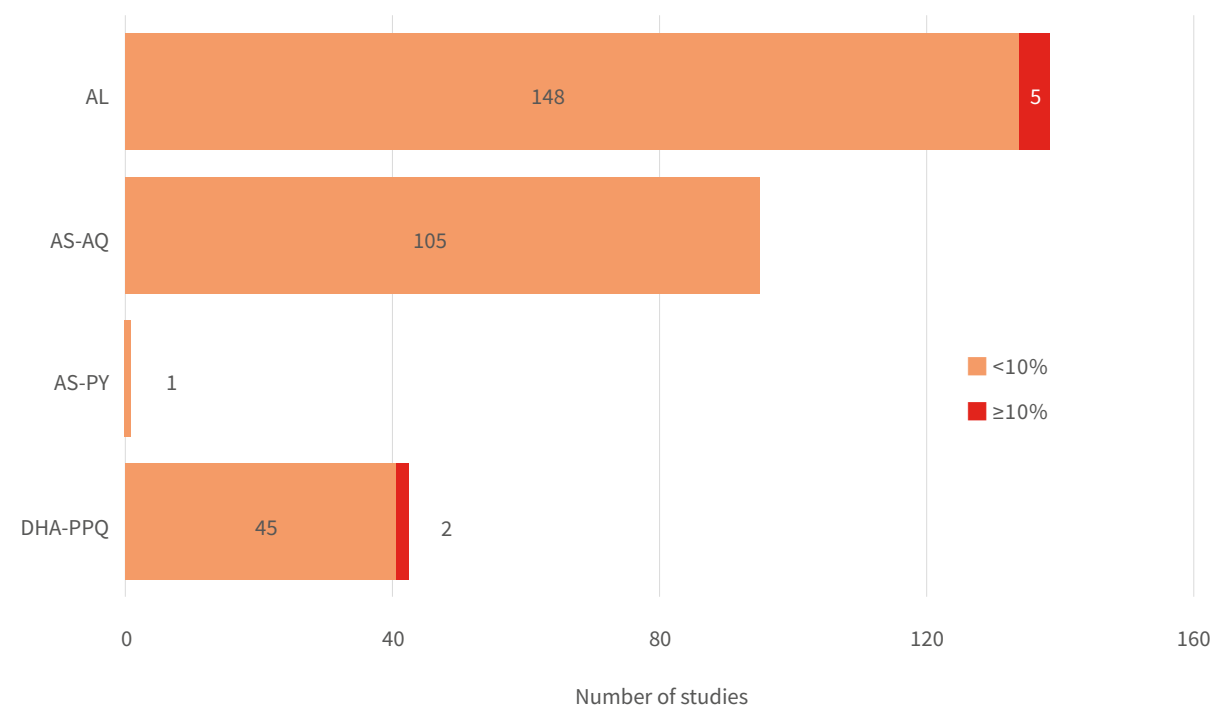
A further five studies with AL and one study with DHA-PPQ reported treatment failure rates greater than 10% when using Bayesian algorithms to distinguish between reinfection and recrudescence; they included studies in Angola (64, 65), the Democratic Republic of the Congo (66) and Uganda (67).

Surveillance of *PfKelch13* polymorphisms associated with artemisinin partial resistance has been undertaken in several countries in the WHO African Region (52), and there is evidence of artemisinin partial resistance associated with clonal expansion of *PfKelch13* mutations in Eritrea (68), Rwanda (69), Uganda (70) and the United Republic of Tanzania (unpublished). In Rwanda, the R561H mutation was first identified in 2014. Several studies undertaken in 2018 and 2019 found R561H in more than 15% of samples

(71). Further, the presence of the R561H mutation has been associated with delayed parasite clearance among patients treated with AL (71, 72). Rwanda was the first country in the WHO African Region to confirm the presence of artemisinin partial resistance. In Uganda, molecular surveillance has shown increases in prevalence and geographical spread for multiple *PfKelch13* mutations (70, 73). Additionally, R622I, a validated marker of artemisinin partial resistance, has been found in an increasing proportion of samples in the Horn of Africa; in particular, in Eritrea where there is also evidence of delayed clearance after treatment with ACTs. In Eritrea and Ethiopia, parasites carrying both R622I and *Pfhrp2/3* deletions have been detected (68, 74). Recently, the United Republic of Tanzania became the fourth country in Africa to have artemisinin partial resistance confirmed; studies in Kagara provided evidence of delayed clearance after treatment with AL and AS-AQ, and a high prevalence of the R561H mutation (unpublished).

Fig. 9.2.

Number of *P. falciparum* TES finding more or less than 10% treatment failures in the WHO African Region, by ACT (2015–2022), among studies with at least 20 patients Source: WHO, 2022 (75).



ACT: artemisinin-based combination therapy; AL: artemether-lumefantrine; AQ: amodiaquine; AS: artesunate; DHA: dihydroartemisinin; *P. falciparum*: *Plasmodium falciparum*; PPQ: piperaquine; PY: pyronaridine; TES: therapeutic efficacy studies; WHO: World Health Organization.

P. vivax is endemic in only a few countries in the WHO African Region. Studies conducted in Ethiopia between 2016 and 2021 found high therapeutic efficacy, with treatment failure rates of less than 5% in nine studies of chloroquine (CQ) and two studies of DHA-PPQ.

9.2.2 WHO Region of the Americas

The first-line treatments for *P. falciparum* in the WHO Region of the Americas include AL, artesunate-mefloquine (AS-MQ) and CQ. Limited data are available from this region. TES undertaken using AL in Brazil (2015) (76) and Colombia (2018) (77) demonstrated high efficacy of this drug. In Guyana, the C580Y mutation was sporadically observed between 2010 and 2017 (78); however, the mutation has not been found in any of the more recent samples, indicating that it has probably disappeared.

All malaria endemic countries in the WHO Region of the Americas recommend CQ as a first-line treatment for *P. vivax*. Efficacy of CQ was studied in Brazil and was found to be high.

9.2.3 WHO South-East Asia Region

The first-line treatments for *P. falciparum* in the WHO South-East Asia Region include AL, AS-MQ, AS-PY, AS plus SP (AS+SP) and DHA-PPQ. As can be seen in **Fig. 9.3a**, no TES reported more than 10% treatment failures. Treatment failures with AS+SP remained low in India; however, findings from a study in Chhattisgarh state between 2015 and 2017 looking at *dhfr* and *dhps* mutations (79) could be an early warning of changes that prompted a need for treatment policy change from AS+SP in north-eastern India. In Thailand, drug efficacy is assessed using iDES (80); hence, these results are not included in **Fig 9.2**. In 2019, a disproportionately high treatment failure rate was detected in Sisaket province, with failure rates of up to 50%. This led Thailand to change its first-line treatment to AS-PY in 2020 in Sisaket and Ubon Ratchathani.

In the GMS, *PfKelch13* mutations associated with artemisinin partial resistance have reached a high prevalence. Among samples collected in Myanmar and western Thailand between 2015 and 2020, *PfKelch13* wild-type parasites were found in 65.5% of samples (52).

The first-line treatments for *P. vivax* are CQ, AL and DHA-PPQ. High treatment efficacy was found in all studies of CQ, DHA-PPQ and AS-PY.

9.2.4 WHO Eastern Mediterranean Region

The first-line treatment for *P. falciparum* in the WHO Eastern Mediterranean Region is AL. TES conducted in 2015 detected high treatment failure rates with AS+SP alone in

Somalia (81) and Sudan (82) (**Fig. 9.3b**), which prompted changes in treatment policy to AL in both countries. Data on the efficacy of AL for the treatment of *P. falciparum* are available from Afghanistan, Pakistan, Somalia, Sudan and Yemen (2015–2020); all demonstrated high treatment efficacy.

The first-line treatments for *P. vivax* are AL and CQ. Studies conducted on the efficacy of first-line treatments for *P. vivax* are available from one study of AL in Somalia (2018) and two studies of CQ in Afghanistan (2016 and 2022); no treatment failures were observed.

9.2.5 WHO Western Pacific Region

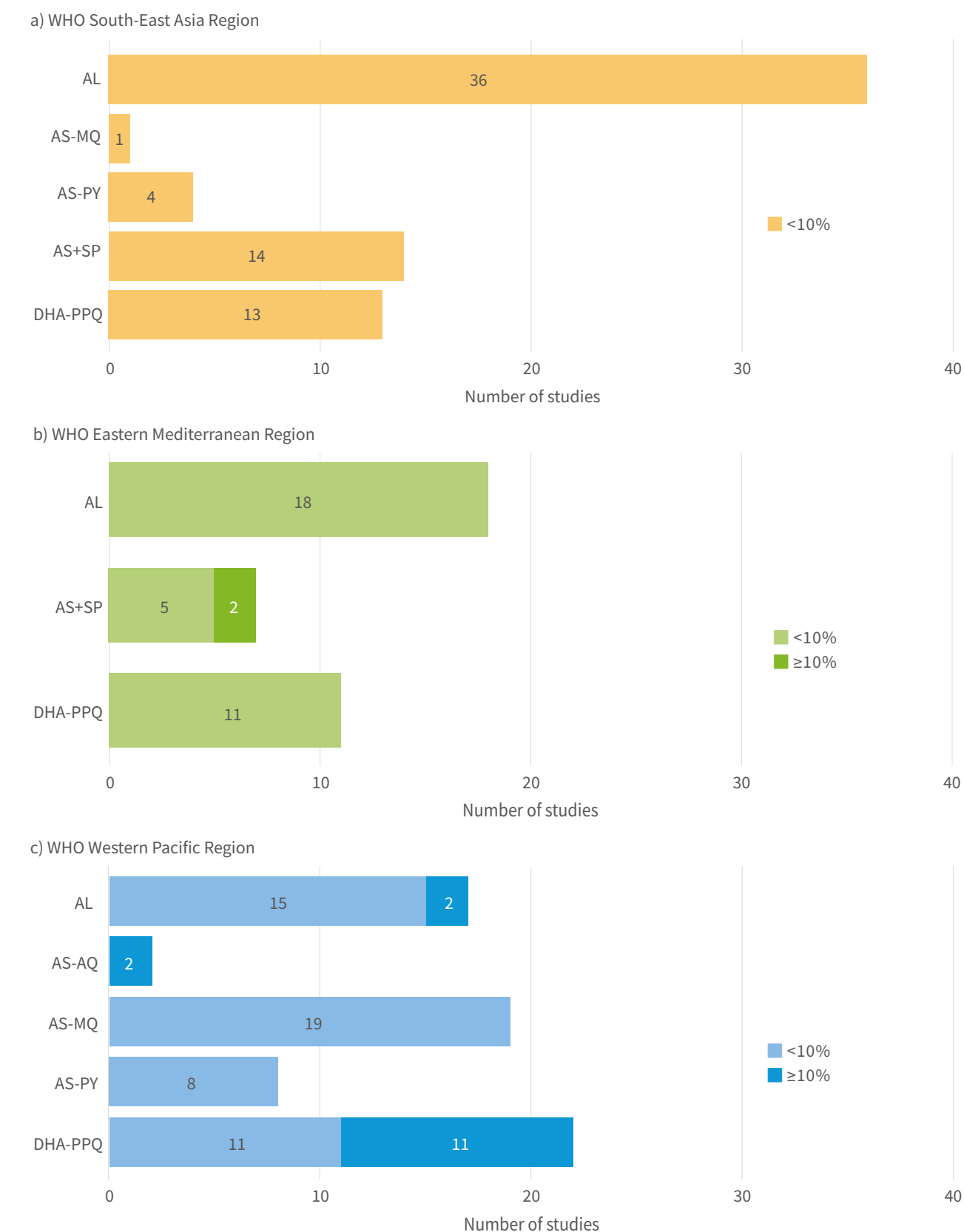
The first-line treatments for *P. falciparum* in the WHO Western Pacific Region include AL, AS-MQ, AS-PY and DHA-PPQ. In this region, TES have found high failure rates in studies with AL, AS-AQ and DHA-PPQ (**Fig. 9.3c**). In the Lao People's Democratic Republic, a high treatment failure rate was observed with AL in one study in Salavanh province in 2017 (17.2%); however, the study was limited to 29 patients. AL was subsequently found to be effective in the Lao People's Democratic Republic provinces of Champassak, Salavanh and Savannakhet in 2019, with failure rates of up to 5%. A failure rate of 13.5% was found in a study with 37 patients enrolled in 2018–2020 in western Cambodia (83). The presence of AQ resistance was documented in Cambodia in 2016–2017, with high treatment failure rates with AS-AQ in the provinces of Monduliri (22.6%) and Pursat (13.8%) (84). High rates of treatment failure were detected with DHA-PPQ in Cambodia, the Lao People's Democratic Republic and Viet Nam. In Cambodia, the findings prompted the replacement of DHA-PPQ with AS-MQ as the first-line treatment in 2016. In Viet Nam, AS-PY has replaced DHA-PPQ in provinces where high treatment failure rates were detected.

PfKelch13 wild-type parasites were found in 29.9% of samples collected between 2015 and 2020 in Cambodia, the Lao People's Democratic Republic and Viet Nam. In Papua New Guinea, the *PfKelch13* C580Y mutation has emerged and appears to be spreading (85).

The first-line treatments for *P. vivax* in the WHO Western Pacific Region are AL, AS-MQ and CQ. In Viet Nam in 2015, one study of CQ found treatment failure rates of 9.8%.

Fig. 9.3.

Number of *P. falciparum* TES finding more or less than 10% treatment failures, a) in the WHO South-East Asia Region, b) in the WHO Eastern Mediterranean Region and c) in the WHO Western Pacific Region, by ACT (2015–2022), among studies with at least 20 patients Source: WHO, 2022 (75).



ACT: artemisinin-based combination therapy; AL: artemether-lumefantrine; AQ: amodiaquine; AS: artesunate; DHA: dihydroartemisinin; MQ: mefloquine; *P. falciparum*: *Plasmodium falciparum*; PPQ: piperazine; PY: pyronaridine; SP: sulfadoxine-pyrimethamine; TES: therapeutic efficacy studies; WHO: World Health Organization.



9.3 Vector resistance to insecticides

Since 2021, insecticide resistance data have been reported to WHO from countries in the WHO African Region (Angola, Burkina Faso, Burundi, Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe), the Region of the Americas (Colombia, the Dominican Republic, Nicaragua and Peru), the Eastern Mediterranean Region (Afghanistan, the Islamic Republic of Iran, Saudi Arabia, Somalia, Yemen), the Western Pacific Region (Cambodia and Papua New Guinea) and the South-East Asia Region (India). These data are under collation and in 2024 will be added to the Malaria Threats Map (52).

Of the 88 countries that reported insecticide resistance monitoring data to WHO between 2010 and 2020, 78 confirmed resistance to at least one insecticide in one malaria vector species from one mosquito collection site. Of these countries, 29 confirmed resistance to four insecticide classes – pyrethroids, organophosphates, carbamates and organochlorines – in at least one malaria vector species across different sites in the country (Fig. 9.4). Of these, 19 presented at least one site where resistance was confirmed for all these four classes in at least one local vector.

Globally, resistance to pyrethroids was detected in at least one malaria vector in 87% of the countries and 68% of the sites, to organochlorines in 82% of the countries and 64% of the sites, to carbamates in 69% of the countries and 34% of the sites, and to organophosphates in 60% of the countries and 28% of the sites. Resistance to these four insecticide classes was confirmed in all WHO regions; however, the geographical extent of the resistance varied widely between regions (Fig. 9.5). Maps showing the status of resistance to different insecticides at each site are available in the Malaria Threats Map (52).

Among the 38 countries that reported data on the intensity of pyrethroid resistance, high intensity resistance was detected in 27 countries and 293 sites, moderate to high intensity resistance in 34 countries and 406 sites, and moderate intensity resistance in 21 countries and 78 sites. High intensity resistance to pyrethroids has been detected more frequently in west Africa than in other subregions.

Between 2019 and 2020, WHO Member States reported the results of 835 bioassays conducted with chlorfenapyr and 603 with clothianidin. For chlorfenapyr, WHO requirements are more elaborate than for procedures for testing of

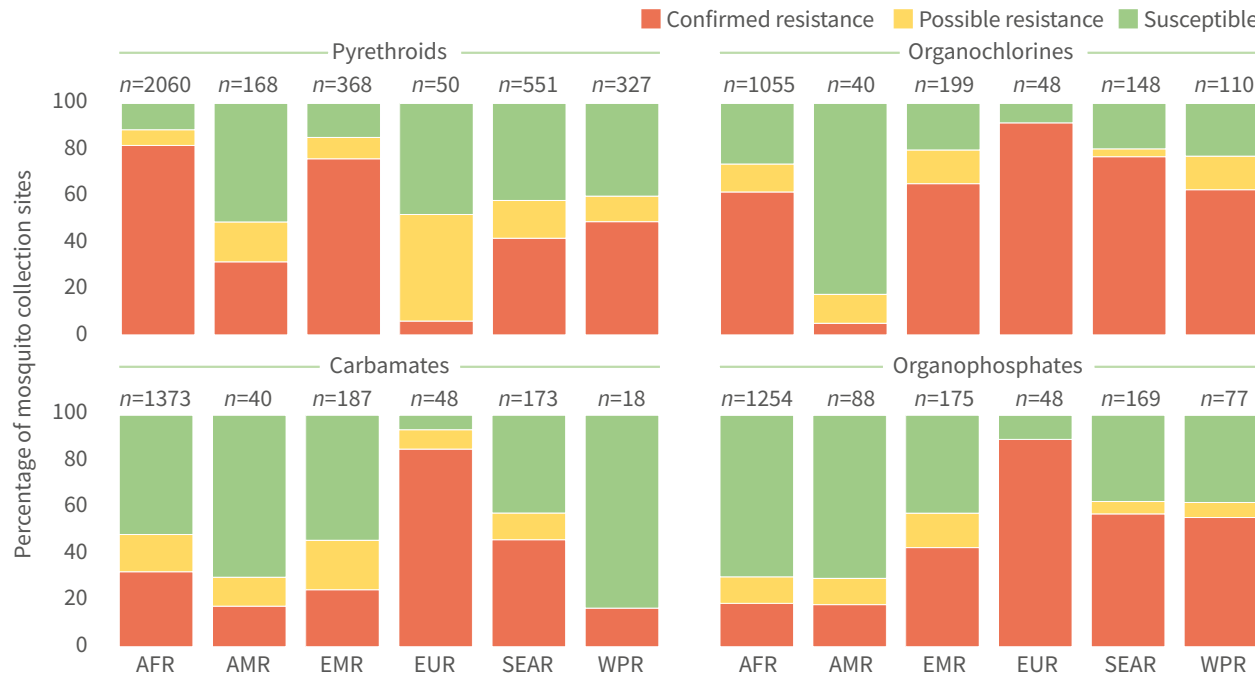
mosquito resistance to other insecticides (86). Specifically, bottles need to be coated with 1 mL of chlorfenapyr-acetone mixture at the discriminating dose 24 hours before the test; tests need to be conducted within a strict range of temperature (27 ± 2 °C) and humidity ($80\% \pm 10\%$); mosquito mortality has to be measured 72 hours after exposure in bottles; and a susceptible colony has to be tested in parallel to the wild mosquitoes. Resistance can be confirmed only when mortality in the exposed wild vector population 72 hours after exposure is less than 90% and mortality in the susceptible colony tested in parallel is more than 98%; also, the same mortality must be recorded in at least three bioassays conducted at the same site with the same wild vector population at different time points. To date, WHO has received results from 502 tests conforming to these requirements, conducted in 391 sites across 20 countries. Until three complete tests are available from each of these sites, WHO cannot interpret these results. For assessing resistance to clothianidin, WHO recommends assessing in the WHO bottle bioassay at a dose of 4 µg/bottle, with MERO® at 800 ppm, with acetone as a solvent (86). To date, only 13 results using this bioassay have been reported to WHO, with one case of possible resistance reported from Senegal. However, there are reports indicating loss of susceptibility using other methods, which require validation using WHO test procedures.

Results of biochemical and molecular assays to detect metabolic resistance mechanisms were available for 35 countries and 364 sites for the period 2010–2020. Mono-oxygenases were detected in 68.3% of the sites for which reports were available, glutathione S-transferases in 81.9% of the sites, esterases in 78.5% of the sites and acetylcholinesterases in 73.5% of the sites. Results of assays to detect target-site resistance mechanisms were available for 40 countries and 596 sites. Kdr L1014F was detected in 76% of the sites and Kdr L1014S in 53.1% of the sites.

Insecticide resistance data collected using WHO procedures are included in the WHO global database on insecticide resistance (87) and are publicly available via the Malaria Threats Map (52). The latter provides a summary table showing the status of phenotypic resistance and resistance mechanisms by country and allows selected datasets to be downloaded; it also includes an animation of insecticide resistance evolution over time, based on reports received by WHO.

Fig. 9.4.

Reported insecticide resistance status as a proportion of sites for which monitoring was conducted, by WHO region, 2010–2020, for pyrethroids, organochlorines, carbamates and organophosphates^a Sources: Reports from NMPs and national health institutes, their implementation partners, research institutions and scientific publications.

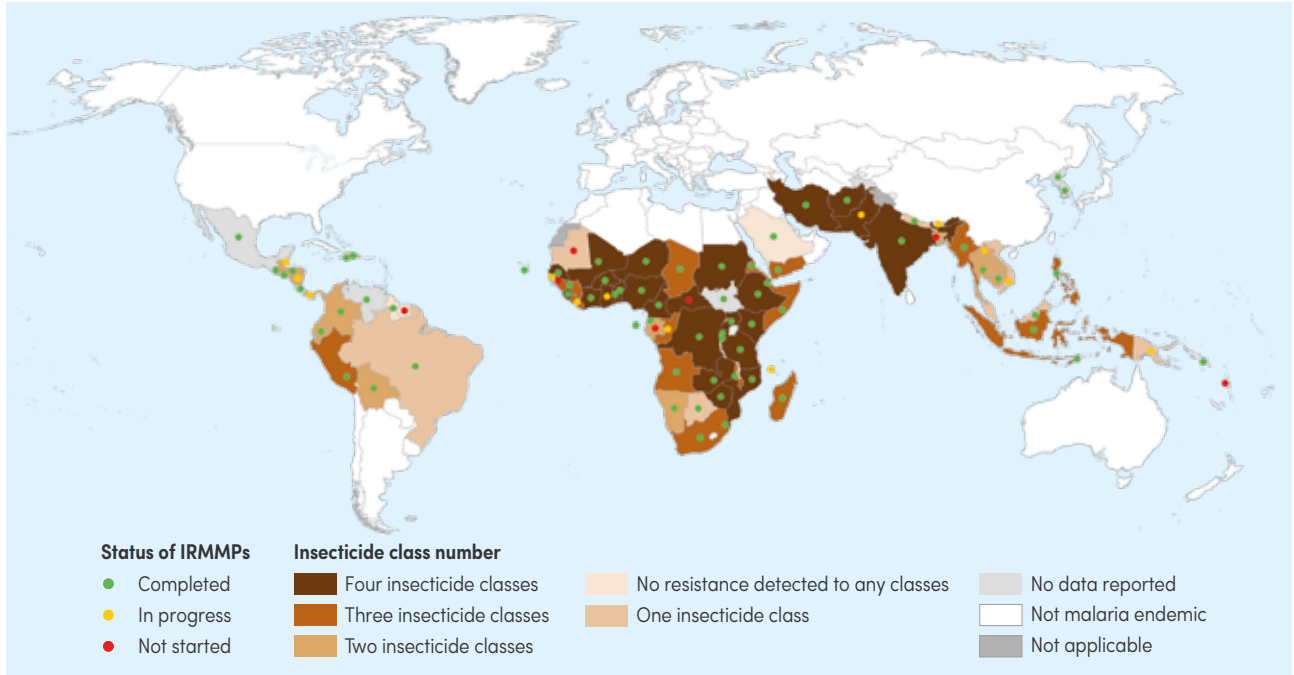


AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; EUR: WHO European Region; IRMMP: insecticide resistance monitoring and management plan; n: number; NMP: national malaria programme; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

^a Status was based on mosquito mortality, where <90% = confirmed resistance, 90–97% = possible resistance and ≥98% = susceptibility. Where multiple insecticide classes or types, mosquito species or time points were tested at an individual site, the highest resistance status was considered. Numbers above bars indicate the total number of sites for which data were reported.

Fig. 9.5.

Number of insecticide classes to which resistance was confirmed in at least one malaria vector in at least one monitoring site, 2010–2020 Sources: Reports from NMPs and national health institutes, their implementation partners, research institutions and scientific publications.



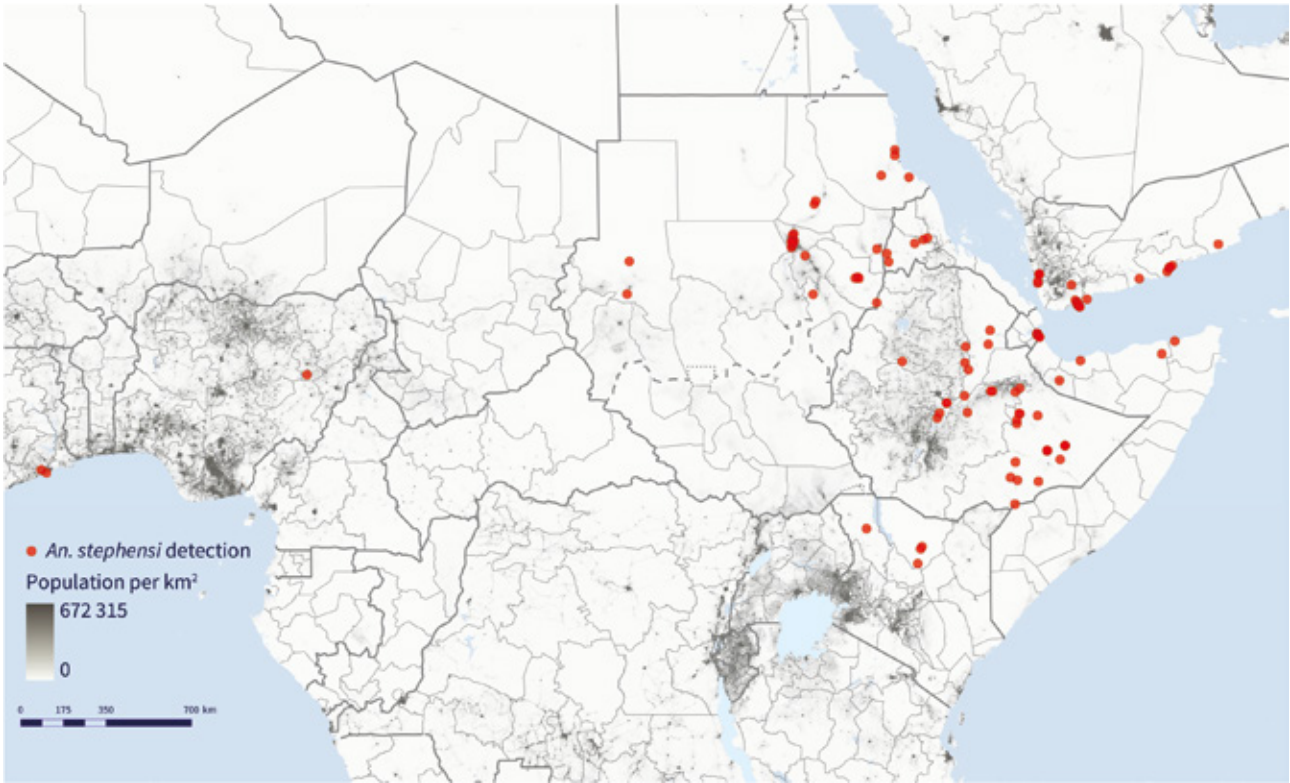
NMP: national malaria programme.

9.4 Anopheles stephensi invasion and spread

Anopheles stephensi is an efficient vector of both *P. falciparum* and *P. vivax* parasites. It was originally native to parts of Asia and the Arabian Peninsula, where it is a major malaria vector in rural and urban areas. It was first detected in Djibouti in 2012 and was implicated in two consecutive malaria outbreaks (88). Since then, *An. stephensi* has been detected in more than 100 sites in 10 countries. To date, WHO has received reports of *An. stephensi* detections from Djibouti, Eritrea, Ethiopia, Ghana, Kenya, Nigeria, Somalia, Sri Lanka, Sudan and Yemen (Fig. 9.6). The characteristics of this vector make its control challenging. *An. stephensi* breeds in human-made water storage containers in urban areas and appears to quickly adapt itself to the local environment (including cryptic habitats such as deep wells). It also survives extremely high temperatures during the dry season, when malaria transmission usually reaches a seasonal low. Insecticide resistance data reported to WHO show that *An. stephensi* has exhibited resistance to pyrethroids, organophosphates, carbamates and organochlorines in the Arabian Peninsula and Asia. In the

Horn of Africa, it has exhibited resistance to pyrethroids, organophosphates and carbamates. *An. stephensi* poses a threat to malaria control and elimination in Africa, the Arabian Peninsula and southern Asia. If uncontrolled, its spread across Africa, combined with rapid and poorly planned urbanization, may increase the risk of malaria transmission in African cities. WHO therefore encourages countries where *An. stephensi* invasion is suspected or has been confirmed to take immediate action. WHO recommends that countries increase vector surveillance to delineate the geographical spread of this vector, and that they use the data to implement interventions aimed at preventing its further spread, especially into urban and periurban areas. Research institutions and implementation partners are encouraged to immediately report any detection of *An. stephensi* to ministries of health and WHO, to inform national and global responses. Further guidance on how to monitor and control *An. stephensi* is provided in the relevant WHO vector alert (89).

Fig. 9.6. Detections of *An. stephensi* in the WHO African and Eastern Mediterranean regions, as reported to WHO since 2012 Sources: Reports from NMPs and national health institutes, their implementation partners, research institutions, scientific publications and WorldPop (90).



An. stephensi: *Anopheles stephensi*; NMP: national malaria programme; WHO: World Health Organization.



10

Climate change, malaria and the global response

10.1 Introduction

WHO has declared climate change the single biggest health threat facing humanity (91, 92). The consequences are felt most strongly by populations in low-income countries, who contribute the least to climate change; such countries include those where malaria is a major public health problem. Climate change threatens to derail progress in global health by affecting livelihoods; increasing the risk of harmful exposures to particulates, pathogens and disease; overburdening health systems; and widening existing inequalities (91, 92). Thus, climate change is not just a singular threat but a major multiplier of other threats.

Vector-borne diseases are driven by environmental and climatic factors, making them sensitive to climate change (93–95). Among these diseases, malaria contributes the highest burden globally, raising legitimate concerns about how climate change will affect progress against the disease (96). Views on how climate change affects malaria transmission are diverse – some experts suggest it may cause a major malaria expansion, whereas others suggest that the direct effect on malaria transmission will

be marginal, especially in the face of changes in other co-determinants (96–102). Regardless of the diverse views, there is a consensus that climate change and its interaction with malaria transmission is complex and that empirical evidence to support reliable predictions is sparse (94, 96, 100, 101). Also, the direction and magnitude of long-term effects of climate change on malaria transmission and burden are likely to vary across social and ecological systems, both within and between countries.

Key to alleviating the direct and indirect effects of climate change on malaria are efforts to rein in global warming, strengthen climate change adaptation and reduce vulnerabilities, including strengthening health systems and accelerating the reduction and elimination of the burden of malaria (94, 97, 100). This chapter provides an overview of the relationship between climate and malaria, global climate predictions, and the potential effects of climate change on malaria transmission and burden (including implications for the global malaria response).

10.2 Climate and malaria – temperature, rainfall and humidity

The separate and interacting effects of temperature, rainfall and humidity greatly influence malaria transmission (94, 98, 103). These factors determine not only the geographical limits of the disease, but also its seasonality and intensity

within those limits (104–106); thus, they influence the epidemiology of malaria, the burden of the disease and the efficacy of various interventions, which are the basis for designing national malaria strategic plans.

Malaria transmission is highest where temperature, rainfall and humidity are at near optimum conditions, as is the case in large parts of sub-Saharan Africa (93). Therefore, it is reasonable to anticipate that changes in these climatic factors due to climate change will affect malaria transmission, control and elimination. The effect on malaria transmission and burden will be non-linear (104) and is likely to vary across different contexts, depending on factors such as the extent of malaria control and elimination, the degree of socioeconomic development and the management of the environment (94, 99). Climate change is also responsible for more extreme and frequent weather events, such as flooding (which can result in malaria epidemics) or severe droughts that suppress transmission for a period but are often followed by epidemics when the rains eventually arrive (94).

Temperature, rainfall and humidity influence several dynamics of malaria transmission; when combined, they affect malaria vectorial capacity, which is a measure of the vector's efficiency in transmitting malaria. Vectorial capacity is defined as the number of new infections that the population of a given vector would induce per case per day at a given place and time (107). Factors that contribute to vectorial capacity include larval development, mosquito survival, human biting rate and parasite development rate, as discussed below.

Larval development

Suitable temperature conditions are required for the development of anopheline mosquito larvae (and pupae) and their survival to adulthood (108, 109). These conditions may vary by mosquito species and other factors, such as larval density. For example, one study (108) showed that the development of *Anopheles gambiae* sensu stricto larvae into adults occurred across a temperature range of 16–34 °C, with larval survival being less than 7 days at ranges of 10–12 °C and 38–40 °C, and more than 30 days at 14–20 °C. Larval mortality was highest at 30–32 °C. The effects of temperature combine with those of rainfall and humidity to influence the distribution, abundance, quality and seasonality of sites for mosquitoes to lay eggs (oviposition) and for larvae to develop. In addition, human activities such as infrastructure development can affect the distribution and quality of these sites (94, 110), and mosquitoes can sometimes adapt to a changing environment and survive outside their natural aquatic habitats, especially in urbanized settings (110–113).

Mosquito survival

In temperate regions, the summer months offer the best conditions for mosquito breeding and survival. In the tropics, mean temperatures are suitable throughout the year; however, in the rainy season, the convergence of

wetter conditions, slightly reduced temperatures and a buildup of humidity offers peak conditions for mosquito survival and density (112, 113). There is variation among species, but studies suggest that mean temperature ranges of 20–27 °C could support daily mosquito survival of more than 80%; mortality increases rapidly beyond 28 °C, and thermal death sets in above 38 °C (109). Microclimatic conditions exist within these broad ranges of temperatures, with mosquitoes sheltering in pockets of elevated heat during winter and in sheltered areas during extreme summer heat (114).

Human biting rate

Broadly, the human biting rate is defined as the average number of mosquito bites received by a host in a unit of time (e.g. hourly or daily) (107). In addition to the mean environmental temperature, the human biting rate of mosquitoes is affected by time of day; interventions; and the characteristics of the location, the host and the vector species. Another feature affected by temperature and environmental factors is the duration of the gonotrophic cycle (i.e. the period between a blood meal and oviposition) (109, 115); this cycle takes a few days or weeks, and has a strong influence on vectorial capacity. Most mosquitoes feed only once per gonotrophic cycle; however, in some species, almost 20% of mosquitoes may consume multiple human blood meals before laying their eggs, a phenomenon referred to as “gonotrophic discordance” (107). Among the factors that determine the frequency of blood feeding per cycle are whether vectors are anthropophilic (i.e. prefer to ingest blood meals from humans), endophagic (i.e. prefer to feed indoors) or endophilic (i.e. prefer to inhabit or rest indoors) (107, 109). Estimation of biting rates across a range of temperatures suggests that rates are low below 15 °C and peak at temperatures of 20–30 °C before dropping precipitously. Biting rates also exhibit seasonality, because temperature conditions interact with patterns of rainfall and humidity, leading to vector and human behavioural adaptations that influence mosquito biting rates (94, 109).

Parasite development rate

Parasite development starts when the mosquito ingests infected blood and ends when sporozoites are fully formed and the mosquito is infectious (109). This period is known as the sporogonic cycle or the extrinsic incubation period (EIP) (109, 116). The EIP is longer in some mosquitoes than others, and in some cases the cycle fails altogether. In addition to biting rates and the female mosquito lifespan, the EIP determines the percentage of female *Anopheles* mosquitoes with sporozoites in the salivary glands at any given time. For many years, Detinova's degree-day model (116) (which was published in the 1960s and describes the relationship between temperature and EIP) has informed



the estimation of the relationship between EIP and temperature. Detinova's model suggested that the ideal temperature range for the *Plasmodium* EIP is 16–31 °C. Since then, several studies have contributed empirical evidence across different species and settings (**Fig. 10.1**) (107–109). Also, it is likely that the parasite development rate is affected not just by mean environmental temperature but also by other biotic and abiotic factors, the vector and parasite species, and genetic diversity (117). EIP and overall parasite development rates, and their variation in

response to temperature and other factors, are important determinants of vector competence.

The influence of temperature, rainfall and humidity on larval development, mosquito survival, parasite development within the mosquito and vector competence quantitatively define the vectorial capacity, and hence the intensity of malaria transmission. Changes in any of these factors are likely to lead to changes in malaria transmission.

10.3 Climate change predictions

The terms “weather” and “climate” are often used interchangeably; however, they refer to two different (but interrelated) systems. According to the Intergovernmental

Panel on Climate Change (IPCC) (117), weather is the result of daily fluctuations in the state of the atmosphere, whereas climate refers to the average weather in terms of the mean

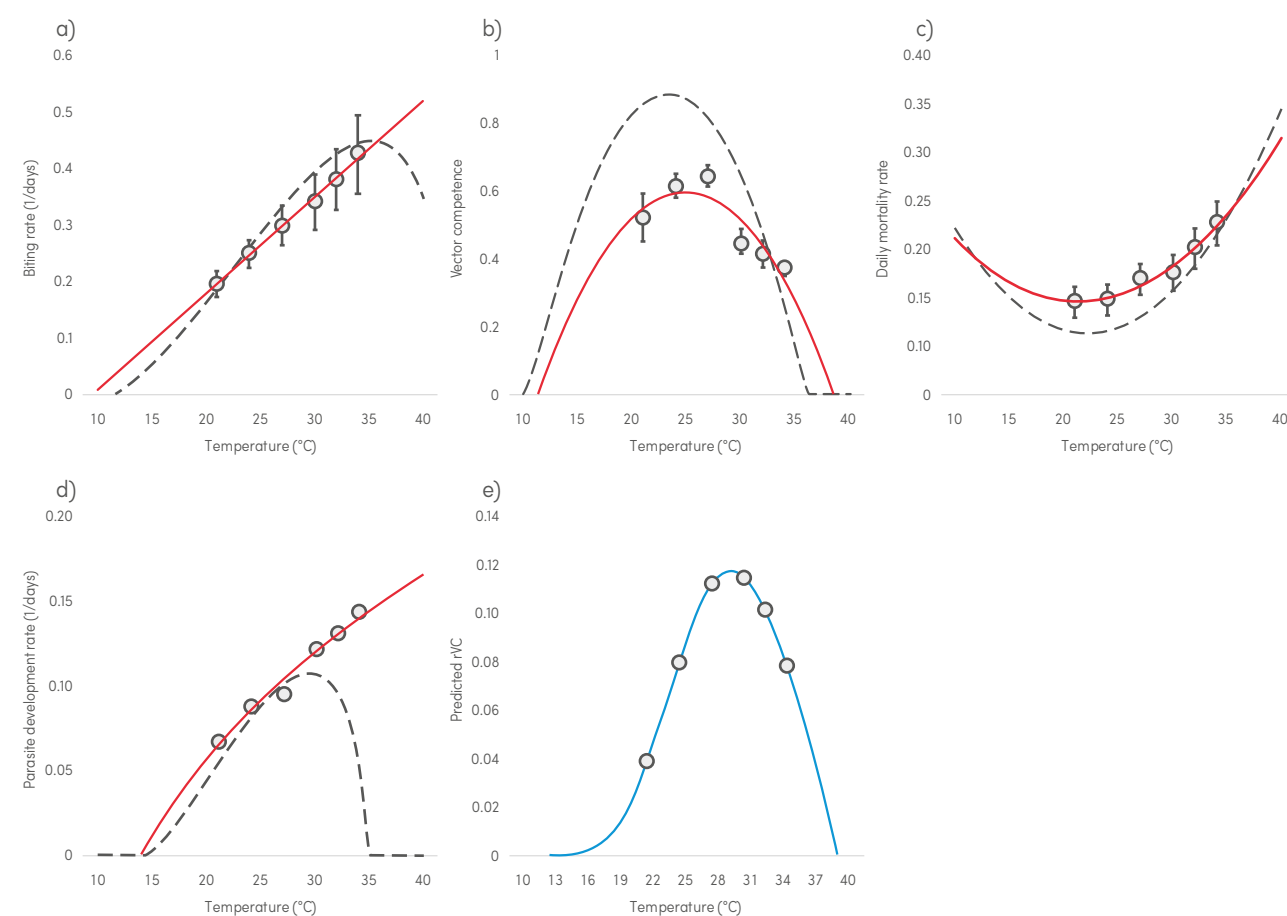
and its variability over a certain time and space. Weather is experienced as specific events (e.g. rainfall, floods, heat and cold) and is usually difficult to predict beyond a week or two. In contrast, climate is experienced over multiple timescales; that is, fluctuations of daily weather and seasonal cycles, and variability over years and decades (94, 118). Although climate change is measured over a period of decades (usually 30 years or more), its effect can be felt as short- and medium-term climatic variations, such as changes in daily mean temperatures, timing of seasons, and intensity and frequency of extreme weather events (94, 118).

To avert catastrophic health impacts, the IPCC has warned of the need to limit temperature rise to 1.5 °C above the baseline (92). Beyond this limit, every additional tenth of a degree of warming will have serious consequences for

human health and well-being. The IPCC uses climate change scenarios – referred to as shared socioeconomic pathways (SSPs) – to consider how projected global socioeconomic changes up to the year 2100 will affect climate change (92). Five SSP scenarios of various carbon emissions and mitigation efforts are used to show how different climate policies will affect greenhouse gas emissions (**Fig. 10.2**). Considering historical trends, only the best-case scenario (SSP1) will lead to an estimated temperature increase of below 1.5 °C by 2100 (**Fig. 10.2a**). SSP2 represents a middle-of-the-road scenario in terms of climate change and its mitigation, whereas SSP5 represents the continuation of the current level of development and fossil fuel use. Across all scenarios, evidence suggests that global land precipitation will increase (**Fig. 10.2b**), the Arctic ice will melt (**Fig. 10.2c**) and mean sea levels will rise (**Fig. 10.2d**).

Fig. 10.1.

Thermal performance curves for a) biting rate, b) vector competence, c) mosquito mortality rate, d) parasite development rate^a and e) predicted temperature-dependent model of rVC based on the thermal performance curves from this study, using data for the EIP₅₀^a Source: Shapiro et al. 2017 (107).

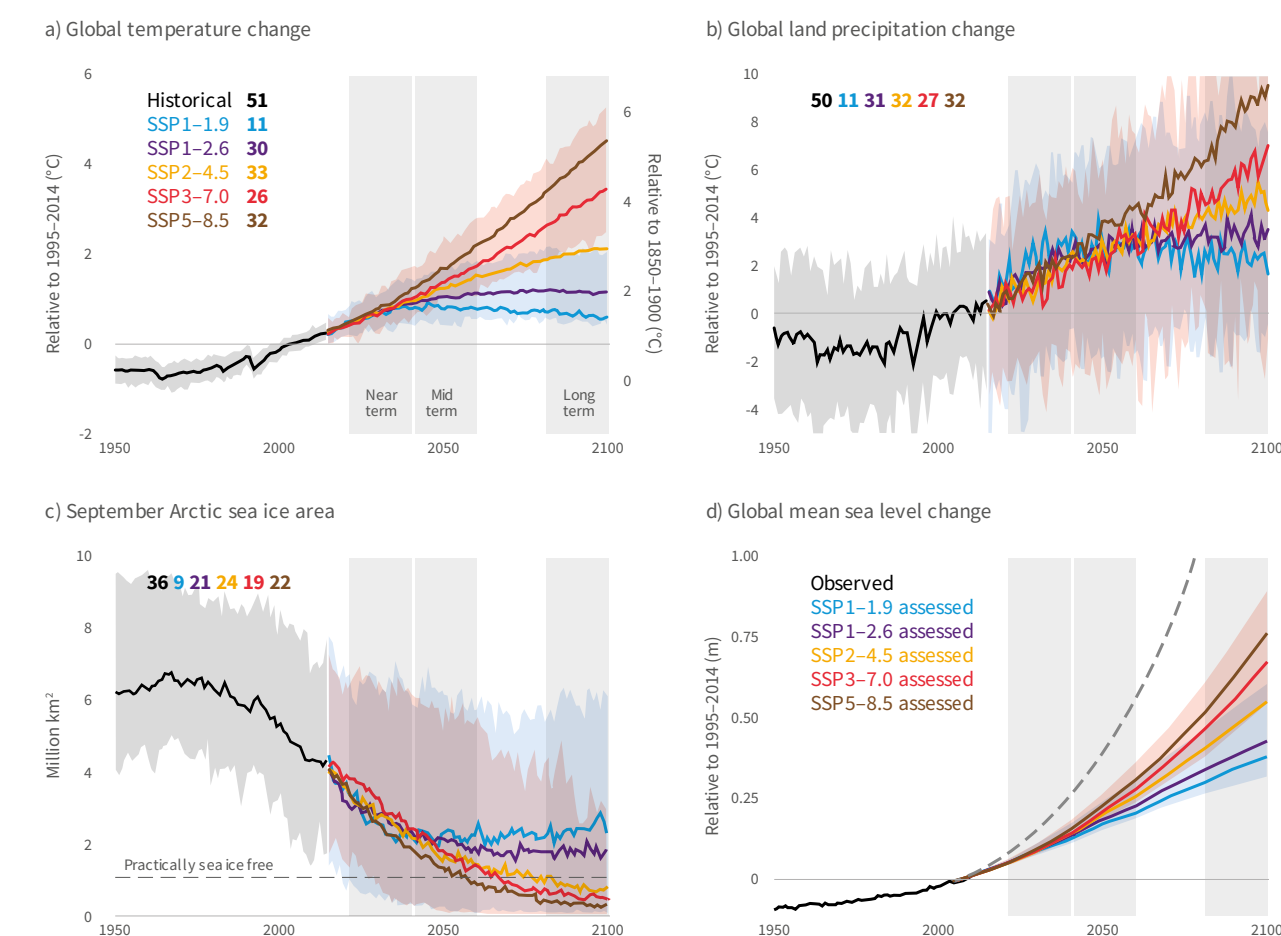


EIP: extrinsic incubation period; rVC: relative vectorial capacity.

^a Graphs a) to d) are based on the EIP in days until 50% of maximum infectiousness [EIP₅₀] (solid lines in red), comparing the current study to the equivalent curves proposed by Mordecai et al. (109) using mixed-species data (broken lines in black).

Fig. 10.2.

Selected indicators of global climate change from CMIP6 historical and scenario simulations: a) global surface air temperature changes relative to the 1995–2014 average (left axis) and relative to the 1850–1900 average (right axis), offset by 0.82 °C, which is the multi-model mean and close to the observed best estimate; b) global land precipitation changes relative to the 1995–2014 average; c) September Arctic sea ice area; and d) global mean sea level changes relative to the 1995–2014 average^a Source: WHO, 2020 (92, 96).



CMIP: coupled model intercomparison project; SSP: shared socioeconomic pathway; WHO: World Health Organization.

^a a), b), and d) are annual averages whereas c) are September averages.



Despite uncertainty in the long-term projections, simulations for 2 °C of global warming show significant changes in mean temperature and precipitation by 2100 (**Fig. 10.3**); for example, the summer of 2023 is considered the hottest on record (119).

The relationship between global warming and changes in rainfall and humidity is less clear; only about 10% of the change seen in rainfall patterns so far has been attributed to climate change (94, 120). However, it is likely that rising

temperatures will increase the relative humidity on the land surface during the rainy season, because warmer air holds more moisture. Also, there is evidence that increased melting of the polar ice, changes to ocean circulation patterns and overall warming of sea surface temperatures (**Fig. 10.2**) are leading to changes in the timing of seasons and to more frequent extreme weather events that result in flooding (94, 121).

10.4 Conceptual pathways of effect of climate change on malaria

Conceptually, changes in temperature, rainfall and humidity due to global warming (with other factors remaining constant) may influence malaria transmission and burden of disease in several ways, both direct and indirect. This section outlines the potential direct and indirect effects.

10.4.1 Potential direct effects

Expanding geographical limit

Temperate areas that are below the lower end of the suitable temperature range for malaria transmission and are therefore currently malaria free may become suitable for competent vectors to breed if temperatures increase by 1–2 °C. The same is true for highland areas in malaria endemic settings. Competent vectors in these areas could then be infected by humans and, if the magnitude of parasite importation is sufficiently high, malaria transmission could start in these locations, which were previously malaria free. The newly malaria infested areas could become prone to epidemics, given that most of the affected populations would not have natural immunity to malaria.

Increasing transmission intensity within current limits of transmission

The relationship of temperature, rainfall and humidity with malaria transmission indicators is non-linear, and temperature increases in areas that currently sustain malaria transmission may lead to changes in the patterns and intensity of malaria. For example, depending on the baseline conditions and vector–parasite dynamics, increases in mean temperature, rainfall and humidity may increase overall vectorial capacity by contributing to better larval development, lower mosquito mortality and higher parasite development rates. In addition, the length of malaria transmission seasons may increase (e.g. through changes in patterns of rainfall and humidity), exposing more people to higher levels of malaria transmission for longer periods. Cyclones and flooding that occur in malaria endemic settings may lead to malaria outbreaks and large-scale epidemics.

Reintroduction of malaria in areas where malaria was eliminated recently

In areas that have high receptivity and in which malaria has recently been eliminated, climate change can trigger

or contribute to the reintroduction of malaria. Malaria transmission can occur when perturbations in climatic conditions are accompanied by population displacement, with people carrying the malaria parasite moving into areas that are malaria free but have high receptivity, or where health systems are disrupted by floods and imported cases do not receive prompt treatment. This risk could be higher in countries that have eliminated the disease but have health systems and infrastructure that are not resilient.

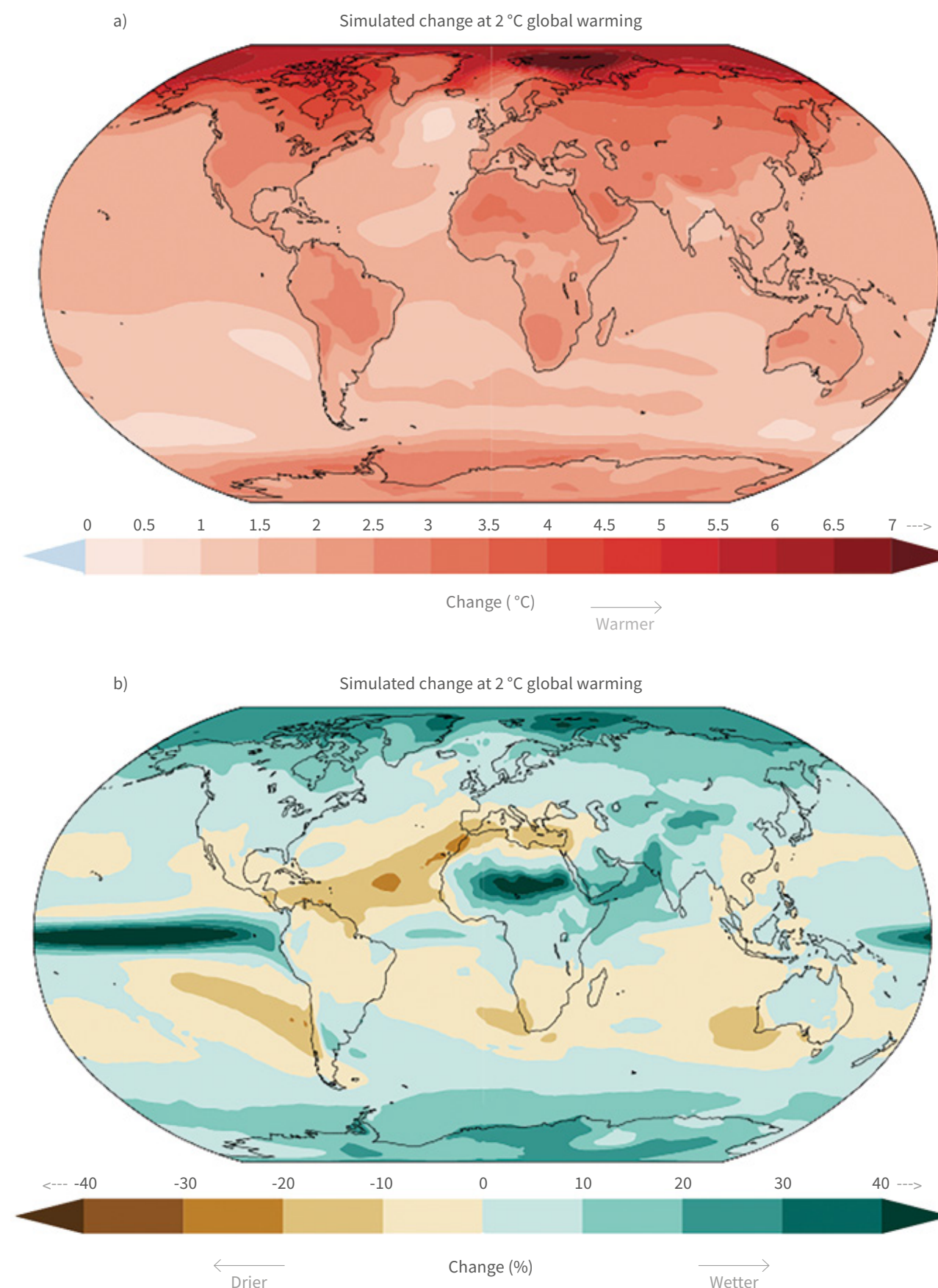
Decreasing transmission intensity within current limits of malaria transmission

Rates of mosquito survival, biting, sporogony and overall vectorial capacity begin to decline rapidly at mean temperatures exceeding 28 °C, and few mosquitoes will survive temperatures above 38 °C (109). Increases in temperature in areas where the mean is already near the upper limit of the optimum range for malaria transmission may create thermal conditions that are unfavourable for mosquito survival, potentially reducing transmission. Also, rising temperatures may be associated with increased dryness and aridity, increasing the risk of mosquito desiccation (i.e. loss of moisture through the body) and death, and reducing the number of quality breeding sites; again, this would lead to a decline in overall vectorial capacity and could even halt malaria transmission. Such extreme levels of dryness can lead to poor agricultural productivity, and loss of livestock and livelihoods; in some cases, the land may even become inhospitable to humans.

Imperceptible change in transmission

In areas where a rise of 1–2 °C may not affect vector dynamics, there may be little impact on malaria transmission. These would be areas where current temperatures are close to the optimum conditions, or areas that are outside the temperature thresholds by more than 2 °C. This does not imply that a rise in temperature will have a negligible effect, given that other diseases may increase and overall human well-being may be negatively affected; in addition, there may be indirect effects that increase malaria transmission and burden, as explored in the next section.

Fig. 10.3.
Simulated change by 2100 of annual a) mean temperature and b) mean precipitation at 2 °C of global warming
Source: Masson-Delmotte et al. 2021 (122).



10.4.2 Potential indirect effects

Loss of livelihoods and increased economic and food insecurity

Extreme weather conditions have a considerable impact on social cohesion, economic productivity, assets and livelihoods in affected populations. For example, climate change already affects global food systems, leading to food insecurity and malnutrition in millions of people (96, 123). Without appropriate mitigation and adaptation mechanisms, access to food of adequate diversity, nutrition, safety and quality will be severely affected by climate shocks and long-term climate change. In relation to malaria, deteriorating nutritional status under climate change and the inability to seek prompt care will make affected populations even more vulnerable to severe malaria disease, lifelong complications and early death. Also, the impoverishing effect of climate change – reducing opportunities for economic growth while devastating traditional livelihoods (96) – will make people more susceptible to malaria, given that the disease predominantly affects the poorest and most marginalized.

Displacements and service disruptions

It is estimated that over 20 million people annually are displaced by extreme weather events and related hazards. These events are expected to increase in frequency, intensity and duration as climate change worsens (124). Low-lying areas and small islands may become uninhabitable, leading to the displacement of millions more people (94, 125). Also, extreme climate events and longer term climate change may negatively affect agriculture and land use, forcing people to move, with social and economic consequences. In some circumstances, people without immunity to malaria may be forced to migrate to areas where they risk being infected with the disease and becoming severely unwell. Another consequence may be considerable migration from rural to urban areas, which increases the risk of epidemics in urban areas, especially if invasive species such as *An. stephensi* (see **Section 9.4**) become established in urban areas. Large-scale extreme weather events and population movements put a severe strain on the ability of countries and their global partners to maintain basic services, let alone respond to the additional needs that result from these situations.

Thus, extreme weather events and the resulting population movements lead to major service disruptions, including of essential malaria services, and to increasing levels of disease and death (96).

Reduced access to, and quality of, health delivery systems

Climate-related factors will impede people's access to health care and undermine the provision of quality services. Severe weather events such as flooding may result in road blockages and transport disruptions, which in turn will affect the access of both consumers and providers to health facilities. In addition, these events could rupture commodity supplies and damage infrastructure, diminish the quality and stability of medical products under extreme heat, and affect the workforce. Overall, these factors make the health system fragile and less able to deliver quality malaria care and interventions, especially for vulnerable groups such as children and those who are pregnant. This situation may increase the overall burden of malaria disease even if actual transmission levels do not change, especially if it is combined with increases in the cost of the malaria response. Concomitant increases in other vector-borne diseases and respiratory illnesses due to climate change will overstretch health systems that are already overburdened.

Increased difficulty and cost of malaria programmes

Extreme weather events, increases in the cost of climate change mitigation (especially in poor communities) and overall geopolitical consequences may disrupt supply chain logistics and the cost of commodities and services (126, 127), including those for overall health care and the fight against malaria. It is also possible that temperature-susceptible products (e.g. diagnostics, medicines and insecticides) may be harder to store and use safely in environments that exceed tolerable thermal thresholds (94). Financing for mitigation of climate change that is not accompanied by scaled-up efforts to fight malaria – especially at a time when climate change is likely to be devastating the ability of countries to fund malaria programmes from domestic sources (128) – will undermine synergies, reverse the progress made so far against malaria and make communities less resilient to climate change.

10.5 The state of evidence – climate change effects on malaria transmission

Conceptually, if other factors remain constant, climate change could have a significant effect on malaria transmission and burden across the world, although the impact will vary across countries and regions (**Section 10.4**). Malaria transmission is a complex system that responds dynamically to various determinants (97, 129, 130) and, although its relationship with climate is established, it is still poorly understood in the dynamic

sense. Even less well understood is how anthropogenic factors (e.g. health system interventions, urbanization and other socioeconomic developments) and climate change interact with malaria transmission and burden of disease. This section presents a brief overview of the evidence to date, recognizing the need for future comprehensive review.

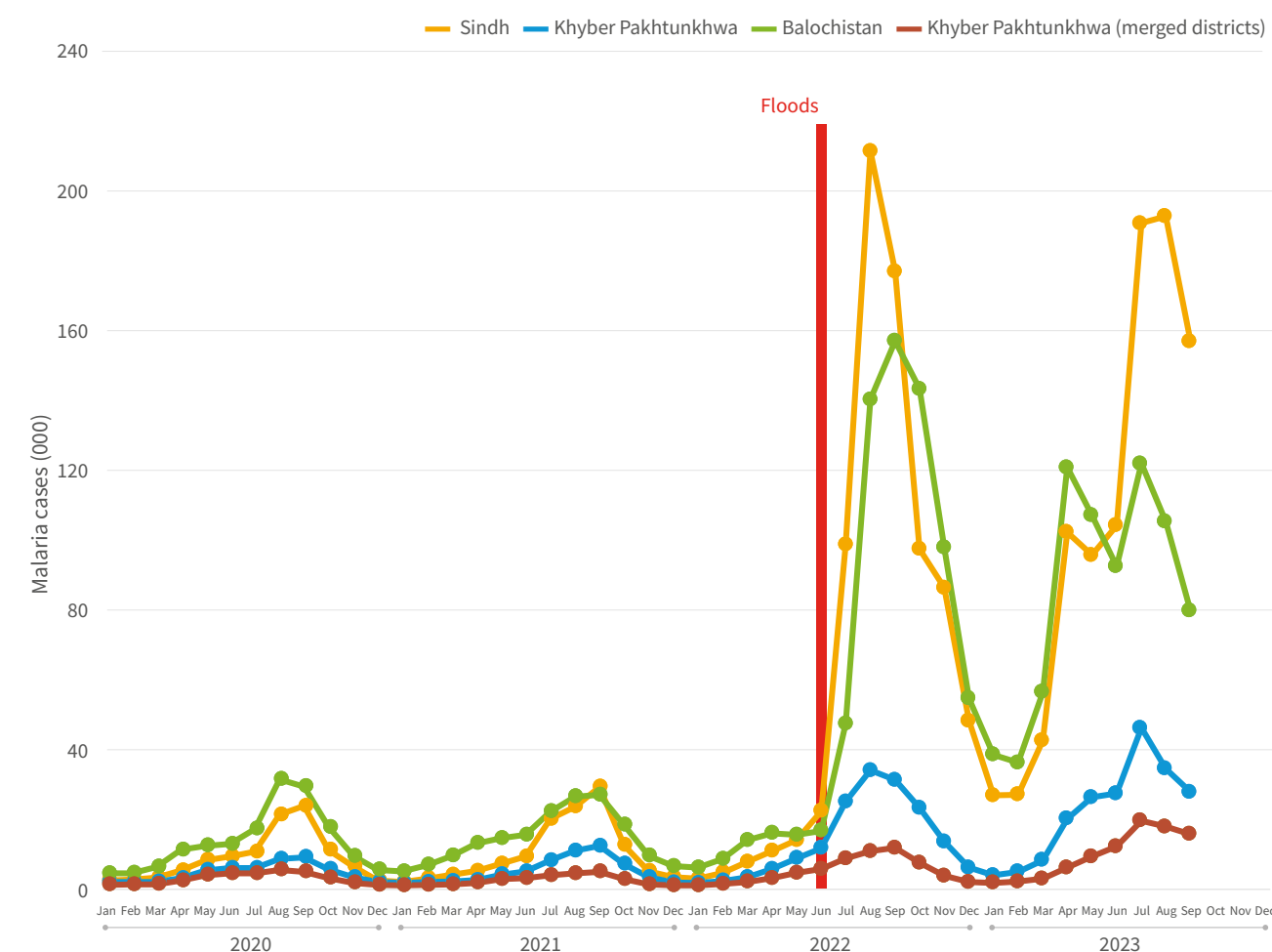
Empirical data on malaria transmission and its determinants are often lacking, and any projection of the

future of malaria over decadal timelines – especially over small geographical scales – is likely to be associated with considerable uncertainty (94). Although there are published data on the relationship between climatic variations and malaria trends, the evidence for the effect of climate change on malaria transmission is mixed (97, 99, 129, 131, 132). The strongest evidence, perhaps, comes from long time-series data from African highland areas that are on the fringes of endemic transmission; these data suggest that, over recent decades, rising temperatures have led to the expansion of malaria to highland areas (132–136). Recently, extreme monsoon rainfall affected many parts of Pakistan, with evidence suggesting that the severity of the monsoon season was heightened by climate change (137). In the large malaria epidemic that followed the floods, there was a fivefold increase in malaria cases in Pakistan when compared with the previous year (**Fig. 10.4**).

A recent analysis of over 50 000 publicly available parasite prevalence surveys from the 1900s onwards (138, 139) investigated whether climate change due to human activities has increased the burden of malaria in children in sub-Saharan Africa. The analysis compared historical climate reconstructions (SSP scenarios) with counterfactual conditions in the absence of human-induced climate change; it found that the odds are two to one that anthropogenic climate change has led to an overall increase in the prevalence of malaria in children in sub-Saharan Africa since 1901 (139). Further, the study suggested that, by 2014, human-caused climate change had been responsible for an average of 84 excess cases of malaria per 100 000 children aged 2–10 years, with the highest increases being in southern and east Africa. In contrast, under future climate change scenarios, the authors projected that increasing temperatures may reduce

Fig. 10.4.

Reported malaria cases in Pakistan, 2020–2023^a Source: *Pakistan national malaria programme*.



^a The cyclone started in June 2022. The decline in cases between the two peaks after the extreme monsoon rainfall occurred during the winter months.

malaria in west and central Africa, highlighting the variable effect of anthropogenic warming across ecosystems. The authors of this study used an innovative climate change framework; however, major limitations were the weak representation of malaria control interventions, and the absence of consideration of indirect effects of climate change (e.g. population displacements, and the role of urbanization and social economic development) and the evolution of immunity, and the combined effects of these factors on past and future trends in malaria prevalence.

Under the Strategic Advisory Group for malaria eradication, WHO commissioned a study, led by the Malaria Atlas Project, to predict future malaria trajectories under various intervention, socioeconomic and climate change scenarios (93). Arguably, this analysis remains the most comprehensive predictive analysis of such trajectories. Using two SSP scenarios (SSP2 = middle-of-the-road

pathway; SSP5 = conventional development pathway), and accounting for a series of environmental and socioeconomic indicators, the study looked at the effect of climate change if current (2017) coverage levels of interventions were maintained through to 2050, versus an increase in current intervention coverage to 80% and versus the addition of innovative tools (e.g. highly efficacious vaccines at high levels of coverage).

Under the “middle-of-the-road” climate scenario (SSP2), the analysis suggested that, under current levels of intervention coverage, combined with changing environmental and socioeconomic conditions, malaria incidence is likely to decrease (Fig. 10.5), even if malaria cases increase slightly because of population growth. If current interventions are scaled up to high levels of coverage, and the predicted changes in environmental and socioeconomic conditions are maintained, the analysis suggests the potential for

substantial reductions in malaria incidence. The addition of novel interventions (e.g. highly efficacious vaccines and monoclonal antibodies) is likely to increase the impact of interventions further, even as the climate changes. A similar analysis under the SSP5 scenario showed similar trends but with a smaller magnitude of decline (Fig. 10.6). However, maintaining current levels of interventions under SSP5 will halt progress in reducing the incidence of malaria and lead to a dramatic increase in cases.

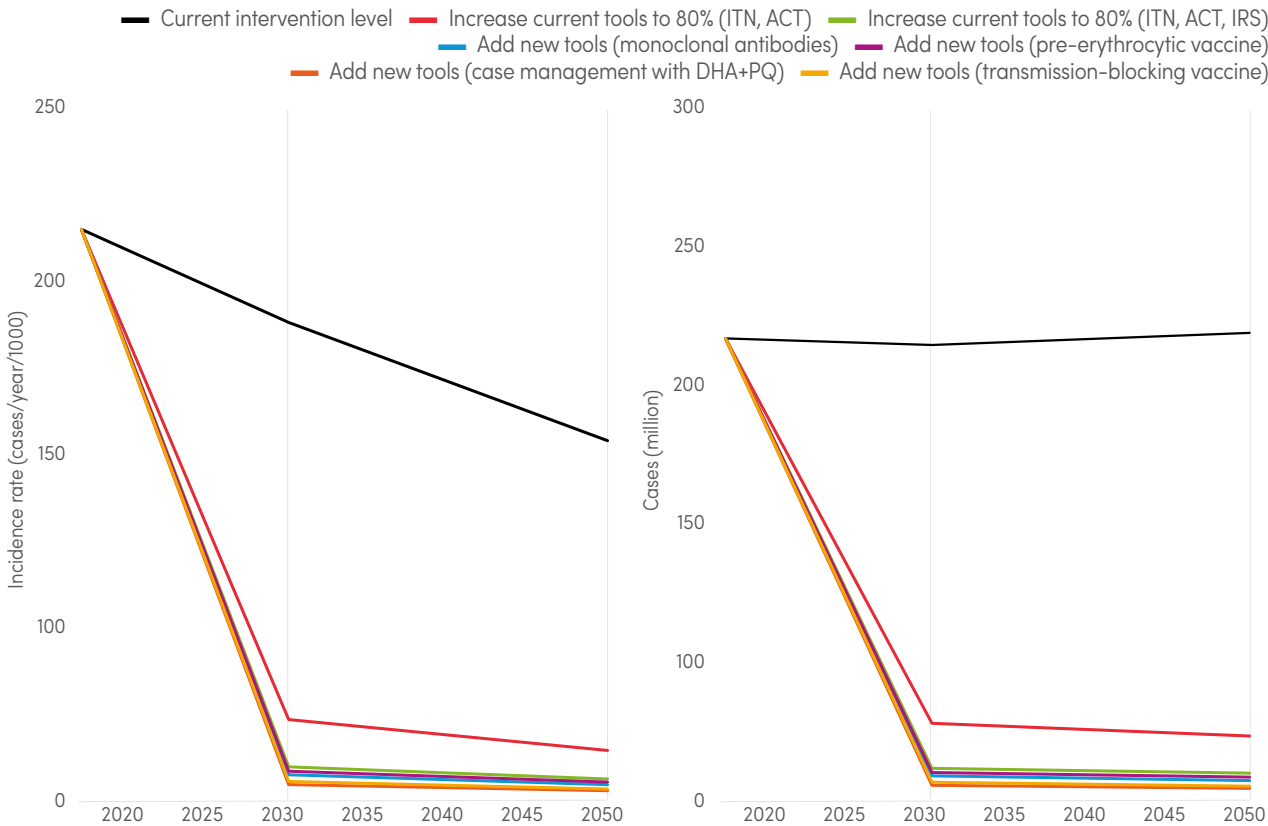
The scaling up of interventions has not yet been fully costed under the different SSP scenarios, but costs are likely to be far higher than currently estimated under the GTS (140).

This study assessed the likely effects of long-term climate change trends on malaria, in combination with changing socioeconomic conditions and infrastructural development. The conclusions on climate effects were sensitive to

predicted changes in patterns of rainfall and vegetation in Africa, which are associated with considerable uncertainty. The study did not consider climate change effects on the frequency of extreme events such as flooding or droughts, which may be more important for malaria than changes in long-term averages.

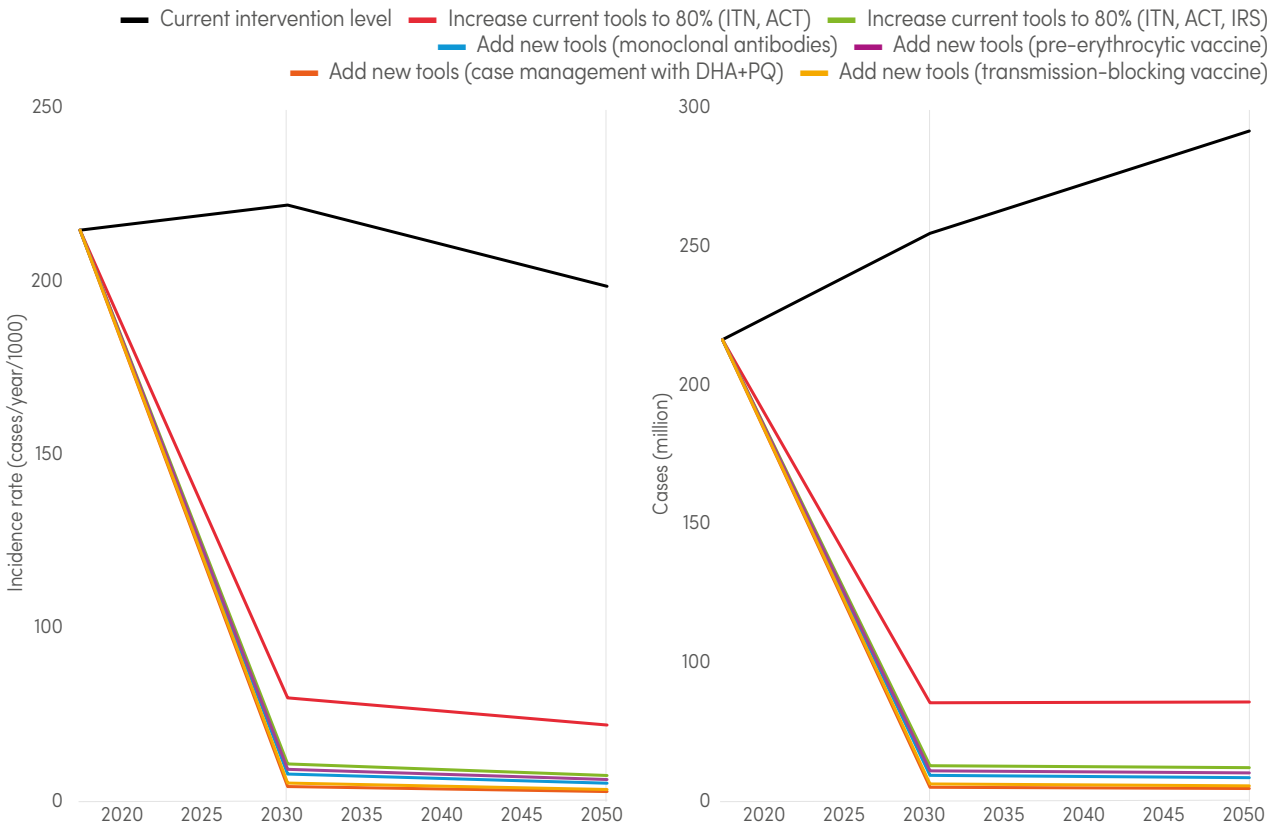
A further limitation of this study was the assumption that the relationship between environmental conditions and malaria transmission, modulated by malaria intervention, remains constant over time. However, changes in dominant vector species and important genetic adaptations are likely to occur, affecting vectorial capacity and the relationship with interventions. Also, the model projects specific climate variables by applying realizable conditions under each SSP scenario; however, these variables are used directly within the models, which may mask trends in climate change that are only visible at multidecadal scales (94).

Fig. 10.5.
Projected changes in a) malaria incidence and b) number of cases in the WHO African Region under different intervention scenarios, from the present day to 2030 and 2050, under SSP2 Sources: IPCC (92) and WHO (96).



ACT: artemisinin-based combination therapy; DHA: dihydroartemisinin; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; PQ: primaquine; SSP: shared socioeconomic pathway; WHO: World Health Organization.

Fig. 10.6.
Projected changes in a) malaria incidence rate and b) number of cases in the WHO African Region under different intervention scenarios, from the present day to 2030 and 2050, under SSP5 Sources: IPCC (92), WHO and Malaria Atlas Project (96).



ACT: artemisinin-based combination therapy; DHA: dihydroartemisinin; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; PQ: primaquine; SSP: shared socioeconomic pathway; WHO: World Health Organization.



10.6 Climate change preparedness of the global malaria response

The empirical evidence on the effect of climate change on malaria transmission is mixed; this is partly because of data limitations, but also because of the many parallel determinants of malaria transmission that occur against a background of a changing climate. The most important determinants are the scale-up of malaria interventions, improved health systems and socioeconomic development.

Overall, in the absence of appropriate mitigation, climate change could have a negative impact on progress against malaria. We can make this assumption based on our conceptual understanding of the interaction of climate and malaria transmission, and the evidence (albeit limited) from the African highlands and on the role climate plays in increasing the magnitude and frequency of extreme weather events. The direct and indirect effects on the malaria response that can be attributed to malaria are likely to vary in different social and ecological systems. However, the debate about the direction and magnitude of effects should not deter the global community from ensuring that malaria responses are sustainable and resilient in the face of the threat posed by climate change. This section outlines a series of actionable strategic, technical and operational actions.

10.6.1 Strategic actions

Freeing the world of malaria while reducing overall climate change vulnerability

Malaria is the most devastating vector-borne disease globally. It is highly correlated with poverty, both as a cause and a consequence, and it makes communities vulnerable to both natural and anthropogenic shocks. In many high transmission settings, the health service delivery system is overwhelmed by people who are affected by malaria. Hence, eradicating malaria would increase the resilience of these communities, unleash their growth potential and prepare them for climate change adaptation. However, in the face of biological threats, limited tools, system inefficiencies, low coverage and resource constraints, the world is nowhere near to eradicating malaria. A substantial pivot – with a different order of magnitude of resourcing, better tools and data-informed local planning and delivery – is needed to make progress towards eradication. At the same time, appropriate efforts to mitigate the impacts of climate change would enhance equitable socioeconomic growth and result in new innovations and technologies, which in turn would increase health resilience in communities. Ensuring these synergies will be key to progress in both areas, but will require global institutions to work in ways that are dramatically different to the current siloed approaches.

Leadership to establish a common voice and build partnerships

As the global malaria community deliberates on ensuring that the malaria response is sustainable and resilient in the face of climate change, we must recognize that efforts to reduce malaria and eliminate it need to be combined with efforts to reduce the pace of climate change and mitigate its effects. A single-issue approach will not work; instead, a common voice that cuts across the various stakeholders is urgently needed. The threat to progress on malaria must be seen within the broader paradigm of climate and health. There is a need for a common narrative that promotes multisectoral actions to both reduce carbon emissions and improve health. The health benefits of transitioning to clean energy are huge, and they provide a useful vehicle for securing a wider societal commitment to protecting the environment. The common narrative should also acknowledge the value of investing in universal health coverage, primary health care, and pandemic preparedness and response. Such investment will effectively and equitably deliver core services through cheaper, cleaner and more reliable systems; adopt a multisectoral response to the climatic determinants of malaria and meaningfully engage communities in the response. This investment will also enable us to respond to, and recover from, many different types of shocks and crises, including those that are climate related. A good starting point would be the Alliance for Transformative Action on Climate and Health, which is convened by WHO and provides a global platform for establishing political commitment by ministers of health to build climate-resilient and low-carbon sustainable health systems (141). Such a commitment will make it possible to develop a whole-of-government, whole-of-society partnership and response to climate and health.

Decarbonizing and making health systems more environmentally sound

Health care is responsible for about 5.2% of carbon emissions globally, reaching almost 10% in some nations, breaching the responsibility of medicine to “do no harm” (142). Comparisons across countries demonstrate that it is possible to deliver high-quality services without this high level of carbon footprint, indicating that there is great potential to reduce emissions without compromising the quality of care. Health systems should share best practice to “level up”, creating services that provide high performance, low cost and low emissions – including in the supply chain, which contributes almost 70% of the emissions from global health care. For example, health systems can decarbonize by using renewable energy sources, and by reducing the carbon footprint associated with product development and supply. Health systems with a higher level of per-capita emissions should start decarbonizing now. In countries

that have historically contributed little to the carbon footprint, the work towards minimizing emissions should be accompanied by support for improving health sector performance and climate resilience. Such changes in health care could make a significant contribution to reducing global carbon emissions, and show leadership that would be an example to other sectors. Decarbonizing the health sector should be part of establishing environmentally sustainable health systems that improve health while minimizing negative impacts on the environment.

Shifting the locus of decision-making

Strong national and subnational leadership is required to translate stated political commitments into resources and tangible actions to ensure greater resilience against climate change and address malaria.

Global health actors have often commented on the need for country ownership, decision-making that is centred on country voices, and mutually responsible and accountable approaches to global health. In reality, decision-making remains largely centralized in global health institutions that have variable agendas that are not coordinated. Sustainable progress against major global threats requires trusting countries and communities to have a greater voice over decisions that relate to their local context and response, thus enabling effective collaboration between governments and their citizens, with support from global health partners. Such progress will require strategic discussions at global level to ensure appropriate links between country and community voices and civil society organizations. Robust, locally led decision-making is key to mitigating the effects of climate change; for example, through improved tailoring of interventions, epidemic response, delivery of malaria interventions, health system strengthening and multisectoral action. This does not absolve richer countries that have disproportionate carbon footprints from their responsibility to finance resource-constrained countries to implement their locally defined mitigation and adaptation responses.

10.6.2 Technical actions

Increasing knowledge of the climate change–health nexus

A combination of low climate literacy among health experts and low health education among climate experts has hampered discussions on appropriate ways to respond to interacting threats in climate change and health. Scaling up knowledge of the climate change–health nexus among policy-makers at all levels is urgently needed; this can be achieved through improvements in education, awareness raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning in relation to health.

Building better, more climate-resilient, environmentally sustainable and equitable health systems

The capacity of health systems to cope will be undermined as climate change disrupts economies, displaces populations and increases the costs of health care. The loss of health system response will undermine the malaria response, but investment in malaria alone will not be sufficient to counteract this situation. WHO has developed an operational framework to guide countries in building health systems that are resilient to climate change (143). The framework has 10 key components to help a country’s health organizations and programmes to better anticipate, prevent, prepare for and manage climate-related health risks, and thus ensure health system resilience. Climate change mitigation measures should be integrated into national policies, strategies and planning. This will include ensuring that core services, environmental sustainability and climate resilience are central components of universal health coverage and primary health care; supporting health systems to “leapfrog” to cheaper, more reliable and cleaner solutions when decarbonizing high-emitting health systems; and mainstreaming climate resilience and environmental sustainability into health service investments, including the capacity of the health workforce. Given that the health risks from climate change are disproportionately high among vulnerable and disadvantaged groups, a more climate-resilient health system will need a strong focus on protecting those who are most vulnerable to the climate crisis, but have the least access to quality services.

Developing guidance and tools for monitoring climate and for health surveillance, monitoring and evaluation

The best way for malaria programmes to effectively respond to the effects of climate change is by monitoring and evaluating the consequences of short- and medium-term risks (94). Practical guidance and tools for the surveillance, monitoring, evaluation and use of both climate and malaria indicators are essential to understand these risks and adapt the responses. This will require synergies with meteorological departments, climate change monitoring centres and other disease surveillance systems.

10.6.3 Operational actions

Using climate information and disease information for decision-making

In relation to malaria control, countries and their programmes make different decisions at different stages of the policy–planning–implementation–monitoring-and-evaluation cycle (94), and each stage of the cycle may require different types of analyses to inform these decisions. It is essential that countries identify key questions across the continuum and develop the appropriate data and analysis plans, with subnational plans for each operational

unit. Further adaptations will be needed, depending on the stage each setting has reached on the disease-transmission continuum. In this context, deliberate efforts will be needed to foster partnerships between climate and public health experts and stakeholders, to develop subnationally tailored plans. Key to better use of both health and climate information is strengthening of epidemiological and entomological surveillance, to understand receptivity and vulnerability to malaria transmission, and investment in appropriate digital solutions, including exploring the potential of artificial intelligence (AI).

Epidemic detection, preparedness and response

Climatic indicators are essential to malaria epidemic forecasting and early warning systems, and such indicators can improve the national preparedness to respond to malaria epidemics. Building the WHO climate and health framework into current systems for epidemic preparedness and response is an immediately feasible goal in many countries, thanks to improvements in malaria surveillance systems and the increased availability of meteorological and climatic data.

Enhancing national capacity

The analysis and use of climate and malaria information requires both climate and health practitioners to be trained in the relevant skills. The first step is to establish platforms for joint work and coordination among such practitioners. Engagement with relevant regional and global institutions will be essential for strengthening national capacity.

10.6.4 R&D response

Malaria eradication is the only way to resolve the devastating effects of this disease, with or without the added threat of climate change. Mitigating biological threats and developing more efficacious tools are essential to achieving malaria eradication. Such tools include highly efficacious vaccines, longer lasting insecticides (preferably non-pyrethroid), vector control tools that address outdoor biting, efficacious single-dose preventive therapies (e.g. monoclonal antibodies), diagnostic tools that can detect latent stages of *P. vivax* infections, new antimalarial drugs to mitigate ACT resistance for treatment of disease, and single-dose chemoprevention therapies. Also essential are innovations in service delivery, surveillance and analytics. The processes for bringing products to market need to be accelerated while maintaining safety, efficacy and quality, and the capacities of national and regional regulatory authorities to review, approve and evaluate these products need to be strengthened.

Future products and their delivery will need to be suited to an operating environment that has been redefined by climate change (e.g. medicines and diagnostics that are heat stable, and prevention tools that are suited for displaced or

migrant populations] The design of such products should minimize their environmental impact (e.g. future products should be biodegradable or easy to manufacture locally).

Investment is needed to research the ways in which climatic variations and climate change influence the malaria response across different timescales, and effective ways to communicate these risks to policy-makers, funders and the public. Also needed is research into lowering the carbon footprint of the health sector, including the malaria response.

10.6.5 Financial

Over the past 2 decades, funding for malaria has proven to be one of the best returns on investment in global health. It is estimated that more than 2 billion cases and about 12 million deaths due to malaria have been averted since 2000 (**Section 8**). However, progress stalled in the latter parts of the decade, owing, for example, to resource constraints, system inefficiencies and inequity, and increasing biological threats. Despite impressive efforts to mitigate its negative effects on malaria services, the COVID-19 pandemic disrupted societies, economies and services (144). This happened against a backdrop of increasing climate change vulnerability in communities that were already overburdened.

Building the resilience of malaria responses to the risks of climate change will require vastly increased financing for combating the disease, combined with better use of local data to effectively tailor interventions, both dynamically and subnationally. The more expensive tools and logistics needed to build resilience will require more resources, while the multisectoral response to both malaria and climate will require more resources and action from a broad range of sectors. The commitment by developed-country parties to the UN Framework Convention on Climate Change (145) to mobilize resources to address climate change should explicitly build links with existing malaria funders; it should also support R&D to intensify the malaria response and address the impacts of climate change on the disease.



11 Key findings and conclusion

This year's *World malaria report* presents the latest updates on the progress against malaria globally, regionally and nationally, mainly for the period up to 2022, the third year since the start of the COVID-19 pandemic.

Against the background of the pandemic, other humanitarian emergencies, biological threats and funding constraints, the global malaria response must also contend with climate change, which is considered the single biggest global health threat by WHO and is the main theme of this year's report.

This section summarizes key findings and messages that have emerged from this year's world malaria report.

11.1 Global state of malaria

The large disruptions to malaria services during the COVID-19 pandemic drove up rates of malaria incidence and mortality at a time when progress against the disease had already stalled. Since then, malaria endemic countries, with the support of global partners, have managed to stabilize these rates, but at a high level. In terms of both malaria cases and deaths, the world is worse off now than before the pandemic. Five countries bore the brunt of these increases, hindered by multiple challenges such as extreme weather events, conflict and humanitarian crises, resource constraints, biological threats and inequities.

11.1.1 Global trends in cases and deaths

Globally, the number of malaria cases in 2022 was significantly higher than in 2019, before the start of the

COVID-19 pandemic. From 2000 to 2019, the global number of malaria cases fell from 243 million to 233 million. There were an additional 11 million cases in 2020, no change in 2021 and an increase of 5 million cases in 2022, to reach a total of about 249 million cases (**Table 3.1**). Global malaria case incidence (number of cases per 1000 population at risk) in 2022 was also slightly higher than in 2019. The case incidence rate declined from 81 in 2000 to 56.8 per population at risk in 2019. By 2020, the rate had climbed to 58.7. A small decrease in 2021 was followed by a small increase in 2022, which ended with a rate of 58.4 per 1000 population at risk (**Fig. 3.3a**).

The 5 million additional cases observed between 2021 and 2022 were mainly concentrated across five countries. Pakistan saw the largest rise, with 2.1 million more cases,

followed by Ethiopia and Nigeria (+1.3 million each), Uganda (+597 000) and Papua New Guinea (+423 000). In Pakistan, case incidence jumped fivefold, from 2.2 to 11.5 cases per 1000 population at risk. Meanwhile, case incidence increased by 32% in Ethiopia (from 46.3 to 60.9), by 32% in Papua New Guinea (from 124.3 to 163.7) and by 2% in Uganda (from 262.9 to 267.8). In Nigeria, the increase in cases was attributable to population growth as incidence remained unchanged.

The number of global malaria deaths in 2022 was higher than in 2019. Between 2000 and 2019, malaria deaths declined steadily from 864 000 to 576 000, respectively. With the onset of the COVID-19 pandemic, the number of deaths increased by 55 000 in 2020, to reach 631 000. Marginal decreases in the following 2 years resulted in an estimated 608 000 deaths in 2022, about 32 000 more deaths than before the pandemic. The global malaria mortality rate (number of deaths per 100 000 population at risk) was also slightly higher in 2022 than in 2019. The mortality rate halved between 2000 and 2019, from 28.8 to 14.1 (**Fig. 3.3b**), but in 2020, it increased to 15.2 before decreasing slightly to 14.3 at the end of 2022.

An estimated 2.1 billion malaria cases and 11.7 million malaria deaths were averted globally in the period 2000–2022. Most of the cases and deaths averted were in the WHO African Region (cases 82%, deaths 94%), followed by the South-East Asia Region (**Fig. 3.9**). Although the pace at which cases and deaths were averted slowed during the COVID-19 pandemic, an estimated 549 million cases and 2.82 million deaths were averted from 2020 to 2022, compared with the estimated burden if case incidence and mortality rates had remained at 2000 levels.

11.1.2 Trends in the 11 HBHI countries

The HBHI approach, spearheaded by WHO and the RBM Partnership to End Malaria in 2018, was designed to support the world's 11 highest burden countries¹ to get back on track. After an initial surge in cases and deaths in HBHI

countries during the first year of the COVID-19 pandemic, case numbers have largely stabilized, and the number of deaths is returning to 2019 levels. In 2022, there were an estimated 167 million malaria cases (67% of the global total) and 426 000 malaria deaths (73% of the global total) in HBHI countries. Of the 11 original HBHI countries, India had the largest relative reduction in cases (30%). Nigeria accounted for the majority of malaria deaths (44%).

Stagnation in incidence and mortality rates in the 11 HBHI countries is largely due to limited health care access, ongoing conflicts and emergencies, lingering effects of COVID-19 on service delivery until late 2022, inadequate funding, and factors that are affecting the overall effectiveness of malaria interventions (e.g. insecticide resistance and quality of products). For example, implementation of a core intervention – ITNs – was uneven; only seven of the 11 countries had mass distribution campaigns for ITNs, with five of those countries distributing at least 90% of their nets.

11.1.3 Progress towards the GTS milestones

WHO's GTS is a comprehensive framework that aims to reduce malaria case incidence and mortality rates by at least 90% by 2030 (compared with a 2015 baseline), among other goals. Key milestones include a reduction in both case incidence and mortality rate of at least 40% by 2020 and 75% by 2025. Data from 2022 show that, despite the gains since 2000, the GTS 2020 milestones were missed by a wide margin. In 2022, global malaria case incidence was 58.4 cases per 1000 population at risk against a target of 26.2. Progress towards the 2025 milestone for case incidence is now 55% off track; if this trajectory persists, the 2030 milestone will be missed by a staggering 89% (**Fig. 8.1a**). The global malaria mortality rate in 2022 was 14.3 deaths per 100 000 population at risk against a target of 6.6, off the mark by 53%. Without an acceleration in the pace of progress, the 2030 outlook indicates a potential shortfall of 88% (**Fig. 8.1b**).

11.2 Global state of malaria interventions

Core interventions to control and eliminate malaria (e.g. ITNs, IRS, antimalarial medicines, RDTs and, most recently, vaccines) are crucial for reducing transmission and mortality rates. They not only support the goal of malaria elimination but also contribute to broader public health gains and economic stability in affected regions. Despite progress in expanding access to WHO-recommended malaria interventions, too many people are still missing out on the services and quality care they need to prevent, detect and treat the disease.

11.2.1 Vector control

ITNs are the primary vector control tool used in most malaria endemic countries. Between 2004 and 2022, manufacturers supplied more than 2.9 billion ITNs globally, with 2.5 billion (86%) going to sub-Saharan Africa. In 2022, about 282 million ITNs were delivered to malaria endemic countries, an increase of 28% over the previous year. Of the 260 million ITNs delivered to sub-Saharan Africa in 2022, about half were dual active ingredient ITNs (pyrethroid-

¹ Burkina Faso, Cameroon, the Democratic Republic of the Congo, Ghana, India, Mali, Mozambique, Niger, Nigeria, Uganda and the United Republic of Tanzania (Sudan joined as a 12th country in 2022).



PBO nets, in particular), an increase of 40% from 2021. By 2022, 70% of households in sub-Saharan Africa had at least one ITN, increasing from just 5% in 2000. Over the same period, the percentage of children aged under 5 years and pregnant women sleeping under an ITN jumped from 3% to 56%, although most of these increases occurred before 2015 (**Fig. 7.2a**).

In 2022, 47 countries implemented IRS to prevent malaria. Globally, the percentage of the population at risk that is protected by IRS in malaria endemic countries declined from 5.5% in 2010 to 1.8% in 2022. In this same period, the number of people protected globally by IRS fell from 153 million to 62 million (**Fig. 7.3**).

11.2.2 Chemoprevention

IPTp is used to prevent malaria among pregnant women living in areas of moderate to high malaria transmission in Africa. WHO recommends at least three doses of IPTp for pregnant women in malaria endemic areas, starting as early as possible in the second trimester; doses are administered at least 1 month apart and are typically delivered during ANC visits. To date, 35 African countries have adopted IPTp. In 2022, coverage of IPTp increased to its highest recorded level but remains well below the target of 80%. An estimated 42% of pregnant woman at risk of malaria benefited from three doses of the preventive therapy in 2022, compared with 34% in 2021 and 1% in 2010 (**Fig. 7.5**). Data also show that more pregnant women are seeking ANC: coverage of pregnant women visiting an ANC facility at least once increased from 73% in 2021 to 78% in 2022.

SMC is a preventive therapy recommended for children at high risk of severe malaria living in areas with seasonal transmission. To date, 17 countries in sub-Saharan Africa have implemented SMC. The average number of children treated per cycle of SMC has increased steadily, from about 0.2 million in 2012 to 49 million in 2022 (**Table 7.1**). Nigeria alone treated an average of 25.5 million children in 2022. In Mozambique, the number of children treated increased 12-fold between 2021 and 2022, with the average number of children treated per cycle increasing from 0.1 million to 1.3 million. In 2022, Mauritania and South Sudan implemented SMC for the first time.

11.2.3 Malaria vaccines

In 2021, WHO recommended the RTS,S vaccine to prevent malaria among children living in regions with moderate to

high rates of *P. falciparum* malaria transmission. To date, more than 2 million children have been reached with at least one dose of the vaccine through the WHO-coordinated Malaria Vaccine Implementation Programme in Ghana, Kenya and Malawi. Data from this pilot programme show that RTS,S has reduced early childhood deaths by 13% in the three countries. In October 2023, WHO recommended a second safe and effective malaria vaccine, R21. A two-vaccine market will make broad vaccine scale-up across Africa possible, so that children living in areas where malaria is a public health risk can benefit.

11.2.4 Case management

RDTs enable health care providers to swiftly distinguish between malarial and non-malarial fevers, facilitating appropriate treatment. Globally, 3.9 billion RDTs for malaria were sold by manufacturers between 2010 and 2022, with more than 82% of sales being in sub-Saharan African countries. NMPs in sub-Saharan Africa distributed 345 million RDTs in 2022, about 30 million more than in 2021. NMP distributions of RDTs have increased in the region for 3 years in a row.

ACTs combine artemisinin with a partner drug, and they are the most effective treatment for *P. falciparum* malaria. Between 2010 and 2022, manufacturers delivered about 4 billion treatment courses of ACTs globally. NMPs distributed 217 million ACTs in 2022, 97% of which were in sub-Saharan Africa.

Household surveys conducted in 22 countries in sub-Saharan Africa between 2005 and 2022 were used to analyse the coverage of treatment seeking, diagnosis and use of ACTs for children aged under 5 years. The surveys found that treatment seeking for febrile children changed little between the baseline surveys in 2005–2011 and more recent surveys in 2015–2022 (65% versus 66%). About one third of febrile children in sub-Saharan Africa do not seek any treatment for their illnesses. The proportion of children aged under 5 years who sought care for a fever, and who received a diagnosis with a finger prick or heel prick, increased from about 30% at baseline to 54% in the latest surveys, indicating an improvement in case management. Surveys also revealed that the use of ACTs among those who sought care and were treated with an antimalarial drug increased from a median of 38% at baseline to 65% in the latest surveys.

term impacts on malaria are sparse, the direction and magnitude of changes in transmission and burden are likely to vary across social and ecological systems, both within and between countries. Short-term extreme weather events can lead not only to population displacement and

socioeconomic devastation, but also to large epidemics of diseases such as malaria. This year's world malaria report presents a series of proposals to help countries and their development partners detect, prepare for, respond to and recover from short-term climate-related threats to progress against malaria and, at the same, take steps to address the longer term impacts.

11.3.1 Climate change is one of the biggest threats to human health

Climate change threatens the complex relationship between natural and human systems, and undermines many of the social determinants of good health, such as livelihoods, nutrition, security and access to quality health services. It is a both singular threat to health and a “threat multiplier”. In many areas, extreme climate events are also having an impact on the health infrastructure and workforce. Without assistance to prepare and respond, countries with weak health systems will be least able to cope.

According to the Sixth Assessment Report of the IPCC, “vulnerable communities who have historically contributed the least to current climate change are disproportionately affected” (92). These groups include women, children, ethnic minorities, poor communities, migrants and displaced persons, older populations and people with underlying health conditions. An estimated 3.6 billion people already live in areas that are highly susceptible to climate change. Low-income and small island developing states experience the harshest impacts. Between 2010 and 2020, human mortality from floods, droughts and storms in vulnerable regions was 15 times higher than in less vulnerable regions (92).

11.3.2 Direct and indirect effects of climate change on malaria transmission and burden.

Climate change can directly affect malaria transmission because of the sensitivity of the malaria parasite and mosquito vectors to temperature, rainfall and humidity. For example, ideal mosquito breeding and survival occur at temperatures of 20–27 °C, with mortality increasing above 28 °C. Conversely, a slight warming in cooler, malaria-free zones could lead to new malaria cases, as has been observed over several decades in some African highlands.

Indirect effects of climate change on malaria transmission can occur through people having reduced access to

essential health services; disruptions to the supply chain for critical malaria commodities (e.g. ITNs and medicines); population displacement, as people without immunity move to malaria endemic areas; and rising food insecurity and malnutrition, a risk factor for severe malaria in young children and pregnant women.

11.3.3 Long-term impact of climate change on malaria transmission

Data on the long-term impact of climate change on malaria transmission are sparse. However, the direction and magnitude of any impacts are likely to vary across social and ecological systems, both within and between countries. Some of the strongest available data collected over several decades found that climate change has contributed to malaria transmission in African highland areas that were previously malaria free. WHO's Strategic Advisory Group for malaria eradication (SAGme) commissioned a study in 2017 to forecast malaria trends under different intervention, socioeconomic and climate change scenarios. Findings indicated that maintaining coverage of malaria interventions under a “middle of the road” climate mitigation scenario could reduce cases by 2050, whereas increasing coverage of interventions to 80% under current levels of development and fossil fuel use could significantly reduce malaria incidence, especially with the addition of new tools such as highly efficacious vaccines. These findings demonstrate the importance of increasing the coverage of malaria interventions.

11.3.4 Short-term impact of climate change on malaria transmission

Extreme weather in Pakistan in 2022 saw glaciers melt and rivers surge in the north, while heating of the Indian Ocean led to excessive rainfall and flooding in the south. After the flood, standing water became an ideal breeding ground for mosquitoes, and malaria cases increased fivefold compared with 2021 (2.1 million additional cases in 2022). Also, the floods destroyed infrastructure and isolated millions of people, hindering medical access and increasing the risk of disease.

According to the IPCC, climate change has led to an increase in the frequency and intensity of extreme weather events. Although the specific contribution of climate change to any particular event is not known, there is a clear need to prepare for, and respond to, such events, while also working to reduce the pace of climate change.

11.4 Other drivers of malaria epidemics

In addition to extreme weather events, other forces have led to both epidemics and significant spikes in malaria cases and deaths. These drivers include biological threats, humanitarian crises, migration and population

displacement, and funding and socioeconomic constraints. Together with the impacts of extreme weather events, these challenges underscore the urgent need to adapt



strategies and commit resources that are equal to the task of controlling and eliminating malaria.

11.4.1 Humanitarian crises

Between 2019 and 2022, 41 malaria endemic countries suffered humanitarian and health emergencies, in addition to the COVID-19 pandemic. Many of these countries saw significant increases in malaria cases and deaths, and a few experienced malaria epidemics.

Ethiopia, in the grip of conflict, saw an increase of 1.3 million cases between 2021 and 2022. Also, the political and social instability in Myanmar led to a surge in malaria, from 78 000 cases in 2019 to 584 000 cases in 2022. The surge of cases in Myanmar spilled over to neighbouring Thailand, as people sought health care across the border, and imported cases fuelled local spread of the disease; thus, cases more than doubled in Thailand between 2021 (2426 cases) and 2022 (6263 cases).

11.4.2 Biological threats

Increasing biological threats include parasite resistance to the frontline medicines for malaria, mosquito resistance to insecticides, genetic mutations that make the malaria parasite more difficult to detect, and the spread of new malarial parasites and mosquito vectors.

Parasite resistance to front-line medicines

Partial resistance to artemisinin, the core compound of ACTs, is a growing concern. In some areas, malaria parasites have also shown signs of resistance to the partner drugs in ACT drug therapies. The GMS has historically been the epicentre of drug-resistant malaria, and high treatment failure rates have been detected over the years in several countries in the subregion. Even so, excellent progress has been made in reducing *P. falciparum* malaria cases, and elimination is within reach in the countries where antimalarial drug resistance has posed the greatest challenge in the past: Cambodia, the Lao People's Democratic Republic, Thailand and Viet Nam.

A key area of concern is the emergence of artemisinin partial resistance in Africa. Such resistance is spreading in countries in east Africa and the Horn of Africa. Currently, nearly all patients infected with artemisinin-resistant parasites who are treated with an ACT are fully cured, provided that the partner drug is efficacious. Should treatment with a particular ACT fail, other options are available.

In November 2022, WHO launched a new strategy to curb antimalarial drug resistance in Africa (56). The strategy builds on lessons learned from past global plans and complements existing strategies, including broader efforts to respond to antimicrobial resistance. Urgent and vigorous

measures are needed to protect the efficacy of ACTs and stay one step ahead of the curve: given the heavy reliance on ACTs in Africa, full-blown treatment failure could have very serious consequences.

Mosquito resistance to insecticides

Resistance to pyrethroids, the most common chemical used on ITNs, is rising globally. Recent data indicate that, between 2010 and 2020, 78 countries confirmed mosquito resistance to at least one insecticide class, with 29 countries noting resistance to all four current classes.¹ High-intensity pyrethroid resistance was particularly prevalent in west Africa.

To overcome insecticide resistance, WHO recommends the use of dual active ingredient ITNs. WHO issued updated guidelines for their use in March 2023 (6). WHO's global database and the Malaria Threats Map (52) offer detailed resistance data and track the evolution of resistance, helping to inform strategies for managing resistance in malaria vectors.

Genetic mutations that prevent diagnosis

Most RDTs for malaria work by detecting either one or two specific proteins produced by the *P. falciparum* malaria parasite. However, parasites with genetic mutations that prohibit the expression of these proteins are spreading, and in some settings they are even becoming dominant in parasite populations.

Since 2010, such mutations have been detected in Latin America, the Middle East, Africa and Asia. Their prevalence among symptomatic patients in Peru is as high as 80%. Because these parasites escape detection by the commonly used RDTs, patients increasingly go undiagnosed. This poses challenges to malaria control and raises the risk of missed cases progressing to severe disease and death.

WHO guidelines suggest that alternative tests are needed when the percentage of false negative RDT results exceeds 5%. However, alternative options are limited, and more research is needed to develop new diagnostic tests.

Invasion of *Anopheles stephensi*

Anopheles stephensi, a mosquito that transmits malaria, has spread beyond its native Asian and Arabian habitats to Africa; first identified in Djibouti in 2012, it has been linked to malaria outbreaks. *An. stephensi* is challenging to control because it thrives in urban settings, endures high temperatures and is resistant to many of the insecticides used in public health. Its spread, along with rapid urbanization, could increase malaria risks in African cities.

In September 2022, WHO launched a new initiative to stop the spread of the *An. stephensi* malaria vector in

Africa (146). The initiative aims to support an effective regional response in Africa through a five-pronged approach: increase collaboration across sectors and borders, strengthen surveillance to determine the extent of the spread of *An. stephensi* and its role in transmission, improve information exchange on the presence of *An. stephensi* and efforts to control it, develop guidance for NMPs on appropriate ways to respond, and prioritize research to evaluate the impact of interventions and tools.

Spread of zoonotic malaria

Until recently, four malaria parasites were known to infect humans, the most common being *P. falciparum* and *P. vivax*. However, a fifth parasite, *P. knowlesi*, has emerged as a significant concern for malaria control, especially in South-East Asia. This zoonotic parasite, initially found in monkeys, has a human fatality rate of 1–2%, and is known for causing severe and rapid onset of disease. Since large infection clusters were discovered in Malaysia in 2004, *P. knowlesi* has spread across nearly all of South-East Asia (except Timor-Leste) and globally through travel and tourism. Although the number of *P. knowlesi* cases declined globally in 2022 by 24.2% (to a total of just 2768 cases), the number increased significantly in Indonesia and Thailand, and *P. knowlesi* caused all malaria deaths in Malaysia and Thailand in that year.

The spread of *P. knowlesi* complicates malaria elimination efforts and affects WHO's certification process for malaria free status, which previously considered only four human malaria parasite species. WHO is now reassessing the certification criteria in light of the rise of *P. knowlesi*.

11.4.3 Socioeconomic threats

Trends in real GDP following the COVID-19 pandemic have further entrenched malaria as a disease that predominantly affects vulnerable people. In 2020, 70% of malaria endemic LMIC saw their economies shrink, with a third experiencing

a decline in GDP greater than 1%. Although the number of countries with economic downturns fell in 2021 and 2022, wealth continues to be unevenly distributed in many areas, and growth is unsustainable. In addition, many recovering economies carry the heaviest burden of climate change and of diseases such as malaria.

The funding gap between the amount invested in malaria control and elimination and the resources needed continues to widen, growing from US\$ 2.3 billion in 2018 to US\$ 3.7 billion in 2022. Spending on malaria reached US\$ 4.1 billion globally in 2022 – a leap from 2021, but well below the US\$ 7.8 billion required to stay on track for the GTS milestones, and the US\$ 9.3 billion needed by 2025 (Fig. 6.1).

During the period 2010–2021, international sources consistently provided an average of 66% of malaria funding, and endemic countries contributed 34%. In 2022, there was a shift in funding distribution, with malaria endemic countries increasing their share of domestic funding to 38%, while international funders contributed 62% (Fig. 6.2).

Individuals and households carry much of the financial burden. In 2020, catastrophic health expenditures – costs surpassing 40% of a family's income – affected more than 47% of households in LMIC, including 1.9 billion people living in areas where the risk of contracting malaria is high. Exorbitant personal health care expenses can limit access to health care, deepen poverty, and widen social and economic inequalities, further intensifying the impact of diseases such as malaria. This situation underscores the urgency of implementing universal health coverage and establishing financial safeguards.

In 2022, global investment in malaria R&D dropped to US\$ 603 million, the steepest fall yet – down more than 10% from 2021 – leaving funding at its lowest recorded level in the past 15 years.

11.5 Progress despite challenges

Despite the challenges, there have been important achievements in the fight against malaria. Countries made remarkable progress between 2000 and 2014 in lowering malaria cases and deaths, as well as incidence and mortality rates. Although a slow, concerning reversal has occurred, most of the gains made over that time have been retained to date.

Other successes include the rollout of the world's first malaria vaccine, RTS,S, and the recommendation by WHO for a safe and effective second vaccine, R21 (Section 2.4); the current availability of a new generation of dual active ingredient ITNs; the scale-up of seasonal malaria prevention for children at high risk of severe malaria (Section 2.2); and progress towards, or achievement of, malaria elimination in

a widening group of countries (Section 4). These and other advances are testament to national commitment and global resolve to control and eliminate the disease.

11.5.1 Progress towards malaria elimination

Despite stalled progress in countries with a high burden of malaria, a growing number of low-burden countries are moving steadily towards the goal of malaria elimination. In 2022, 34 countries reported fewer than 1000 cases of malaria, compared with just 13 countries in 2000. Twenty-seven countries reported fewer than 100 cases of malaria in 2022, up from just six countries in 2000 (Fig 4.1).

¹ Pyrethroids, organophosphates, carbamates and organochlorines.



Certification of malaria elimination by WHO requires the elimination of the four main human parasite species: *P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*. A country or territory is awarded this certification when it has been proven, beyond a reasonable doubt, that the chain of mosquito-borne transmission has been interrupted nationwide for at least the past 3 consecutive years. Additionally, there must be a programme in place to prevent re-establishment of transmission.

Between 2000 and 2023, 25 countries that were malaria endemic in 2000 achieved zero indigenous malaria cases for 3 consecutive years, and 15 of these countries were certified as malaria free by WHO. Three countries – Azerbaijan, Belize and Tajikistan – were certified malaria free in 2023. In 2021, China became the first country in the WHO Western Pacific Region to be certified malaria free in more than 3 decades.

Cabo Verde reported zero malaria cases for the fourth consecutive year in 2022 and has requested an official certification of malaria elimination from WHO (a decision is expected in early 2024). The number of countries reporting zero cases is increasing. In 2022, Timor-Leste and Saudi Arabia reported zero indigenous cases for the second consecutive year, and Bhutan and Suriname reported zero indigenous cases for the first time. Other malaria-eliminating countries also reported substantial reductions in indigenous malaria cases in 2022: Botswana (43.5%), the Democratic People's Republic of Korea (9.3%), Ecuador (38.0%), Eswatini (57.6%), the area of French Guiana (71.6%), Mexico (32.6%) and South Africa (31.3%).

11.6 Implications for the global malaria response

Amid extreme weather challenges, scarce resources, system inefficiencies and biological threats, the goal of a world free from malaria is still far from reach. A substantial pivot – with much greater financing, better tools and data-driven strategies – is needed to get back on track. Holistic measures, with whole-of-society engagement, will be crucial for building integrated and climate-resilient malaria responses. Key to alleviating the direct and indirect effects of climate change on malaria are efforts to rein in global warming, strengthen climate change adaptation and reduce vulnerabilities, including strengthening health systems, and accelerating burden reduction and elimination of malaria.

11.6.1 Strategic use of data

Health surveillance systems and the strategic use of data and information are critical for estimating the burden of malaria, and developing strategies for its control and elimination. However, weak surveillance systems and data collection and analysis in many malaria endemic countries limit the effective use of data. In some countries (e.g. Afghanistan, Somalia, Sudan and Yemen), there are

11.5.2 Uneven progress towards elimination in the GMS

From 2000 to 2022, the countries of the GMS (Cambodia, China's Yunnan Province, the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam) saw a 55.5% decline in indigenous malaria cases and an 89.1% decline in cases caused by *P. falciparum*. This is important because, historically, the subregion has been the epicentre of antimalarial drug resistance. However, some GMS countries – notably Myanmar and Thailand – are now experiencing a concerning resurgence of malaria.

The number of indigenous cases in the subregion increased from 90 082 in 2021 to 170 527 in 2022; similarly, the number of indigenous *P. falciparum* cases nearly doubled, increasing from 16 490 in 2021 to 30 789 in 2022 (Fig. 4.6). Myanmar accounted for 92.4% of indigenous malaria cases and 95.0% of *P. falciparum* malaria cases in the GMS. Resources are limited in Myanmar owing to internal political conflict, which is driving many people to seek medical care across the border in Thailand. This raises the need for increased investments and resources for diagnostics, treatment and prevention in Thailand.

Nonetheless, GMS countries, excluding Myanmar, are moving towards subnational verification, and aiming for certification of malaria elimination, following the example set by China's successful elimination of the disease.

insufficient reliable data to estimate recent trends in the burden of malaria.

SNT of malaria interventions exemplifies the importance of using local data to achieve maximum impact. SNT uses local data to guide the mix of interventions (e.g. ITNs, IRS, vaccines and chemoprevention) and to inform the integration of new tools, strengthen health systems, and allocate resources efficiently and equitably. Use of data with an emphasis on SNT is one of four pillars of the HBHI approach. This approach was used by China to accelerate the successful elimination of malaria.

Between 2018 and 2023, WHO has supported more than 30 countries in the strategic use of data for decision-making and SNT. This has sparked the integration of data as part of countries' regular decision-making processes, and has strengthened the collection, review and quality of data on a regular basis. It has also revealed the uneven capacity of countries to fully implement the SNT process and the insufficient investments in surveillance, highlighting the need for countries, their partners and donors to collectively address any gaps in capacity.

WHO is in the process of finalizing guidance to aid countries in prioritizing malaria interventions, which will help to optimize the impact of interventions under resource constraints.

11.6.2 Investment in new tools

Developing more efficacious tools will be essential to accelerate progress towards global malaria targets. Such tools include highly efficacious vaccines, longer lasting insecticides (preferably non-pyrethroid), vector control tools that address outdoor biting, efficacious single-dose preventive therapies (e.g. monoclonal antibodies), diagnostic tools that can detect latent stages of *P. vivax* infections, new antimalarial drugs to mitigate ACT resistance and single-dose chemoprevention therapies. Also essential are innovations in service delivery, surveillance and analytics, as well as diagnostics and medicines that are simple to produce and less susceptible to changes in temperature.

Processes for bringing affordable products to market need to be accelerated while maintaining safety, efficacy and quality. In addition, capacities of national and regional regulatory authorities to review, approve and evaluate these products must be strengthened.

11.6.3 Ensuring that malaria responses are sustainable and climate resilient

Proposed strategic, technical and operational actions needed include the following:

- **Establish a common voice and build partnerships** that integrate malaria reduction with climate action. The threat to progress on malaria must be seen within the broader paradigm of climate and health. The Alliance for Transformative Action on Climate and Health, convened by WHO, provides a global platform for ministers of health to establish political commitment to build climate-resilient and low-carbon sustainable health systems.
- **Decarbonize health systems, and make them more climate resilient and environmentally sustainable.** Health care is responsible for nearly 5% of global greenhouse gas emissions globally, and there is great potential to reduce health sector emissions without compromising quality of care. Health systems should share best practices to “level up”, establishing services that provide high performance, low cost and low emissions – including in the supply chain, a major contributor of carbon emissions. A resilient health system can anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress. Countries with a higher level of per-capita emissions should start to build climate-resilient health systems now. In countries that have historically contributed little to the carbon footprint, the work towards minimizing emissions should be accompanied by improving health

sector performance and climate resilience. WHO has developed an operational framework to guide countries in building health systems that are resilient to climate change (147). The 10 key components of the framework can help health organizations and programmes in a country to better anticipate, prevent, prepare for and manage climate-related health risks, thereby ensuring health system resilience.

- **Shift the locus of decision-making** from global health institutions to country and community actors for action to address risks and opportunities at the climate change–health nexus. Robust, locally led decision-making will be key to addressing the effects of climate change; for example, through improved tailoring of interventions, epidemic response, delivery of malaria interventions, health system strengthening and multisectoral action.
- **Increase knowledge of the climate change and health nexus.** A combination of low climate literacy among health experts and low health education among climate experts has hampered discussions on the appropriate ways to respond to interacting threats in climate change and health. There is an urgent need to scale up knowledge of the climate change–health nexus among policy-makers at all levels.
- **Improve guidance and tools for monitoring climate and for health surveillance, monitoring and evaluation.** Practical guidance and tools for the surveillance, monitoring, evaluation and use of both climate and malaria indicators are essential to understand short- and medium-term risks, and adapt responses accordingly.
- **Use climate and disease information for decision-making.** Deliberate efforts will be needed to foster partnerships between climate and public health experts and stakeholders to develop subnationally tailored plans. Investment in appropriate digital solutions, including artificial intelligence, is key to making better use of health and climate information.
- **Strengthen epidemic detection, preparedness and response.** Climatic indicators are essential to malaria epidemic forecasting and early warning systems; such indicators can improve national preparedness to respond to malaria epidemics. Building the WHO climate and health framework into current systems for epidemic preparedness and response is an immediately feasible goal in many countries.
- **Enhance national capacity in the analysis and use of climate and malaria information,** with coordinated training of both climate and health practitioners. The first step is to establish platforms for joint work and coordination among such practitioners. Engagement with relevant regional and global institutions will be essential for strengthening national capacity.

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Annexes

Annex 1 - Data sources and methods

Annex 2 - Number of ITNs distributed through campaigns in malaria endemic countries, 2020–2022

Annex 3 - Regional profiles

- > A. WHO African Region
 - a. West Africa
 - b. Central Africa
 - c. Countries with high transmission in east and southern Africa
 - d. Countries with low transmission in east and southern Africa
- > B. WHO Region of the Americas
- > C. WHO Eastern Mediterranean Region
- > D. WHO South-East Asia Region
- > E. WHO Western Pacific Region

Annex 4 - Data tables and methods

- > A. Policy adoption, 2022
- > B. Antimalarial drug policy, 2022
- > C. Funding for malaria control, 2020–2022
- > D. Commodities distribution and coverage, 2020–2022
- > E. Household survey results, 2018–2022
 - a. Compiled through STATcompiler
 - b. Compiled through WHO calculations
- > F. Population denominator for case incidence and mortality rate, and estimated malaria cases and deaths, 2000–2022
- > G. Population denominator for case incidence and mortality rate, and reported malaria cases by place of care, 2022
- > H. Reported malaria cases by method of confirmation, 2010–2022
- > I. Reported malaria cases by species, 2010–2022
- > J. Reported malaria deaths, 2010–2022
- > K. Methods for Tables A-D-G-H-I-J

Fig. 2.1. People in humanitarian need in malaria endemic countries as of December 2022

Figure created based on data from the *Global humanitarian overview 2022* (1).

Fig. 2.2. Malaria endemic countries that account for 89% of people in humanitarian aid in 2022

Figure created based on data from the *Global humanitarian overview 2022* (1).

Fig. 3.1. Estimated number of malaria cases per country and area in 2022

See methods notes for **Table 3.1**.

Table 3.1. Global estimated malaria cases and deaths, 2000–2022

a) Global estimated malaria cases

For each country or area, the number of malaria cases was estimated by one of the three methods described below.

Method 1

Method 1 was used for countries and areas outside the World Health Organization (WHO) African Region, and for low transmission countries and areas in the African Region as follows: Afghanistan, Bangladesh, the Bolivarian Republic of Venezuela, Botswana, Brazil, Cambodia, Colombia, the Dominican Republic (until 2020), Eritrea, Ethiopia, French Guiana (until 2020), the Gambia, Guatemala (until 2020), Guyana, Haiti, Honduras (until 2020), India, Indonesia, the Lao People’s Democratic Republic, Madagascar, Mauritania, Myanmar, Namibia, Nepal (until 2020), Nicaragua, Pakistan, Panama (until 2020), Papua New Guinea, Peru, the Philippines, the Plurinational State of Bolivia, Rwanda, Senegal, Solomon Islands, Timor-Leste (until 2016), Vanuatu, Viet Nam (until 2020), Yemen and Zimbabwe.

Estimates were made by adjusting the number of reported malaria cases for completeness of reporting, the likelihood that cases were parasite positive, and the extent of health service use. The procedure, which is described in the *World malaria report 2008* (2), combines national data annually reported by national malaria programmes (NMPs) (i.e. reported cases, reporting completeness and likelihood that cases are parasite positive) with data obtained from nationally representative household surveys on health service use among children aged under 5 years, which was assumed to be representative of the service use in all ages. Briefly:

$$T=(a + (c \times e))/d \times (1+f/g+(1-g-f)/2/g)$$

where:

a is malaria cases confirmed in the public sector

c is presumed cases (not tested but treated as malaria)

d is reporting completeness

e is test positivity rate (malaria positive fraction)=a/b, where b is suspected cases tested

f is the fraction seeking treatment in the private sector

g is the fraction seeking treatment in the public sector

Factor to adjust for those not seeking treatment: $(1-g-f)$

Cases in the public sector: $(a + (c \times e))/d$

Cases in the private sector: $(a + (c \times e))/d \times f/g$

To estimate the uncertainty around the number of cases, the *test positivity rate* was assumed to have a normal distribution centred on the test positivity rate value and standard deviation – defined as $0.244 \times e^{0.5547}$ and truncated to be in the range 0, 1. *Reporting completeness* (d), when reported as a range or below 80%, was assumed to have one of three distributions, depending on the value reported by the NMP. If the value was reported as a range greater than 80%, the distribution was assumed to be triangular, with limits of 0.8 and 1.0, and the peak at 0.8. If the value was more than 50% but less than or equal to 80%, the distribution was assumed to be rectangular, with limits of 0.5 and 0.8. Finally, if the value was less than or equal to 50%, the distribution was assumed to be triangular, with limits of 0 and 0.5, and the peak at 0.5 (3). If the reporting completeness was reported as a value and was more than 80%, a beta distribution was assumed, with a mean value of the reported value (maximum of 95%) and confidence intervals (CIs) of 5% around the mean value. The fraction of children brought for care in the public sector and in the private sector was assumed to have a beta distribution, with the mean value being the estimated value in the survey and the standard deviation being calculated from the range of the estimated 95% CIs. The fraction of children not brought for care was assumed to have a rectangular distribution, with the lower limit being 0 and the upper limit calculated as 1 minus the proportion that were brought for care in the public and private sectors. The three distributions (fraction seeking treatment in the public sector, fraction seeking treatment in the private sector only and fraction not seeking treatment) were constrained to add up to 1.

Sector-specific care seeking fractions were linearly interpolated between the years that had a survey, and were extrapolated for the years before the first or after the last survey with the values reported in those surveys. The parameters used to propagate uncertainty around these fractions were also imputed in a similar way or, if there was no value for any year in the country or area, were imputed as a mixture of the distributions of the region for that year. CIs were obtained from 10 000 draws of the convoluted distributions. The data were analysed using R statistical software, using the *convdistr* R package to propagate uncertainty and manage distributions (4).

For India, the values were obtained at subnational level using the same methodology but adjusting the private sector for an additional factor because of the active case detection activities, estimated as the ratio of the test positivity rate in active case detection divided by the test positivity rate for passive case detection. This factor was assumed to have a normal distribution, with mean value and standard deviation calculated from the values reported in 2010. An additional adjustment was applied in several states in India between 2020 and 2022, to control for the reductions in reported testing rates associated with disruptions in health services related to the COVID-19 pandemic. The states with reductions in testing rates below those expected (defined as a change in testing rates of more than 10% observed between 2018 and 2019) in 2020 were Bihar,

Chandigarh, Chhattisgarh, Dadra and Nagar Haveli, Delhi, Goa, Jharkhand, Karnataka, Puducherry, Punjab, Uttar Pradesh, Uttarakhand and West Bengal. In 2021, the states with reductions in testing rates were Assam, Chandigarh, Chhattisgarh, Daman and Diu, Delhi, Goa, Himachal Pradesh, Karnataka, Kerala, Manipur, Puducherry, Punjab, Uttar Pradesh, Uttarakhand and West Bengal. In 2022, cases were corrected for the states of Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Manipur, Puducherry, Punjab, Sikkim and West Bengal. In these states, the excess number of indigenous cases expected in the absence of diagnostic disruptions was calculated by estimating the number of additional tests that would have been conducted if testing rates were similar to those observed in 2019, then applying the test positivity ratio observed in 2019 (or in 2020, for Delhi and Jharkhand, or in 2021 and 2022 for Delhi and Puducherry) to this number. The malaria burden in countries outside the WHO African Region was affected by the COVID-19 pandemic in different ways. In several countries, the movement disruptions led to transmission reductions, but in other countries, testing rates remained unchanged. This made it challenging to apply a single source of data for correction to all countries, considering also that it was difficult to relate the reported data to the essential health services (EHS) response. No adjustment for private sector treatment seeking was made for the following countries and areas because they report cases from the private and public sector together: Bangladesh, the Bolivarian Republic of Venezuela, Botswana, Brazil, Colombia, the Dominican Republic, French Guiana, Guatemala, Guyana, Haiti, Honduras, Indonesia (since 2017), Myanmar (since 2013), Nicaragua, Nepal (since 2019), Panama, Peru, the Plurinational State of Bolivia and Rwanda.

Method 2

Method 2 was used for high transmission countries in the WHO African Region and for countries in the Eastern Mediterranean Region in which the quality of surveillance data did not permit a robust estimate from the number of reported cases. These countries were Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, Congo, Côte d’Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria, Sierra Leone, Somalia, South Sudan, Sudan, Togo, Uganda, the United Republic of Tanzania and Zambia. In this method, estimates of the number of malaria cases were derived from information on parasite prevalence obtained from household surveys.

First, data on parasite prevalence from almost 60 000 survey records were assembled within a spatiotemporal Bayesian geostatistical model, together with environmental and sociodemographic covariates, and data distribution on interventions such as insecticide-treated mosquito nets (ITNs), antimalarial drugs and indoor residual spraying (IRS) (5) that are updated yearly to review the model. The geospatial model enabled predictions of *Plasmodium falciparum* prevalence in children aged 2–10 years, at a resolution of 5×5 km², throughout all malaria endemic WHO African Region countries for each year from 2000 to 2020. Second, an ensemble model

was developed to predict malaria incidence as a function of parasite prevalence (6). The model was then applied to the estimated parasite prevalence, to obtain estimates of the malaria case incidence at 5×5 km² resolution for each year from 2000 to 2021.¹ Data for each 5×5 km² area were then aggregated within country and regional boundaries, to obtain both national and regional estimates of malaria cases (8).

Between 2020 and 2022, additional cases estimated using this method were added to account for the disruptions in malaria prevention, diagnostic and treatment services during the COVID-19 pandemic. Disruption information was reported per country and was obtained from the national pulse surveys on continuity of EHS during the COVID-19 pandemic conducted by WHO (first round in May–July 2020, second in January–March 2021 and third in November–December 2021) (9–11), and extended into 2022. The medium, minimum and maximum (with a limit of 50%) values of the ranges provided by countries to define disruptions were used to quantify the percentage of malaria service disruptions. This information was integrated into the estimates by applying an approach previously used for assessing the impacts of interventions on malaria burden through the creation of counterfactual burden estimates for scenarios with varying levels of intervention coverage. It was assumed that COVID-19-related disruptions to health care manifested themselves as reduced treatment seeking for malaria, and thus reduced effective treatment with an antimalarial drug. The counterfactual estimates were then aligned, per country, with the estimates from the pulse surveys to produce a set of COVID-19 adjusted estimates for 2020, 2021 and 2022. For countries for which the estimates with the updated spatiotemporal model were considerably different from previous estimates without addition of new data or evidence that explained the drastic changes estimated by the model (i.e. Benin, Burkina Faso, Gabon, Guinea, Liberia, Malawi, Mali, Niger, Nigeria, Sudan and Uganda), the case series published in the *World malaria report 2020* (8) were used until 2021, adjusting for the changes in population at risk values. The values for 2022 were estimated by applying the change rate between the cases estimated using the spatiotemporal model of incidence between 2021 and 2022, and adjusting for population changes between these two years.

Method 3

For most of the elimination countries and countries at the stage of prevention of reintroduction, the number of indigenous and introduced cases registered by NMPs are reported without further adjustments. The countries in this category were Algeria, Argentina, Armenia, Azerbaijan, Belize, Bhutan, Cabo Verde, China, the Comoros, Costa Rica, the Democratic People’s Republic of Korea, Djibouti, the Dominican Republic (since 2021), Ecuador, Egypt, El Salvador, Eswatini, French Guiana (since 2021), Georgia, Guatemala (since 2021), Honduras (since 2021), Iraq, the Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Malaysia, Mexico, Morocco, Nepal (since 2021), Oman, Panama (since 2021), Paraguay, the Republic of Korea, Sao Tome and Principe, Saudi Arabia, South Africa, Sri Lanka, Suriname, the

¹ See the Malaria Atlas Project website for methods on the development of maps (7).

Annex 1 – Data sources and methods

Syrian Arab Republic, Tajikistan, Thailand, Timor-Leste (since 2017), Türkiye, Turkmenistan, the United Arab Emirates, Uzbekistan and Viet Nam (since 2021).

Country-specific adjustments

For some years, information for certain countries was not available or could not be used because it was of poor quality. For countries in this situation, the number of cases was imputed from other years where the quality of the data was better, taking into consideration population growth, as follows: for Afghanistan, values for 2000–2001 were imputed from 2002–2003; and for Bangladesh, values for 2001–2005 were imputed from 2006–2008. For Ethiopia, values for 2000–2019 were taken from a mixed distribution between values from Method 1 and Method 2 (50% from each method). For the Gambia, values for 2000–2010 were imputed from 2011–2013; for Haiti, values for 2000–2005, 2009 and 2010 were imputed from 2006–2008; for Indonesia, values for 2000–2003 and 2007–2009 were imputed from 2004–2006; and for Mauritania, values for 2000–2010 were imputed from a mixture of Method 1 and Method 2, starting with 100% values from Method 2 for 2001–2002, with that percentage decreasing to 10% of Method 1 in 2010. For Myanmar, values for 2000–2005 were imputed from 2007–2009; and for Namibia, values for 2000 were imputed from 2001–2003 and values for 2012 were imputed from 2011 and 2013. For Pakistan, values for 2000 were imputed from 2001–2003; and for Papua New Guinea, values for 2012 were imputed from 2009–2011. For Rwanda, values for 2000–2006 were imputed from a mixture of Method 1 and Method 2, starting with 100% values from Method 2 in 2000, with that percentage decreasing to 10% in 2006. For Senegal, values for 2000–2006 were imputed from a mixture of Method 1 and Method 2, with 90% of Method 2 in 2000, decreasing to 10% of Method 2 in 2006. For Thailand, values for 2000 were imputed from 2001–2003; for Timor-Leste, values for 2000–2001 were imputed from 2002–2004; and for Zimbabwe, values for 2000–2006 were imputed from 2007–2009.

Estimation of *P. vivax* cases

The number of malaria cases caused by *P. vivax* in each country was estimated by multiplying the country’s reported proportion of *P. vivax* cases (computed as $1 - P. falciparum$) by the total number of estimated cases for the country. For countries where the estimated proportion was not 0 or 1, the proportion of *P. falciparum* cases was assumed to have a beta distribution and was estimated from the proportion of *P. falciparum* cases reported by NMPs.

Population at risk

To transform malaria cases into incidence, an estimate of population at risk was used. The proportion of the population at high, low or no risk of malaria was provided by NMPs. Population at risk was estimated as the population at risk in high endemic areas and half of the population at risk in low endemic areas. This was applied to the latest United Nations (UN) population estimates available (2022, an update from the estimates used for the world malaria reports for 2020 and 2021), to compute the number of people at risk of malaria. This

number was sustained over time to ensure comparability of incidence estimates across years in the same cohort of countries that had been endemic since 2000. The population at risk at regional and global level was aggregated; it included the population of all endemic countries since 2000, even though some of them achieved elimination during this time.

b) Global estimated malaria deaths

The number of malaria deaths was estimated using methods from Category 1, 2 or 3, as outlined below.

Category 1 method

The Category 1 method was used for low transmission countries and areas, both within and outside the WHO African Region: Afghanistan, Bangladesh, the Bolivarian Republic of Venezuela, Cambodia, the Comoros, Djibouti, Eritrea, Ethiopia, French Guiana (until 2020), Guatemala (until 2020), Guyana, Haiti, Honduras (until 2020), India, Indonesia, the Lao People’s Democratic Republic, Madagascar, Myanmar, Nepal (until 2020), Pakistan, Papua New Guinea, Peru, the Philippines, the Plurinational State of Bolivia, Senegal (since 2008), Solomon Islands, Somalia, Sudan, Timor-Leste, Vanuatu (until 2012), Viet Nam (until 2017), Yemen and Zimbabwe.

A case fatality rate of 0.256% was applied to the estimated number of *P. falciparum* cases, which represents the average of case fatality rates reported in the literature (12–14) and rates from unpublished data from Indonesia, 2004–2009.¹ The proportion of deaths followed a rectangular distribution of between 0.01% and 0.40% – the minimum and maximum values available that were reported. A case fatality rate of 0.0375% was applied to the estimated number of *P. vivax* cases, representing the midpoint of the range of case fatality rates reported in a study by Douglas et al. (15), following a rectangular distribution of between 0.012% and 0.063%. Following the nonlinear association explained for the Category 2 method below, the proportion of deaths in children aged under 5 years was estimated as:

Proportion of deaths_{under 5} = $-0.2288 \times \text{Mortality}_{\text{overall}}^2 + 0.823 \times \text{Mortality}_{\text{overall}} + 0.2239$

where $\text{Mortality}_{\text{overall}}$ is the number of estimated all-age deaths over the estimated population at risk per 1000 (see **Annex 4-F** for national estimates of population at risk).

Category 2 method

The Category 2 method was used for countries in the WHO African Region with a high proportion of deaths due to malaria: Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, Congo, Côte d’Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Senegal (until 2007), Sierra Leone, South Sudan, Togo, Uganda, the United Republic of Tanzania and Zambia.

With this method, child malaria deaths were estimated using a new multinomial Bayesian least absolute shrinkage and selection operator (LASSO) model that was reviewed by the WHO Child and Adolescent Cause of Death Estimates (CA-CODE)

(formerly, the Maternal and Child Health Epidemiology Estimation Group [MCEE]) in 2021, to produce updated estimates of cause of death (CoD) in children aged 1–59 months between 2000 and 2019 (16). Mortality estimates (and 95% CIs) were derived for eight causes of post-neonatal death (pneumonia, diarrhoea, malaria, tuberculosis, meningitis, injuries, pertussis and other disorders), four causes arising in the neonatal period (prematurity, birth asphyxia and trauma, sepsis and other conditions of the neonate) and other causes (e.g. malnutrition). Deaths due to measles, unknown causes and HIV/AIDS were estimated separately. The resulting cause-specific estimates were adjusted, country by country, to fit the estimated all-cause mortality envelope of 1–59 months (excluding HIV/AIDS and measles deaths) for corresponding years.

The number of malaria deaths among children aged under 5 years was calculated by applying the country-specific yearly malaria CoD fraction to the all-cause mortality envelope of 1–59 months estimated by the UN Inter-agency Group for Child Mortality Estimation (17). The same malaria CoD fractions observed in 2021 were used in 2022. It was considered that the number of deaths follows a rectangular distribution, with limits being the estimated 95% CI.

The malaria mortality rate in children aged under 5 years estimated with this method was then used to infer malaria-specific mortality in those aged 5 years and over, using the relationship between levels of malaria mortality in a series of age groups and the intensity of malaria transmission (18), and assuming a nonlinear association between under-5-years mortality and over-5-years mortality, as follows:

Proportion of deaths_{over 5} = $-0.293 \times \text{Mortality}_{\text{under 5}}^2 + 0.8918 \times \text{Mortality}_{\text{under 5}} + 0.2896$

where $\text{Mortality}_{\text{under 5}}$ is estimated from the number of deaths from the CA-CODE-estimated malaria CoD fractions and the all-cause under-5 death envelope.

Between 2020 and 2022, additional malaria deaths estimated using this method were included to account for the disruptions in malaria diagnostic and treatment services as a result of the COVID-19 pandemic. Country-specific mortality inflation ratios were calculated by comparing the malaria mortality estimates for 2020 to 2022, in the presence and absence of diagnosis and treatment disruptions from the Malaria Atlas Project’s (MAP’s) malaria mortality estimates (results not presented in the report, but derived from the malaria incidence estimates), with both estimates accounting for disruptions to prevention interventions. Inflation ratios were then applied to the number of malaria deaths for 2020, 2021 and 2022 to estimate the number of deaths expected, considering the reported disruptions.

Category 3 method

For the Category 3 method, the number of indigenous malaria deaths registered by NMPs is reported without further adjustments. This category was used in the following countries: Algeria, Argentina, Armenia, Azerbaijan, Belize, Bhutan, Brazil, Cabo Verde, China, Colombia, Costa Rica, the Democratic People’s Republic of Korea, the Dominican Republic, Ecuador, Egypt, El Salvador, French Guiana (since 2021), Georgia, Guatemala (since 2021), Honduras (since 2021), Iraq, the Islamic

Republic of Iran, Kazakhstan, Kyrgyzstan, Malaysia, Mexico, Morocco, Nepal (since 2021), Nicaragua, Oman, Panama, Paraguay, the Republic of Korea, Sao Tome and Principe, Saudi Arabia, South Africa, Sri Lanka, Suriname, the Syrian Arab Republic, Tajikistan, Thailand, Türkiye, Turkmenistan, the United Arab Emirates, Uzbekistan, Vanuatu (since 2013) and Viet Nam (since 2021).

Fig. 3.2. Countries with indigenous cases in 2000 and their status by 2022

Data on the number of indigenous cases (an indicator of whether countries are endemic for malaria) were as reported to WHO by NMPs. Countries with 3 consecutive years of zero indigenous cases are considered to have eliminated malaria.

Fig. 3.3. Global trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) distribution of malaria cases and d) deaths by country, 2022

See methods notes for Fig. 3.1.

Table 3.2. Estimated malaria cases and deaths in the WHO African Region, 2000–2022

See methods notes for Fig. 3.1.

Fig. 3.4. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO African Region, 2022

See methods notes for Fig. 3.1.

Table 3.3. Estimated malaria cases and deaths in the WHO South-East Asia Region, 2000–2022

See methods notes for Fig. 3.1.

Fig. 3.5. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO South-East Asia Region, 2022

See methods notes for Fig. 3.1.

Table 3.4. Estimated malaria cases and deaths in the WHO Eastern Mediterranean Region, 2000–2022

See methods notes for Fig. 3.1.

Fig. 3.6. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO Eastern Mediterranean Region, 2022

See methods notes for Fig. 3.1.

¹ Dr Ric Price, Menzies School of Health Research, Australia, personal communication (November 2014).

Annex 1 – Data sources and methods

Table 3.5. Estimated malaria cases and deaths in the WHO Western Pacific Region, 2000–2022

See methods notes for Fig. 3.1.

Fig. 3.7. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO Western Pacific Region, 2022

See methods notes for Fig. 3.1.

Table 3.6. Estimated malaria cases and deaths in the WHO Region of the Americas, 2000–2022

See methods notes for Fig 3.1.

Fig. 3.8. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2022; and c) malaria cases by country in the WHO Region of the Americas, 2022

See methods notes for Fig 3.1.

Fig. 3.9. Cumulative number of a) cases and b) deaths averted, globally and by WHO region, 2000–2022

See methods notes for Fig 3.1 for information on estimation of cases and deaths. Estimated cases and deaths averted over the period 2000–2022 were computed by comparing current estimates for each year since 2000 with the malaria case incidence and mortality rates from 2000, assuming that they remained constant throughout the same period, adjusting for population growth.

Fig. 3.10. Percentage of a) cases and b) deaths averted, by WHO region, 2000–2022

See methods notes for Fig. 3.1 for information on estimation of cases and deaths. See notes for Fig. 3.9 for methods used to estimate cases and deaths averted. The percentage of cases and deaths averted was estimated using overall global cases and deaths averted as the denominator, and regional cases and deaths averted as the numerator.

Fig. 3.11. Estimated prevalence of exposure to malaria infection during pregnancy, overall and by subregion in 2022, in moderate to high transmission countries in the WHO African Region

Estimates of malaria-exposed pregnancies and preventable malaria-attributable low birthweight (LBW) deliveries in the absence of pregnancy-specific malaria prevention (i.e. long-lasting insecticidal nets [LLINs] delivery based on intermittent preventive treatment in pregnancy [IPTp] or antenatal care [ANC]) were obtained using a model of the relationship between these outcomes, slide microscopy prevalence in the general population, and age- and gravidity-specific fertility patterns. This model was developed by fitting an established model of

the relationship between malaria transmission and malaria infection by age (19) to patterns of infection in placental histology (20) and attributable LBW risk by gravidity, in the absence of IPTp or other effective chemoprevention (21). The model was run across a 0.2 degree (5 km²) longitude/latitude grid for 100 realizations of the MAP (7) joint posterior estimated slide prevalence in children aged 2–10 years in 2021 (22). Country-specific, age-specific or gravidity-specific fertility rates, stratified by status (urban or rural), were obtained from demographic and health surveys (DHS) and malaria indicator surveys (MIS), where such surveys had been carried out since 2014 and were available from the DHS programme website (23). Countries where surveys were not available were allocated fertility patterns from a survey undertaken in another country, matched on the basis of total fertility rate (24) and geography. Fertility patterns of individual women within simulations at each grid-point were simulated based on the proportion of women estimated to be living in urban or rural locations. Urban or rural attribution at a 1 km² scale was conducted based on WorldPop 1 km² population estimates from 2018 (25) and an urban/rural threshold of 386 people per km² (26); the estimates were then aggregated to the 0.2 degree (5 km²) resolution of the MAP surfaces. This provided a risk of malaria infection and malaria-attributable LBW in the absence of prevention during pregnancy, along with a modelled per capita pregnancy rate for each grid-point, which was aggregated to country level (using WorldPop population estimates) to provide a per-pregnancy risk of malaria infection and a per live birth estimate of malaria-attributable LBW in the absence of prevention. These were then multiplied by country-level estimates of pregnancies and estimates of malaria-attributable LBW deliveries in 2022 (Fig. 3.12).

Fig. 3.12. Estimated number of LBWs due to exposure to malaria infection during pregnancy (without IPTp versus at estimated levels of IPTp coverage), overall and by subregion in 2022, in moderate to high transmission countries in sub-Saharan Africa

Methods for estimating malaria infection in pregnancy and malaria-attributable LBW deliveries are described in Walker et al. (2014) (21). Numbers of pregnancies were estimated from the latest UN population-estimated number of births and were adjusted for the rate of abortion, miscarriage and stillbirths (27, 28). The underlying *P. falciparum* parasite prevalence estimates were from the PfPR_{2–10} estimates described in methods notes for Table 3.1, using methods described in Bhatt et al. (2015) (22).

Fig. 3.13. Estimated number of LBWs averted if current levels of IPTp coverage are maintained, and additional number averted if coverage of IPTp1 was optimized to match levels of coverage of ANC1 in 2022 while maintaining IPTp2 and IPTp3 at current levels, in moderate to high transmission countries in the WHO African Region

Efficacy of IPTp was modelled as a per sulfadoxine-pyrimethamine (SP) dose reduction in the attributable risk of

LBW, fitted to data from trials of IPTp-SP efficacy before the implementation of the intervention as policy; thus, the results reflect the impact on drug-sensitive parasites, with the central estimate being based on an assumed malaria-attributable LBW fraction of 40% within these trials. The modelling produced estimates of 48.5%, 73.5% and 86.3% efficacy in preventing malaria-attributable LBW for women receiving one, two or three doses of SP through IPTp, respectively. This analysis excluded South Sudan owing to the lack of consistent IPTp data reporting through time.

Fig. 3.14. Estimated number of LBWs averted if levels of IPTp3 coverage were optimized to match levels of coverage of ANC1 in 2022, in moderate to high transmission countries in the WHO African Region

See methods notes for Fig. 3.12 and Fig. 3.13.

Fig. 3.15. Estimated number of LBWs averted if levels of IPTp3 were optimized to achieve 90% coverage in 2022, in moderate to high transmission countries in the WHO African Region

See methods notes for Fig. 3.12 and Fig. 3.13.

Fig. 4.1. Number of countries that were malaria endemic in 2000 and had fewer than 10, 100, 1000 and 10 000 indigenous malaria cases, 2000–2022

The figure is based on the countries where malaria was endemic in 2000 that also had cases of malaria reported in 2000 (108 endemic countries, excluding Egypt, Kazakhstan and the United Arab Emirates, with zero reported cases in 2000). *P. knowlesi* cases were not included. The number of estimated cases was tabulated.

Fig. 4.2. Countries eliminating malaria since 2000

Countries are placed on the year in which they attained 3 consecutive years of zero indigenous cases. Blue represents countries with zero indigenous cases but which are not yet certified. Green represents countries that have been certified as malaria free (with the year of certification in parentheses). Maldives was certified in 2015; however, it was already malaria free before 2000 and thus is not listed here.

Fig. 4.3. Countries and areas selected for the E-2025 initiative

The selection of countries and areas for the E-2025 initiative was based on the following criteria: a set goal for malaria elimination by 2025 backed by a government-endorsed elimination plan; meeting a defined threshold of malaria case reductions in recent years; and meeting pre-defined malaria programme requirements.

Fig. 4.4. Total number of indigenous cases in E-2025 countries and areas, 2010–2022

Data were derived from NMP reports. Total indigenous malaria cases are based on confirmed malaria cases reported as

indigenous by all countries and one area in the “malaria eliminating countries for 2025” (E-2025) category between 2010 and 2022. For countries where not all cases are classified, total confirmed cases minus imported and introduced cases were used. For years where no case classification was carried out, all confirmed cases were considered to be indigenous. In Costa Rica (2021) and South Africa (2018–2021), unclassified cases were reclassified as indigenous and added to reported indigenous cases. *P. knowlesi* cases were excluded from countries reporting this species (Indonesia, Malaysia, the Philippines and Thailand). Because of the caseload, the Islamic Republic of Iran was unable to carry out case investigation and, as a result, could not distinguish between introduced and indigenous cases, resulting in all locally transmitted cases being classified as indigenous.

Table 4.1. Number of indigenous malaria cases in E-2025 countries and areas, 2010–2022

See methods notes for Fig. 4.4.

Fig. 4.5. Number of total *P. knowlesi*, indigenous *P. knowlesi* and total malaria cases in Indonesia, Malaysia and Thailand, 2013–2022

Data were derived from NMP reports. Total indigenous malaria cases are based on confirmed malaria cases reported as indigenous, indigenous *P. knowlesi* and total *P. knowlesi*.

Fig. 4.6. Total indigenous malaria and *P. falciparum* cases in the GMS, 2000–2022

Data on the Greater Mekong subregion (GMS) were derived from the WHO database. Total indigenous malaria cases and indigenous *P. falciparum* cases are based on confirmed cases reported as indigenous per country for all E-2025 countries and for those GMS countries where 100% of malaria cases are investigated and classified. For GMS countries where not all cases are classified, total confirmed minus imported and introduced cases, and total *P. falciparum* minus imported and introduced *P. falciparum* cases were used to calculate indigenous malaria cases and indigenous *P. falciparum* cases, respectively. For GMS countries where cases are not classified, all confirmed cases are assumed to be indigenous. The methodology used can vary by year for the same country. *P. knowlesi* cases were excluded from total indigenous cases.

Fig. 4.7. Total indigenous malaria and *P. falciparum* cases in the GMS, by country, 2012–2022

Countries are shown from the highest number of total indigenous malaria cases in 2022 to the lowest.

See methods notes for Fig. 4.6.

Fig. 4.8. Number of annual indigenous malaria cases between 2013 and 2022 in E-2025 countries that recently reported zero cases

Countries are shown from the highest number of indigenous malaria cases in any year between 2013 and 2016 to the lowest.

Orange bars represent substantial increases in cases or outbreaks compared with the previous year of the time series. See methods notes for **Fig. 4.4**.

Fig. 4.9. Regional map of malaria incidence in the GMS, by area, 2012–2022

Data were derived from NMP reports to the GMS Malaria Elimination Database. Malaria incidence was calculated by total confirmed cases (rapid diagnostic test [RDT] + microscopy positive) per 1000 population. For Viet Nam, data are shown at provincial level; for all other countries, data are shown at district level.

Fig. 5.1. Estimated malaria a) cases and b) deaths in the original HBHI countries, 2000–2022

These estimates were for high burden high impact (HBHI) countries. See methods notes for **Fig. 3.1**.

Fig. 5.2. Essential steps for the development and monitoring of prioritized malaria control and elimination programmes as implemented under the SNT process

The figure describes the steps in the process of subnational tailoring (SNT) of malaria interventions.

Fig. 5.3. Countries that conducted SNT and related analyses between 2018 and 2023 with support from WHO and technical partners and funders

The map presents HBHI-phase 1 countries (in green), other moderate-to-high endemic countries (in yellow) and low transmission countries (in purple) that implemented the SNT process or conducted related analyses between 2018 and 2023 with support from WHO and technical partners and funders.

Fig. 6.1. GTS funding targets for 2025 and 2030 (current 2022 US\$)

Fig. 6.1. reflects data from 2020–2022 for malaria control and elimination funding. It also shows projected targeted funding values from the Global Technical Strategy (GTS) (29, 30) for 2025 and the annual investments required for malaria research and development (R&D) from 2021 to 2030. The methodology is explained in methods notes for **Fig. 6.2**.

Table 6.1. Sources of data on funding for malaria

The table describes the main sources of funding as reported by donors and countries. An additional amount for patient care (based on estimated costs of patient care delivery services at public health facilities) is calculated for each country and added to domestic funding.

Fig. 6.2. Funding for malaria control and elimination, 2010–2022 (% of total funding), by source of funds (constant 2022 US\$)

Total funding for malaria control and elimination over the period 2010–2022 was estimated using available data obtained from several sources. The methodology below describes the

collection and analysis for all available public sector domestic funding and international funding for **Figs. 6.2–6.8**. The methodology for **Figs. 6.9–6.12** is described within each figure’s respective section.

Fig. 6.2 and **Fig. 6.3** reflect data for the years 2010–2022 because country-specific unit cost estimates were not available until 2010 and data from the Organisation for Economic Co-operation and Development (OECD) use of the multilateral system were not available until 2011 (whereby 2010 estimates were derived from 2011 data). **Fig. 6.4**, **Fig. 6.5** and **Fig. 6.8** reflect data for 2000–2022, where available. **Fig. 6.6** reflects data for the years 2010–2022 because the trends in funding per person at risk before 2010 cannot be reliably interpreted, owing to significant gaps in data on international and domestic funding in each WHO region. **Fig. 6.7** focuses on data from 2020–2022 and projections for 2025 and 2030. In the case of missing data for a specific funder, no imputation was conducted; hence, the trends presented in the figures in the main text should be interpreted carefully. Funding for malaria control and elimination is presented in constant 2022 US\$ throughout the text and figures, unless otherwise stated.

Contributions from governments of endemic countries were estimated as the sum of government contributions reported by NMPs for the world malaria report of the relevant year plus the estimated costs of patient care delivery services at public health facilities. NMP contributions in the form of domestic expenditures, where available, were used from 2000 through 2022. When domestic government expenditure was unavailable, budgets were used. In cases where neither domestic expenditure nor budgets were available, estimates were conducted. These estimates were based on either an average from the country-reported data for the previous 2 years (i.e. 2020 and 2021), or the data reported in the previous year (i.e. 2021), based on the country’s preference and representability of the truest funding estimate. The number of reported malaria cases attending public health facilities was sourced from NMP reports, adjusted for diagnosis and reporting completeness. Between 1% and 3% of uncomplicated reported malaria cases were assumed to have moved to the severe stage of disease, and 50–80% of these severe cases were assumed to have been hospitalized. Among the cases that were assumed to have been hospitalized, a 3-day average hospital stay was used. Costs of outpatient visits and inpatient bed-stays were estimated from the perspective of the public health care provider, using unit cost estimates from WHO-CHOosing Interventions that are Cost-Effective (WHO-CHOICE) (31). For each country, WHO-CHOICE 2010 unit cost estimates expressed in national currency were estimated for the period 2011–2022 using the gross domestic product (GDP) annual price deflator published by the World Bank (32) in July 2023 and converted in the base year 2010. Country-specific unit cost estimates were then converted from national currency to constant 2022 US\$ for each year over the period 2010–2022 using the exchange rates published by the World Bank (33). For each country, the number of adjusted reported malaria cases attending public health facilities was then multiplied by the estimated unit costs. In the absence of information on the level of care at which malaria patients attend public facilities, uncertainty around unit cost estimates was handled through

probabilistic uncertainty analysis. The mean total cost of patient care service delivery was calculated from 1000 estimations.

International bilateral funding data were obtained from several sources. Data on planned funding from the government of the United States of America (USA) were sourced with the technical assistance of the KFF (formerly Kaiser Family Foundation) (34). Country-level funding data were available from the United States (US) Agency for International Development (USAID) for the period 2006–2022. Country-specific planned funding data from two agencies – the US Centers for Disease Control and Prevention (CDC) and the US Department of Defense (DoD) – were not available; therefore, data on total annual planned funding from each of these two agencies were used for the period 2001–2022. Global and regional funding that was not country specific was used for the period 2006–2022; although this funding may ultimately be used at the country level, this situation means that the country-specific totals are not available. Total annual planned funding from USAID was used for 2001–2005, until the introduction of country-specific funding from 2006 through 2022. The combination of country-level and global and regional funding, along with agency-supported funding, made up the total funding for the government of the USA. Total US government funding in the report does not include funding for malaria research activities at the National Institutes of Health (NIH). Funding amounts from agencies in 2001 through 2018 are final; 2019–2022 totals for funding from US CDC and DoD are preliminary estimates based on prior year amounts.

For the government of the United Kingdom of Great Britain and Northern Ireland (United Kingdom), data on funding for malaria control since 2017 have been sourced from *Statistics on international development: final UK aid spend 2022* (35). Data from the final UK aid spend 2022 were used with the technical assistance of the United Kingdom Foreign, Commonwealth and Development Office. Disbursement data from the UK final aid spend for were available for both 2021 and 2022 this year. As a result, both years were updated accordingly (in 2022, only the final aid spend for 2020 was available and therefore estimates using 2020 data were reported for 2021). The final UK aid spend data do not capture all spending from the United Kingdom that may affect malaria outcomes because the country supports malaria control and elimination through a broad range of interventions – for example, via support to health systems in malaria endemic countries, to R&D and contributions to the Global Fund that are not included in these data. For the period 2007–2016, United Kingdom spending data were sourced from the OECD creditor reporting system (CRS) database on aid activity (36).

For all other donors, disbursement data were also obtained from the OECD CRS database on aid activity for the period 2002–2021. Disbursement data for 2022 were estimated using 2021 reported figures. All data were converted to constant 2022 US\$. For years where no data were available for a particular funder, no imputation was conducted; hence, trends presented in the figures in the main text should be interpreted carefully.

Malaria-related annual funding from donors through multilateral agencies was estimated from data on:

- i. donors’ contributions published by the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) (37) from 2010 to 2022, and annual disbursements by the Global Fund to malaria endemic countries, as reported by the Global Fund; and
- ii. donors’ disbursements to malaria endemic countries published in the OECD CRS and in the OECD Development Assistance Committee (DAC) members’ total use of the multilateral system from 2011 through 2021 (36). All funding flows were converted to constant 2022 US\$.

For (i), the amount of funding contributed by each donor was estimated as the proportion of funding paid by each donor out of the total amount received by the Global Fund in a given year, multiplied by the total amount disbursed by the Global Fund in that same year.

For (ii), contributions from donors to multilateral channels were estimated by calculating the proportion of the core contributions received by a multilateral agency each year by each donor, then multiplying that amount by the multilateral agency’s estimated investment in malaria control in that same year. Contributions from malaria endemic countries to multilateral agencies were allocated to governments of endemic countries under the “funding source” category.

Contributions from non-DAC countries and other sources to multilateral agencies were not available and were therefore not included. Annual estimated investments were summed to estimate the total amount each funder contributed to malaria control and elimination over the period 2010–2022, and the relative percentage of the total spending contributed by each funder was calculated for the period 2010–2022.

Fig. 6.2 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.3. Funding for malaria control and elimination, 2010–2022, by source of funds (constant 2022 US\$)

See methods notes for **Fig. 6.2** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows.

Fig. 6.3 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Annex 1 – Data sources and methods

Fig. 6.4. Funding for malaria control and elimination, 2000–2022, by channel (constant 2022 US\$)

See methods notes for **Fig. 6.2** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. For years in which no data were available for a particular funder, no imputation was conducted; hence, trends presented in the figures in the main text should be interpreted carefully.

Fig. 6.4 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.5. Funding for malaria control and elimination, 2000–2022, by World Bank 2023 income group and source of funding (constant 2022 US\$)

See methods notes for **Fig. 6.2** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. Data on income group classification for 2023 were sourced from the World Bank (38). For years in which no data were available for a particular funder, no imputation was conducted; hence, trends presented in the figures in the main text should be interpreted carefully.

Fig. 6.5 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.6. Funding for malaria control and elimination per person at risk, 2010–2022, by WHO region (constant 2022 US\$)

See methods notes for **Fig. 6.2** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows.

Fig. 6.6 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with

the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.7. Funding for malaria control and elimination per person at risk, globally, and the 2025 and 2030 targets (current 2022 US\$)

See methods notes for **Fig. 6.2** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. WHO population projections were used for 2025 and 2030 (see **Table 3.1**), and forecasting was used to project global funding for 2025 and 2030 based on 2020–2022 trends. These projections were compared with estimated targets in the GTS.

Fig. 6.7 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.8. Funding for malaria control and elimination, 2000–2022, by WHO region (constant 2022 US\$)

See methods notes for **Fig. 6.2** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. The “Unspecified” category in **Fig. 6.8** includes all funding data for which there was no geographical information on the recipient. For years in which no data were available for a particular funder, no imputation was conducted; hence, trends presented in the figures in the main text should be interpreted carefully.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO’s Global Health Expenditure Database.

Fig. 6.9. Real GDP growth annual per cent change by World Bank income classification (constant 2022 US\$)

Data on real GDP annual growth per cent change for 2022 were sourced directly from the International Monetary Fund data mapper (39). Data on income group classification for 2022 were sourced from the World Bank (38). This section outlines the global economic outcome from 2020 to 2022, which provides a limitation as it does not capture the differences across countries.

Fig. 6.10. Out-of-pocket health expenditure as a percentage of total current health expenditure in a) 2010 and b) 2020

Data on out-of-pocket health expenditure was sourced from the Global Health Observatory (40). The years 2010 and 2020 were used for exploratory purposes to compare household spending over a decade, with 2020 being the most recent year for which data are available. The maps show total out-of-pocket expenditure for health care, which means that malaria spending would be a fraction of this total; however, the actual figures were not available. Nevertheless, elevated levels of out-of-pocket health care spending can be used as an indicator for spending on malaria in endemic countries.

Fig. 6.11. Funding for malaria-related R&D, 2013–2022, by product type (constant 2022 US\$)

Data on funding for malaria-related R&D for 2013–2022 were sourced directly from Policy Cures Research through the G-FINDER data portal (41).

Fig. 6.12. Funding for malaria-related R&D, 2013–2022, by sector (constant 2022 US\$)

See methods notes for **Fig. 6.8**.

Fig. 7.1. Number of ITNs delivered by manufacturers and distributed by NMPs, 2010–2022

Data on the number of ITNs delivered by manufacturers to countries were provided to WHO by Milliner Global Associates; data were collected by the Alliance for Malaria Prevention Net Mapping Project. Data from NMP reports were used for the number of ITNs distributed within countries; these data include nets distributed through ANC clinics, the Expanded Programme on Immunization (EPI), mass campaigns and other distribution channels. Where NMP reports on ITN distributions were unavailable, data were provided by the Global Fund. This applied to Botswana (2018, 2019), the Central African Republic (2020), Chad (2021, 2022), the Comoros (2019, 2022), Djibouti (2021), Eritrea (2020), Ethiopia (2021), Haiti (2020), India (2020, 2021), Sudan (2019) and Yemen (2020). In 2022, those countries that have reported 3 or more years of zero indigenous cases (Belize, Cabo Verde and Malaysia) were excluded from the analysis of ITNs.

Fig. 7.2. a) Indicators of population-level access to ITNs, sub-Saharan Africa, 2000–2022 and b) indicators of population-level use of ITNs, sub-Saharan Africa, 2000–2022

Estimates of ITN coverage were derived from a model developed by MAP (42), using a two-stage process. First, a mechanism was designed for estimating net crop (i.e. the total number of ITNs in households in a country at a given time), taking into account inputs to the system (e.g. deliveries of ITNs to a country) and outputs (e.g. loss of ITNs from households). Second, empirical modelling was used to translate estimated

net crops (i.e. total number of ITNs in a country) into resulting levels of coverage (e.g. access within households, use in all ages and use among children aged under 5 years).

The model incorporates data from three sources:

- the number of ITNs delivered by manufacturers to countries, as provided to WHO by Milliner Global Associates;
- the number of ITNs distributed within countries, as reported to WHO by NMPs; and
- data from nationally representative household surveys from 40 countries in sub-Saharan Africa, from 2000 to 2022.

Countries for analysis

The main analysis covered 40 of the 46 malaria endemic countries or areas of sub-Saharan Africa. The island of Mayotte (for which no ITN delivery or distribution data were available) was excluded, as were the low transmission countries of Botswana, Eswatini, Namibia, Sao Tome and Principe, and South Africa, for which ITNs comprise a small proportion of vector control. Analyses were limited to populations categorized by NMPs as being at risk.

Estimating national net crops through time

As described by Flaxman et al. (43), national ITN systems were represented using a discrete-time stock-and-flow model. Nets delivered to a country by manufacturers were modelled as first entering a “country stock” compartment (i.e. stored in-country but not yet distributed to households). Nets were then available from this stock for distribution to households by the NMP or through other distribution channels. To accommodate uncertainty in net distribution, the number of nets distributed in a given year was specified as a range, with all available country stock (i.e. the maximum number of nets that could be delivered) as the upper end of the range and the NMP-reported value (i.e. the assumed minimum distribution) as the lower end. The total household net crop comprised new nets reaching households plus older nets remaining from earlier times, with the duration of net retention by households governed by a loss function. However, rather than the loss function being fitted to a small external dataset – as per Flaxman et al. (43) – the loss function was fitted directly to the distribution and net crop data within the stock-and-flow model itself. Loss functions were fitted on a country-by-country basis, were allowed to vary through time, and were defined separately for conventional ITNs (cITNs) and LLINs. The fitted loss functions were compared with existing assumptions about rates of net loss from households. The stock-and-flow model was fitted using Bayesian inference and Markov chain Monte Carlo methods, which provided time-series estimates of national household net crop for cITNs and LLINs in each country and an evaluation of underdistribution, all with posterior credible intervals.

Estimating indicators of national ITN access and use from the net crop

Rates of ITN access within households depend not only on the total number of ITNs in a country (i.e. the net crop), but also on how those nets are distributed among households. One factor that is known to strongly influence the relationship between net

Annex 1 – Data sources and methods

crop and net distribution patterns among households is the size of households, which varies among countries, particularly across sub-Saharan Africa. Many recent national surveys report the number of ITNs observed in each household surveyed. Hence, it is possible to both estimate net crop and generate a histogram that summarizes the household net ownership pattern (i.e. the proportion of households with 0, 1, 2, etc. nets). In this way, the size of the net crop was linked to distribution patterns among households while accounting for household size, making it possible to generate ownership distributions for each stratum of household size. The bivariate histogram of net crop to distribution of nets among households by household size made it possible to calculate the proportion of households with at least one ITN. Also, because the numbers of both ITNs and people in each household were available, it was possible to directly calculate two additional indicators: the proportion of households with at least one ITN for every two people, and the proportion of the population with access to an ITN within their household. For the final ITN indicator – the proportion of the population who slept under an ITN the previous night – the relationship between ITN use and access was defined using 62 surveys in which both these indicators were available ($ITN\ use\ all\ ages=0.8133 \times ITN\ access\ all\ ages + 0.0026$, $R^2=0.773$). This relationship was applied to MAP’s country–year estimates of household access, to obtain ITN use among all ages. The same method was used to obtain the country–year estimates of ITN use in children aged under 5 years ($ITN\ use_{children\ under\ 5}=0.9327 \times ITN\ access_{children\ under\ 5} + 0.0282$, $R^2=0.754$).

Fig. 7.3. Percentage of the population at risk protected by IRS, by WHO region, 2010–2022

The number of people protected by IRS was reported to WHO by NMPs. The total population of each country was taken from the 2022 revision of the *World population prospects* (24); the population at risk of malaria was calculated using the methods previously described for **Fig. 3.1**. For South Africa, the number of people protected by IRS exceeded the population at risk in 2014. For this reason, in South Africa, the reported population at risk in 2014 was used as the denominator in 2014. In 2022, those countries that have reported 3 or more years of zero indigenous cases (Belize, Cabo Verde and Malaysia) were excluded from the analysis of IRS.

Table 7.1. Average number of children treated with at least one dose of SMC, by year, in countries implementing SMC, 2012–2022

Data were provided by the London School of Hygiene & Tropical Medicine (LSHTM) and Medicines for Malaria Venture (MMV). The table shows the average number of children receiving seasonal malaria chemoprevention (SMC) for each district, regardless of the number of cycles (the average is based on 3, 4 or 5 cycles in a district where 3, 4 or 5 cycles have been done, respectively). The sum of the district averages is used to obtain the average for each country.

Until and including the *World malaria report 2021*, the total number of children who received SMC at the country level was divided by four. The rationale for this approach was twofold.

First, most countries performed four cycles in all districts up until 2021. Second, it was assumed that children receiving a fifth cycle had already received the first four cycles and were therefore de facto counted. The limitation of this approach was that it underestimated the average number of children covered by SMC in countries that performed fewer than four cycles.

Table 7.2. Number of treatment doses delivered, by year, in countries implementing SMC, 2014–2022

Data were provided by LSHTM and MMV. The number of treatments delivered is the sum of all the children who received SMC at each cycle. Previously, in the *World malaria report 2021* (44), the number of treatments delivered was calculated by multiplying the average number of children treated by four. This assumed that each country conducted four cycles in each district, which is not the case.

Fig. 7.4. Subnational areas where SMC was delivered, and number of treatment cycles per district, in implementing countries in sub-Saharan Africa, 2022

Data were provided by MMV and assembled through the SMC Alliance.

Fig. 7.5. Percentage of pregnant women attending an ANC clinic at least once and receiving IPTp, by number of SP doses, sub-Saharan Africa, 2010–2022

The total number of pregnant women eligible for IPTp was calculated by adding total live births calculated from UN population data and spontaneous pregnancy loss (specifically, miscarriages and stillbirths) after the first trimester (27). Spontaneous pregnancy loss has previously been calculated by Dellicour et al. (28). Country-specific estimates of IPTp coverage were calculated as the ratio of pregnant women receiving IPTp during ANC visits to the estimated number of pregnant women eligible for IPTp in a given year. ANC attendance rates were derived in the same way, using the number of initial ANC clinic visits reported through routine information systems. Local linear interpolation of information for national representative surveys was used to compute missing values. The same dose-specific IPTp and ANC coverage estimates reported in 2021 were assumed to be observed in 2022 for three countries that had incomplete information for 2022: Côte d’Ivoire, the Democratic Republic of the Congo and Guinea-Bissau. Annual aggregate estimates exclude countries for which a report or interpolation was not available for the specific year. Dose coverage between 2010 and 2020 was calculated for 33 of the 35 countries with an IPTp policy (the Comoros, and Sao Tome and Principe were excluded because of their low malaria burden).

The coverages of at least one ANC visit were corrected in 2020 and 2021 based on the country-specific disruptions to ANC services reported per country and obtained from the national pulse surveys on continuity of EHS during the COVID-19

pandemic conducted by WHO (first round in May–July 2020, second in January–March 2021, and third in November–December 2021) (9–11). Disruptions were quantified by using the middle value of the disruption ranges reported by countries. A 5% reduction in ANC attendance was assumed in all countries that did not provide information on ANC service disruptions in the pulse surveys (45–49). The corrected number of women that attended at least one ANC visit, after adjusting for disruptions, multiplied by the operational coverage of the first IPTp dose reported in 2020 or 2021 (calculated as the number of women who received the first IPTp dose divided by the corrected number of women who attended the first ANC visit) made it possible to re-estimate the expected number of pregnant women who took the first IPTp dose, which in turn made it possible to re-estimate the population coverage of the first IPTp dose. The ratio observed among the first, second and third IPTp doses was used to calculate the corrected coverage for the second and third IPTp doses, assuming no disruptions in IPTp dose follow-up.

Diagnostic testing and treatment

The analysis is based on the latest nationally representative household surveys (DHS and MIS) conducted between 2015 and

2022; surveys from 2005–2011 were considered as baseline surveys from sub-Saharan African countries where data on malaria case management were available. The data are only available for children aged under 5 years because DHS and MIS focus on the most vulnerable population groups. Interviewers ask caregivers whether the child has had fever in the 2 weeks preceding the interview and, if so, where care was sought; whether the child received a finger or heel prick as part of the care; what treatment was received for the fever and when; and, in particular, whether the child received an artemisinin-based combination therapy (ACT) or other antimalarial medicine. In addition to self-reported data, DHS and MIS also include biomarker testing for malaria, using RDTs that detect *P. falciparum* histidine-rich protein 2 (HRP2). Percentages and 95% CIs were calculated for each country each year, taking into account the survey design. Median values and interquartile ranges were calculated using country percentages for the latest and baseline surveys. The indicators outlined at the bottom of the previous page are presented in **Table 7.3**.

The use of household survey data has several limitations. One issue is that, because of difficulty recalling past events, respondents may not provide reliable information, especially

Indicator	Numerator	Denominator
Median prevalence of fever in the past 2 weeks	Children aged under 5 years with a history of fever in the past 2 weeks	Children aged under 5 years
Median prevalence of fever in the past 2 weeks in children for whom treatment was sought	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought	Children aged under 5 years with fever in the past 2 weeks
Median prevalence of treatment seeking by source of treatment for fever in the public sector (health facility)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought in the public sector (health facility)	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment seeking by source of treatment for fever in the public sector (community health worker)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought in the public sector (community health worker)	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment seeking by source of treatment for fever in the private sector (formal and informal)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought in the private sector (formal and informal)	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of receiving finger or heel prick	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought and who received a finger or heel prick	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment with ACTs	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought and who were treated with ACTs	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment with ACTs among those who received a finger or heel prick	Received ACT treatment	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought and who received a finger or heel prick
Median prevalence of treatment with ACTs	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought and who were treated with ACTs	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought and who were treated with antimalarials

on episodes of fever and the identity of prescribed medicines, resulting in a misclassification of drugs. Also, because respondents can choose more than one source of care for one episode of fever, and because the question on diagnostic test and treatment is asked broadly and hence is not linked to any specific source of care, it has been assumed that the diagnostic test and treatment were received in all the selected sources of care. However, only a low percentage (<5%) of febrile children were brought to more than one source of care to receive care. Data may also be biased by the seasonality of survey data collection because DHS are carried out at various times during the year and MIS are usually timed to correspond with the high malaria transmission season. Another limitation, when undertaking trend analysis, is that DHS and MIS are done intermittently or not at all in some countries, resulting in a relatively small number of countries in sub-Saharan Africa or for any particular 4-year period. In addition, depending on the sample size of the survey, the denominator for some indicators can be small – countries where the number of children in the denominator was less than 30 were excluded from the calculation.

Fig. 7.6. Number of RDTs sold by manufacturers and distributed by NMPs for use in testing suspected malaria cases, 2010–2022

The numbers of RDTs distributed by WHO region are the annual totals reported as having been distributed by NMPs. Where data on RDT distributions were missing, the number of RDTs tested was used as a proxy, given that number of RDTs tested normally approximates RDT distributions. In 2022, this situation affected the following countries: Burkina Faso, the Central African Republic, Chad, Djibouti, the Dominican Republic, Eritrea, Gabon, Guatemala, Guinea, Haiti, Liberia, Malawi, Namibia, Nepal, Sao Tome and Principe, and Togo.

Numbers of RDTs sold between 2010 and 2022 reflect sales by companies eligible for procurement. From 2010 to 2017, WHO received reports from up to 44 (cumulative number; the number of eligible manufacturers and responders differed from year to year) manufacturers that participated in the RDT Product Testing Programme by WHO, the Foundation for Innovative New Diagnostics (FIND), the US CDC and the Special Programme for Research and Training in Tropical Diseases. Since WHO prequalification became a selection criterion for procurement, sales data from 2018 onwards were provided by a limited number of eligible manufacturers. For 2022, all 10 of the eligible companies reported to WHO.

Fig. 7.7. Number of ACT treatment courses delivered by manufacturers and distributed by NMPs to people with malaria, 2010–2022

Data on ACT deliveries from 2022 were provided by 11 manufacturers eligible for procurement by WHO and the UN Children’s Fund (UNICEF). ACT deliveries were categorized as being to either the public sector or the private sector, also taking into account the Affordable Medicines Facility–for malaria (AMFm) initiative and the Global Fund co-payment mechanism for the relevant years. Data on ACTs distributed within countries through the public sector were taken from

NMP reports. Since 2019, missing data from NMP reports for ACT distributions were calculated based on the rate of ACT distributions to the number of patients treated with ACTs from the previous year, multiplied by the number of patients treated with ACTs in the current year. If these data were not available, the number of patients treated with ACTs was used as a proxy for ACT distributions. Please also refer to the methods described for **Annex 4-D**, found in **Annex 4-K**.

Table 7.3. Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years, from household surveys in sub-Saharan Africa, at baseline (2005–2011) and most recently (2015–2022)

See the information provided in the section titled *Diagnostic testing and treatment* (under **Fig. 7.5**).

Table 7.4. Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years from the most recent household survey for countries in sub-Saharan Africa

See the information provided in the section titled *Diagnostic testing and treatment* (under **Fig. 7.5**).

Fig. 8.1. Comparison of global progress in malaria a) case incidence and b) mortality rate, considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

The *Global technical strategy for malaria 2016–2030* (GTS) target is a 90% reduction of malaria incidence and mortality rate by 2030, with milestones of 40% and 75% reductions in both indicators for the years 2020 and 2025, respectively (29). A curve based on a quadratic fit is used for the GTS malaria incidence milestones. For projection of malaria incidence under current estimated trends, the same year-on-year trend observed in the previous 10 years (2013–2022) is forecast up to 2030. Where predicted cases between 2022 and 2030 are 20% higher than the maximum number of cases ever observed in the time series, predictions are capped at the maximum case value × 1.2 to avoid unreasonably high projections. Regions affected by the cap will experience a decrease in projected incidence starting from the year in which the cap is applied, due to population growth under a stable number of maximum projected cases. The distance between the target and the observed or projected incidence or mortality estimates is calculated using the following formula: 1 minus (GTS expected value for a given year / observed or projected value for the same year).

Fig. 8.2. Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2025 malaria case incidence milestone of at least 75% reduction from a 2015 baseline

See methods notes for **Fig. 8.1**.

The milestone of 55% represents the estimated expected reduction for 2022 that lies between the GTS targets of 2020 (40%) and 2025 (75%), based on a quadratic fit of the GTS targets.

Fig. 8.3. Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2025 malaria mortality rate milestone of at least 75% reduction from a 2015 baseline

See methods notes for **Fig. 8.1**.

Fig. 8.4. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO African Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.5. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Region of the Americas considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.6. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Eastern Mediterranean Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.7. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO South-East Asia Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.8. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Western Pacific Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 9.1. Estimated prevalence of *Pfhrp2* gene deletions, 2022

The map of the estimated prevalence of *Pfhrp2* gene deletions is based on the published data included in the Malaria Threats Map (50).

Fig. 9.2. Number of *P. falciparum* TES finding more or less than 10% treatment failures in the WHO African Region, by ACT (2015–2022), among studies with at least 20 patients

The bars show the number of therapeutic efficacy studies (TES) undertaken in 2015 to 2022, and the number of studies which found more or less than 10% treatment failures for each ACT tested in the WHO region. Only studies with at least 20 patients were included. The data were obtained from the WHO *Global database on antimalarial drug efficacy and resistance* (51).

Fig. 9.3. Number of *P. falciparum* TES finding more or less than 10% treatment failures, a) in the WHO South-East Asia Region, b) in the WHO Eastern Mediterranean Region and c) in the WHO Western Pacific Region, by ACT (2015–2022), among studies with at least 20 patients

See methods notes for **Fig. 9.2**.

Fig. 9.4. Reported insecticide resistance status as a proportion of sites for which monitoring was conducted, by WHO region, 2010–2020, for pyrethroids, organochlorines, carbamates and organophosphates

The status of resistance at each mosquito collection site for each insecticide class was assessed based on the lowest mosquito mortality reported across all standard WHO tube tests or US CDC bottle bioassays conducted at the site during 2010–2020, with validated discriminating concentrations of the insecticides in the class. If multiple insecticides and mosquito species were tested between 2010 and 2020 at the collection site, the lowest mosquito mortality was considered. If the lowest mosquito mortality was below 90%, resistance was considered to be confirmed at the site; if the lowest mosquito mortality was at least 90% but less than 98%, resistance was considered to be possible at the site; if the lowest mortality was 98% or more, vectors at the site were considered to be susceptible to the insecticide class. The figure was developed based on data in the WHO global database for insecticide resistance in malaria vectors. These data were reported to WHO by NMPs, national public health institutes, universities and research centres, the African Network for Vector Resistance, MAP (7), VectorBase and the US President’s Malaria Initiative (PMI), or were extracted from scientific publications.

Fig. 9.5. Number of insecticide classes to which resistance was confirmed in at least one malaria vector in at least one monitoring site, 2010–2020

Resistance to an insecticide class was considered to be confirmed in a country if at least one vector species exhibited resistance to one insecticide in the class in at least one collection site in the country, as measured by standard WHO tube tests or US CDC bottle bioassays conducted with validated discriminating concentrations in 2010–2021. The map was developed based on data contained in the WHO global database for insecticide resistance in malaria vectors. These data were reported to WHO by NMPs, national public health institutes,

universities and research centres, the African Network for Vector Resistance, MAP (7), VectorBase and PMI, or were extracted from scientific publications.

Fig. 9.6. Detections of *An. stephensi* in the WHO African and Eastern Mediterranean regions, as reported to WHO since 2012

Map of the invasion of *Anopheles stephensi* was produced from data submitted to the WHO global database on invasive species on the Malaria Threats Map (50).

Fig. 10.1. Thermal performance curves for a) biting rate, b) vector competence, c) mosquito mortality rate, d) parasite development rate and e) predicted temperature-dependent model of rVC based on the thermal performance curves from this study, using data for the EIP₅₀

Methods were as described in Shapiro et al. 2017 (52).

Fig. 10.2. Selected indicators of global climate change from CMIP6 historical and scenario simulations: a) global surface air temperature changes relative to the 1995–2014 average (left axis) and relative to the 1850–1900 average (right axis), offset by 0.82 °C, which is the multi-model mean and close to the observed best estimate; b) global land precipitation changes relative to the 1995–2014 average; c) September Arctic Sea ice area; and d) global mean sea level changes relative to the 1995–2014 average

Methods were as described in WHO 2020 (53).

Fig. 10.3. Simulated change by 2100 of annual a) mean temperature and b) mean precipitation at 2 °C of global warming

Methods were as described in Masson-Delmotte et al. 2021 (54).

Fig. 10.4. Reported malaria cases in Pakistan, 2020–2023

The cyclone started in June 2022. The decline in cases between the two peaks after the extreme monsoon rainfall occurred during the winter months. The monthly number of reported malaria cases confirmed by microscopy or RDT were aggregated to the province level for the high burden provinces of Pakistan that have consistently reported routine data to the District Health Information System 2 since 2020.

Fig. 10.5. Projected changes in a) malaria incidence and b) number of cases in the WHO African Region under different intervention scenarios, from the present day to 2030 and 2050, under SSP2

The projected changes in malaria incidence and cases in Africa were investigated through the development of an analytical

framework that generated estimates of malaria risk in Africa for 2030 and 2050 (55). First, MAP (7) used a Bayesian geostatistical model to establish empirical relationships between the environmental and intervention variables, to characterize the *P. falciparum* prevalence rate (PR). The model used exhaustive databases of three types of relevant spatially referenced data spanning the years 2000–2018: malariometric data that included about 50 000 independent observations of PR at defined point locations across Africa; data on ITN, IRS and ACT coverage at point locations and across national and subnational regions; and gridded geospatial data for rainfall, temperature, vegetation density, land cover classes, population density, urban areas and housing quality (available as continent-wide gridded data surfaces where each grid cell represents an area of about 5 × 5 km²).

Second, future projections of spatial data on plausible environmental conditions in 2030 and 2050 were inferred under different scenarios of global change defined by two shared socioeconomic pathways (SSPs), determined by the Intergovernmental Panel on Climate Change (IPCC): SSP2 (representing a central tendency or “middle of the road” vision of the future) and SSP5 (representing the future world under a pathway of “conventional development”, with high atmospheric carbon concentrations).

Third, the fitted geospatial model defined in the first step (i.e. with the defined environment–malaria relationships) was rerun to generate maps of PR in 2030 and 2050. This was achieved by replacing the contemporary geospatial environmental input data with the equivalent surfaces projected to those future years (as defined in the second step), while holding input data on intervention coverage constant at 2017 levels.

Fourth, the EMOD (Epidemiological MODELing software) (56) mathematical model was used to represent the possible future impact of changes to contemporary malaria control on malaria incidence and cases, whether by increasing coverage of existing tools or by widespread application of potential new, or currently nascent, tools. Different possibilities for malaria interventions were modelled: contemporary coverage, with malaria control in the future maintained at 2017 levels; scale-up of current tools, where no new malaria control tools were introduced, but tools currently in widespread use (i.e. ITNs, IRS and ACTs) were increased to 80%, to represent improved coverage levels; and innovation of new tools, which evaluated the possible impact of a variety of new vector control tools, vaccines and drug classes to be used in conjunction with, or to replace, existing interventions.

Fig 10.5 presents the results obtained after applying the above analytical framework using the projections under the SSP2 scenario.

Fig. 10.6. Projected changes in a) malaria incidence rate and b) number of cases in the WHO African Region under different intervention scenarios, from the present day to 2030 and 2050, under SSP5

Fig 10.6 presents the results obtained after applying the analytical framework described for **Fig. 10.5** but using the projections under the SSP5 scenario (representing the future world under a pathway of “conventional development”, with high atmospheric carbon concentrations).

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140

141

Annex 2 – Number of ITNs distributed through campaigns in malaria endemic countries, 2020–2022

Data on number of insecticide-treated mosquito nets were collected from reports from national malaria programmes and other sources by the Alliance for Malaria Prevention, RBM Partnership to End Malaria and the Global Fund.							
Country	2020				2021		
	ITNs planned for distribution in 2020	ITNs distributed in 2020	ITNs remaining for distribution in 2021	Percentage of planned ITNs distributed in 2020	ITNs distributed in 2021 from 2020 campaigns	Percentage of remaining ITNs from 2020 distributed in 2021	ITNs planned for distribution in 2021 (including carry-over from 2020)
Afghanistan	2 833 365	2 833 365	0	100	0	NA	0
Angola ¹	0	0	0	NA	0	NA	0
Bangladesh	2 014 200	1 219 329	794 871	61	794 871	100	1 052 526
Benin ²	9 236 936	9 236 936	0	100	0	NA	0
Bhutan ³	122 670	122 670	0	100	0	NA	0
Bolivia (Plurinational State of) ^{2,4}	88 200	81 727	6 473	93	6 473	100	6 473
Botswana	89 179	80 525	8 654	90	8 654	100	0
Burkina Faso	0	0	0	NA	0	NA	0
Burundi	0	0	0	NA	0	NA	0
Cambodia ³	793 359	793 068	291	99.96	291	100	829 358
Cameroon ⁵	2 112 900	1 980 471	132 429	94	132 429	100	369 000
Central African Republic	2 861 765	2 312 311	264 315	81	264 315	100	1 626 470
Chad	8 779 988	8 686 550	93 438	99	93 438	100	1 000 000
Comoros ²	444 750	412 022	32 728	93	32 728	100	0
Congo	0	0	0	NA	0	NA	0
Côte d'Ivoire	18 991 346	0	18 991 346	0	18 991 346	100	18 991 346
Democratic Republic of the Congo ³	31 718 777	15 541 956	16 176 821	49	16 176 821	100	16 708 809
Djibouti ¹	145 392	145 392	0	100	0	NA	0
Eritrea ²	1 922 249	621 094	1 301 155	32	1 301 155	100	0
Eswatini	0	0	0	NA	0	NA	0
Ethiopia ³	6 517 480	6 517 480	0	100	0	NA	7 897 450
Gambia ¹	0	0	0	NA	0	NA	0
Ghana	0	0	0	NA	0	NA	18 948 893
Guinea	0	0	0	NA	0	NA	0
Guinea-Bissau ³	1 292 818	1 292 818	0	100	0	NA	0
Haiti	1 216 186	971 530	244 656	80	244 656	100	244 656
Honduras ¹	21 588	19 605	1 983	91	1 983	100	23 427
India ⁶	3 302 466	1 698 023	1 604 443	51	1 604 443	100	9 648 384
Indonesia ²	3 632 014	3 354 382	277 632	92	50 350	18	94 450
Kenya	12 943 663	194 292	12 749 371	2	12 749 371	100	16 151 848
Lao People's Democratic Republic	0	0	0	NA	0	NA	0
Liberia	0	0	0	NA	NA	NA	2 783 264
Madagascar	0	0	0	NA	NA	NA	13 703 700
Malawi ³	0	0	0	NA	NA	NA	7 357 003
Mali ^{1,2}	7 620 011	7 479 747	140 264	98	140 264	100	1 128 120
Mauritania ³	1 622 322	1 622 322	0	100	0	NA	0
Mozambique ²	17 467 640	17 255 566	212 074	99	212 074	100	212 074

2021			2022				
ITNs distributed in 2021 (including carry-over from 2020)	ITNs remaining for distribution in 2022	Percentage of ITNs planned for distribution in 2021 distributed in 2021	ITNs distributed in 2022 from 2021 campaigns	Percentage of remaining ITNs from 2021 distributed in 2022 (including carry-over from 2021)	ITNs planned for distribution in 2022 (including carry-over from 2021)	ITNs distributed in 2022 (including carry-over from 2021)	Percentage of ITNs planned for distribution in 2022 distributed in 2022
0	0	NA	0	NA	2 195 198	1 950 586,00	89
0	0	NA	0	NA	6 927 274	6 927 274	100
823 336	229 190	78	229 190	100	900 047	600 813	67
0	0	NA	0	NA	0	0	NA
0	0	NA	0	NA	0	0	NA
6 473	0	100	0	NA	115 500	105 500	91
0	0	NA	0	NA	0	0	NA
0	0	NA	0	NA	16 051 515	14 446 364	90
0	0	NA	0	NA	6 611 501	6 548 442	99
559 790	269 568	67	269 568	100	307 572	307 572	100
344 763	24 237	93	24 237	100	16 756 200	11 193 768	67
0	1 626 470	0	1 371 125	84	1 626 470	1 371 125	84
0	1 000 000	0	0	0	0	0	NA
0	0	NA	0	NA	0	0	NA
0	0	NA	0	NA	3 502 800	3 355 112	96
18 509 750	481 596	97	0	0	0	0	NA
16 708 809	0	100	0	NA	37 294 622	28 131 033	75
0	0	NA	0	NA	236 469	215 839	91
0	0	NA	0	NA	0	0	NA
0	0	NA	0	NA	10 000	8 313	83
5 300 000	2 597 450	67	2 597 450	100	10 398 413	8 595 938	83
0	0	NA	0	NA	1 594 136	1 594 136	100
15 976 996	2 971 897	84	0	0	0	0	NA
0	0	NA	0	NA	9 419 350	8 927 578	95
0	0	NA	0	NA	0	0	NA
0	244 656	0	0	0	0	0	NA
17 744	5 683	76	5 683	100	70 165	70 165	100
16 197 740			NA	NA	11 345 797	1 259 541	91
50 350	44 100	53	44 100	100	2 485 716	2 485 716	100
15 128 756	1 023 092	94	0	0	0	0	NA
0	0	NA	0	NA	972 310	915 981	94
2 783 264	0	100	0	NA	0	0	NA
13 288 561	415 139	97	415 139	100	2 106 406	1 729 231	82
7 357 003	0	100	0	NA	1 896 849	0	0
1 128 120	0	100	0	NA	0	0	NA
0	0	NA	0	NA	0	0	NA
0	212 074	0	212 074	100	5 198 450	5 173 420	100

Annex 2 – Number of ITNs distributed through campaigns in malaria endemic countries, 2020–2022

Data on number of insecticide-treated mosquito nets were collected from reports from national malaria programmes and other sources by the Alliance for Malaria Prevention, RBM Partnership to End Malaria and the Global Fund.							
Country	2020				2021		
	ITNs planned for distribution in 2020	ITNs distributed in 2020	ITNs remaining for distribution in 2021	Percentage of planned ITNs distributed in 2020	ITNs distributed in 2021 from 2020 campaigns	Percentage of remaining ITNs from 2020 distributed in 2021	ITNs planned for distribution in 2021 (including carry-over from 2020)
Myanmar	137 582	59 189	78 393	43	78 393	100	588 645
Nepal	0	0	0	NA	0	NA	0
Nicaragua ¹	61 766	61 520	246	99.6	246	100	61 766
Niger	9 645 683	7 862 993	1 782 690	82	1 782 690	100	5 420 231
Nigeria	26 047 544	14 311 644	11 735 900	55	11 735 900	100	27 125 810
Pakistan	1 487 878	1 487 721	157	99.99	157	100	3 106 391
Papua New Guinea ^{1,3}	1 495 298	1 495 298	0	100	0	NA	1 301 748
Rwanda ^{1,3}	5 061 637	5 061 637	0	100	0	NA	0
Sao Tome and Principe	0	0	0	NA	0	NA	0
Senegal	0	0	0	NA	0	NA	0
Sierra Leone	4 601 419	4 346 613	254 806	94	254 806	100	254 806
Solomon Islands	7 530	7 530	0	100	0	NA	605 384
Somalia ³	1 473 529	1 473 529	0	100	0	NA	1 597 274
South Sudan ¹	4 768 792	4 198 875	569 917	88	569 917	100	1 586 285
Sudan ³	1 495 298	1 495 298	0	100	0	NA	0
Suriname ³	6 864	6 864	0	100	0	NA	15 000
Thailand ¹	76 865	76 865	0	100	0	NA	220 873
Timor-Leste	150 652	140 878	9 774	94	9 774	100	29 283
Uganda	29 184 557	23 728 961	5 455 596	81	5 455 596	100	0
United Republic of Tanzania ³	8 728 803	8 728 803	0	100	0	NA	611 717
Zanzibar ¹	205 000	205 000	0	100	0	NA	746 420
Vanuatu	0	0	0	NA	0	NA	70 747
Venezuela (Bolivarian Republic of) ¹	73 605	73 605	0	100	0	NA	36 362
Viet Nam ¹	53 155	53 155	0	100	0	NA	1 629 600
Yemen	1 248 377	855 693	392 684	69	392 684	100	2 890 856
Zambia ³	5 621 419	5 621 419	0	100	0	NA	0
Zimbabwe ^{1,3}	443 231	443 231	0	100	0	NA	1 017 646
Total	239 867 749	166 269 502	73 313 108	69	73 085 826	99.7	167 694 095

ITN: insecticide- treated mosquito net; NA: not applicable.

¹ No data were reported on planned distribution; therefore, adjustment was made that planned distribution was equal to ITNs distributed.

² The carry-over of ITNs from 2020 were distributed through routine channels.

³ Planned distribution was adjusted based on ITNs distributed; where ITN distribution was more than planned, ITNs distributed were equal to ITNs planned for distribution.

2021			2022				
ITNs distributed in 2021 (including carry-over from 2020)	ITNs remaining for distribution in 2022	Percentage of ITNs planned for distribution in 2021 distributed in 2021	ITNs distributed in 2022 from 2021 campaigns	Percentage of remaining ITNs from 2021 distributed in 2022 (including carry-over from 2021)	ITNs planned for distribution in 2022 (including carry-over from 2021)	ITNs distributed in 2022 (including carry-over from 2021)	Percentage of ITNs planned for distribution in 2022 distributed in 2022
155 186	433 459	26	433 459	100	541 200	464 780	86
0	0	NA	0	NA	344 006	101 097	29
61 766	0	100	0	NA	188 924	188 924	100
4 358 451	1 061 780	80	1 061 780	100	9 367 018	9 267 397	99
17 397 772	9 728 038	64	9 728 038	100	46 131 125	43 088 675	93
0	3 106 391	0	2 415 672	78	3 002 590	2 415 672	80
1 301 748	0	100	0	NA	1 332 559	973 828	73
0	0	NA	0	NA	4 437 461	4 437 461	100
0	0	NA	0	NA	124 700	120 404	97
0	0	NA	0	NA	6 976 498	6 935 681	99
0	254 806	0	0	0	0	0	NA
164 384	441 000	27	0	0	0	0	NA
0	1 597 274	0	1 597 274	100	2 707 067	2 707 067	100
1 586 285	0	100	0	NA	2 468 144	969 822	39
0	0	NA	0	NA	18 758 082	18 758 082	100
10 059	4 941	67	4 941	100	17 877	17 877	100
118 300	102 573	54	45 000	44	50 000	45 000	90
19 948	9 335	68	9 335	100	38 379	36 449	95
0	0	NA	0	NA	0	0	NA
611 717	0	100	0	NA	818 644	818 644	100
712 872	33 548	96	0	0	0	0	NA
37 090	33 657	52	33 657	100	70 865	62 359	88
36 362	0	100	0	NA	405 256	251 337	62
1 481 700	147 900	91	147 900	100	151 093	151 093	100
1 126 314	1 764 542	39	900 955	51	2 527 322	900 955	36
0	0	NA	0	NA	0	0	NA
1 017 646	0	100	0	NA	2 586 904	2 538 878	98
144 379 055	29 864 396	86	21 546 577	72	241 068 474	201 164 929	83

⁴ The 2019 mass campaign resulted in carry-over of ITNs that were distributed in 2020 and 2021 through routine distribution channels.

⁵ The 2019 mass campaign resulted in carry-over of ITNs that were distributed in 2020 and 2021.

⁶ India provided information on its mass campaign distributions between 2020 and 2022 based on the initial nets planned for 2020. Adjustments were made for 2022 to determine the proportion of nets distributed by the end of 2022 out of the initial number of nets planned to be distributed in 2020.

Note: Remaining nets not distributed through mass campaigns may be distributed through other channels (e.g. antenatal care).

Annex 3 – A. WHO African Region, a. West Africa

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 431 million

Parasites: *P. falciparum* (100%)

Vectors: *An. arabiensis*, *An. coluzzii*, *An. funestus* s.l., *An. gambiae* s.l., *An. hispaniola*, *An. labranchiae*, *An. melas*, *An. moucheti*, *An. multicolor*, *An. nili* s.l., *An. pharoensis*, *An. sergentii* s.l. and *An. stephensi* s.l.

FUNDING (US\$), 2010–2022

628.4 million (2010), 641.4 million (2015), 1240.6 million (2022); 2010–2022: 97% increase

Proportion of domestic source^a in 2022: 36%

^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Countries with ≥80% coverage with either LLINs or IRS in 2022:^a Burkina Faso, Côte d'Ivoire, the Gambia, Niger and Togo

Countries with 50–80% coverage with either LLINs or IRS in 2022:^a Cabo Verde, Ghana, Guinea, Liberia, Mali, Nigeria, Senegal and Sierra Leone

Countries that carried out LLIN mass campaigns in 2022 (including carry-over from 2021): Burkina Faso, the Gambia, Guinea, Niger, Nigeria and Senegal

^a ITN coverage model from MAP.

Countries that implemented IPTp in 2022: Benin, Burkina Faso, Côte d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo

Countries with >50% IPTp3+ in 2022: Burkina Faso, the Gambia, Ghana, Guinea, Liberia, Sierra Leone and Togo

Children treated with at least one dose of SMC per cycle in 2022: 43.1 million

Percentage of suspected cases tested (reported): 54% (2010), 73% (2015), 89% (2022)

Number of ACT courses distributed: 32.2 million (2010), 47.4 million (2015), 58.0 million (2022)

Number of any antimalarial treatment courses (incl. ACT) distributed: 32.2 million (2010), 49.4 million (2015), 63.1 million (2022)

REPORTED CASES AND DEATHS,^a 2010–2022

Total (presumed and confirmed) cases:^b 30.6 million (2010), 56.8 million (2015), 73.1 million (2022)

Confirmed cases: 6.8 million (2010), 36.4 million (2015), 67.1 million (2022)

Percentage of total cases confirmed: 22.1% (2010), 64.1% (2015), 91.9% (2022)

Deaths:^{b,c} 39 000 (2010), 30 900 (2015), 28 200 (2022)

Children aged under 5 years, presumed and confirmed cases:^a 11.9 million (2010), 21.0 million (2015), 26.7 million (2022)

Children aged under 5 years, percentage of total cases: 38.9% (2010), 37.0% (2015), 36.6% (2022)

Children aged under 5 years, deaths:^b 22 900 (2010), 22 100 (2015), 20 600 (2022)

Children aged under 5 years, percentage of total deaths: 59% (2020), 72% (2015), 73% (2022)

^a Includes malaria endemic countries only; ^b No data for Mauritania in 2022; ^c Nigeria only reports deaths in children aged under 5 years.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 117.8 million (2010), 108.2 million (2015), 120.7 million (2022); 2010–2022: 2% increase

Deaths: 381 900 (2010), 310 300 (2015), 323 800 (2022); 2010–2022: 15% decrease

ACCELERATION TO ELIMINATION

Countries with subnational/territorial elimination programme: the Gambia, Mauritania, Niger and Senegal

Countries with nationwide elimination programme: Cabo Verde

Countries part of the E-2025 initiative: Cabo Verde

Zero indigenous cases for 3 or more consecutive years (2019–2022): Cabo Verde

Certification in process: Cabo Verde

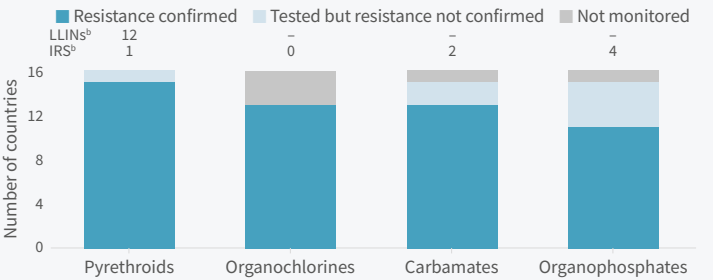
Certified as malaria free since 2010: Algeria (2019)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH P. FALCIPARUM MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile	
						25	75
AL	2015–2021	58	0.0	1.2	42.6	0.0	3.6
AS-AQ	2015–2019	46	0.0	0.0	9.8	0.0	2.0
DHA-PPQ	2016–2021	13	0.0	1.2	18.7	0.0	2.9

AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine; DHA-PPQ: dihydroartemisinin-piperaquine.

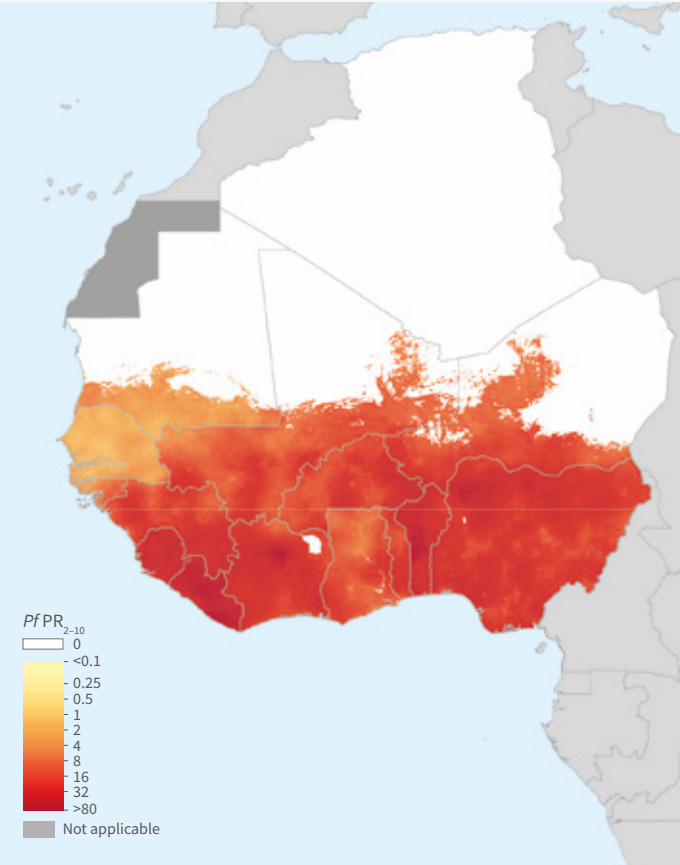
STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)



^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.

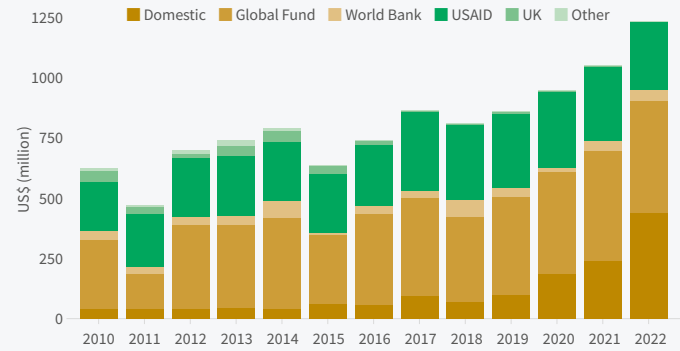
^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. P. falciparum parasite rate (PfPR), 2022



Note: PfPR data for Senegal are from 2017.

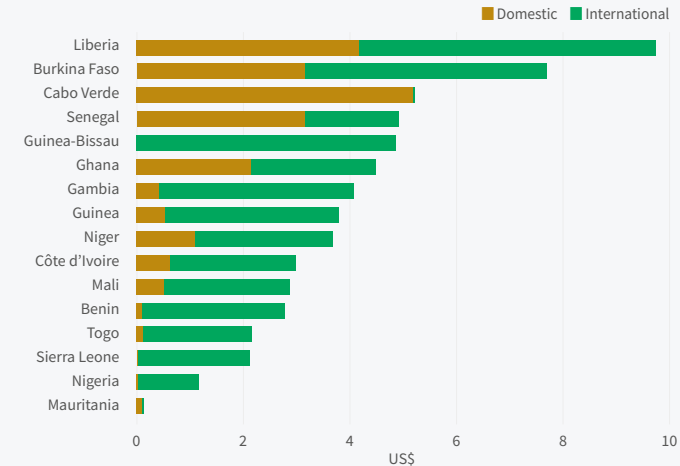
B. Malaria funding^a by source, 2010–2022



Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.

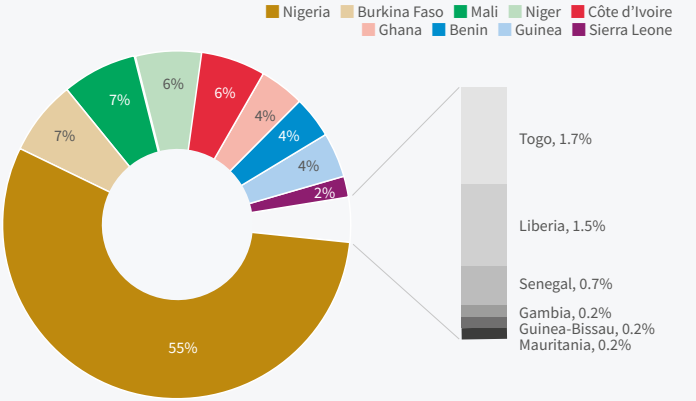
^a Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Guinea-Bissau, Mauritania and Togo in 2022.

C. Malaria funding^a per person at risk, average 2020–2022

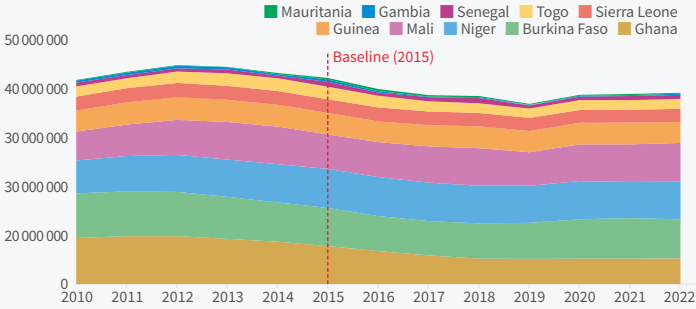


^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

D. Share of estimated malaria cases, 2022

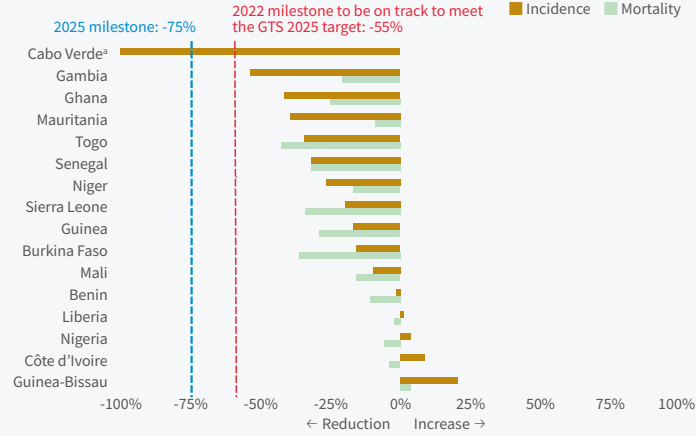


F. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015



Note: Algeria was certified malaria free in 2019. Cabo Verde met the GTS 2020 milestone with zero malaria cases and again had zero cases in 2022.

H. Change in estimated malaria incidence and mortality rates, 2015–2022



^a This country achieved the 40% reduction in mortality rate in 2015; since then, there has been no change.

KEY MESSAGES

In 2022, there were 15 malaria endemic countries in the World Health Organization (WHO) subregion of west Africa. Algeria was certified malaria free in May 2019, following 3 consecutive years with zero indigenous cases. Cabo Verde has had 4 consecutive years (2019–2022) of zero indigenous cases and is in the final stages of the certification process. The high burden high impact (HBHI) initiative was started in Burkina Faso, Ghana, Niger and Nigeria in 2019, and in Mali in 2020, leading to evidence-based national strategic plans and funding requests. In all countries of this subregion except Algeria and Cabo Verde, malaria transmission occurs year round and is almost exclusively due to *Plasmodium falciparum*, with strong seasonality in the Sahelian countries. The main vectors in the region are *Anopheles gambiae*, *An. arabiensis*, *An. coluzzii*, *An. melas*, *An. funestus*, *An. stephensi* and *An. nili*.

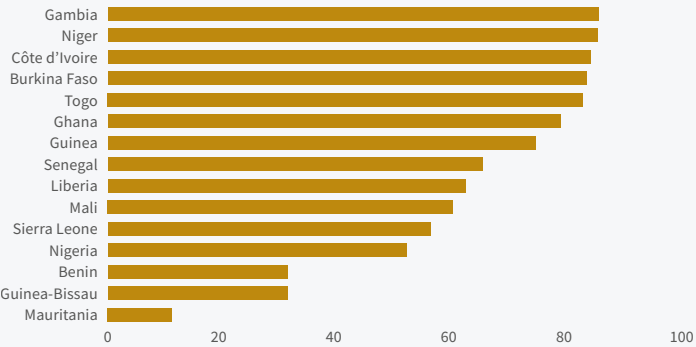
In 2022, the subregion had about 121 million estimated cases and about 324 000 estimated deaths – a 2% increase and a 15% decrease, respectively, compared with 2010. Five countries accounted for more than 80% of the estimated cases: Nigeria (55%), Burkina Faso (7%), Mali (7%), Niger (6%) and Côte d'Ivoire (6%). About 73 million cases were reported in the public and private sectors and in the community, of which 36.6% were in children aged under 5 years and 67 million were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 22.1% in 2010 to 64.1% in 2015 and 91.9% in 2022. Most deaths (73%) were in children aged under 5 years.

In 12 of the 15 endemic countries in this subregion, where routine distribution of insecticide-treated mosquito nets (ITNs) is applicable, 50% or more of the population was estimated to have access to ITNs, despite country-specific variations. In 2022, six countries (Burkina Faso, the Gambia, Guinea, Niger, Nigeria and Senegal) carried out mass ITN distribution campaigns. Twelve countries in the subregion implemented seasonal malaria chemoprevention (SMC); the number of rounds varied, but about 43.1 million children were provided with at least one dose of SMC per cycle. Mauritania implemented SMC for the first time in 2022. Fifteen countries in this subregion implemented intermittent preventive treatment in pregnancy (IPTp) in 2022, with seven having more than 50% coverage with IPTp3 (third dose of IPTp). Ghana has been part of the malaria vaccine implementation programme for the programmatic use of RTS,S/AS01 since 2019.

Two countries are on track to meet the *Global technical strategy for malaria 2016–2030* (GTS) 2025 target as they reached zero malaria cases in 2022: Algeria (which is already certified malaria free) and Cabo Verde (which is in the final stages of the certification process). In 10 countries, although there was progress towards meeting the GTS target, reductions in incidence were less than 55% (which is the expected reduction for countries to be on track to meet the GTS 2025 target): Burkina

E. Percentage of population with access to an ITN, 2022

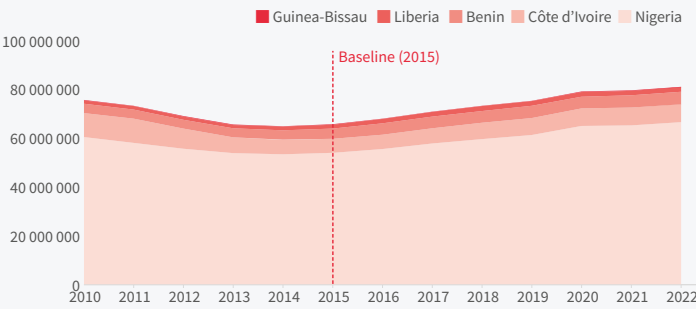
Source: ITN coverage model from MAP



ITN: insecticide-treated mosquito net; MAP: Malaria Atlas Project.

Note: Algeria was certified malaria free in 2019, and Cabo Verde is a low transmission country where vector control is targeted to foci.

G. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2022



I. Reported indigenous cases in countries with national elimination activities, 2015 versus 2022



Faso, the Gambia, Ghana, Guinea, Mali, Mauritania, Niger, Senegal, Sierra Leone and Togo. In Benin, Côte d'Ivoire, Guinea-Bissau, Liberia and Nigeria, incidence increased in 2022 compared with the 2015 baseline.

The subregion is also facing biological threats to malaria interventions, with *An. stephensi* having been found in Ghana and Nigeria. Vector resistance to pyrethroids has been confirmed in 91% of sites, resistance to organochlorines in 96%, resistance to carbamates in 43% and resistance to organophosphates in 26%. The intensity of pyrethroid resistance in this subregion is high overall. Eleven countries have developed insecticide resistance monitoring and management plans. Most therapeutic efficacy studies (TES) conducted according to the WHO standard protocol show good efficacy of antimalarial treatment; however, artemether-lumefantrine (AL) treatment failure rates exceeding 10% were reported in Burkina Faso during the reporting period (2015–2022). These results warrant further investigation and could be a sign of emergence of artemisinin-based combination therapy (ACT) partner drug resistance in the subregion.

Total funding for malaria has increased exponentially (by 97%) in the subregion since 2010 and is principally from international sources (64%). In 2022, total funding increased by 17% compared with 2021, stemming primarily from an increase in domestic funding. Total funding per person at risk in 2022 ranged from US\$ 0.14 in Mauritania to US\$ 9.73 in Liberia over a 3-year average, which is similar to the 2019–2021 average.

The Nouakchott Declaration was adopted in 2013 and has now become the Sahel Malaria Elimination Initiative (SaME), which was launched in 2018 by ministers of the eight Sahelian countries (Burkina Faso, Cabo Verde, Chad, the Gambia, Mali, Mauritania, Niger and Senegal) to accelerate implementation of high-impact strategies towards eliminating malaria by 2030 in the Sahel region. In line with this initiative, an action plan was adopted in 2019. In addition to Cabo Verde as an eliminating country, the Gambia, Mauritania, Niger and Senegal have reoriented their programmes towards malaria subnational elimination.

Political instability in the subregion has led to a lack of prioritization of the malaria response and inadequate financing. Other challenges include weak malaria programme management, unsustainable interventions, inappropriate application of case management guidelines, limited community engagement and weak surveillance systems (including a lack of well-functioning vital registration systems and a shortage of human resources to carry out malaria activities). Tackling these issues could greatly improve the malaria situation in the subregion.

Annex 3 – A. WHO African Region, b. Central Africa

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 209 million
Parasites: *P. falciparum* (100%)
Vectors: *An. arabiensis*, *An. funestus* s.l., *An. gambiae* s.l., *An. melas*, *An. moucheti*, *An. nili* s.l. and *An. pharoensis*

FUNDING (US\$), 2010–2022

282.5 million (2010), 424.6 million (2015), 555.7 million (2022); 2010–2022: 97% increase
Proportion of domestic source^a in 2022: 10%

^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Countries with ≥80% coverage with either LLINs or IRS in 2022:^a Congo
Countries with 50–80% coverage with either LLINs or IRS in 2022:^a Burundi, Cameroon, the Central African Republic, the Democratic Republic of the Congo and Sao Tome and Principe
Countries that carried out LLIN mass campaigns in 2022 (including carry-over from 2021): Angola, Burundi, Cameroon, the Central African Republic, Congo, the Democratic Republic of the Congo and Sao Tome and Principe

^a ITN coverage model from MAP.

Countries that implemented IPTp in 2022: Angola, Burundi, Cameroon, the Central African Republic, Chad, Congo, the Democratic Republic of the Congo, Equatorial Guinea, Gabon and Sao Tome and Principe
Countries with >50% IPTp3+ in 2022: Burundi and the Democratic Republic of the Congo
Children treated with at least one dose of SMC per cycle in 2022: 4.7 million

Percentage of suspected cases tested (reported): 46% (2010), 92% (2015), 94% (2022)
Number of ACT courses distributed: 18.2 million (2010), 22.4 million (2015), 48.9 million (2022)
Number of any antimalarial treatment courses (incl. ACT) distributed: 19.1 million (2010), 22.4 million (2015), 50.2 million (2022)

REPORTED CASES AND DEATHS,^a 2010–2022

Total (presumed and confirmed) cases: 20.4 million (2010), 26.6 million (2015), 55.2 million (2022)
Confirmed cases: 6.1 million (2010), 23.4 million (2015), 51.1 million (2022)
Percentage of total cases confirmed: 30.1% (2010), 87.9% (2015), 92.4% (2022)
Deaths: 40 400 (2010), 58 200 (2015), 47 700 (2022)

Children aged under 5 years, presumed and confirmed cases: 9.1 million (2010), 11.3 million (2015), 24.2 million (2022)
Children aged under 5 years, percentage of total cases: 44.9% (2010), 42.6% (2015), 43.8% (2022)
Children aged under 5 years, deaths: 26 000 (2010), 37 100 (2015), 28 700 (2022)
Children aged under 5 years, percentage of total deaths: 64% (2010), 64% (2015), 60% (2022)

^a Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 43.2 million (2010), 43.1 million (2015), 56.5 million (2022); 2010–2022: 31% increase
Deaths: 136 800 (2010), 111 000 (2015), 131 700 (2022); 2010–2022: 4% decrease

ACCELERATION TO ELIMINATION

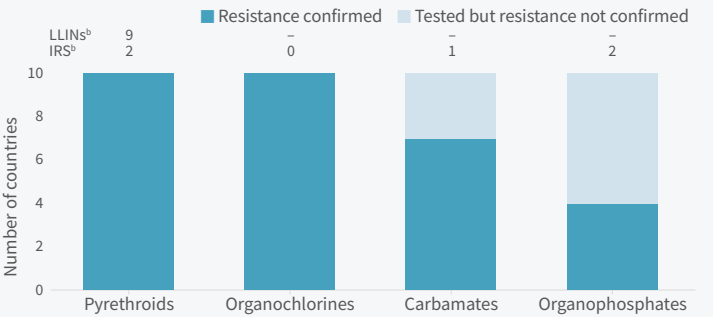
Countries with nationwide elimination programme: Sao Tome and Principe
Countries part of the E-2025 initiative: Sao Tome and Principe

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	75
AL	2015–2021	37	0.0	1.6	18.0	0.0	4.0
AS-AQ	2015–2021	37	0.0	0.0	9.0	0.0	4.8
DHA-PPQ	2015–2019	15	0.0	0.0	12.0	0.0	1.4

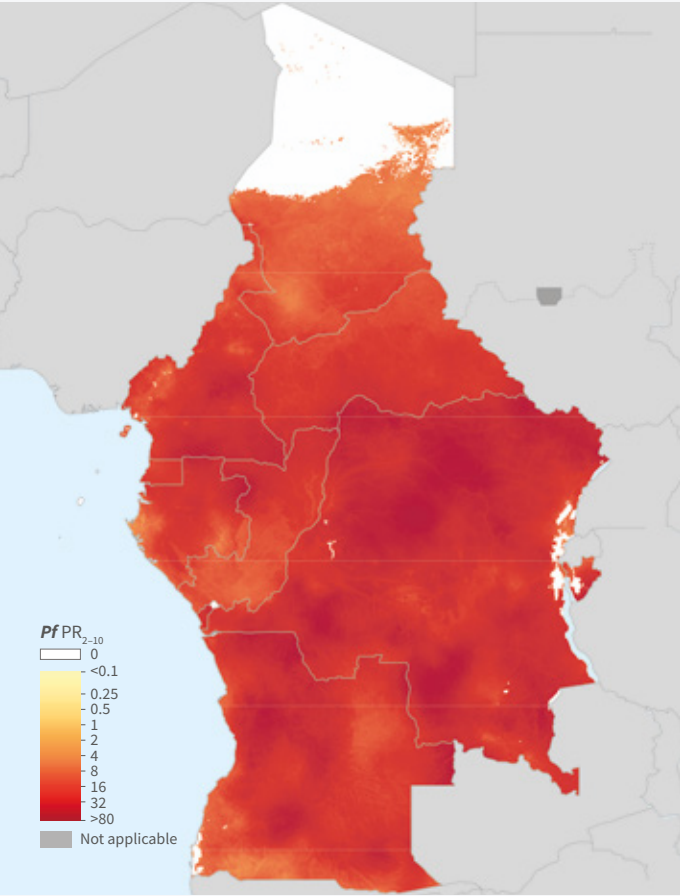
AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

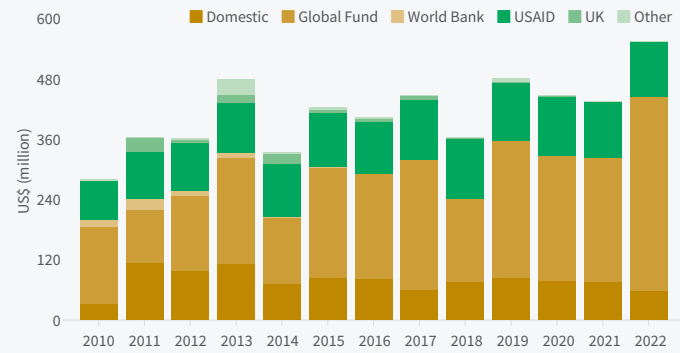


^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.
^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. *P. falciparum* parasite rate (PfPR), 2022

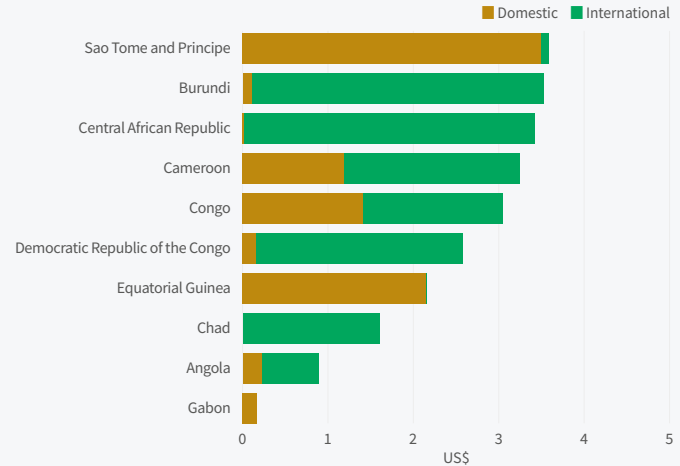


B. Malaria funding^a by source, 2010–2022



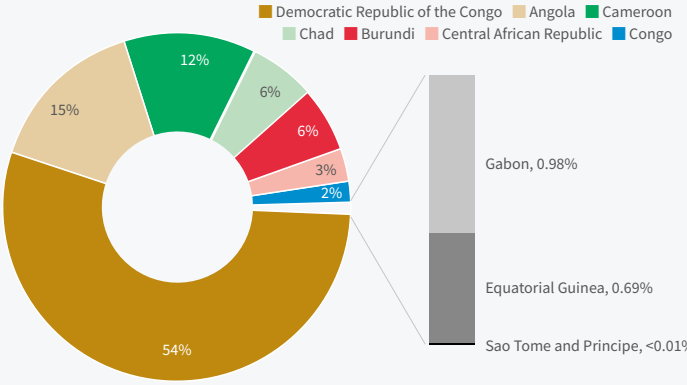
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
^a Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Chad in 2022.

C. Malaria funding^a per person at risk, average 2020–2022

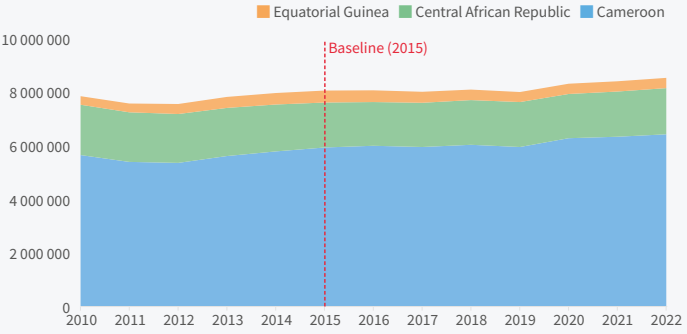


^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

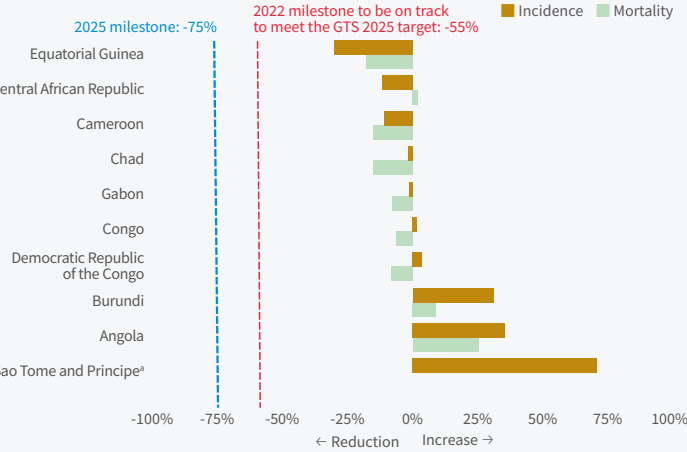
D. Share of estimated malaria cases, 2022



F. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015

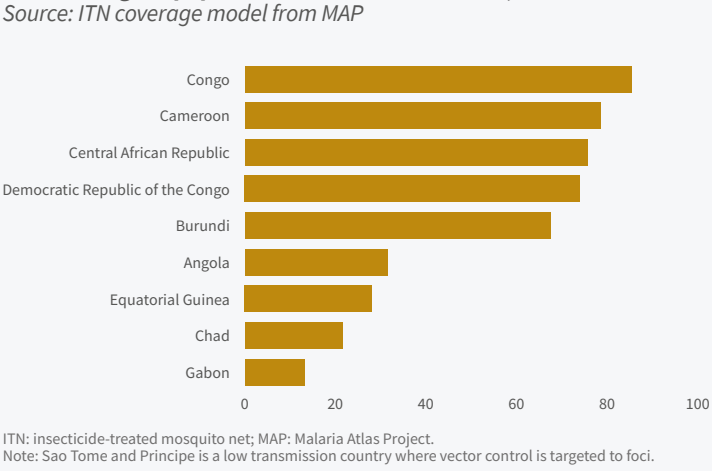


H. Change in estimated malaria incidence and mortality rates, 2015–2022

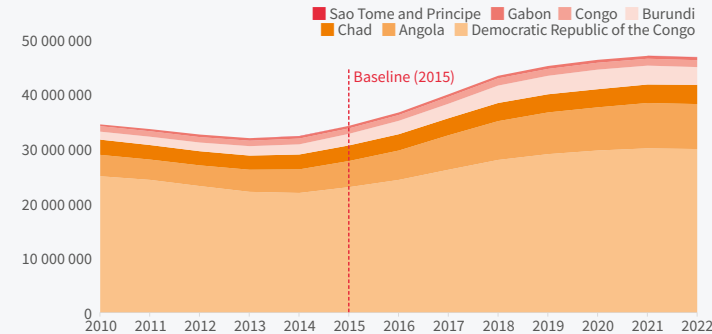


^a This country achieved the GTS 2020 target of 40% reduction in mortality rate in 2015.

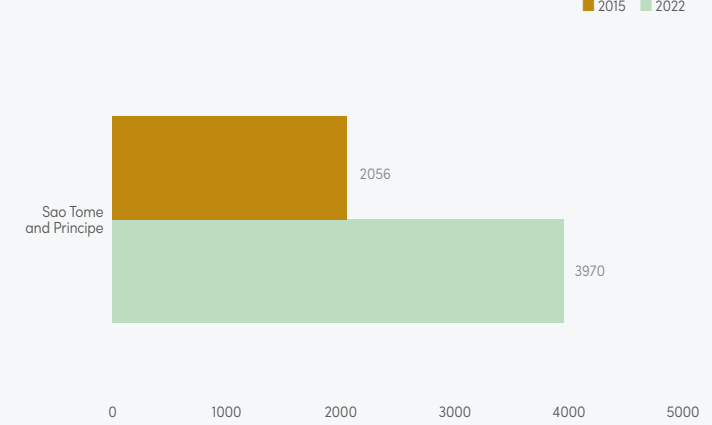
E. Percentage of population with access to an ITN, 2022



G. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2022



I. Reported indigenous cases in countries with national elimination activities, 2015 versus 2022



KEY MESSAGES

About 209 million people living in the 10 countries of central Africa are at high risk of malaria. Malaria transmission, almost exclusively due to *P. falciparum*, occurs throughout the year except in the north of Cameroon, northern Chad and the southern part of the Democratic Republic of the Congo. The HBHI initiative has been initiated in Cameroon and the Democratic Republic of the Congo. The principal vectors in central Africa are *An. gambiae*, *An. arabiensis*, *An. melas*, *An. funestus*, *An. moucheti* and *An. nili*. In 2022, the subregion had more than 56 million estimated cases and almost 132 000 estimated deaths – a 31% increase and a 4% decrease, respectively, compared with 2010. Three countries in the subregion accounted for more than 80% of the estimated cases: the Democratic Republic of the Congo (54%), Angola (15%) and Cameroon (12%). A similar distribution was seen for estimated malaria deaths, which were mainly observed in the Democratic Republic of the Congo (54%), Angola (15%) and Cameroon (10%). More than 55 million cases were reported in the public and private sectors and in the community; of these, 44% were in children aged under 5 years and 51 million (92%) were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 30% in 2010. Estimated population access to ITNs remains low in the subregion, with only five of nine countries having more than 50% access to ITNs. In 2022, Angola, Cameroon, the Central African Republic, Congo, the Democratic Republic of the Congo and Sao Tome and Principe conducted long-lasting insecticidal net (LLIN) mass campaigns. Additionally, Cameroon and Chad are implementing SMC in targeted areas of the country, covering about 4.7 million children with at least one dose of SMC per cycle in 2022. All countries implemented IPTp in 2022, and two (Burundi and the Democratic Republic of the Congo) had more than 50% coverage with IPTp3. None of the countries in the subregion are on track to meet the GTS target of a 75% reduction in estimated incidence by 2025 compared with the GTS 2015 baseline. Incidence was reduced in three countries, Cameroon, the Central African Republic and Equatorial Guinea, but by less than 55% (the expected reduction for countries to be on track to meet the GTS 2025 target). Three countries saw an increase of more than 5% in estimated malaria incidence between 2015 and 2022; Sao

Tome and Principe had the largest increase (71%), followed by Angola (35%) and Burundi (31%). Sao Tome and Principe, which is part of the malaria eliminating countries for 2025 (E-2025) initiative, reported a 46% increase in the number of indigenous cases in 2022 compared with 2021. The subregion is also facing biological threats to malaria interventions. For example, vector resistance to pyrethroids was confirmed in 86% of sites, resistance to organochlorines in 90%, resistance to carbamates in 21% and resistance to organophosphates in 6%. Vector resistance to pyrethroids and to organochlorines was confirmed in all countries of the subregion. Six countries have developed insecticide resistance monitoring and management plans. Most TES conducted according to the WHO standard protocol show good efficacy of antimalarial treatment. However, during the reporting period (2015–2022), studies of AL in Angola and dihydroartemisinin-piperaquine (DHA-PPQ) in the Democratic Republic of the Congo found treatment failure rates of 10% or more when using Bayesian algorithms to distinguish between reinfection and recrudescence. These results warrant further investigation and could be a sign of emergence of resistance to the ACT partner drugs. Total funding has increased consistently in the subregion since 2010 (by 97%), with domestic expenditures representing 10% of total funding in 2022, a slight decrease since 2021. In 2022, total funding was the highest it has ever been, with an increase of 27% since 2021, largely owing to a 57% increase in funding by the Global Fund. Domestic funding has continued to fall each year since 2019 and, by 2022, it had fallen by 30% compared with 2019. Total funding per person at risk ranged from US\$ 0.17 in Gabon to US\$ 3.59 in Sao Tome and Principe over a 3-year average. Total funding per person at risk over the 3-year average was more than US\$ 1.00 for eight of the 10 countries in the subregion. The performance of surveillance systems varies across countries in the subregion (e.g. in 2022, Gabon had a notably low reporting rate of 69%). Additional challenges include inadequate responses because of political instability and insufficient domestic funding, and frequent malaria outbreaks. Tackling these issues could greatly improve the malaria situation in the subregion.

Annex 3 – A. WHO African Region, c. Countries with high transmission in east and southern Africa

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 391 million
Parasites: *P. falciparum* (almost 100%), *P. vivax* (<1%) and other (<1%)
Vectors: *An. arabiensis*, *An. funestus* s.l., *An. gambiae* s.l., *An. gambiae* s.s., *An. leesonii*, *An. nili*, *An. pharoensis*, *An. rivulorum*, *An. stephensi* s.l.^a and *An. vaneedeni*
^a A potential vector identified.

FUNDING (US\$), 2010–2022

855.7 million (2010), 827.6 million (2015), 1046.3 million (2022); 2010–2022: 22% increase
Proportion of domestic source^a in 2022: 26%
^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Countries with 50–80% coverage with either LLINs or IRS in 2022:^a Kenya, Madagascar, Malawi, Mozambique, Rwanda, South Sudan, Uganda, the United Republic of Tanzania and Zimbabwe
Countries that carried out LLIN mass campaigns in 2022 (including carry-over from 2021): Ethiopia, Mozambique, Rwanda, the United Republic of Tanzania and Zimbabwe
^a ITN coverage model from MAP.

Countries that implemented IPTp in 2022: Kenya, Madagascar, Malawi, Mozambique, South Sudan, Uganda, the United Republic of Tanzania (mainland), Zambia and Zimbabwe
Countries with >50% IPTp3+ in 2022: Mozambique, Uganda and Zambia
Children treated with at least one dose of SMC per cycle in 2022: 1.5 million

Percentage of suspected cases tested (reported): 38% (2010), 80% (2015), 97% (2022)
Number of ACT courses distributed: 67.9 million (2010), 108.2 million (2015), 96.0 million (2022)
Number of any antimalarial treatment courses (incl. ACT) distributed: 68.0 million (2010), 109.9 million (2015), 98.7 million (2022)

REPORTED CASES AND DEATHS,^a 2010–2022

Total (presumed and confirmed) cases: 53.3 million (2010), 59.0 million (2015), 64.0 million (2022)
Confirmed cases: 8.6 million (2010), 36.2 million (2015), 59.4 million (2022)
Percentage of total cases confirmed: 16.1% (2010), 61.5% (2015), 92.9% (2022)
Deaths: 70 700 (2010), 38 400 (2015), 15 300 (2022)

Children aged under 5 years, presumed and confirmed cases: 21.6 million (2010), 17.6 million (2015), 22.5 million (2022)
Children aged under 5 years, percentage of total cases: 40.5% (2010), 29.9% (2015), 35.1% (2022)
Children aged under 5 years, deaths:^b 25 300 (2010), 10 400 (2015), 7300 (2022)
Children aged under 5 years, percentage of total deaths: 36% (2010), 27% (2015), 47% (2022)

^a Includes malaria endemic countries only; ^b No data for Mozambique in 2022.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 55.1 million (2010), 59.8 million (2015), 55.5 million (2022); 2010–2022: 1% increase
Deaths: 133 300 (2010), 129 200 (2015), 124 500 (2022); 2010–2022: 7% decrease

ACCELERATION TO ELIMINATION

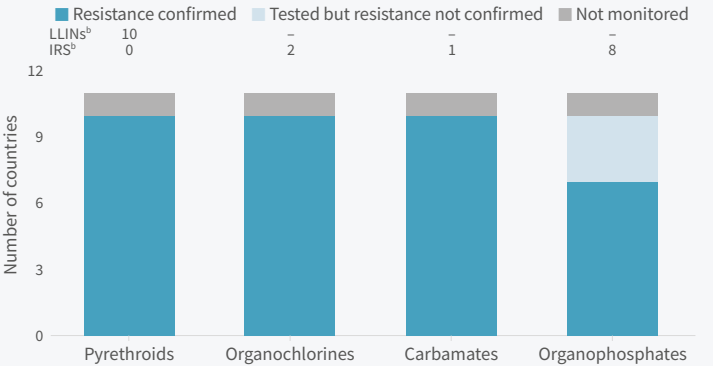
Countries with subnational/territorial elimination programme: the United Republic of Tanzania (Zanzibar), Zambia and Zimbabwe

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile	
						25	75
AL	2015–2022	56	0.0	1.5	17.9	0.0	3.8
AS-AQ	2016–2018	14	0.0	0.0	2.0	0.0	0.6
DHA-PPQ	2015–2019	17	0.0	1.1	9.2	0.0	1.6

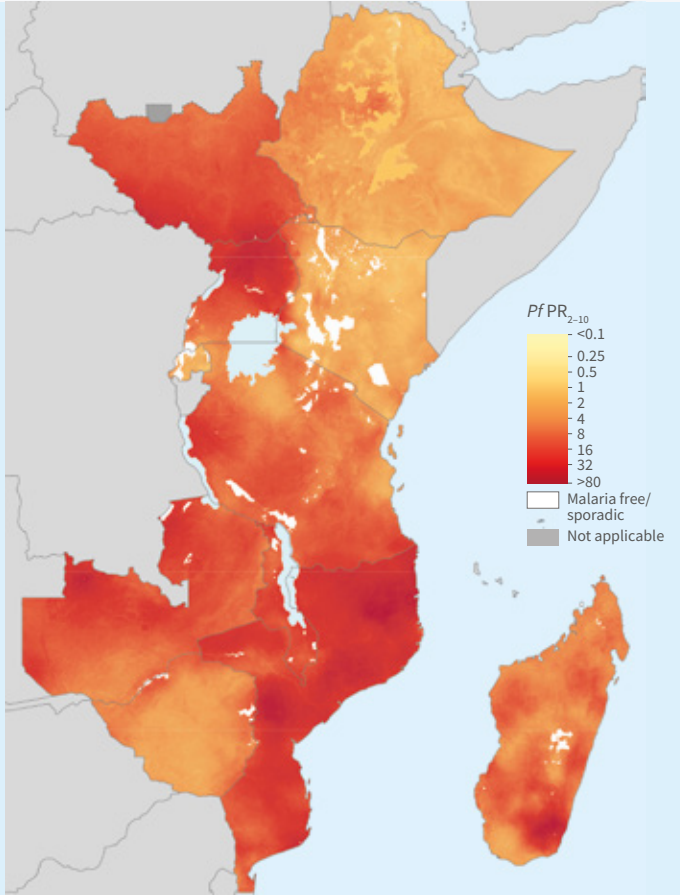
AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

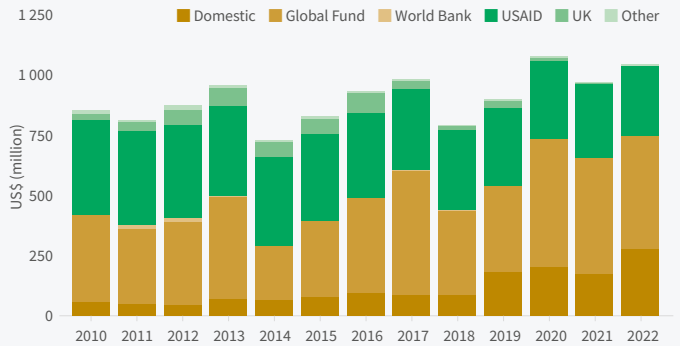


^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.
^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. *P. falciparum* parasite rate (PfPR), 2022

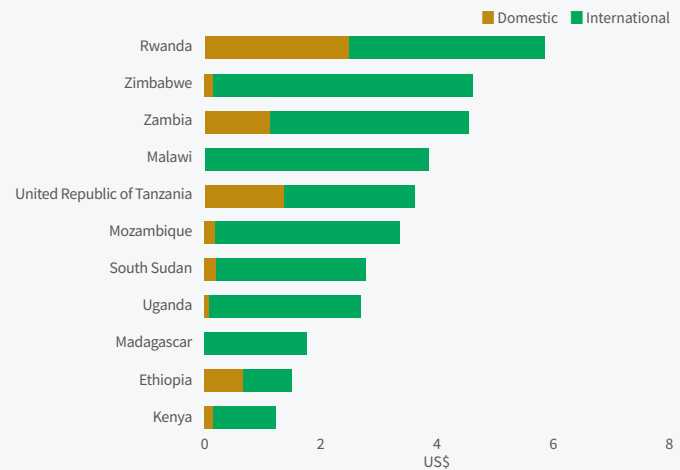


B. Malaria funding^a by source, 2010–2022



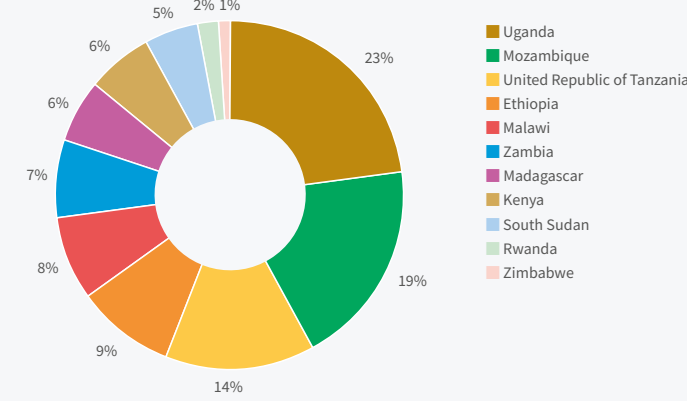
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
^a Excludes patient service delivery costs and out-of-pocket expenditure.

C. Malaria funding^a per person at risk, average 2020–2022

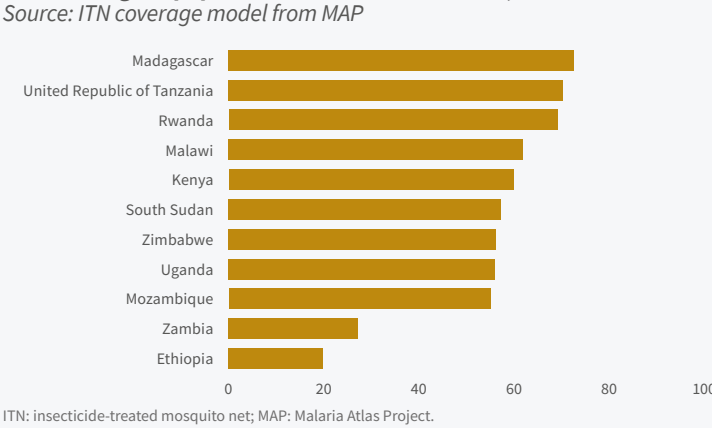


^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

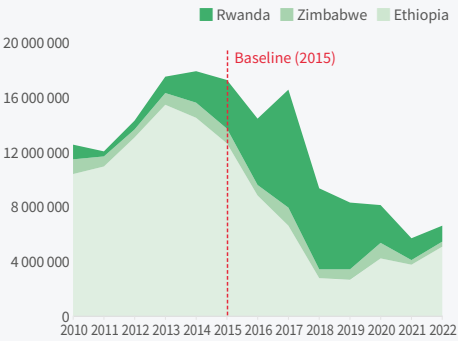
D. Share of estimated malaria cases, 2022



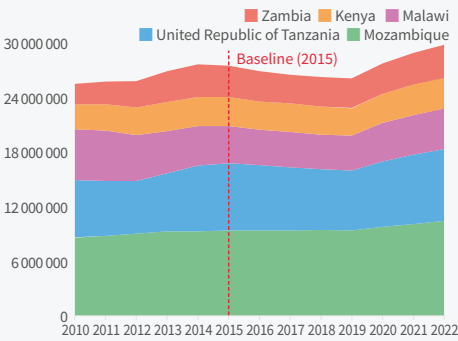
E. Percentage of population with access to an ITN, 2022



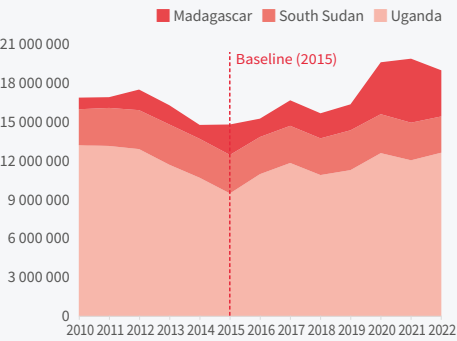
F. Estimated number of cases in countries that reduced case incidence by ≥55% in 2022 compared with 2015



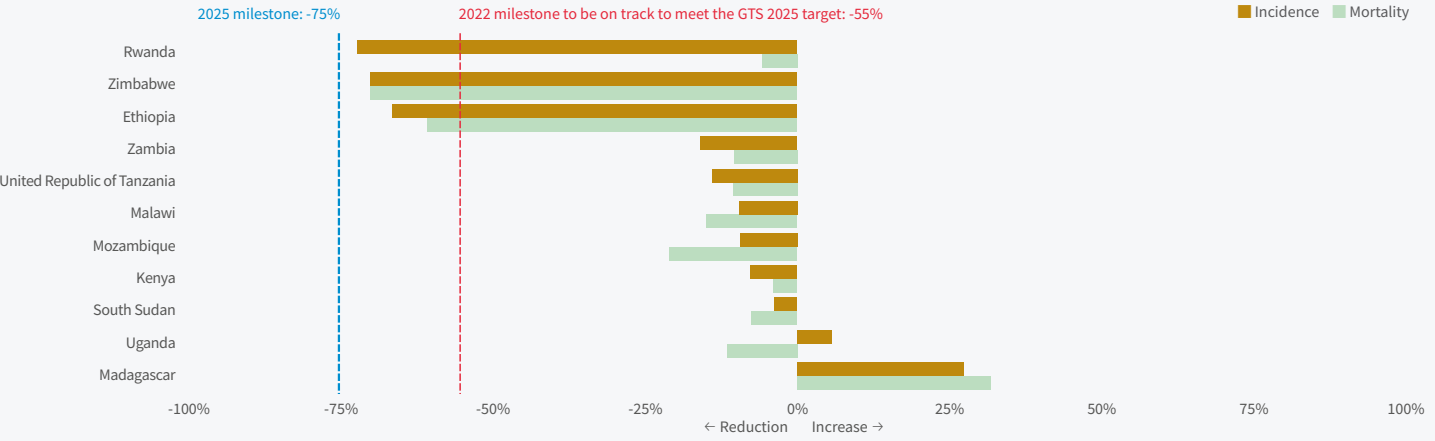
G. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015



H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2022



I. Change in estimated malaria incidence and mortality rates, 2015–2022



KEY MESSAGES

About 391 million people in the 11 countries with high transmission in east and southern Africa are at high risk of malaria. Malaria transmission is almost exclusively due to *P. falciparum* (except in Ethiopia) and is highly seasonal in Ethiopia, Madagascar and Zimbabwe, and in coastal and highland areas of Kenya. Malaria transmission is stable in most of Malawi, Mozambique, South Sudan, Uganda, the United Republic of Tanzania and Zambia. The HBHI initiative was launched in Mozambique in 2018 and in Uganda in 2019. The principal vectors in this region are *An. gambiae*, *An. arabiensis*, *An. merus*, *An. funestus*, *An. nili* and *An. stephensi*.
The subregion had about 56 million estimated cases and about 124 000 estimated deaths, representing a 1% increase and 7% decrease, respectively, compared with 2010. Three countries accounted for more than 50% of the estimated cases: Uganda (23%), Mozambique (19%) and the United Republic of Tanzania (14%). In these three countries, about 64 million cases were reported in the public and private sectors and in the community, of which 35.1% were in children aged under 5 years and 59 million (92.9%) were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 16% in 2010. A significantly lower number of deaths was reported in 2022 (15 300) compared with 2010 (70 700) and 2015 (38 400). In 2022, 47% of the reported deaths were among children aged under 5 years.
In nine countries, an estimated 50% or more of the population had access to ITNs, and nine countries implemented IPTp, with three countries reporting more than 50% of pregnant women attending antenatal care (ANC) receiving three or more doses of IPTp. In 2022, Ethiopia, Mozambique, Rwanda, the United Republic of Tanzania and Zimbabwe carried out mass ITN campaigns. South Sudan, Mozambique and Uganda implemented SMC for the first time, covering more than 1.5 million children, who received at least one dose of SMC per cycle in 2022. Since 2019, Malawi and Kenya have been part of the malaria vaccine implementation programme for the programmatic use of RTS,S.
Ethiopia, Rwanda and Zimbabwe are on track to meet the GTS target of a 75% reduction in incidence by 2025 compared with the GTS 2015 baseline. Despite not being on track to meet the GTS incidence target, Kenya, Malawi, Mozambique, the United Republic of Tanzania and Zambia did succeed in reducing incidence in 2022, but by less than 55% (the expected reduction for countries to be on track to meet the GTS 2025 target) compared with the 2015 baseline. No changes in incidence were seen in Madagascar, South Sudan and Uganda.

In 2022, South Sudan had a 76% increase in reported malaria cases compared with 2021 – from 3.1 million to 5.5 million – probably owing to improvements in the surveillance system. Uganda had several malaria outbreaks and a 32% increase in reported cases, from 15.1 million in 2021 to 20.0 million in 2022. Ethiopia reported a 23% increase in cases between 2021 (1.5 million) and 2022 (1.8 million). Reported cases decreased by more than 26% in Rwanda, by 28% in Zanzibar (the United Republic of Tanzania) and Madagascar, and by 39% in Malawi. Between 2017 and 2022, the number of reported cases in Rwanda decreased from 5.9 million to 857 000 – a total reduction of 86%.
The subregion is also facing biological threats to malaria interventions, with *An. stephensi* having been detected in Ethiopia and Kenya. Vector resistance to pyrethroids was confirmed in 74% of sites, resistance to organochlorines in 40%, resistance to carbamates in 27% and resistance to organophosphates in 16%. Vector resistance to pyrethroids, organochlorines and carbamates was confirmed in all countries except South Sudan, which did not report resistance monitoring. All countries have developed insecticide resistance monitoring and management plans. Most TES conducted according to the WHO standard protocol show good efficacy of antimalarial treatment. However, during the reporting period (2015–2022), studies of AL in Kenya and Uganda found treatment failure rates of 10% or more. In Uganda, Bayesian algorithms to distinguish between reinfection and recrudescence were used. These results warrant further investigation and could be a sign of emergence of resistance to the ACT partner drugs. Surveillance of *PfKelch13* polymorphisms has detected artemisinin partial resistance and clonal expansion of *PfKelch13* mutations in Rwanda, Uganda and the United Republic of Tanzania.
Total funding in the subregion has increased by 22% since 2010, with fluctuations over the past decade. Overall, total funding increased by 8% in 2022 compared with 2021, stemming from a significant (56%) increase in domestic spending, with other funding sources remaining at similar levels as in 2021. Funding per person at risk ranged from US\$ 1.22 in Kenya to US\$ 5.85 in Rwanda over a 3-year average.
Challenges include frequent epidemics (Mozambique or Uganda), humanitarian and health emergencies, inadequate response (South Sudan) due to political instability, inadequate funding for interventions and human resources, delays in delivery of critical commodities and weak surveillance systems (including lack of early warning systems for detection of outbreaks) in several countries.

Annex 3 – A. WHO African Region, d. Countries with low transmission in east and southern Africa

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 15 million
Parasites: *P. falciparum* (91%), *P. vivax* (9%) and other (<1%)
Vectors: *An. arabiensis*, *An. funestus* s.l., *An. funestus* s.s., *An. gambiae* s.l., *An. gambiae* s.s. and *An. stephensi* s.l.

FUNDING (US\$), 2010–2022

77.7 million (2010), 29.3 million (2015), 46.6 million (2022); 2010–2022: 40% decrease
Proportion of domestic source^a in 2022: 79%
Regional funding mechanisms: Southern African Development Community Malaria Elimination Eight Initiative

^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Countries with 50–80% coverage of high-risk population with either LLINs or IRS in 2022:^a the Comoros
Countries that carried out LLIN mass campaigns in 2022 (including carry-over from 2021): Eswatini

^a ITN coverage model from MAP.

Countries that implemented IPTp in 2022: the Comoros

Percentage of suspected cases tested (reported): 81% (2010), 99% (2015), 99.4% (2022)
Number of ACT courses distributed: 575 000 (2010), 366 000 (2015), 193 000 (2022)
Number of any antimalarial treatment courses (incl. ACT) distributed: 575 000 (2010), 366 000 (2015), 193 000 (2022)

REPORTED CASES AND DEATHS,^a 2010–2022

Total (presumed and confirmed) cases: 205 300 (2010), 52 900 (2015), 106 500 (2022)
Confirmed cases: 82 500 (2010), 47 700 (2015), 105 700 (2022)
Percentage of total cases confirmed: 40.2% (2010), 90.2% (2015), 99.3% (2022)
Deaths: 242 (2010), 176 (2015), 121 (2022)

Children aged under 5 years, presumed and confirmed cases: 56 400 (2010), 7300 (2015), 11 500 (2022)
Children aged under 5 years, percentage of total cases: 27.5% (2010), 13.7% (2015), 10.8% (2022)
Children aged under 5 years, deaths: 37 (2010), 16 (2015), 7 (2022)
Children aged under 5 years, percentage of total deaths: 15% (2010), 9% (2015), 6% (2022)

^a Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 133 200 (2010), 86 700 (2015), 179 500 (2022); 2010–2022: 35% increase
Deaths: 415 (2010), 284 (2015), 434 (2022); 2010–2022: 5% increase

ACCELERATION TO ELIMINATION

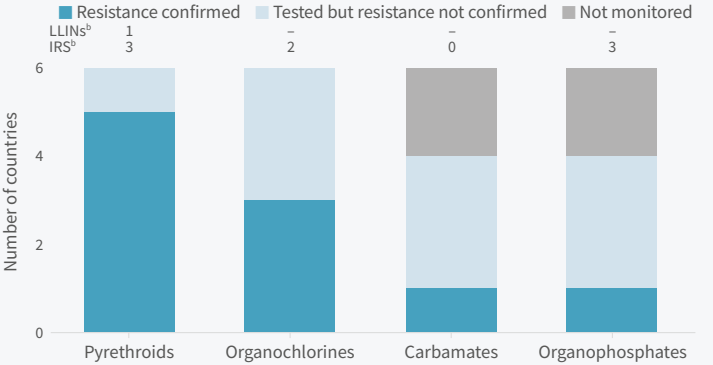
Countries with nationwide elimination programme: Botswana, the Comoros, Eswatini, Namibia and South Africa
Countries part of the E-2025 initiative: Botswana, the Comoros, Eswatini and South Africa

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH P. FALCIPARUM MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile	
						25	75
AL	2017–2020	5	0.0	0.0	1.0	0.0	0.0
AS-AQ	2016–2019	8	0.0	3.2	4.7	1.1	4.4

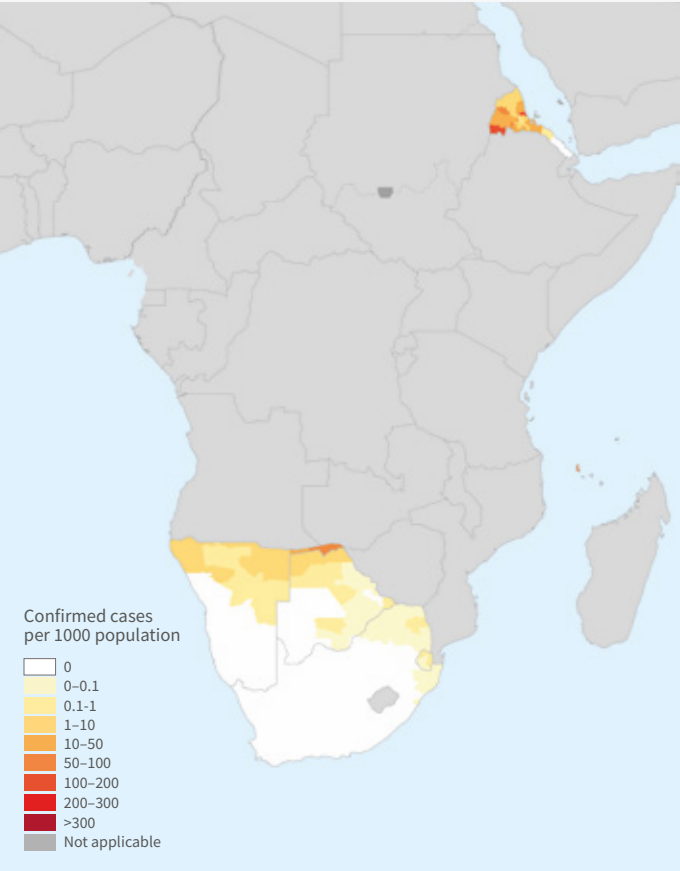
AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine.

STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

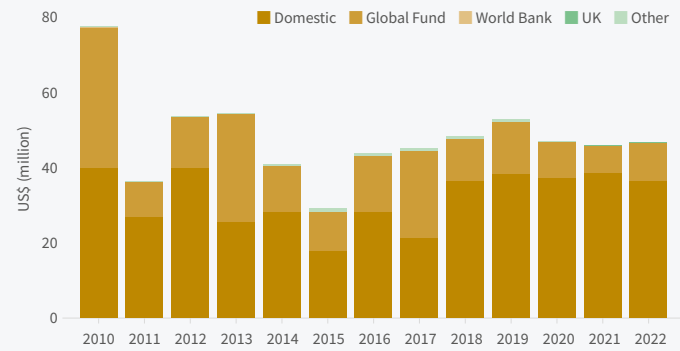


^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.
^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2022

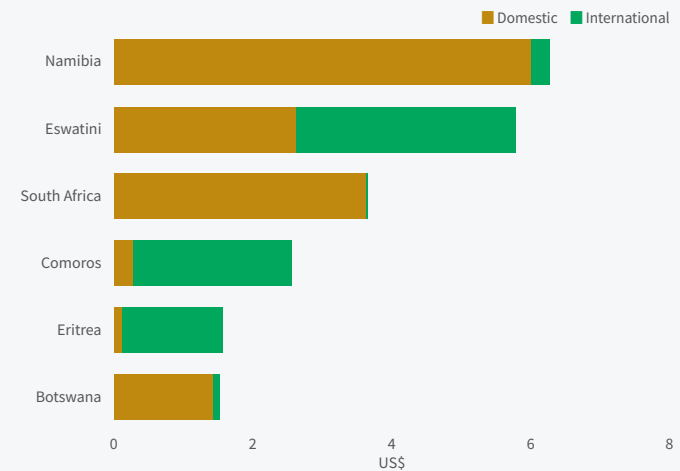


B. Malaria funding^a by source, 2010–2022



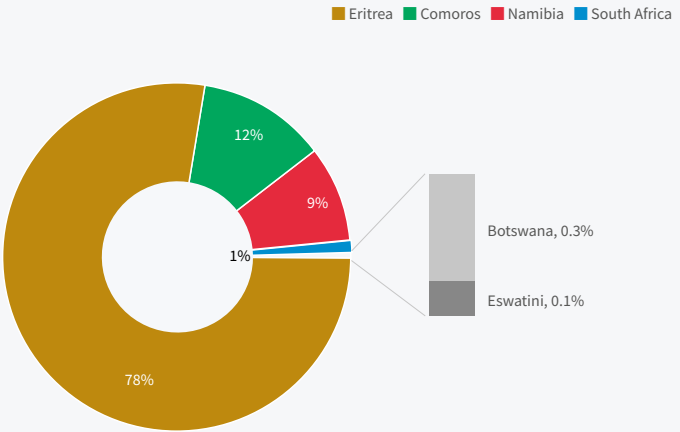
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland.
^a Excludes patient service delivery costs and out-of-pocket expenditure.

C. Malaria funding^a per person at risk, average 2020–2022

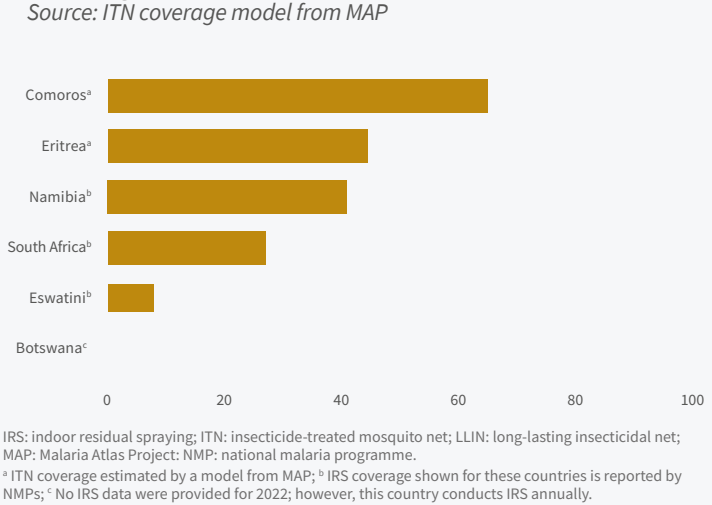


^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

D. Share of estimated malaria cases, 2022

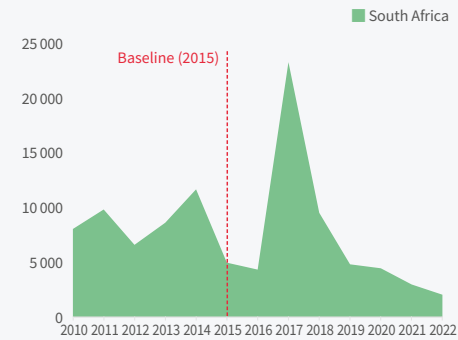


E. Percentage of population with access to either LLINs or IRS, 2022

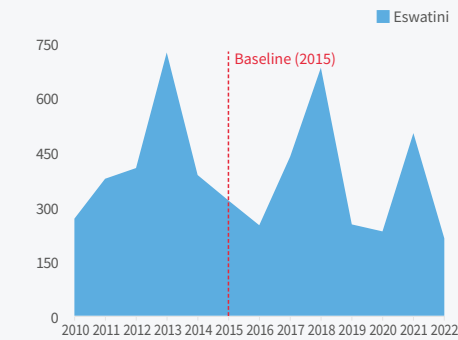


IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; MAP: Malaria Atlas Project; NMP: national malaria programme.
^a ITN coverage estimated by a model from MAP; ^b IRS coverage shown for these countries is reported by NMPs; ^c No IRS data were provided for 2022; however, this country conducts IRS annually.

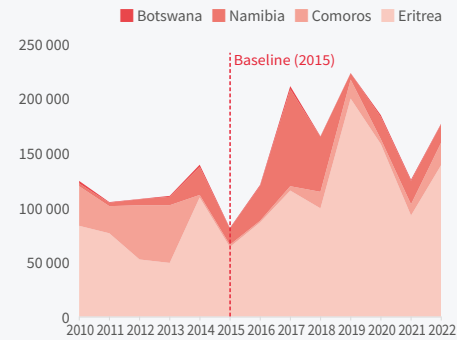
F. Estimated number of cases in countries that reduced case incidence by ≥55% in 2022 compared with 2015



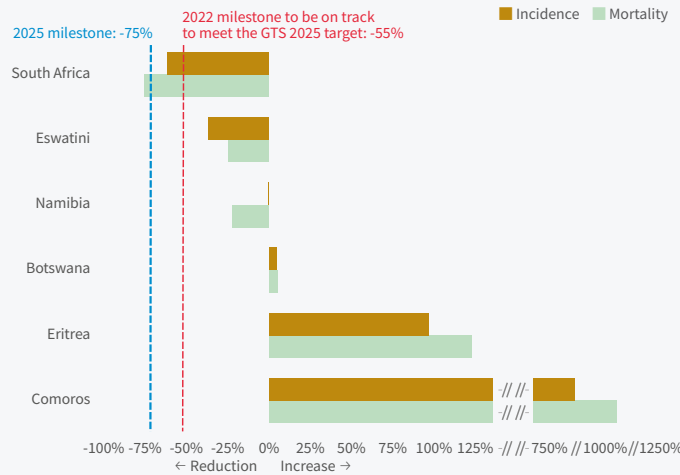
G. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015



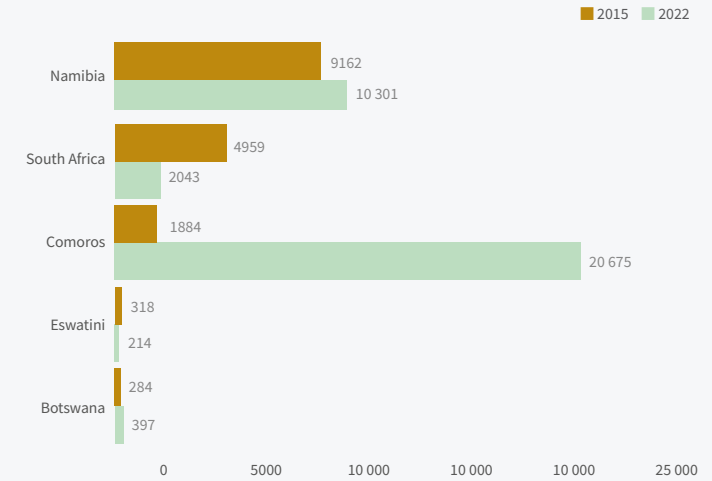
H. Estimated number of cases in countries with an increase in case incidence, 2015–2022



I. Change in estimated malaria incidence and mortality rates, 2015–2022



J. Reported indigenous cases in countries with national elimination activities, 2015 versus 2022



KEY MESSAGES

About 15 million people in the six countries with low transmission in east and southern Africa are at risk of malaria. More than 106 000 cases were reported, of which 10.8% were in children aged under 5 years and 99.3% were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 40.2% in 2010. The proportion of all malaria deaths that were in children aged under 5 years decreased significantly, from 15% in 2010 to 6% in 2022. The numbers of indigenous deaths estimated for Botswana, Eswatini and Namibia were reported directly as malaria deaths for the entire time series, compared with previous reports, in which death estimates were calculated. Most of the cases in the subregion (91%) are due to *P. falciparum*, and the main vectors of transmission are *An. gambiae*, *An. arabiensis* and *An. funestus*. *An. stephensi* has been detected in Eritrea.

In 2022, there were an estimated 179 000 cases and 434 deaths – an increase of 35% and 5%, respectively, compared with 2010. Eritrea accounted for 78% of all estimated cases in the subregion, followed by the Comoros (12%) and Namibia (9%). South Africa is on track to meet the GTS target of a 75% reduction in incidence by 2025 compared with the GTS 2015 baseline, as a result of strong political support and advocacy within the country, coupled with increased domestic funding. Incidence also decreased in Eswatini, but by less than 55%, largely thanks to improvements in case-based surveillance and the use of data to respond to the contextual factors driving transmission. In 2022, Eswatini carried out a mass ITN campaign. Botswana, the Comoros, Eritrea and Namibia are not on track to meet the GTS 2025 targets; these countries had similar incidence or increases in incidence between 2015 and 2022. After a few years of reporting increases in cases due to outbreaks, Namibia and Botswana had reductions in incidence of 22% and 50%, respectively, between 2021 and 2022. In 2022, the Comoros had a 93% increase in incidence compared with 2021 – from 10 537 cases to 20 675 cases – probably stemming from improvements in its surveillance system. No malaria deaths were reported in the Comoros

in 2022, despite the increase in indigenous cases. Eritrea had an increase in incidence of 47% between 2021 and 2022. South Africa reported a steady reduction in cases, with a 32% reduction in incidence between 2021 and 2022. In 2022, reporting completeness in South Africa was below 90%. Four countries – Botswana, the Comoros, Eswatini and South Africa – that are part of the E-2025 initiative continue to lead the race towards malaria elimination within the subregion. These countries, with the exception of the Comoros, reported a reduction in indigenous malaria cases.

All countries in the region conduct indoor residual spraying (IRS). Vector resistance to pyrethroids was confirmed in 55% of sites, resistance to organochlorines in 33%, resistance to carbamates in 7% and resistance to organophosphates in 8%. Five countries have developed insecticide resistance monitoring and management plans.

Funding in the subregion decreased by 40% from 2010 to 2022; a similar trend was reported in 2021. Compared with 2021, total funding has remained essentially unchanged, with most funding (79%) continuing to stem from domestic sources. Funding per person at risk ranged from US\$ 1.54 in Botswana to US\$ 6.27 in Namibia over a 3-year average. Funding per person at risk in Eritrea was similar to the funding per person in Botswana and is among the lowest in the region; however, Eritrea had 78% of the estimated malaria cases, highlighting the increasing need for domestic and international funding across all countries to achieve the targets set out in the GTS.

Challenges include reduction of malaria funding at programme level, inadequate coverage of vector control interventions, bottlenecks in procurement and supply management, high population movement between high and low endemic countries (which increases the risk of importation), insufficient human and logistical resources to meet the operational requirements of malaria programmes, and inadequate surveillance and response systems at peripheral level.

Annex 3 – B. WHO Region of the Americas

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 155 million
Parasites: *P. vivax* (75%), *P. falciparum* and mixed (25%) and other (<1%)
Vectors: *An. albimanus*, *An. albitarsis*, *An. aquasalis*, *An. argyritarsis*, *An. braziliensis*, *An. cruzii*, *An. darlingi*, *An. neivai*, *An. nuneztovari*, *An. pseudopunctipennis* and *An. punctimacula*

FUNDING (US\$), 2010–2022

251.1 million (2010), 215.9 million (2015), 141.6 million (2022); 2010–2022: 44% decrease
Proportion of domestic source^a in 2022: 73%
Regional funding mechanisms: Regional Malaria Elimination Initiative
^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Number of people protected by IRS^a: 7.04 million (2010), 3.97 million (2015), 1.13 million (2022)
Total LLINs distributed^a: 978 000 (2010), 1.14 million (2015), 951 000 (2022)
Number of RDTs distributed^a: 83 700 (2010), 533 900 (2015), 1 216 500 (2022)

Number of ACT courses distributed^d: 148 400 (2010), 209 400 (2015), 210 400 (2022)
Number of any first-line antimalarial treatment courses (incl. ACT) distributed^d: 1.14 million (2010), 652 500 (2015), 826 000 (2022)
^a No data for Colombia, French Guiana, Guatemala and Peru in 2022; ^b Includes PBO nets, G2 nets and Royal Guard nets in 2022; no data for Colombia, Costa Rica, French Guiana, Guyana, Panama and Peru in 2022; ^c No data for Nicaragua and Peru in 2022; ^d No data for French Guiana in 2022.

REPORTED CASES AND DEATHS, ^a 2010–2022

Total (presumed and confirmed) cases^a: 677 400 (2010), 479 000 (2015), 482 000 (2022)
Confirmed cases: 677 400 (2010), 479 000 (2015), 482 000 (2022)
Percentage of total cases confirmed: 100% (2010), 100% (2015), 100% (2022)
Indigenous cases: 677 373 (2010), 443 428 (2015), 430 693 (2022)
Imported cases: 11 (2010), 14 881 (2015), 5074 (2022)
Introduced cases: 23 (2010), 0 (2015), 9673 (2022)
Indigenous deaths: 190 (2010), 169 (2015), 89 (2022)
^a Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 818 000 (2010), 573 000 (2015), 552 000 (2022); 2010–2022: 33% decrease
Deaths: 502 (2010), 390 (2015), 343 (2022); 2010–2022: 32% decrease

ACCELERATION TO ELIMINATION

Countries with nationwide elimination programme: Belize, Bolivia (Plurinational State of), Brazil, Colombia, Costa Rica, the Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru and Suriname
Countries and territories part of the E-2025 initiative: Belize, Costa Rica, the Dominican Republic, Ecuador, French Guiana, Guatemala, Honduras, Mexico, Panama and Suriname
Certified as malaria free since 2010: Argentina (2019), Belize (2023), El Salvador (2021) and Paraguay (2018)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile	
						25	75
AL	2015–2019	2	0.0	0.0	0.0	0.0	0.0

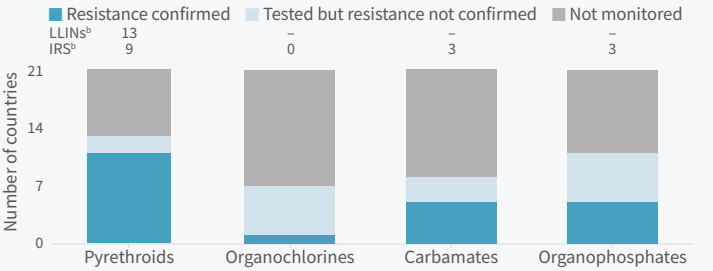
AL: artemether-lumefantrine.

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. VIVAX* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile	
						25	75
CQ	2019–2020	1	0.0	0.0	0.0	0.0	0.0
CQ+PQ	2016–2020	3	0.0	0.0	1.2	0.0	1.2

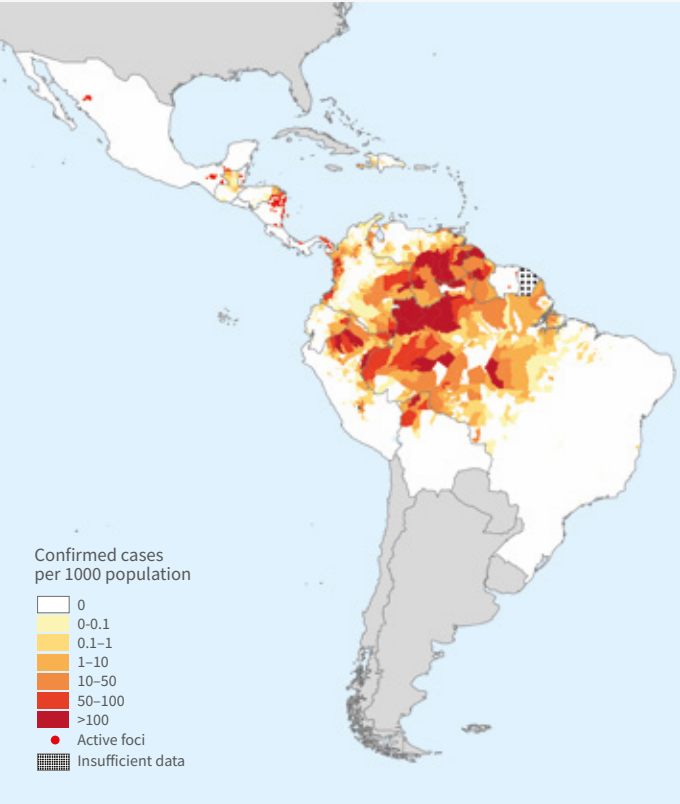
CQ: chloroquine; CQ+PQ: chloroquine+primaquine.

STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

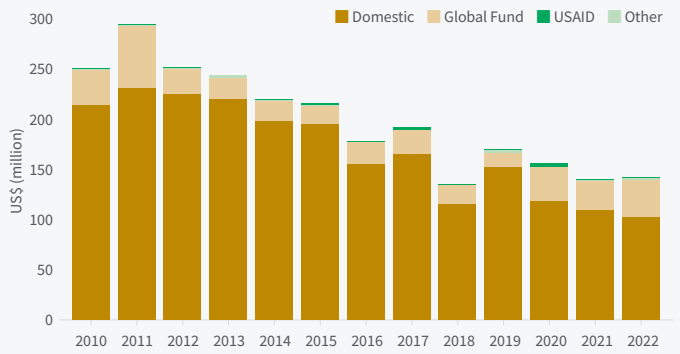


^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.
^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2022

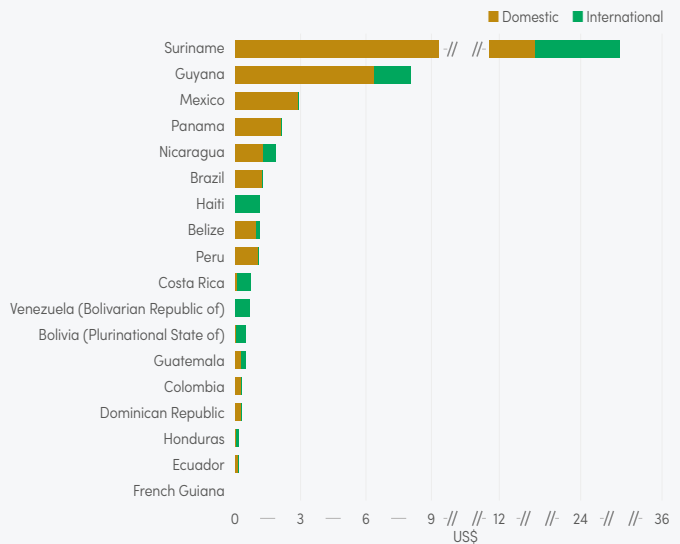


B. Malaria funding^a by source, 2010–2022



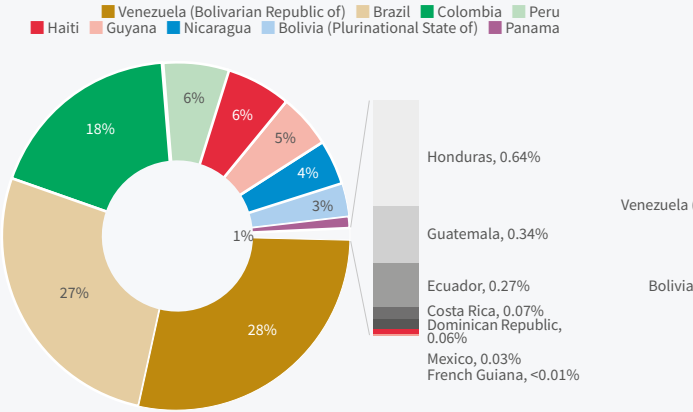
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; USAID: United States Agency for International Development.
^a Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for the Bolivarian Republic of Venezuela in 2022.

C. Malaria funding^a per person at risk, average 2020–2022



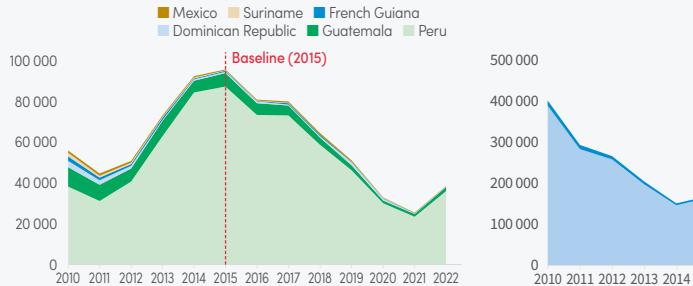
^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

D. Share of estimated malaria cases, 2022



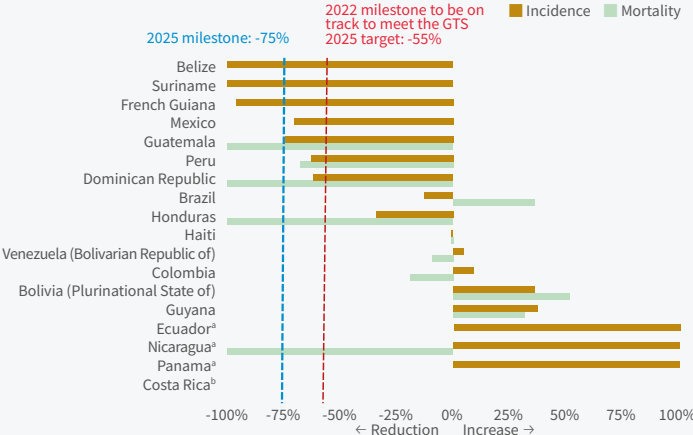
Note: El Salvador was certified as malaria free in 2021; Belize has reported zero indigenous cases since 2019.

F. Estimated number of cases in countries and areas that reduced case incidence by ≥55% in 2022 compared with 2015



Note: El Salvador was certified as malaria free in 2021; Belize has reported zero indigenous cases since 2019.

I. Change in estimated malaria incidence and mortality rates, 2015–2022



^a In these countries, change in case incidence is more than 100%; ^b In this country, there was no change in incidence and mortality in 2022.

KEY MESSAGES

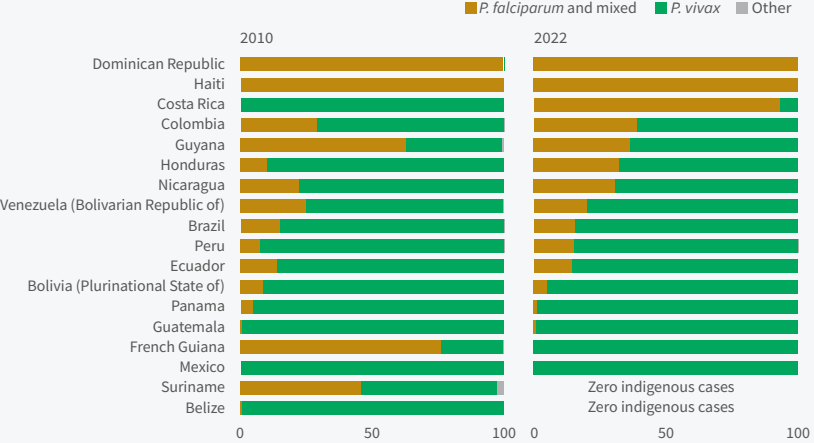
Seventeen countries and one territory in the WHO Region of the Americas are currently at risk of malaria. Paraguay, Argentina, El Salvador and Belize were certified malaria free by WHO in 2018, 2019, 2021 and 2023, respectively. Three quarters of reported malaria cases in the region are caused by *Plasmodium vivax*. In 2022, the region reported 481 778 malaria cases (including relapses) and 89 indigenous deaths – decreases of 29% and 53%, respectively, compared with 2010. Four countries accounted for almost 80% of all estimated cases: Venezuela (Bolivarian Republic of) (28%), Brazil (27%), Colombia (18%) and Peru (6%).

Seven countries and one territory experienced reductions in the number of reported cases between 2015 and 2022: Brazil (11%), the Dominican Republic (49%), French Guiana (88%), Guatemala (66%), Haiti (16%), Mexico (56%), Peru (58%) and Suriname (84%). All other countries in the region experienced varying levels of increases in reported cases; such increases in 2022 were attributed to outbreaks, population dynamics within the countries and gaps in the malaria response. In 2022, Costa Rica experienced an outbreak of *P. falciparum* on the Nicaraguan border, associated with the movement of agricultural workers from endemic areas.

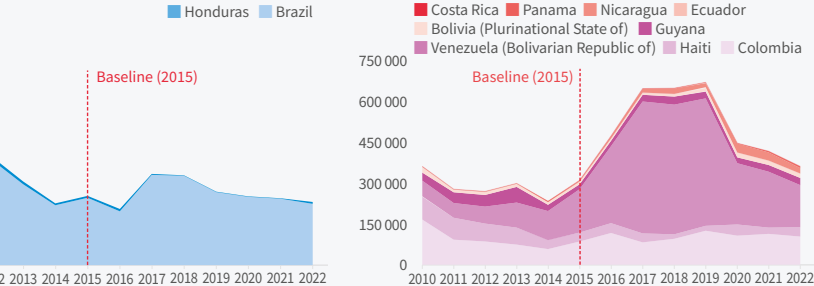
All the indigenous cases reported by French Guiana and Mexico were due to *P. vivax*, and between 61% and 99% of the indigenous cases were due to *P. vivax* in Bolivia (Plurinational State of), Brazil, Colombia, Ecuador, Guatemala, Guyana, Honduras, Nicaragua, Panama, Peru and Venezuela (Bolivarian Republic of). Conversely, all the indigenous cases reported by the Dominican Republic and Haiti and 93% of the indigenous cases reported in Costa Rica in 2022 were due to *P. falciparum*.

Five countries and one territory in the region are on track to meet the GTS target for 2025 (i.e. 75% reduction in incidence and mortality), having reduced case incidence by 55% or more in 2022 compared with the 2015 baseline: the Dominican Republic, French Guiana, Guatemala, Mexico, Peru and Suriname. Two countries, Brazil and Honduras, reduced case incidence, but by less than 55% (which is the expected reduction for countries to be on track to meet the GTS 2025 target). Nine countries – Bolivia (Plurinational State of), Colombia, Costa Rica, Ecuador, Guyana, Haiti, Nicaragua, Panama and Venezuela (Bolivarian Republic of) – saw either an increase or no change in incidence in 2022 compared with the 2015 baseline. Belize, Costa Rica, El Salvador, French Guiana, Mexico, Panama and Suriname reported zero deaths in 2022. Peru had a 68% reduction in mortality between 2015 and 2022. Therefore, all these countries are on track to meet the GTS 2025 targets for mortality. Two countries – Colombia and Venezuela (Bolivarian Republic of) – are not

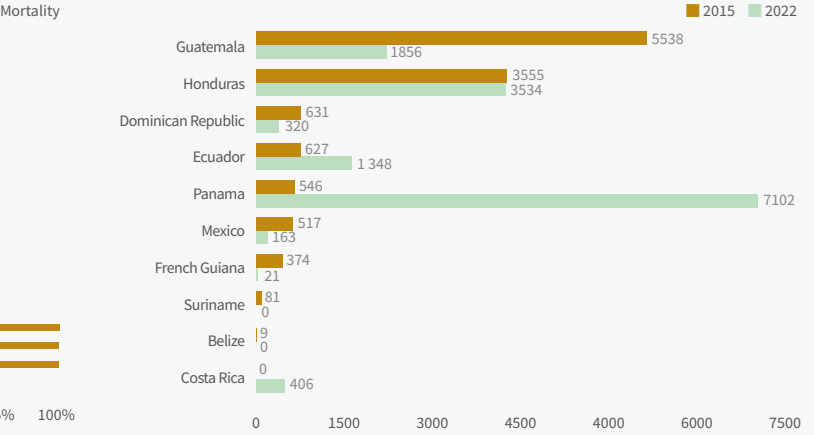
E. Percentage of *Plasmodium* species from indigenous cases, 2010 and 2022



H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2022



J. Number of reported indigenous cases in countries with national elimination activities, 2015 versus 2022



on track but did have reductions in deaths of 5–25% between 2015 and 2022. No data on deaths were reported for Guyana.

Nine countries and one territory in this region are part of the E-2025 initiative: Belize, Costa Rica, the Dominican Republic, Ecuador, French Guiana, Guatemala, Honduras, Mexico, Panama and Suriname. An additional seven countries in Central America plus Colombia and the Dominican Republic are taking part in the Regional Malaria Elimination Initiative – a subregional initiative to eliminate malaria by 2025. Among the nine countries taking part in the E-2025 initiative, Suriname celebrated zero indigenous cases for the first time in 2022, three countries (Ecuador, Honduras and Mexico) reported decreases in cases and the remaining countries reported increases. In 2022, imported cases accounted for 98% of the cases in Suriname (60/61), 32% of the cases in Mexico (77/244), 29% of the cases in French Guiana (15/51), 8% of the cases in Costa Rica (36/462), 5% of the cases in the Dominican Republic (17/337) and 3% of the cases in Ecuador (42/1666). The proportion of all cases classified as relapses was 29% in French Guiana, 13% in Brazil, 9% in Venezuela (Bolivarian Republic of) and 1% in Mexico.

Malaria prevention in most of the countries relies on IRS, or mass or routine distribution of ITNs. Bolivia (Plurinational State of) and Peru introduced the distribution of nets treated with pipерonyl butoxide (PBO) in 2019 and 2020, respectively. Vector resistance to pyrethroids was confirmed in 32% of sites, resistance to organochlorines in 5%, resistance to carbamates in 18% and resistance to organophosphates in 18%. Significant gaps remain in standard resistance monitoring for the insecticide classes commonly used for vector control. Fourteen countries have developed their insecticide resistance monitoring and management plans.

Total funding for malaria decreased by 44% since 2010; it peaked in 2011 and then gradually declined over the following decade. In 2022, the world malaria report adopted donor-reported funding as the primary international funding source for some donors in the region, rather than relying on country-reported donor funding, to provide a more accurate depiction of the funding landscape. Each donor contribution can originate from various channels, and there is ongoing discussion about the optimal approach for incorporating both reporting sources. In 2022, funding remained relatively unchanged compared with 2021, with most funding (73%) stemming from domestic sources. Total funding per person at risk ranged from US\$ 0.14 in Ecuador to US\$ 29.32 in Suriname.

Annex 3 – C. WHO Eastern Mediterranean Region

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 546 million

Parasites: *P. falciparum* and mixed (57%), *P. vivax* (42%) and other (<1%)

Vectors: *An. arabiensis*, *An. culicifacies* s.l., *An. d'thali*, *An. fluviatilis* s.l., *An. funestus* s.s., *An. gambiae* s.s., *An. hyrcanus*, *An. maculipennis* s.l., *An. pulcherrimus*, *An. rhodesiensis*, *An. sacharovi*, *An. sergentii*, *An. stephensi* and *An. superpictus* s.l.

FUNDING (US\$), 2010–2022

146.7 million (2010), 180.7 million (2015), 119.5 million (2022); 2010–2022: 19% decrease

Proportion of domestic source^a in 2022: 49%

Regional funding mechanism: annual disbursements to Yemen from the malaria component of the Global Fund MER Initiative were unavailable, and the World Bank funding through the International Development Association for 2020–2022 could not be confirmed; therefore, these grants were not included as a source of funding

^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Number of people protected by IRS:^a 6.1 million (2010), 5.1 million (2015), 1.9 million (2022)

Total LLINs distributed:^a 3.0 million (2010), 6.0 million (2015), 31.1 million (2022)

Number of RDTs distributed:^c 2.0 million (2010), 6.1 million (2015), 9.2 million (2022)

Number of ACT courses distributed:^{c,d} 2.6 million (2010), 3.2 million (2015), 7.3 million (2022)

Number of any first-line antimalarial treatment courses (incl. ACT) distributed:^{c,d} 2.6 million (2010), 4.0 million (2015), 8.0 million (2022)

^a No data reported for Pakistan and Somalia in 2022; ^b Includes PBO nets, G2 nets and Royal Guard nets in 2022; ^c No data reported for Somalia in 2022; ^d No data reported for Afghanistan, Djibouti and Pakistan in 2010.

REPORTED CASES AND DEATHS,^a 2010–2022

Total (presumed and confirmed) cases: 6.4 million (2010), 5.4 million (2015), 6.0 million (2022)

Confirmed cases: 1.2 million (2010), 1.0 million (2015), 3.5 million (2022)

Percentage of total cases confirmed: 18.3% (2010), 18.8% (2015), 58.8% (2022)

Deaths: 1145 (2010), 1016 (2015), 1902 (2022)

^a Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS,^a 2010–2022

Cases: 4.5 million (2010), 4.3 million (2015), 8.3 million (2022); 2010–2022: 85% increase

Deaths: 8620 (2010), 8200 (2015), 15 900 (2022); 2010–2022: 84% increase

^a Estimates for global trend analysis. Country-level subnational analysis is ongoing for decision-making for strategy development for countries and the region.

ACCELERATION TO ELIMINATION

Countries with nationwide elimination programme: the Islamic Republic of Iran and Saudi Arabia

Zero indigenous cases for 2 consecutive years (2021–2022): Saudi Arabia

Countries part of the E-2025 initiative: the Islamic Republic of Iran and Saudi Arabia

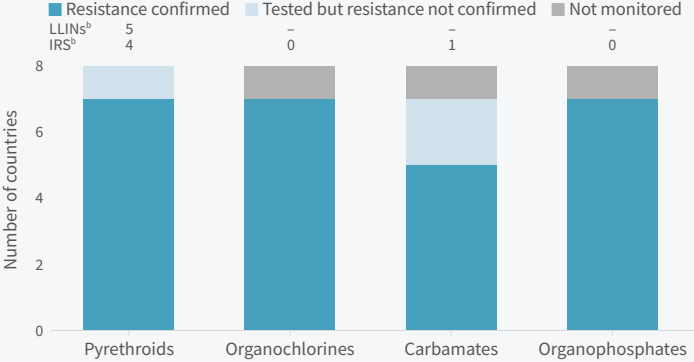
Certified as malaria free since 2010: Morocco (2010)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH P. FALCIPARUM MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2020	18	0.0	0.0	7.9	0.0	2.4
AS+SP	2015–2017	7	0.0	0.0	16.4	0.0	12.3
DHA-PPQ	2015–2020	11	0.0	0.0	2.5	0.0	1.0

AL: artemether-lumefantrine; AS+SP: artesunate+sulfadoxine-pyrimethamine; DHA-PPQ: dihydroartemisinin-piperaquine.

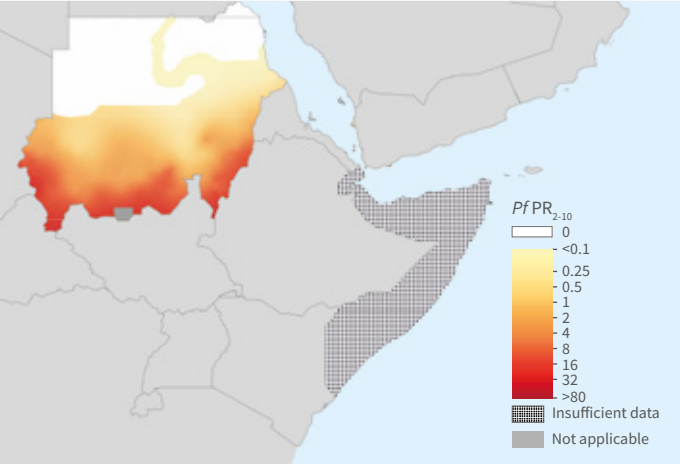
STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)



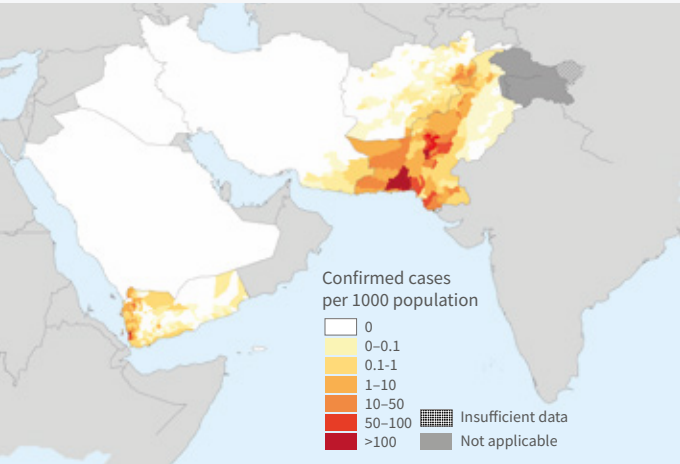
^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.

^b Number of countries that reported using the insecticide class for malaria vector control (2020).

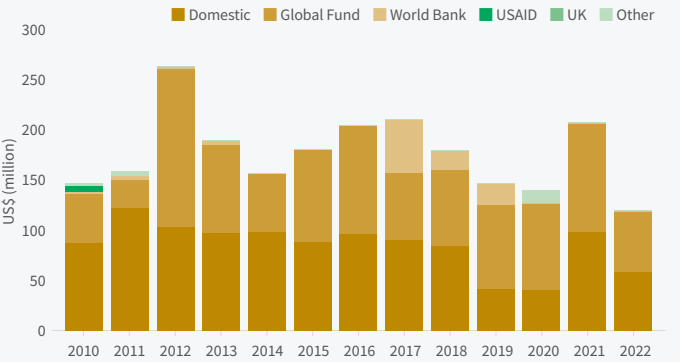
A. P. falciparum parasite rate (PfPR) and confirmed malaria cases per 1000 population, 2022



Note: Prevalence estimates from the 2018 Malaria Programme Review: courtesy of R. Snow.



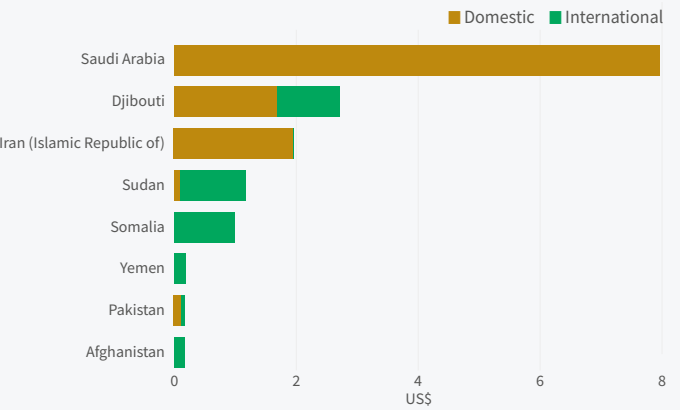
B. Malaria funding^a by source, 2010–2022



Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.

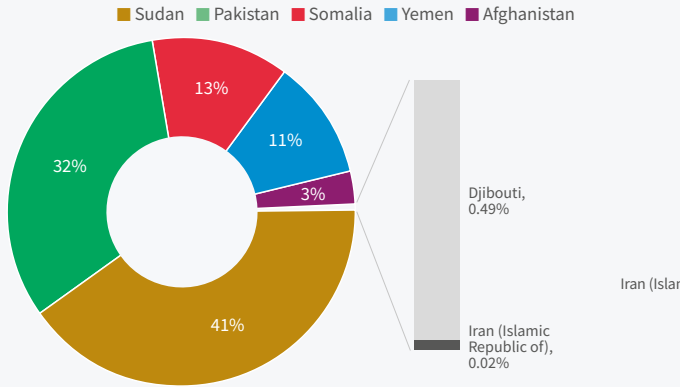
^a Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Afghanistan and Yemen in 2022.

C. Malaria funding^a per person at risk, average 2020–2022



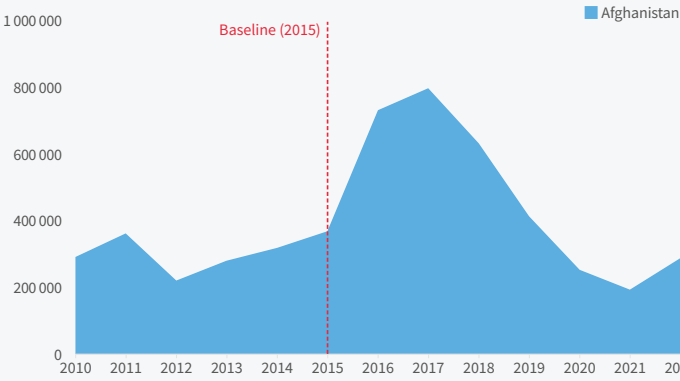
^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding; no domestic funding data were reported for Afghanistan and Yemen in 2022.

D. Share of estimated malaria cases, 2022

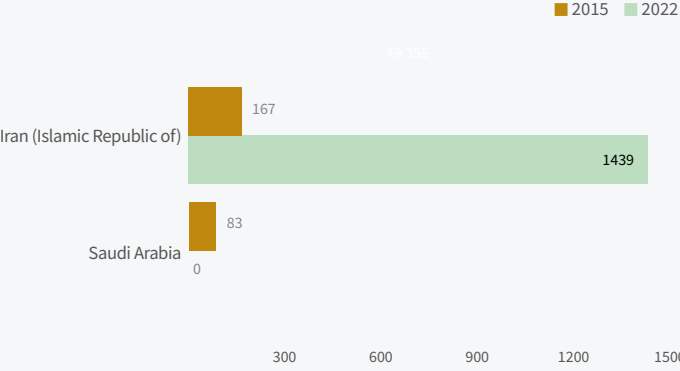


Note: Saudi Arabia has had zero indigenous cases since 2021.

F. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015



H. Reported indigenous cases in countries with national elimination activities, 2015 versus 2022



Note: In 2022, the Islamic Republic of Iran reported 1439 locally acquired cases, including indigenous cases.

KEY MESSAGES

Fourteen countries in the WHO Eastern Mediterranean Region are free of indigenous malaria and are at the stage of preventing re-establishment of local transmission. There are six high malaria burden countries in the region, and *P. falciparum* is responsible for 57% of all detected infections. Saudi Arabia reported zero indigenous cases in 2021 and 2022. This country is undertaking continued vigilance for malaria in its general health services and providing diagnosis and treatment free of charge for all imported cases.

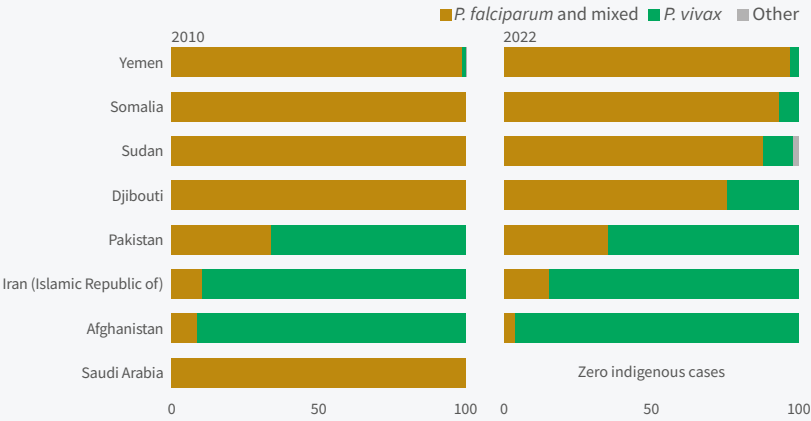
Estimated malaria incidence in the region increased by 65% between 2015 and 2021; this was followed by a substantial increase (of 31%) in 2022. The increase in cases and deaths observed in the region between 2021 and 2022 was largely due to the malaria outbreak resulting from the catastrophic floods in Pakistan, which led to an additional 2.1 million cases and 2589 deaths. This shifted the geographical distribution of cases and deaths in the region towards Pakistan between 2021 and 2022. In 2021, 88% of cases in the region were observed in three countries: Sudan (54%), Somalia (18%) and Yemen (16%). In 2022, the three countries with 85% of observed cases were Sudan (41%), Pakistan (32%) and Somalia (13%).

In 2022, the Islamic Republic of Iran reported 1439 locally transmitted cases, including indigenous cases, after reporting zero indigenous cases for the 4 consecutive years between 2018 and 2021. A major contributing factor to this increase was the upsurge in cases in neighbouring Pakistan, particularly along the border, which people cross frequently. In addition, malaria control efforts and resources were diverted because of flash flooding and the emergence and spread of *Aedes aegypti*, and sanctions led to the country experiencing insufficient funding and difficulties in procuring essential malaria commodities. These factors increased the likelihood of transmission and disrupted malaria elimination efforts.

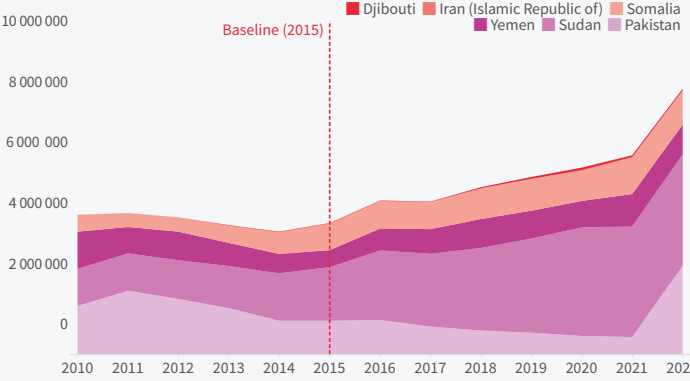
Based on the estimates from reported figures, Afghanistan reduced incidence by more than 55% compared with the 2015 baseline. Djibouti, Pakistan, Somalia, Sudan and Yemen are not on track to meet the GTS targets for 2025 (i.e. 75% reduction in incidence and mortality), with increases in malaria case incidence of 25% or more. These estimates need to be verified with ongoing subnational-level burden estimates, particularly in Somalia and Sudan, given the presence of factors affecting data quality and completeness. The Islamic Republic of Iran reported zero malaria deaths in 2022, despite malaria elimination challenges resulting in the country not being on track to meet the malaria incidence reduction target.

The region is also facing biological threats to malaria interventions. Among the eight malaria endemic countries, four (Afghanistan, Saudi Arabia, Sudan and Yemen) conducted insecticide

E. Percentage of Plasmodium species from indigenous cases, 2010 and 2022



G. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2022



Annex 3 – D. WHO South-East Asia Region

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 1.7 billion

Parasites: *P. falciparum* and mixed (49%), *P. vivax* (51%) and other (<1%)

Vectors: *An. albimanus*, *An. annularis*, *An. balabacensis*, *An. barbirostris*, *An. culicifacies* s.l., *An. dirus* s.l., *An. farauti* s.l., *An. fluviatilis*, *An. lesteri*, *An. maculatus* s.l., *An. minimus* s.l., *An. peditaeniatus*, *An. philippinensis*, *An. pseudowillmori*, *An. punctulatus* s.l., *An. sinensis* s.l., *An. stephensi* s.l., *An. subpictus* s.l., *An. sundaicus* s.l., *An. tessellatus*, *An. vagus*, *An. varuna* and *An. yatsushiroensis*

FUNDING (US\$), 2010–2022

291.8 million (2010), 228.7 million (2015), 178.6 million (2022); 2010–2022: 39% decrease

Proportion of domestic source^a in 2022: 64%

Regional funding mechanisms: Mekong Malaria Elimination (MME) programme in the Greater Mekong subregion: Myanmar and Thailand

^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Number of people protected by IRS^a: 57.0 million (2010), 44.0 million (2015), 12.5 million (2022)

Total LLINs distributed:^{a,b} 8.1 million (2010), 14.5 million (2015), 5.3 million (2022)

Number of RDTs distributed: 11.4 million (2010), 23.5 million (2015), 12.1 million (2022)

Number of ACT courses distributed:^a 3.5 million (2010), 2.8 million (2015), 4.1 million (2022)

Number of any first-line antimalarial treatment courses (incl. ACT) distributed: 2.9 million (2010), 2.9 million (2015), 4.2 million (2022)

^a Data for the Democratic People's Republic of Korea were not available for 2022; ^b Includes PBO nets, G2 nets and Royal Guards nets in 2022.

REPORTED CASES AND DEATHS,^a 2010–2022

Total (presumed and confirmed) cases:^b 3.1 million (2010), 1.7 million (2015), 809 000 (2022)

Confirmed cases: 2.6 million (2010), 1.6 million (2015), 809 000 (2022)

Percentage of total cases confirmed: 85.6% (2010), 98.9% (2015), 100% (2022)

Indigenous cases: 2 640 900 (2010), 1 633 555 (2015), 804 169 (2022)

Imported cases: 0 (2010), 10 610 (2015), 4292 (2022)

Deaths:^c 2421 (2010), 620 (2015), 190 (2022)

^a Includes malaria endemic countries only; ^b Includes *P. knowlesi* cases; ^c Includes *P. knowlesi* deaths.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 23.9 million (2010), 13.3 million (2015), 5.2 million (2022); 2010–2022: 78% decrease

Deaths: 38 000 (2010), 24 000 (2015), 8100 (2022); 2010–2022: 79% decrease

ACCELERATION TO ELIMINATION

Countries with subnational/territorial elimination programme: Bangladesh, India, Indonesia and Myanmar

Countries with nationwide elimination programme: Bhutan, the Democratic People's Republic of Korea, Nepal, Thailand and Timor-Leste

Zero indigenous cases for 2 consecutive years (2021–2022): Timor-Leste

Zero indigenous cases in 2022: Bhutan

Countries part of the E-2025 initiative: Bhutan, the Democratic People's Republic of Korea, Nepal, Thailand and Timor-Leste

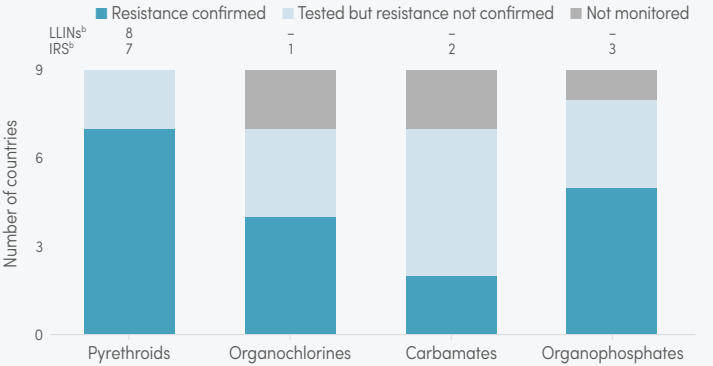
Certified as malaria free since 2010: Maldives (2015) and Sri Lanka (2016)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH P. FALCIPARUM MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2020	36	0.0	0.0	3.8	0.0	1.9
AS+SP	2015–2017	14	0.0	0.0	5.6	0.0	1.5
DHA-PPQ	2015–2020	12	0.0	0.0	3.9	0.0	2.0

AL: artemether-lumefantrine; AS+SP: artesunate+sulfadoxine-pyrimethamine; DHA-PPQ: dihydroartemisinin-piperaquine.

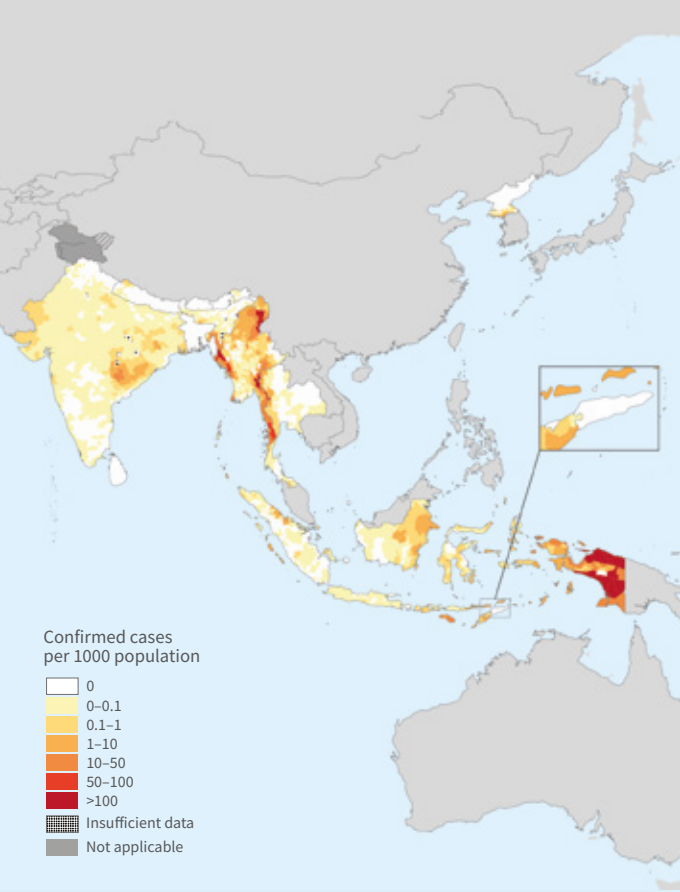
STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)



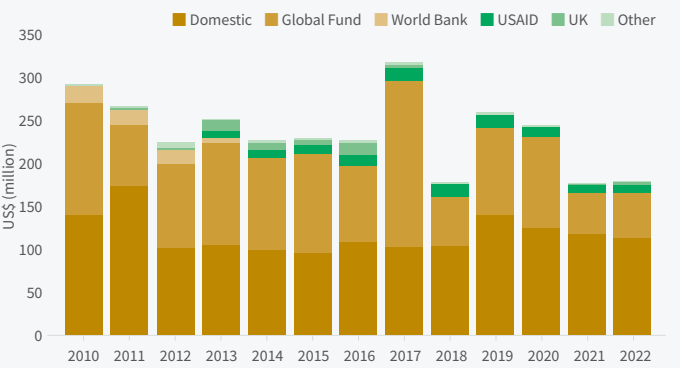
^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.

^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2022



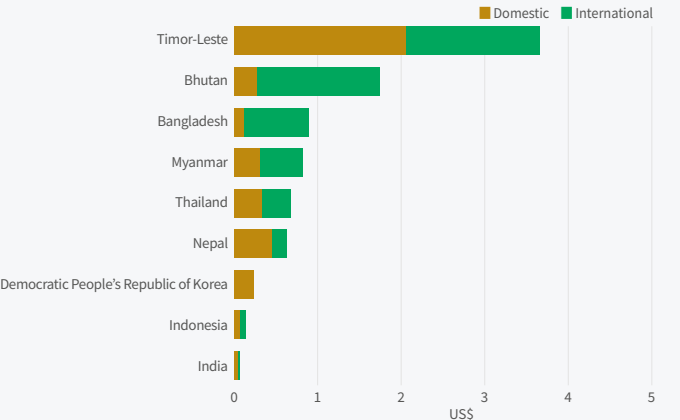
B. Malaria funding^a by source, 2010–2022



Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.

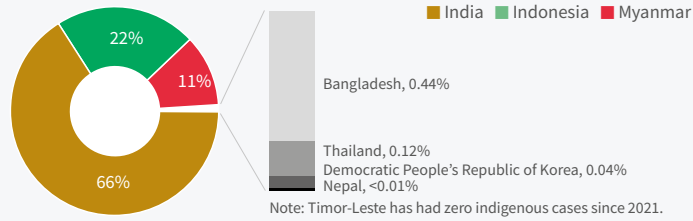
^a Excludes patient service delivery costs and out-of-pocket expenditure.

C. Malaria funding^a per person at risk, average 2020–2022

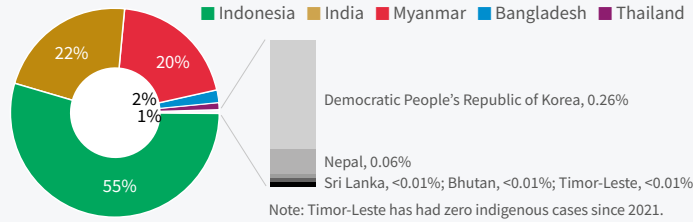


^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

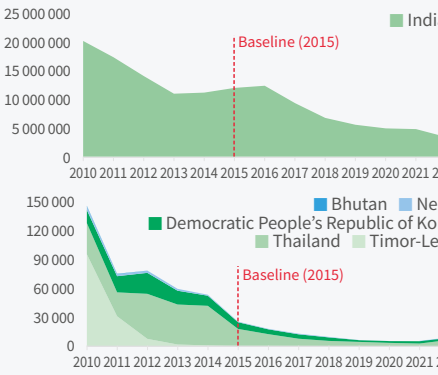
Da. Share of estimated malaria cases, 2022



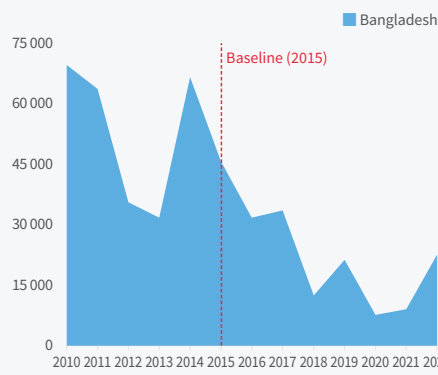
Db. Share of reported confirmed cases, 2022



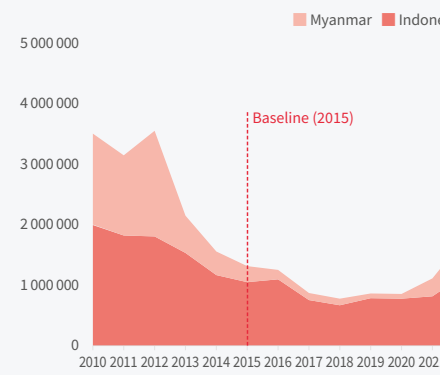
F. Estimated number of cases in countries that reduced case incidence by ≥55% in 2022 compared with 2015



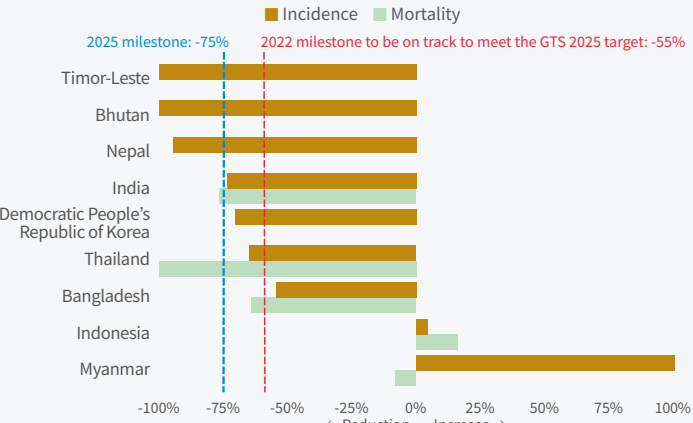
G. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015



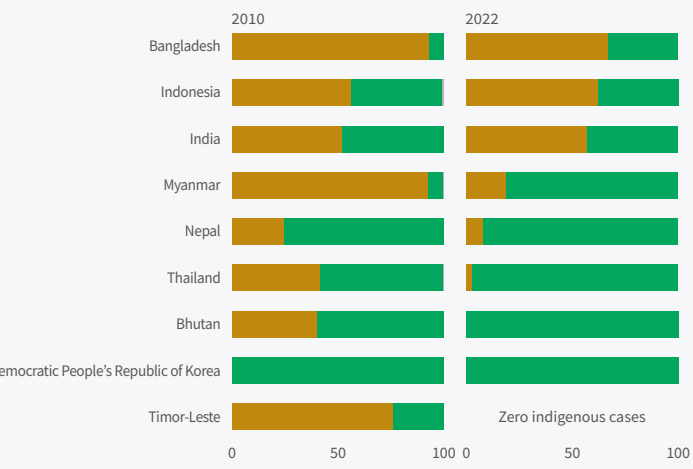
H. Estimated number of cases in countries with an increase in case incidence, 2015–2022



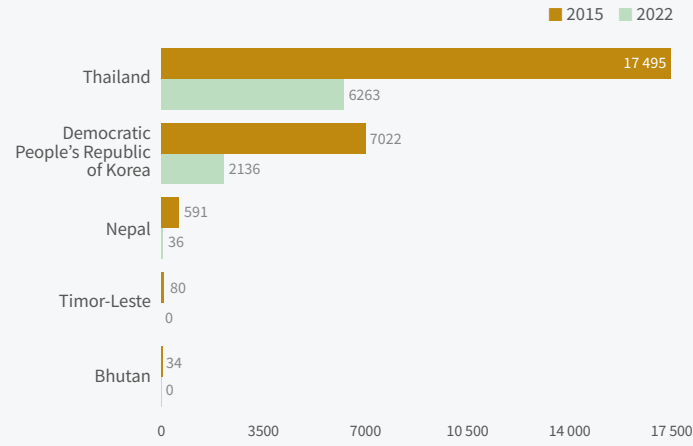
I. Change in estimated malaria incidence and mortality rates, 2015–2022



E. Percentage of Plasmodium species from indigenous cases, 2010 and 2022



J. Reported indigenous cases in countries with national elimination activities, 2015 versus 2022



KEY MESSAGES

Malaria is endemic in nine of the WHO South-East Asia Region's 11 countries, accounting for 33% of the estimated burden of malaria outside the African Region. In 2022, the region had 5.2 million estimated cases and 8053 estimated deaths – reductions of 78% and 79%, respectively, compared with 2010; these reductions represented the largest decline among all WHO regions. All countries except Bangladesh, Indonesia and Myanmar are on track to meet the GTS target of more than 75% reduction in case incidence by 2025 compared with the 2015 baseline. In 2022, case incidence in Bangladesh was reduced by 54% compared with 2015, nearly reaching the expected reduction threshold to be considered on track to meet the GTS target. Case incidence in Indonesia and Myanmar increased by 5% and 104%, respectively.

Reported malaria deaths in the region dropped to 190 in 2022; a 92% reduction from 2421 deaths in 2010. India, Indonesia and Myanmar accounted for 44%, 37% and 11%, respectively, of the total reported deaths in the region. Most countries in the region are on track to meet the GTS 2025 target for a reduction in mortality rate of at least 75% compared with the 2015 baseline, except for Indonesia (increased by 16%) and Myanmar (reduced by only 8%). In 2022, Bhutan, the Democratic People's Republic of Korea, Nepal and Timor-Leste all reported zero indigenous deaths, and Thailand reported one death due to a *Plasmodium knowlesi* infection. The Maldives and Sri Lanka were certified malaria free in 2015 and 2016, respectively, and have maintained their malaria free status.

Three countries accounted for 99.4% of the estimated cases in the region, with India being the largest contributor (66%), followed by Indonesia (22%) and Myanmar (11%). In Myanmar between 2019 and 2022, there was an increase of more than 500 000 cases (increasing nearly sevenfold, from 78 000 to 584 000 cases) due to political and social instability in the country. Indonesia accounted for the highest proportion of reported cases in the region (55%), followed by India (22%). The gap between reported and estimated cases in India in 2022 was due to adjustments made for rates of care seeking and diagnostic testing, which in some states were affected by the disruption of services due to the coronavirus disease (COVID-19) pandemic. In this region, 51% of reported cases are due to *P. vivax*; in 2022, *P. vivax* was the dominant species (>50% of local cases) in Bhutan (100%), the Democratic People's Republic of Korea (100%), Myanmar (81%), Nepal (92%)

and Thailand (97%), whereas *P. falciparum* was the dominant species in Bangladesh (67%), India (57%) and Indonesia (62%).

Three countries in this region – Bhutan, Nepal and Timor-Leste – are part of the E-2025 initiative. Among these countries, Timor-Leste almost completed 3 consecutive years with malaria free status, reporting zero indigenous cases in 2018 and 2019, but experienced a small malaria outbreak in 2020 with the introduction of three indigenous cases. In 2021 and 2022, Timor-Leste again reported zero indigenous cases. In 2022, Bhutan reported zero indigenous cases for the first time, as the country aims for 3 years of reporting zero cases. Nepal reported 73 indigenous cases in 2020, 31 in 2021 and 36 in 2022, with most (93%) of the reported cases classified as imported. In 2022, Sri Lanka reported 37 cases, all of which were imported.

Vector resistance to pyrethroids was confirmed in 49% of sites, resistance to organochlorines in 80%, resistance to carbamates in 49% and resistance to organophosphates in 62%. Seven countries have developed their insecticide resistance monitoring and management plans.

Total funding in the region has decreased by 39% since 2010. Between 2021 and 2022, overall funding remained relatively stable, with domestic sources accounting for most (64%) of the funding. The United Kingdom of Great Britain and Northern Ireland increased funding by almost 700% compared with 2021, with all its funding directed to Myanmar. Malaria funding per person at risk ranged from US\$ 0.06 in India to US\$ 3.65 in Timor-Leste over a 3-year average. This is concerning because India is the largest contributor to the estimated cases in the region but receives the lowest amount of funding per person at risk.

Challenges include decreased funding, the continuing threat of multiple ACT failures in the countries of the Greater Mekong subregion and vector resistance to pyrethroids. In recent years, Myanmar has had setbacks, with increases in both the number of *P. falciparum* and *P. vivax* cases owing to continued political instability in the area. These setbacks have in turn had major effects on malaria elimination efforts in Thailand, which had a 158% increase in reported cases in 2022 compared with 2021.

Annex 3 – E. WHO Western Pacific Region

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 768 million
Parasites: *P. falciparum* and mixed (73%), *P. vivax* (27%) and other (<1%)
Vectors: *An. anthropophagus*, *An. balabacensis*, *An. barbirostris* s.l., *An. dirus* s.l., *An. donaldi*, *An. epiroticus*, *An. farauti* s.l., *An. flavirostris*, *An. jeyporiensis*, *An. koliensis*, *An. litoralis*, *An. maculatus* s.l., *An. mangyanus*, *An. minimus* s.l., *An. punctulatus* s.l., *An. sinensis* s.l. and *An. sundaicus* s.l.

FUNDING (US\$), 2010–2022

238.6 million (2010), 165.1 million (2015), 90.9 million (2022); 2010–2022: 62% decrease
Proportion of domestic source^a in 2022: 63%
Regional funding mechanisms: MME programme in the Greater Mekong subregion: Cambodia, China (Yunnan), the Lao People’s Democratic Republic and Viet Nam (supported by RAI3E Global Fund)
^a Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2022

Number of people protected by IRS: 2.8 million (2010), 2.1 million (2015), 1.0 million (2022)
Total LLINs distributed:^a 4.6 million (2010), 4.6 million (2015), 3.1 million (2022)
Number of RDTs distributed:^b 1.6 million (2010), 2.5 million (2015), 5.6 million (2022)

Number of ACT courses distributed:^b 591 000 (2010), 1.3 million (2015), 2.0 million (2022)
Number of any antimalarial treatment courses (incl. ACT) distributed: 963 000 (2010), 1.3 million (2015), 2.0 million (2022)
^a Includes PBO nets, G2 nets and Royal Guard nets in 2022; data were not available for the Republic of Korea and Solomon Islands in 2022; ^b Data were not available for the Republic of Korea in 2022.

REPORTED CASES AND DEATHS, ^a 2010–2022

Total (presumed and confirmed) cases:^b 1.8 million (2010), 810 000 (2015), 1.2 million (2022)
Confirmed cases:^b 308 000 (2010), 499 000 (2015), 1.0 million (2022)
Percentage of total cases confirmed: 17.3% (2010), 61.6% (2015), 86.1% (2022)
Indigenous cases: 305 898 (2010), 496 712 (2015), 1 011 931 (2022)
Imported cases: 887 (2010), 599 (2015), 512 (2022)
Introduced cases: 108 (2010), 0 (2015), 25 (2022)
Deaths:^c 912 (2010), 215 (2015), 307 (2022)
Indigenous deaths:^c 891 (2010), 215 (2015), 304 (2022)
^a Includes malaria endemic countries only; ^b Includes *P. knowlesi* cases; ^c Includes *P. knowlesi* deaths.

ESTIMATED CASES AND DEATHS, 2010–2022

Cases: 1.7 million (2010), 1.2 million (2015), 1.9 million (2022); 2010–2022: 11% increase
Deaths: 3477 (2010), 2450 (2015), 3631 (2022); 2010–2022: 4% increase

ACCELERATION TO ELIMINATION

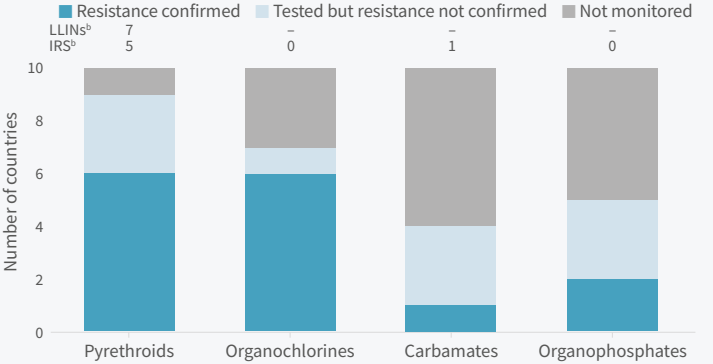
Countries with subnational/territorial elimination programme: the Philippines
Countries with nationwide elimination programme: Cambodia, the Lao People’s Democratic Republic, Malaysia, the Republic of Korea, Vanuatu and Viet Nam
Zero indigenous cases for 3 consecutive years (2020–2022): Malaysia
Countries part of the E-2025 initiative: Malaysia, the Republic of Korea and Vanuatu
Certified as malaria free since 2010: China (2021)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	75
AL	2015–2022	14	0.0	0.0	17.2	0.0	4.8
AS-MQ	2015–2020	19	0.0	0.0	1.9	0.0	0.0
AS-PY	2017–2019	8	0.0	1.7	5.1	0.0	2.5
DHA-PPQ	2015–2019	22	0.0	11.8	68.1	0.0	32.4

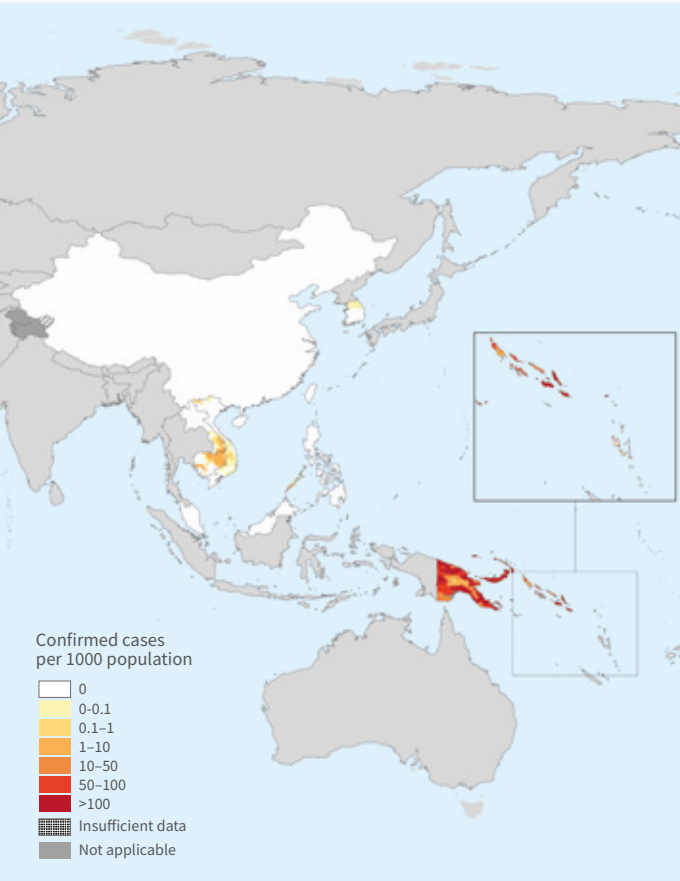
AL: artemether-lumefantrine; AS-MQ: artesunate-mefloquine; AS-PY: artesunate-pyronaridine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE^a PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

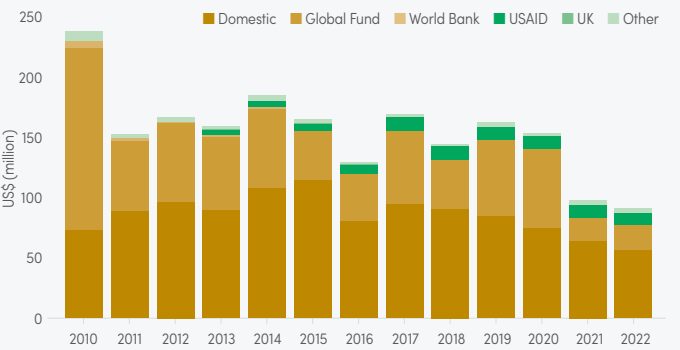


^a Resistance is considered confirmed when it is detected to one insecticide in the class, in at least one malaria vector from one collection site.
^b Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2022

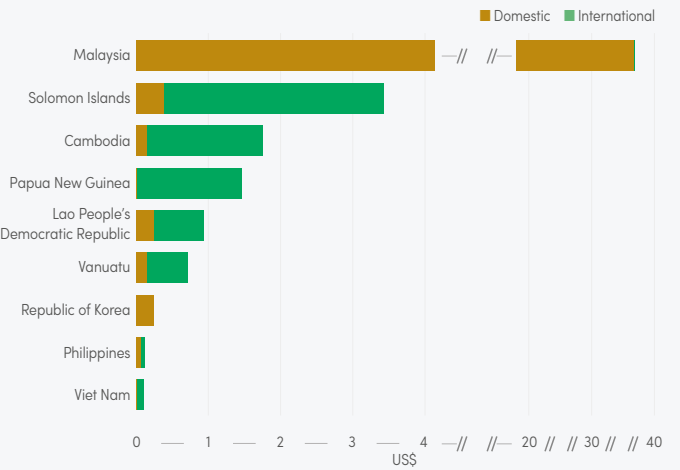


B. Malaria funding^a by source, 2010–2022



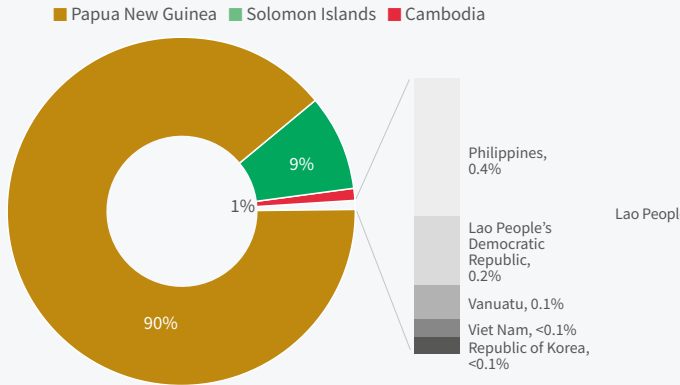
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
^a Excludes patient service delivery costs and out-of-pocket expenditure.

C. Malaria funding^a per person at risk, average 2020–2022



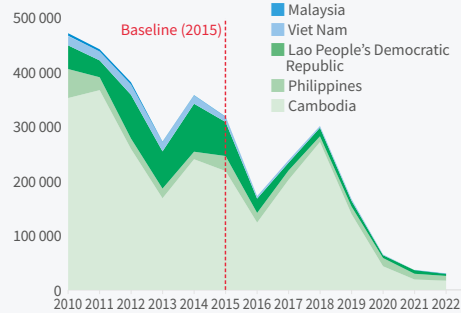
^a Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs.

D. Share of estimated malaria cases, 2022



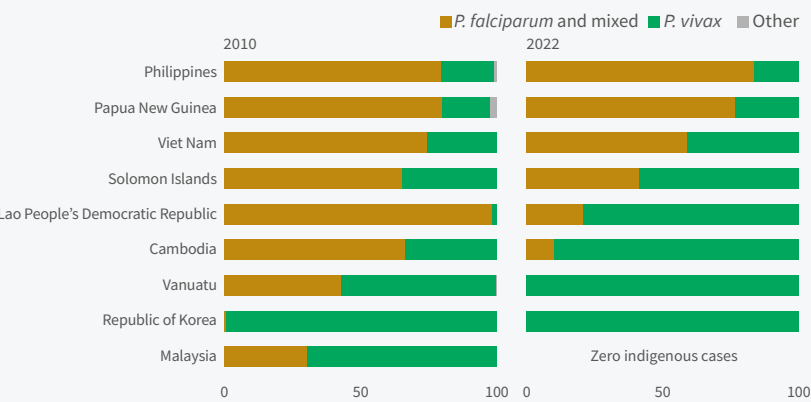
Note: Countries with zero cases: China and Malaysia.

F. Estimated number of cases in countries that reduced case incidence by ≥55% in 2022 compared with 2015

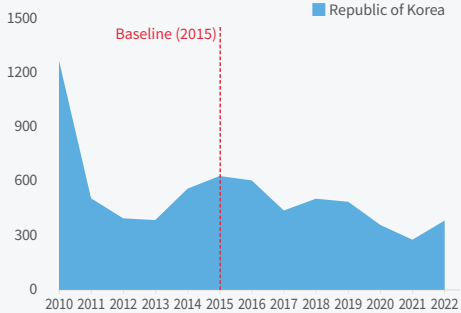


Note: China was certified malaria free in 2021.

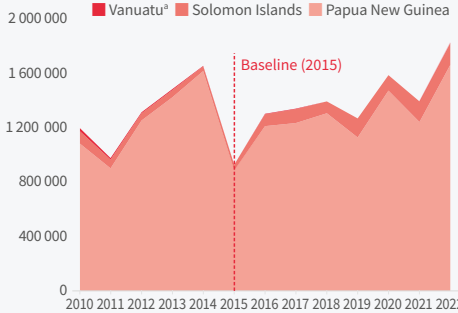
E. Percentage of *Plasmodium* species from indigenous cases, 2010 and 2022



G. Estimated number of cases in countries that reduced case incidence by <55% in 2022 compared with 2015

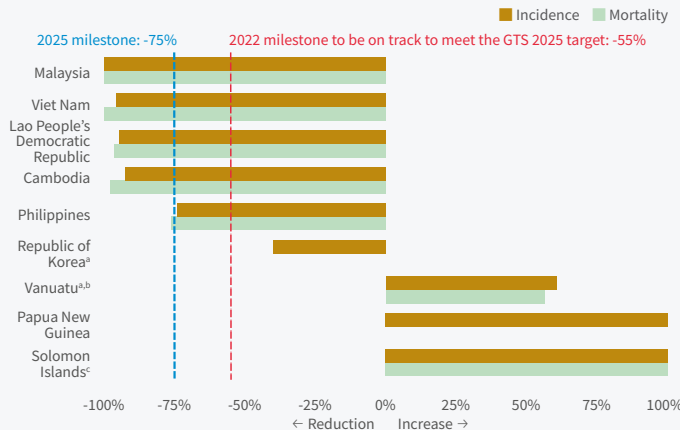


H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2022



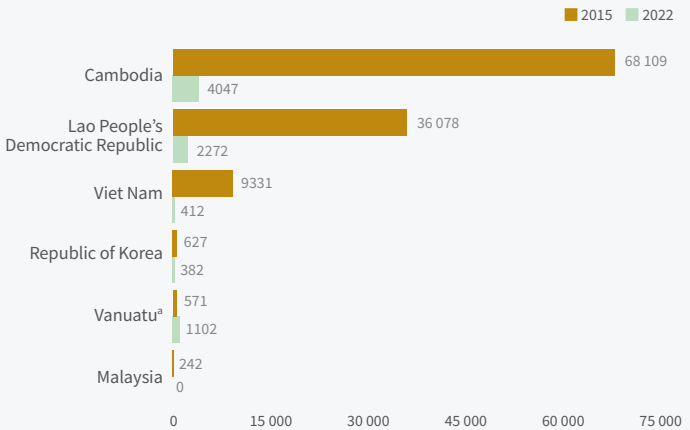
^a Malaria cases in 2015 are likely to be underestimated due to several natural disasters; this confounds assessment of progress towards the GTS 2025 target relative to a 2015 baseline.

I. Change in estimated malaria incidence and mortality rates, 2015–2022



^a There have been no estimated indigenous deaths between 2015 and 2020 in these countries; ^b Malaria cases in 2015 are likely to be underestimated; this confounds assessment of progress towards the GTS 2025 target relative to a 2015 baseline; ^c Change in estimated incidence is more than 100%.

J. Reported indigenous cases in countries with national elimination activities, 2015 versus 2022



^a Malaria cases in 2015 are likely to be underestimated; this confounds assessment of progress towards the GTS 2025 target relative to a 2015 baseline.

KEY MESSAGES

Nine countries in the WHO Western Pacific Region are at risk of malaria, which is predominantly caused by *P. falciparum* (73%), with *P. vivax* accounting for just under a third of all reported cases (27%). In 2022, the region had more than 1.9 million estimated malaria cases and 3631 estimated deaths – increases of 11% and 4%, respectively, compared with 2010. Most cases occurred in Papua New Guinea (90%), which, together with Solomon Islands (9%), comprised 99% of the estimated cases in the region. About 1 180 000 cases were reported in the public and private sectors and in the community, of which 86% were confirmed. This was a significant improvement over 2015, when only 61.6% of cases were confirmed. There were 307 indigenous malaria deaths reported in the region in 2022, and 304 deaths due to all *Plasmodium* species (including *P. knowlesi*), with most being in Papua New Guinea.

Five of the nine malaria endemic countries in the region in 2015 are on track to achieve the GTS target of a more than 75% reduction in case incidence by 2025: Cambodia, the Lao People’s Democratic Republic, Malaysia, the Philippines and Viet Nam. China was certified as malaria free in early 2021, and Malaysia reported zero indigenous cases for the fifth consecutive year in 2022. The Republic of Korea experienced a 39% reduction in malaria incidence between 2015 and 2022, which was below the reduction required for the country to be on track to meet the GTS 2025 target. Countries that have experienced an increase in estimated cases since 2015 are Papua New Guinea, Solomon Islands and Vanuatu. In 2015, Vanuatu was affected by a major cyclone that severely disrupted malaria diagnostic services and care seeking. As a result, malaria cases in 2015 are likely to be underestimated, which confounds assessment of the country’s progress towards the GTS targets relative to a 2015 baseline. All countries in the region, except Papua New Guinea, Solomon Islands and Vanuatu, reduced the malaria mortality rate by at least 55% by 2022.

Malaysia is facing increasing cases of zoonotic malaria due to *P. knowlesi*, with an increase from 1600 cases in 2015 to 2500 cases in 2022; nine deaths from *P. knowlesi* malaria were reported in 2022. The Republic of Korea continues to face the challenge of malaria transmission among military personnel along the northern border. The Philippines has continued its subnational elimination efforts, having declared 62 of its 81 provinces as malaria free, as of 2021.

In the Greater Mekong subregion (GMS), three countries – Cambodia, the Lao People’s Democratic Republic and Viet Nam – aim to eliminate *P. falciparum* by 2024, with support from a regional artemisinin-resistance initiative financed by the Global Fund, and Cambodia aims to eliminate all species of malaria parasites by 2030. The percentage of reported indigenous cases in Cambodia due to *P. falciparum* fell significantly, from 62% in 2015 to 10% in 2022, owing to intensified efforts in community outreach and active case detection.

The region is also facing biological threats to malaria interventions. TES have found high failure rates in studies of artemether-lumefantrine (AL), artesunate-amodiaquine (AS-AQ) and DHA-PPQ. *PfKelch13* wild-type parasites were found in 29.9% of samples collected between 2015 and 2020 in Cambodia, the Lao People’s Democratic Republic and Viet Nam. In Papua New Guinea, the *PfKelch13* C580Y mutation that is associated with artemisinin partial resistance has emerged and appears to be spreading. Vector resistance to pyrethroids was confirmed in 49% of tested sites, resistance to organochlorines in 63%, resistance to carbamates in 17% and resistance to organophosphates in 56%. Six malaria endemic countries have developed insecticide resistance monitoring and management plans.

Total funding in this region has decreased by 62% since 2010. In 2022, there was a 7% decrease in total funding compared with 2021, primarily attributable to a reduction in domestic funding. Nonetheless, domestic funding retained its position as the primary source of funding, accounting for 63% in 2022. Funding per person at risk ranged from US\$ 0.11 in Viet Nam to US\$ 38.26 in Malaysia over a 3-year average.

Challenges include resurgence of malaria in Solomon Islands and sustained high levels of malaria in Papua New Guinea, owing to challenges in health system strengthening to halt transmission in the highest burden provinces. Efforts are underway to improve access to services and case-based surveillance in the Pacific Island countries and to intensify community efforts to reach malaria elimination, particularly in Cambodia and the Lao People’s Democratic Republic.

WHO region Country/area	Insecticide-treated mosquito nets				Indoor residual spraying		Chemoprevention	
	ITNs/LLINs are distributed free of charge	ITNs/LLINs are distributed through ANC	ITNs/LLINs are distributed through EPI/well baby clinic	ITNs/LLINs are distributed through mass campaigns	IRS is recommended by malaria control programme	DDT is used for IRS	IPTp is used to prevent malaria during pregnancy	SMC is used
AFRICAN								
Angola	●	●	●	●	●	●	●	●
Benin	●	●	●	●	●	●	●	●
Botswana	●	●	●	●	●	●	NA	NA
Burkina Faso	●	●	●	●	●	●	●	●
Burundi	●	●	●	●	●	●	●	●
Cabo Verde	NA	●	NA	NA	●	●	NA	NA
Cameroon	●	●	●	●	●	●	●	●
Central African Republic	●	●	●	●	●	●	●	●
Chad	●	●	●	●	●	●	●	●
Comoros	●	●	●	●	●	●	●	NA
Congo	●	●	●	●	●	●	●	●
Côte d'Ivoire	●	●	●	●	●	●	●	●
Democratic Republic of the Congo	●	●	●	●	●	●	●	●
Equatorial Guinea	●	●	●	●	●	●	●	●
Eritrea	●	●	●	●	●	●	●	NA
Eswatini	●	NA	NA	●	●	●	NA	NA
Ethiopia	●	●	●	●	●	●	●	NA
Gabon ²	●	●	●	●	●	●	●	●
Gambia	●	●	●	●	●	●	●	●
Ghana	●	●	●	●	●	●	●	●
Guinea	●	●	●	●	●	●	●	●
Guinea-Bissau	●	●	●	●	●	●	●	●
Kenya	●	●	●	●	●	●	●	●
Liberia	●	●	●	●	●	●	●	●
Madagascar	●	●	●	●	●	●	●	NA
Malawi	●	●	●	●	●	●	●	●
Mali	●	●	●	●	●	●	●	●
Mauritania	●	●	●	●	●	●	●	●
Mozambique	●	●	●	●	●	●	●	●
Namibia	●	●	NA	●	●	●	NA	NA
Niger	●	●	●	●	●	●	●	●
Nigeria	●	●	●	●	●	●	●	●
Rwanda	●	●	●	●	●	●	NA	NA
Sao Tome and Principe	●	●	●	●	●	●	●	NA
Senegal	●	●	●	●	●	●	●	●
Sierra Leone	●	●	●	●	●	●	●	●
South Africa	●	●	●	●	●	●	●	NA
South Sudan ³	●	●	●	●	●	●	●	●
Togo	●	●	●	●	●	●	●	●
Uganda	●	●	●	●	●	●	●	●
United Republic of Tanzania ⁴								
Mainland	●	●	●	●	●	●	●	●
Zanzibar	●	●	●	●	●	●	NA	●
Zambia	●	●	●	●	●	●	●	●
Zimbabwe	●	●	●	●	●	●	●	NA
AMERICAS								
Bolivia (Plurinational State of)	●	●	●	●	●	●	NA	NA
Brazil ⁵	●	●	●	●	●	●	NA	NA
Colombia	●	●	●	●	●	●	NA	NA
Costa Rica	●	●	●	●	●	●	NA	NA
Dominican Republic ⁵	●	●	●	●	●	●	NA	NA
Ecuador ²	●	●	●	●	●	●	NA	NA

163

WHO region Country/area	Insecticide-treated mosquito nets				Indoor residual spraying		Chemoprevention	
	ITNs/LLINs are distributed free of charge	ITNs/LLINs are distributed through ANC	ITNs/LLINs are distributed through EPI/well baby clinic	ITNs/LLINs are distributed through mass campaigns	IRS is recommended by malaria control programme	DDT is used for IRS	IPTp is used to prevent malaria during pregnancy	SMC is used

ACT: artemisinin-based combination therapy; ANC: antenatal care; DDT: dichloro-diphenyl-trichloroethane; EPI: Expanded Programme on Immunization; G6PD: glucose-6-phosphate dehydrogenase; IM: intramuscular; IPTp: intermittent preventive treatment in pregnancy; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; *P. Plasmodium*; RDT: rapid diagnostic test; SMC: seasonal malaria chemoprevention; WHO: World Health Organization.

¹ Single dose of primaquine (0.75 mg base/kg) for countries in the WHO Region of the Americas.

² ITNs were distributed; however, the channel of distribution was not specified.

³ In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

⁴ Where national data for the United Republic of Tanzania are unavailable, refer to Mainland and Zanzibar.

⁵ ITNs were distributed; however, the distribution channel could not be specified due to the use of different operational definitions.

⁶ ITNs distributed in 2022 were those remaining from the 2021 mass campaign.

- = Policy exists and has been implemented this year.
- = Only microscopy is free.
- = Policy exists but is not implemented this year or no data exist to support implementation.
- = Only RDT is free.
- = Policy does not exist.
- = Neither microscopy nor RDT are free.
- = Policy discontinued.
- NA = Policy not applicable.
- = Both microscopy and RDT are free.
- = Question not answered and there is no information from previous years.
- = Diagnosis is free but diagnostic test was not specified.

- = Policy exists and has been implemented this year.
- = Only microscopy is free.
- = Policy exists but is not implemented this year or no data exist to support implementation.
- = Only RDT is free.
- = Policy does not exist.
- = Neither microscopy nor RDT are free.
- = Policy discontinued.
- NA = Policy not applicable.
- = Both microscopy and RDT are free.
- = Question not answered and there is no information from previous years.
- = Diagnosis is free but diagnostic test was not specified.

Annex 4 – B. Antimalarial drug policy, 2022					
WHO region Country/area	<i>P. falciparum</i>				<i>P. vivax</i>
	Uncomplicated unconfirmed	Uncomplicated confirmed	Severe	Prevention during pregnancy	Treatment
AFRICAN					
Angola	AL; AL+PQ; AL+AM	AL; AL+PQ; AL+AM	AS	SP(IPT)	AL+PQ
Benin	–	AL	AS	SP(IPT)	NA
Botswana	NA	AL+PQ	AM	NA	AL+PQ
Burkina Faso	AL	AL	AS	SP(IPT)	NA
Burundi	AL	AL	ART; AS	SP(IPT)	NA
Cabo Verde	AL	AL+PQ	QN	NA	–
Cameroon	AL; AS-PYR; DHA-PPQ; AS-AQ	AL; AS-PYR; AS-AQ; DHA-PPQ	AM; AS; QN	SP(IPT)	NA
Central African Republic	AL	AL	AS	SP(IPT)	NA
Chad	AL; AS-AQ	AL; AS-AQ	ART; AS; QN	SP(IPT)	NA
Comoros	AL	AL; AL+PQ	AS	SP(IPT)	NA
Congo	AS-AQ	AS-AQ; AL+PQ	AS	SP(IPT)	NA
Côte d’Ivoire	AL; AS-AQ	AL; AS-AQ	QN	SP(IPT)	NA
Democratic Republic of the Congo	AS-AQ	AL; AS-PYR; AS-AQ	AS; QN	SP(IPT)	NA
Equatorial Guinea	AS-AQ	AL; AS-AQ	AS	SP(IPT)	NA
Eritrea	AS-AQ	AS-AQ	AS	NA	AS-AQ
Eswatini	–	AL+PQ	AS	NA	PQ
Ethiopia	AL+PQ	AL+PQ	AS+AL+PQ	CQ	CQ+PQ
Gabon	AL; AS-AQ	AL+PQ; AS-AQ	AS	SP(IPT)	NA
Gambia	AL	AL	AS	SP(IPT)	NA
Ghana	AL; AS-AQ; DHA-PPQ	AL; AS-AQ	AM; AS; QN	SP(IPT)	AL+PQ; AS-AQ+PQ; DHA-PPQ+PQ
Guinea	AL	AL	AS-QN; AS+AL	SP(IPT)	NA
Guinea-Bissau	AL	AL	QN	SP(IPT)	NA
Kenya	AL	AL	AS	SP(IPT)	AL+PQ
Liberia	AL; AS-AQ	AL; AS-AQ	AM; AS; QN	SP(IPT)	NA
Madagascar	AS-AQ	AS-AQ	ART	SP(IPT)	AS-AQ
Malawi	AL	AL	AS	SP(IPT)	NA
Mali	AL	AL	AS	SP(IPT)	AL
Mauritania	AS-AQ	AS-AQ	AS	SP(IPT)	AS-AQ+PQ
Mayotte	–	–	–	–	–
Mozambique	AL	AS-AQ	AS	SP(IPT)	NA
Namibia	AL	AL+PQ	QN	NA	AL
Niger	AL	AL	AS; AM	SP(IPT)	NA
Nigeria	AL; AS-AQ	AL; AS-PYR; AS-AQ; DHA-PPQ	AS	SP(IPT)	NA
Rwanda	AL	AL	AS; QN	NA	ACT+PQ
Sao Tome and Principe	–	AS+MQ+PQ	AS	SP(IPT)	NA
Senegal	NA	AL; AS-AQ	AS	SP(IPT)	NA
Sierra Leone	AL	AL; AS-AQ	AM; AS; QN	SP(IPT)	NA
South Africa	AL	AL	AS; QN	–	AL
South Sudan ¹	AS-AQ	AS-AQ	AM; AS; QN	SP(IPT)	PYR
Togo	AL; AS-AQ	AL; AS-AQ	AS; AM; QN	SP(IPT)	NA
Uganda	–	AL	AS	SP(IPT)	AL+PQ
United Republic of Tanzania	–	–	–	–	–
Mainland	AL	AL	AM; AS; QN	SP(IPT)	NA
Zanzibar	NA	AS-AQ	AS	NA	PQ
Zambia	AL	AL	AS	SP(IPT)	NA
Zimbabwe	–	AL	AS	SP(IPT)	NA
AMERICAS					
Belize	–	AL+PQ	AS	NA	CQ+PQ
Bolivia (Plurinational State of)	NA	AL+PQ	AS	NA	CQ+PQ
Brazil	–	AL+PQ; AS+MQ+PQ	AS	CQ	CQ+PQ
Colombia	AL+PQ	AL; AL+PQ	AS	CQ	CQ+PQ
Costa Rica	CQ+PQ	CQ+PQ	AS	NA	CQ+PQ

Annex 4 – B. Antimalarial drug policy, 2022					
WHO region Country/area	<i>P. falciparum</i>				<i>P. vivax</i>
	Uncomplicated unconfirmed	Uncomplicated confirmed	Severe	Prevention during pregnancy	Treatment
AMERICAS					
Dominican Republic	–	CQ+PQ	AS	NA	CQ+PQ
Ecuador	NA	AL+AM	AS	NA	CQ+PQ
French Guiana	–	AL; DHA-PPQ	AS; AL+PQ; AT-PG; QN	QN	CQ+PQ
Guatemala	–	AL	AS	NA	CQ+PQ
Guyana	–	AL+PQ	AM; AS-QN; QN+CL	NA	CQ+PQ
Haiti	–	CQ+PQ	AS	NA	CQ+PQ
Honduras	NA	CQ+PQ	AS	NA	CQ+PQ
Mexico	NA	AL; AL+PQ	AL; AL+PQ; AS	NA	CQ+PQ
Nicaragua	–	CQ+PQ	AS	NA	CQ+PQ
Panama	AL+PQ	AL+PQ	AS	CQ	CQ+PQ
Peru	AS+MQ+PQ	AS+MQ+PQ	AS+PQ	NA	CQ+PQ
Suriname	–	AL+PQ	AS	NA	CQ+PQ
Venezuela (Bolivarian Republic of)	–	AL+PQ	AS	NA	CQ+PQ
EASTERN MEDITERRANEAN					
Afghanistan	CQ	AL+PQ	AM; AS; QN	NA	CQ+PQ
Djibouti	NA	AL+PQ	AS	NA	AL+PQ
Iran (Islamic Republic of)	NA	AL	AS	NA	CQ+PQ
Pakistan	CQ	ACT-AL	AS	–	CQ+PQ
Saudi Arabia	NA	AL+PQ	AS	NA	CQ+PQ
Somalia	AL	AL+PQ	AS	SP(IPT)	AL+PQ
Sudan	AL	AL	AS; QN	SP(IPT)	AL+PQ
Yemen	AL	AL	AS; QN	NA	CQ+PQ; AL+PQ
SOUTH-EAST ASIA					
Bangladesh	NA	AL+PQ	AS; AL+PQ	NA	CQ+PQ
Bhutan	AL+PQ	AL+PQ	AM; AS; QN	NA	CQ+PQ
Democratic People’s Republic of Korea	NA	NA	NA	NA	CQ+PQ
India	NA	AL+PQ; AS+SP+PQ	AM; AS; QN	NA	CQ+PQ
Indonesia	NA	DHA-PPQ	AS	NA	DHA-PPQ+PQ
Myanmar	NA	AL+PQ	ART+AL+PQ	NA	CQ+PQ
Nepal	AL	AL+PQ	AS	NA	CQ+PQ
Thailand	–	DHA-PPQ+PQ; AS-PYR+PQ	AS	NA	CQ+PQ
Timor-Leste	AL+PQ	AL+PQ	AS; QN	NA	AL+PQ
WESTERN PACIFIC					
Cambodia	AS+MQ	AS+MQ	AS, AM, QN	NA	AS+MQ+PQ
Lao People’s Democratic Republic	–	AL+PQ	AS	NA	AL+PQ
Malaysia	NA	AL	AS	NA	AL+PQ
Papua New Guinea	AL	AL	ART+AL	SP(IPT)	AL+PQ
Philippines	–	AL+PQ	AS	NA	AL+PQ
Republic of Korea	AT-PG; PYR-AS; MQ	PYR; MQ	AS; MQ; AT-PG	NA	CQ+PQ
Solomon Islands	AL+PQ	AL+PQ	AS	CQ	AL+PQ
Vanuatu	AL	AL	AS	CQ	AL+PQ
Viet Nam	AS-PYR; DHA-PPQ	DHA-PPQ	AS	NA	CQ+PQ
Data as of 24 October 2023					
ACT: artemisinin-based combination therapy; AL: artemether-lumefantrine; AM: artemether; AQ: amodiaquine; ART: artemisinin; AS: artesunate; AT: atovaquone; CL: clindamycin; CQ: chloroquine; DHA: dihydroartemisinin; IPT: intermittent preventive treatment of malaria; MQ: mefloquine; NA: not applicable; <i>P.</i> : <i>Plasmodium</i> ; PG: proguanil; PPQ: piperazine; PQ: primaquine; PYR: pyronaridine; QN: quinine; SP: sulfadoxine-pyrimethamine; WHO: World Health Organization.					
“–” refers to data not available.					
¹ In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).					

Annex 4 – C. Funding for malaria control, 2020–2022						
WHO region Country/area	Year	Contributions reported by donors				
		Global Fund¹	PMI/USAID²	World Bank³	United Kingdom⁴	Others
AFRICAN						
Algeria	2020	–	–	–	–	14
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Angola	2020	6 603 260	21 175 831	–	–	54 515
	2021	2 328 851	20 331 002	–	–	–
	2022	–288 671	19 000 000	–	–	–
Benin	2020	13 822 172	18 946 796	–	–	46 279
	2021	12 141 226	17 655 870	–	–	5 254
	2022	24 516 992	17 000 000	–	–	5 254
Botswana	2020	148 693	–	–	–	14 841
	2021	347 610	–	–	–	–
	2022	4 288	–	–	–	–
Burkina Faso	2020	43 294 285	28 977 453	1 539 447	–	40 630
	2021	66 757 381	29 426 451	–	–	402 245
	2022	103 016 907	26 000 000	–	–	402 245
Burundi	2020	23 160 859	8 916 139	–	–	36 780
	2021	34 574 830	8 025 396	–	–	–
	2022	43 024 688	11 000 000	–	–	–
Cabo Verde	2020	–	–	–	–	11 031
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Cameroon	2020	16 596 499	26 191 159	–	163 070	74 864
	2021	19 899 167	24 076 187	–	248 668	49 904
	2022	57 573 515	23 500 000	–	–	49 904
Central African Republic	2020	15 622 441	–	–	–	101 831
	2021	19 395 525	–	–	–	–
	2022	20 639 094	–	–	–	–
Chad	2020	14 678 888	–	–	–	211 026
	2021	23 264 426	–	–	–	163 408
	2022	43 209 630	–	–	–	163 408
Comoros	2020	2 147 704	–	–	–	36 068
	2021	1 256 457	–	–	–	–
	2022	2 160 399	–	–	–	–
Congo	2020	5 749 687	–	–	–	31 140
	2021	5 077 624	–	–	–	–
	2022	17 850 394	–	–	–	–
Côte d'Ivoire	2020	50 489 128	27 862 935	–	–	68 580
	2021	42 348 291	26 751 319	–	–	268 583
	2022	20 510 663	25 000 000	–	–	268 583
Democratic Republic of the Congo	2020	169 101 074	61 298 457	–	1 972 006	51 189
	2021	143 878 029	58 317 875	–	326 161	–
	2022	206 800 868	54 500 000	–	425 321	–
Equatorial Guinea	2020	0	–	–	–	41 344
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Eritrea	2020	4 975 427	–	–	–	1 585
	2021	4 210 626	–	–	–	–
	2022	6 538 112	–	–	–	–
Eswatini	2020	630 562	–	–	–	40 429
	2021	1 260 814	–	–	–	–
	2022	1 228 475	–	–	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	PMI/USAID	World Bank	Other bilaterals	WHO	UNICEF	Other contributions ⁷
2 229 715	0	0	0	0	0	0	0
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
2 671 884	–	22 000 000	–	–	–	–	–
16 518 614	–	19 000 000	–	–	–	–	–
4 707 227 ⁵	–	19 000 000	–	–	250 000	–	69 779 797
232 472	19 234 523	3 267 868	0	0	0	0	0
1 578 967	6 969 348	13 915 191	–	–	65 372	–	43 978
1 999 638	28 650 814	1 093 169	–	–	16 643	–	595 757
2 438 179	–	–	–	–	–	–	–
1 821 010	–	–	–	–	–	–	–
3 144 250	–	–	–	–	–	–	405 890
61 427 632	27 553 483	18 844 577	42 623	–	52 206	333 334	8 289 677
50 006 218	23 061 297	14 739 304	0	–	17 066	331 713	7 443 864
98 492 016	74 798 345	17 181 246	0	0	17 677	153 483	5 382 660
10 947	986 489	–	–	–	11 959	75 337	–
2 562 822	532 091	–	–	–	185 887	82 603	–
1 700 443	5 375 225	–	–	–	421 394	–	–
674 801	182 196	–	–	–	11 497	–	–
881 513	305 597	–	–	–	7 747	–	841 304
823 803	647 502	–	–	–	7 747	–	–
48 718 775	24 499 314	27 157 756	0	0	0	0	0
47 265 771	27 717 241	22 434 482	0	0	0	0	0
1 049 869	55 882 390	22 000 000	0	0	0	0	23 520
184 955	15 452 952	–	–	–	50 000	–	1 273 044
55 600	15 068	–	–	–	20 000	–	–
55 078	1 162 730	–	–	–	30 000	–	50 000
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
53 800	1 968 573	–	–	–	–	1 932	–
344 560	1 658 731	0	0	38 604	15 627	–	–
322 003	1 691 163	–	–	–	39 828	–	–
20 144 969 ⁵	12 660 948	7 200	0	0	0	0	15 000
2 261 436	–	–	–	–	–	–	–
2 323 703	–	–	–	–	–	–	–
19 415 751	33 908 462	25 000 000	–	–	–	–	–
14 897 040	22 074 036	25 000 000	0	0	8 211	5 076 318	0
17 156 396 ⁶	12 137 877	25 000 000	0	0	–	–	0
1 590 685	141 146 584	39 293 479	0	0	412 688	0	32 000 000
1 527 223	104 336 236	70 289 620	0	0	328 000	0	32 000 000
44 001 352	183 964 842	47 407 407	0	–	350 534	–	33 641 000
3 588 201 ⁶	–	–	–	–	–	–	–
3 445 046 ⁶	–	–	–	–	–	–	–
3 516 624 ⁶	–	–	–	–	–	–	–
456 910 ⁶	12 302 113	–	–	–	0	–	–
438 681 ⁶	3 133 493	–	–	–	–	–	0
447 796 ⁶	5 353 129	–	–	–	0	–	0
980 998	736 128	0	0	0	10 613	0	0
900 801	1 434 576	0	0	0	–	0	0
751 182	1 234 594	0	0	0	0	0	0

Annex 4 – C. Funding for malaria control, 2020–2022						
WHO region Country/area	Year	Contributions reported by donors				
		Global Fund ¹	PMI/USAID ²	World Bank ³	United Kingdom ⁴	Others
AFRICAN						
Ethiopia	2020	16 258 125	40 122 627	–	–	37 443
	2021	23 136 737	38 521 899	–	–	–
	2022	50 427 776	36 000 000	–	–	–
Gabon	2020	–30 226	–	–	–	27 811
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Gambia	2020	6 259 640	–	–	–	9 322
	2021	12 725 069	–	–	–	–
	2022	9 847 591	–	–	–	–
Ghana	2020	40 612 640	31 206 487	–	821 934	48 696
	2021	57 828 600	29 961 477	–	233 781	–
	2022	39 989 156	28 000 000	–	36 956	–
Guinea	2020	17 704 384	17 832 279	259 985	–	25 006
	2021	38 261 447	16 050 791	–	–	–
	2022	24 710 638	17 000 000	–	–	–
Guinea-Bissau	2020	22 407 184	–	–	–	967
	2021	2 410 409	–	–	–	–
	2022	5 208 590	–	–	–	–
Kenya	2020	18 271 373	37 336 333	–	271 505	304 805
	2021	28 871 917	35 846 767	–	124 184	710 716
	2022	15 776 452	33 500 000	–	–	710 716
Liberia	2020	10 314 435	15 603 244	–	–	94 556
	2021	21 895 302	14 980 739	–	–	58 290
	2022	8 613 584	15 000 000	–	–	58 290
Madagascar	2020	37 432 974	28 977 453	–	–	69 867
	2021	16 146 415	27 821 372	–	–	18 982
	2022	16 787 001	26 000 000	–	–	18 982
Malawi	2020	44 592 153	26 748 418	–	–	46 319
	2021	65 321 494	25 681 266	–	–	–
	2022	43 457 528	24 000 000	–	–	–
Mali	2020	30 071 310	27 862 935	2 275 334	–	617 572
	2021	10 908 873	28 356 398	1 991 150	–	3 210
	2022	25 135 491	25 000 000	1 991 150	–	3 210
Mauritania	2020	548 969	–	–	–	1 025
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Mozambique	2020	98 870 848	32 321 005	–	–	3 486
	2021	26 216 859	31 031 530	–	–	10 321
	2022	87 344 763	29 000 000	–	–	10 321
Namibia	2020	1 499 062	–	–	–	101 154
	2021	–3 350	–	–	–	–
	2022	0	–	–	–	–
Niger	2020	41 394 085	20 061 313	8 991 943	–	48 111
	2021	44 490 085	20 331 002	1 077 542	–	50 060
	2022	38 033 632	20 000 000	1 077 542	–	50 060
Nigeria	2020	113 582 567	85 817 840	5 913 802	4 671 668	10 740
	2021	126 299 731	79 183 904	41 671 077	5 099 446	–
	2022	151 181 247	73 000 000	41 671 077	65 706	–
Rwanda	2020	26 760 934	22 290 348	–	–	72 696
	2021	29 320 994	20 866 029	–	–	96 634
	2022	17 150 321	19 000 000	–	–	96 634

Contributions reported by countries							
Government (NMP)	Global Fund	PMI/USAID	World Bank	Other bilaterals	WHO	UNICEF	Other contributions ⁷
29 679 308	27 356 758	32 000 000	–	–	–	–	–
28 738 027	22 014 812	36 000 000	–	–	–	–	–
104 426 438	37 680 694	35 000 000	–	–	–	–	–
89 429 ⁶	–	–	–	–	2 000	–	6 000
336 394	0	0	0	44 064	24 141	15 195	–
776 723	59 006	0	0	–	55 748	–	35 000
1 029 015 ⁶	–	–	–	–	–	–	–
1 177 642	15 802 151	–	–	–	–	–	–
1 100 546	7 225 542	–	–	–	–	–	–
12 716 796 ⁶	60 415 856	28 000 000	0	0	300 000	0	0
12 819 920	35 593 618	28 000 000	0	0	300 000	0	0
185 673 179	31 270 091	28 000 000	0	0	300 000	0	0
4 905 824 ⁶	0	15 000 000	0	0	0	0	–
8 820 310	0	15 000 000	0	0	0	0	–
7 962 947	35 327 716	15 000 000	0	0	185 000	0	8 321 822
–	30 119 831	–	–	–	–	–	–
–	4 499 347	–	–	–	–	–	–
–	4 499 347	–	–	–	–	–	–
6 667 287 ⁵	48 427 650	35 000 000	0	0	0	0	0
5 322 008 ⁵	–	33 500 000	0	0	0	0	0
10 706 063 ⁵	31 121 864	33 500 000	0	0	0	0	0
22 133 945 ⁶	–	–	–	–	–	–	–
21 250 892 ⁶	–	–	–	–	–	–	–
21 692 419 ⁶	–	–	–	–	–	–	–
8 212	17 500 000	26 000 000	0	–	40 000	–	–
7 488	30 712 141	–	–	–	45 200	–	–
15 600 ⁵	–	–	–	–	74 600	199 800	–
313 418	162 082 558	24 000 000	0	–	0	300 000	–
139 157	16 143 765	24 000 000	0	0	0	300 000	0
326 923	8 608 483	23 000 000	0	0	0	300 000	0
7 076 968	9 401 568	25 000 000	3 682 999	–	103 223	4 356 515	5 579
6 662 190	16 113 605	25 000 000	0	0	33 766	1 588 792	0
19 962 960	2 414 325	25 000 000	680 071	0	17 132	158 581	0
1 327 986 ⁶	3 172 626	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
15 358 383	84 260 635	29 000 000	–	1 102 477	67 741	2 051 725	–
1 573 969	15 473 237	29 000 000	–	1 138 630	–	–	2 525 488
1 470 927	141 882 820	2 795 300	–	1 363 895	70 000	–	1 265 934
11 503 840	1 055 154	–	–	–	100 000	–	150 000
12 149 373	1 160 669	–	–	–	–	–	–
12 489 393	1 276 736	–	–	–	–	–	–
2 710 515	42 538 813	18 000 000	5 666 648	–	372 600	382 247	20 000
38 287 766	28 962 663	18 000 000	0	0	68 000	0	0
41 775 635	33 392 683	18 000 000	0	–	133 552	244 839	1 795 695
6 799 480 ⁶	116 796 451	70 000 000	–	–	–	–	–
6 528 208 ⁶	66 425 495	77 000 000	–	–	–	–	–
6 663 844 ⁶	120 468 411	740 000 000	–	–	–	–	–
34 390 503	29 647 540	18 000 000	–	–	–	–	–
32 687 566	22 490 626	18 000 000	–	–	–	–	–
33 539 035 ⁶	–	–	–	–	–	–	–

Annex 4 – C. Funding for malaria control, 2020–2022

WHO region Country/area	Year	Contributions reported by donors				
		Global Fund ¹	PMI/USAID ²	World Bank ³	United Kingdom ⁴	Others
AFRICAN						
Sao Tome and Principe	2020	0	0	–	–	32 119
	2021	–	0	–	–	13 559
	2022	–	0	–	–	13 559
Senegal	2020	11 698 147	25 076 642	–	–	281 903
	2021	943 823	27 286 345	–	–	58 642
	2022	–821 047	24 000 000	–	–	58 642
Sierra Leone	2020	886 008	16 717 761	–	–	37 045
	2021	2 434 083	17 120 844	–	–	–
	2022	–118 670	16 000 000	–	–	–
South Africa	2020	–	–	–	173 242	27 525
	2021	–	–	–	215 968	–
	2022	–	–	–	38 354	–
South Sudan ^a	2020	15 560 546	0	–	5 992 351	619 051
	2021	38 956 168	0	–	3 770 939	1 954 863
	2022	10 360 923	0	–	3 990 910	1 954 863
Togo	2020	18 221 092	–	–	–	2 553
	2021	16 885 154	–	–	–	–
	2022	17 713 966	–	–	–	–
Uganda	2020	95 952 639	39 008 109	–	6 441 493	38 616
	2021	63 840 992	36 381 794	–	308 463	3 210
	2022	82 122 196	34 000 000	–	–	3 210
United Republic of Tanzania	2020	97 677 823	46 809 731	–	–	1 563 560
	2021	98 361 078	44 942 216	–	–	1 139 016
	2022	93 908 762	44 000 000	–	–	1 139 016
Mainland	2020	–	–	–	–	–
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Zanzibar	2020	–	–	–	–	–
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Zambia	2020	45 656 081	33 435 522	590 122	–	422 313
	2021	38 647 166	32 101 583	–	–	–
	2022	18 531 899	30 000 000	–	–	–
Zimbabwe	2020	35 750 797	16 717 761	–	–	33 141
	2021	49 085 307	16 050 791	–	–	–
	2022	36 225 930	15 000 000	–	–	–
AMERICAS						
Belize	2020	–	–	–	–	11 873
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Bolivia (Plurinational State of)	2020	2 063 414	–	–	–	26 198
	2021	1 316 081	–	–	–	–
	2022	3 722 678	–	–	–	–
Brazil	2020	–	–	–	–	201 592
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Colombia	2020	–	–	–	–	16 699
	2021	–	–	–	–	–
	2022	–	–	–	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	PMI/USAID	World Bank	Other bilaterals	WHO	UNICEF	Other contributions ⁷
96 217	164 173	–	–	–	75 939	4 186	0
2 090 274	3 282 933	0	0	–	59 812	–	–
154 105	–	–	–	–	–	–	–
44 012 229	11 880 855	21 818 182	0	1 478 320	0	0	6 246 030
78 459 351	16 233 123	22 500 000	0	0	0	0	37 370 100
37 805 254	4 876 402	22 500 000	0	0	0	0	10 428 852
109 952 ⁶	–	15 000 000	–	–	–	–	–
105 565 ⁶	–	14 500 000	–	–	–	–	–
229 643 ⁵	6 691 624	15 000 000	–	–	10 762	500 460	–
22 079 426	624 227	0	0	0	0	0	0
23 160 798 ⁶	5 504 950	0	0	0	0	0	0
19 491 826	5 201 402	0	0	0	0	0	0
2 129 072 ⁶	8 131 978	–	–	–	–	–	–
2 044 130 ⁶	5 044 295	–	–	–	–	–	–
2 086 601 ⁶	189 768	–	–	–	–	–	–
3 100 385	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
8 117 611	76 941 854	33 000 000	0	6 014 987	–	–	–
1 554 075	67 076 251	31 000 000	–	–	–	–	–
1 452 335	69 735 582	31 000 000	–	–	–	–	–
86 167 831	–	1 034 687	–	–	–	–	10 000
86 959 305	2 569 360	1 180 198	–	–	–	–	6 883
86 712 687	–	–	–	–	–	–	–
86 080 265 ⁶	–	–	0	0	0	0	0
86 904 464	–	–	0	0	0	0	0
86 492 364 ⁶	–	–	–	–	–	–	–
87 567	0	1 034 687	0	0	0	0	10 000
54 841	2 569 360	1 180 198	0	0	0	0	6 883
220 323 ⁵	678 783	786 325	0	0	0	0	0
17 097 249	47 613 297	30 000 000	–	–	300 000	–	2 302 615
15 670 315	29 446 626	30 000 000	–	–	250 000	–	2 888 256
33 336 650	17 804 222	28 000 000	–	–	250 000	–	1 393 654
1 986 237	12 796 329	12 000 000	–	–	–	–	–
1 873 149	42 425 446	11 208 490	–	–	–	–	–
1 750 520	21 732 515	11 208 490	–	–	32 500	–	–
271 786	20 554	0	0	0	0	0	0
224 325	41 109	0	0	0	0	0	0
332 755	47 095	112 000	0	0	0	0	0
167 178	1 269 187	–	–	–	–	–	–
360 251	1 400 000	–	–	–	–	–	–
228 809	2 519 076	60 000	–	–	–	–	–
59 450 313 ⁵	–	13 000	–	–	–	–	–
43 943 480 ⁵	–	40 000	–	–	–	–	–
61 086 829 ⁵	–	150 000	–	–	–	–	–
5 938 970	0	–	0	0	–	0	1 066 811
2 178 983	–	84 662	–	–	–	–	795 345
2 187 500	0	81 000	0	0	0	0	583 702

Annex 4 – C. Funding for malaria control, 2020–2022

WHO region Country/area	Year	Contributions reported by donors				
		Global Fund ¹	PMI/USAID ²	World Bank ³	United Kingdom ⁴	Others
AMERICAS						
Costa Rica	2020	–	–	–	–	3 064 838
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Dominican Republic	2020	–	–	–	–	18 646
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Ecuador	2020	–	–	–	–	13 259
	2021	–	–	–	–	–
	2022	–	–	–	–	–
El Salvador	2020	75 507	–	–	–	15 691
	2021	–6 439	–	–	–	–
	2022	0	–	–	–	–
French Guiana	2020	–	–	–	–	–
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Guatemala	2020	3 147 594	–	–	–	25 843
	2021	1 454 733	–	–	–	–
	2022	3 218 151	–	–	–	–
Guyana	2020	332 960	–	–	–	3 938
	2021	1 508 692	–	–	–	–
	2022	873 060	–	–	–	–
Haiti	2020	8 595 330	–	–	–	24 933
	2021	7 984 314	–	–	–	–
	2022	18 273 306	–	–	–	–
Honduras	2020	2 158 283	–	–	–	30 143
	2021	683 331	–	–	–	–
	2022	717 075	–	–	–	–
Mexico	2020	–	–	–	–	54 464
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Nicaragua	2020	1 782 633	–	–	–	11 271
	2021	1 681 870	–	–	–	–
	2022	6 652 854	–	–	–	–
Panama	2020	–	–	–	–	30 092
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Peru	2020	–	–	–	–	58 038
	2021	–	–	–	–	327 246
	2022	–	–	–	–	327 246
Suriname	2020	1 018 506	–	–	–	10 951
	2021	975 225	–	–	–	–
	2022	1 001 912	–	–	–	–
Venezuela (Bolivarian Republic of)	2020	14 178 618	–	–	–	35 788
	2021	12 515 489	–	–	–	–
	2022	1 982 585	–	–	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	PMI/USAID	World Bank	Other bilaterals	WHO	UNICEF	Other contributions ⁷
223 306	0	0	0	0	56 000	0	8 000
113 860	0	83 093	14 000	0	97 200	0	0
172 594	0	110 006	0	–	5 000	–	–
1 348 174	0	0	0	0	10 440	0	232 021
984 328	0	67 380	10 000	0	25 821	0	621 664
2 814 052	0	26 000	0	0	20 614	0	144 293
1 233 796	0	40 000	0	0	31 000	–	33 000
1 233 796 ⁶	–	68 178	55 000	–	45 838	–	–
1 658 000 ⁵	–	121 205	–	–	48 171	–	20 000
4 367 293	300 000	0	0	0	0	0	0
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	0	0	0	0	–	0	0
–	0	0	0	0	16 340	0	0
–	–	–	–	–	7 275	–	–
3 531 380	2 984 711	–	1 025 373	–	11 122	–	1 025 373
3 673 647	–	–	236 937	–	–	–	236 936
3 967 212	–	62 000	1 209 104	–	103 997	–	–
681 676	421 050	28 415	0	0	0	0	0
9 448 707 ⁵	485 999	901 000	–	–	–	–	207 741
5 362 369 ⁵	266 582	331 000	–	0	–	0	198 201
–	–	131 147	0	0	75 612	–	123 742
–	3 590 047	144 000	–	–	–	–	–
–	–	248 000	–	–	–	–	–
605 531	926 108	0	0	0	45 451	0	–
581 373	1 438 564	–	–	–	10 000	–	1 903 289
789 768	873 673	111 000	0	–	–	–	–
9 041 693	0	0	0	0	0	0	0
7 988 762	0	0	–	0	20 100	0	0
6 302 199	0	0	0	0	0	0	0
7 697 789	1 607 911	–	–	–	15 235	–	444 514
8 195 684	1 722 062	–	–	–	–	–	1 474 595
8 042 095	3 521 510	–	–	–	–	–	–
6 687 187	418 786	9 058	0	0	–	0	44 949
6 672 863	198 000	20 930	0	0	99 636	0	179 472
5 449 002	175 674	27 893	28 750	0	–	0	2 752 783
16 305 118	–	51 143	–	–	–	–	–
23 252 963	–	35 661	–	–	–	–	–
3 287 671 ⁵	–	99 000	–	–	–	–	–
1 640 513	849 957	–	–	15 000	–	–	65 000
1 575 063	849 957	76 565	–	15 000	63 835	–	0
1 471 949	849 957	188 568	–	–	57 105	–	–
–	–	–	–	–	39 384	–	–
–	7 475 893	0	0	0	6 000	0	0
–	4 158 168	0	0	0	32 469	0	0

Annex 4 – C. Funding for malaria control, 2020–2022

WHO region Country/area	Year	Contributions reported by donors				
		Global Fund ¹	PMI/USAID ²	World Bank ³	United Kingdom ⁴	Others
EASTERN MEDITERRANEAN						
Afghanistan	2020	6 956 504	–	–	–	69 869
	2021	9 312 416	–	–	–	–
	2022	–605 312	–	–	–	–
Djibouti	2020	1 209 370	–	262 895	–	6 783
	2021	–	–	539 414	–	–
	2022	–	–	539 414	–	–
Iran (Islamic Republic of)	2020	0	–	–	–	45 837
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Pakistan	2020	13 289 623	–	–	–	65 168
	2021	13 354 832	–	–	–	–
	2022	12 984 126	–	–	–	–
Saudi Arabia	2020	–	–	–	–	–
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Somalia	2020	11 471 340	–	–	–	38 413
	2021	13 499 724	–	–	–	17 848
	2022	25 376 239	–	–	–	17 848
Sudan	2020	52 921 727	0	–	–	73 118
	2021	72 118 821	0	–	–	235 843
	2022	22 573 390	0	–	–	235 843
Yemen ⁹	2020	–	–	–	–	12 055 581
	2021	–	–	–	–	–
	2022	–	–	–	–	–
SOUTH-EAST ASIA						
Bangladesh	2020	15 155 863	–	–	–	255 452
	2021	6 724 656	–	–	–	–
	2022	20 178 407	–	–	–	–
Bhutan	2020	1 461 213	–	–	–	39 381
	2021	461 051	–	–	–	–
	2022	577 380	–	–	–	–
Democratic People's Republic of Korea	2020	–1 002 980	–	–	–	44 877
	2021	–	–	–	–	–
	2022	–	–	–	–	–
India	2020	19 140 164	–	–	–	295 959
	2021	26 086 463	–	–	–	–
	2022	2 406 990	–	–	–	–
Indonesia	2020	15 663 764	–	–	–	290 054
	2021	11 689 248	–	–	–	556 666
	2022	24 333 590	–	–	–	556 666
Myanmar	2020	35 614 936	11 145 174	–	395 230	424 824
	2021	–	10 700 528	–	327 468	271 564
	2022	–	10 000 000	–	2 596 753	271 564
Nepal	2020	1 808 031	–	–	–	158 593
	2021	1 275 647	–	–	–	–
	2022	1 367 187	–	–	–	–
Sri Lanka	2020	975 203	–	–	–	76 135
	2021	0	–	–	–	–
	2022	1 499 878	–	–	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	PMI/USAID	World Bank	Other bilaterals	WHO	UNICEF	Other contributions ⁷
–	11 733 984	–	–	–	19 367	–	–
–	12 150 115	–	–	–	46 378	–	–
–	6 880 085	–	–	–	1 044 643	–	–
542 821 ⁵	–	0	0	0	0	0	–
1 653 470 ⁵	1 349 614	–	0	0	153 658	0	–
2 011 389 ⁵	1 349 614	–	–	–	661 775	–	–
3 009 197	0	0	0	0	156 373	–	–
1 198 459	0	0	0	0	923 878	0	85 000
1 050 000	0	0	0	0	200 000	0	120 000
3 571 584	11 858 304	–	–	–	149 566	–	–
55 598 484	13 601 348	0	0	0	–	0	0
21 631 295	13 831 926	0	0	0	5 523 000	–	–
33 435 522	0	0	0	0	0	0	0
32 101 583	0	0	0	0	0	0	0
27 000 000	0	0	0	0	0	0	0
180 702	9 515 651	0	0	0	12 450	0	–
260 239	21 735 290	0	0	0	28 680	0	0
288 050	20 251 086	0	0	0	29 064	0	0
–	43 955 667	–	–	–	50 000	–	–
7 465 675	8 892 637	–	–	–	1 249 098	–	–
6 399 120	67 363 488	–	–	–	2 316 517	–	–
–	7 203 048	–	–	–	–	–	–
–	2 162 232	–	–	–	–	–	–
–	2 080 274	–	–	–	1 703 444	–	–
2 750 807 ⁵	15 561 791	0	0	0	44 600	0	0
2 641 061 ⁶	22 847	0	944 146	0	78 781	0	0
1 237 571	5 761 497	0	0	0	450 000	0	0
192 812	530 814	0	0	0	31 728	0	114 285
140 601	397 061	–	–	–	–	–	94 108
141 187	252 337	0	0	0	0	0	98 637
2 496 853	0	0	0	0	–	434 830	–
2 427 950	513 556	–	–	–	–	–	–
2 278 000	19 822	–	–	–	–	–	–
70 430 128	22 618 171	0	0	0	–	0	–
67 620 256 ⁶	35 570 992	–	–	–	–	–	–
69 025 192 ⁶	37 020 933	–	–	–	–	–	–
19 047 352 ⁵	21 448 055	–	–	–	100 000	234 343	12 687 804
18 287 441 ⁶	14 063 928	–	–	–	100 000	41 228	–
18 667 397 ⁶	21 137 669	–	–	–	90 778	108 653	142 991
14 877 308 ⁵	34 571 679	10 000 000	–	3 367 484	500 000	–	–
14 283 765 ⁶	19 518 115	–	–	–	500 000	–	–
14 580 537 ⁶	41 296 701	–	–	–	500 000	–	–
3 973 411	1 862 647	0	0	0	40 000	0	0
4 774 009	1 079 644	0	0	0	40 000	0	0
3 220 453	1 294 219	–	–	–	40 000	–	–
1 109 332	–	–	–	–	10 869	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–

Annex 4 – C. Funding for malaria control, 2020–2022

WHO region Country/area	Year	Contributions reported by donors				
		Global Fund ¹	PMI/USAID ²	World Bank ³	United Kingdom ⁴	Others
SOUTH-EAST ASIA						
Thailand	2020	13 850 253	–	–	–	53 448
	2021	–	–	–	–	2 640
	2022	–	–	–	–	2 640
Timor-Leste	2020	3 335 895	0	–	–	101 382
	2021	1 115 703	0	–	–	1 732
	2022	1 378 134	0	–	–	1 732
WESTERN PACIFIC						
Cambodia	2020	21 764 683	11 145 174	–	–	343 588
	2021	–	10 700 528	–	–	1 363 639
	2022	–	10 000 000	–	–	1 363 639
China	2020	–	–	–	–	–
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Lao People's Democratic Republic	2020	7 908 569	–	–	–	12 989
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Malaysia	2020	–	–	–	–	36 418
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Papua New Guinea	2020	10 585 598	–	–	–	1 067 186
	2021	14 973 712	–	–	–	1 485 392
	2022	13 823 830	–	–	–	1 485 392
Philippines	2020	4 977 478	–	–	–	17 193
	2021	1 855 744	–	–	–	420 523
	2022	3 169 143	–	–	–	420 523
Republic of Korea	2020	–	–	–	–	–
	2021	–	–	–	–	–
	2022	–	–	–	–	–
Solomon Islands	2020	577 254	–	–	–	242 293
	2021	2 171 036	–	–	–	126 839
	2022	3 177 289	–	–	–	126 839
Vanuatu	2020	–	–	–	–	283 663
	2021	–	–	–	–	123 239
	2022	–	–	–	–	123 239
Viet Nam	2020	19 786 075	–	–	–	309 566
	2021	–	–	–	–	–
	2022	–	–	–	–	–

Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; MER: Middle East Response; NGO: nongovernmental organization; NMP: national malaria programme; PMI: United States President’s Malaria Initiative; UNICEF: United Nations Children’s Fund; United Kingdom: United Kingdom of Great Britain and Northern Ireland government; USAID: United States Agency for International Development; WHO: World Health Organization.

“–” refers to not applicable or data not available.

¹ Source: Global Fund.

² Source: www.foreignassistance.gov.

³ Source: Organisation for Economic Co-operation and Development (OECD) creditor reporting system (CRS) database.

⁴ Source: Final UK aid spend.

⁵ WHO NMP funding estimates.

⁶ Budget not expenditure.

Contributions reported by countries							
Government (NMP)	Global Fund	PMI/USAID	World Bank	Other bilaterals	WHO	UNICEF	Other contributions ⁷
6 435 123	8 247 913	885 845	0	0	87 663	0	27 514
3 922 836	8 379 275	1 156 640	–	–	15 362	–	347 033
3 275 124	4 344 253	1 386 500	–	–	127 865	–	103 048
3 393 980 ⁵	–	–	–	–	60 000	–	21 340
3 258 575 ⁶	–	–	–	–	40 000	–	10 414
1 026 788	0	0	0	0	119 300	0	4 056
1 048 259	4 690 075	8 649 000	–	520 000	–	–	5 633
2 474 937	11 561 139	3 942 850	–	520 000	246 523	–	0
2 075 156	13 706 674	4 032 596	–	0	392 621	–	0
10 777 383 ⁵	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
535 860	5 157 000	903 988	0	0	–	0	551 020
1 761 198	3 718 049	859 788	0	0	711 542	0	1 278 402
676 885	5 890 875	870 860	0	0	915 902	0	2 346 764
53 769 163	0	0	0	0	0	0	0
52 187 376	0	0	0	0	0	0	0
48 146 131	0	0	0	0	0	0	0
55 726	94 632 334	–	–	–	52 000	–	–
75 439	11 996 849	–	–	–	45 000	–	–
111 000	14 146 533	–	–	–	45 000	–	9 695 115
5 460 171	5 150 000	0	0	0	0	0	0
4 699 916	3 918 641	–	–	–	–	–	–
4 560 922	2 560 992	–	–	–	–	–	–
899 128	0	0	0	0	0	0	0
910 314	0	0	0	0	0	0	0
847 392	–	–	–	–	–	–	–
124 279	121 522	–	–	578 144	23 400	–	–
296 351	1 227 347	–	–	13 600	14 025	–	–
393 093 ⁶	1 259 059	0	0	–	–	–	–
117 588	218 935	–	–	–	166 293	–	–
18 619 ⁵	329 022	0	0	0	–	0	–
11 541	468 501	0	0	0	28 890	0	0
2 160 011	9 366 317	–	–	–	–	–	858 369
1 650 036	2 418 471	–	–	–	–	–	755 652
322 580	13 435 794	–	–	–	0	–	70 434

Data as of 27 October 2023

⁷ Other contributions as reported by countries: NGOs, foundations, etc.

⁸ South Sudan became an independent state on 9 July 2011 and a Member State of WHO on 27 September 2011. South Sudan and Sudan have distinct epidemiological profiles comprising high transmission and low transmission areas, respectively. For this reason, data up to June 2011 from the Sudanese high transmission areas (10 southern states which correspond to contemporary South Sudan) and low transmission areas (15 northern states which correspond to contemporary Sudan) are reported separately.

⁹ Through Grant Cycles 5 (2019–2021 MER2) and 6 (2022–2024 MER3), the malaria component allocation of the MER initiative of the Global Fund to Yemen included US\$ 14 869 781 and US\$ 17 997 941 to the MER, respectively. Given that the yearly disbursement information associated with these grants for Yemen was not available as of 27 October 2023, this source of funding was not included in the financial analysis of this report.

Note: Negative disbursements reflect recovery of funds on behalf of the financing organization.

Note: All contributions reported by donors are displayed in constant 2022 US dollars.

Annex 4 – D. Commodities distribution and coverage, 2020–2022									
WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first- line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
AFRICAN									
Angola	2020	528 563	29.65	44 633	7 570 498	2 575 738 ^s	5 797 209	2 575 738 [†]	5 797 209
	2021	875 247	11.84	620 815	6 481 900	4 215 061	7 793 251	4 215 061	7 793 251
	2022	7 373 106	31.41	863 135	18 119 755	4 250 515 ^s	7 858 802	4 250 515 [†]	7 858 802
Benin	2020	9 637 292	68.60	1 104 928	4 202 384	3 966 505 ^s	2 095 303	3 966 505 [†]	2 095 303
	2021	662 290	66.50	927 007	2 298 798	2 985 960	2 985 960	2 985 960	2 985 960
	2022	778 924	31.28	–	3 060 466	3 395 018	3 395 018	3 060 466	3 060 466
Botswana	2020	80 525	–	152 560	–	11 205 ^s	953	11 205 [†]	953
	2021	–	–	24 620	–	6 102 ^s	519	6 102 [†]	519
	2022	–	–	–	–	1 011 ^s	86	1 011 [†]	86
Burkina Faso	2020	1 017 084	36.40	508 017	12 936 865	11 336 876 ^s	10 237 424	11 336 876 [†]	10 237 424
	2021	1 353 233	53.63	591 249	9 794 711	8 892 174	11 030 942	8 892 174	11 030 942
	2022	15 685 633	83.32	–	16 410 865	9 104 729	10 693 078	9 104 729	10 693 078
Burundi	2020	729 431	71.00	1 243 848	7 773 268	4 743 324 [*]	4 289 288	4 708 998 [†]	4 289 288
	2021	802 309	45.19	914 778	9 563 340	11 404 672	5 953 811	5 693 645	5 693 645
	2022	7 432 731	67.50	1 075 211	12 793 380	13 327 115	7 077 860	12 559 933	6 768 576
Cabo Verde	2020	–	–	233 171	4 399	10	10	10	10
	2021	–	–	241 552	4 279	21	21	21	21
	2022	–	–	102 333	6 196	27	27	27	27
Cameroon	2020	2 270 567	74.98	–	2 840 269	1 849 716 ^s	1 433 934	1 849 716 [†]	1 122 865
	2021	1 030 131	69.36	–	2 027 275	1 816 440	1 439 118	1 816 440	1 359 417
	2022	11 796 503	78.41	–	3 107 869	4 432 753	2 430 345	3 880 857	1 878 449
Central African Republic	2020	2 635 388	74.66	–	2 181 204	4 293 758 [*]	1 980 804	3 773 875 [†]	1 740 970
	2021	121 607	77.19	–	2 736 457	3 753 972	2 223 562	3 753 972	2 223 562
	2022	1 534 570	75.67	–	2 771 175	2 460 689	2 460 689	2 460 689	2 460 689
Chad	2020	9 138 032	60.12	1 707 286	2 340 650	1 806 225 [^]	1 806 225	1 452 420 [#]	1 452 420
	2021	731 254	55.98	613 037	1 788 058	1 012 958	1 012 958	1 012 958	1 012 958
	2022	450 442	21.48	1 104 986	2 073 184	1 243 864	1 243 864	1 243 864	1 243 864
Comoros	2020	462 154	73.89	57 658	–	4 546 [^]	4 546	4 546 [#]	4 546
	2021	30 891	81.06	127 487	31 467	10 547	10 547	10 547	10 547
	2022	14 660	64.91	–	120 595	11 100	11 100	11 100	11 100
Congo	2020	1 488	78.62	–	0	48 459 ^s	103 692	48 459 [†]	103 692
	2021	36 873	70.32	–	–	187 940	187 940	187 940	187 940
	2022	3 465 585	85.33	–	–	282 026	349 345	282 026	349 345
Côte d'Ivoire	2020	1 579 505	49.58	193 935	4 837 781	4 365 387	4 469 333	4 365 387	4 365 387
	2021	21 736 998	78.51	–	7 338 750	7 073 535	6 422 581	7 073 535	6 234 917
	2022	3 755 051	84.06	228 432	814 500	7 769 130	8 079 217	7 769 130	6 671 931
Democratic Republic of the Congo	2020	20 620 187	64.79	–	28 054 832	19 192 708	19 192 708	19 192 707	19 192 707
	2021	22 579 391	67.07	–	26 740 915	19 260 604	18 535 664	19 260 604	18 535 664
	2022	35 545 472	73.97	–	34 941 153	24 059 399	23 153 840	24 059 399	23 153 840
Equatorial Guinea	2020	–	40.16	–	–	–	–	–	–
	2021	–	33.58	–	–	–	–	–	–
	2022	–	28.05	152 472	–	40 476	7 496	33 075	33 075
Eritrea	2020	621 094	54.81	466 238	505 675	118 350	73 419	118 350	73 419
	2021	69 347	51.37	444 318	437 525	89 680	42 056	89 680	42 056
	2022	101 173	44.34	503 111	275 147	139 825 ^s	65 572	139 825 [†]	65 572
Eswatini	2020	–	–	53 517	104 325	279	316	270	316
	2021	–	–	67 346	52 400	484	484	474	474
	2022	8 267	–	26 540	51 725	367	367	367	367
Ethiopia	2020	6 517 480	27.23	6 349 834	7 055 575	17 135 346 [*]	1 458 804	7 258 381 [†]	1 197 131
	2021	7 897 450	19.43	6 690 048	7 004 725	7 090 882	1 144 562	5 725 330	1 126 731
	2022	8 595 938	19.76	–	7 685 700	4 870 125	2 634 520	4 870 125 [†]	2 634 520
Gabon	2020	–	13.73	–	1 250	30 819 ^s	30 819	30 819 [#]	30 819
	2021	–	13.42	–	38 093	255 700	–	103 866	103 866
	2022	14 130	13.04	–	37 481	85 741 ^s	85 741	85 741 [#]	85 741

Annex 4 – D. Commodities distribution and coverage, 2020–2022									
WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first- line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
AFRICAN									
Gambia	2020	71 469	54.60	477 032	525 505	90 603 ^s	72 300	90 603 ⁱ	72 300
	2021	262 065	54.09	423 511	773 375	151 189	72 247	151 045	72 247
	2022	1 719 337	85.37	172 010	488 650	97 592	110 988	97 592	110 988
Ghana	2020	2 957 388	64.40	2 214 552	–	7 037 451 ^s	5 174 075	7 037 451 ⁱ	5 174 075
	2021	17 845 229	75.98	2 128 109	10 663 060	5 948 832	5 728 505	5 948 832	5 728 505
	2022	3 340 175	78.76	2 232 692	10 483 525	4 898 867	5 142 790	4 898 867	5 142 790
Guinea	2020	837 395	76.69	–	3 205 353	1 982 693	1 831 203	1 982 693	1 792 653
	2021	945 879	50.28	–	3 803 960	2 446 547	2 358 447	2 446 547	2 358 447
	2022	9 498 167	74.38	–	4 161 365	2 118 957	2 118 957	2 118 957	2 118 957
Guinea-Bissau	2020	1 390 024	24.12	–	–	130 251	130 251	130 251	130 251
	2021	72 748	22.10	–	–	176 172	176 172	176 172	176 172
	2022	75 578	31.27	–	–	156 057	156 057	156 057	156 057
Kenya	2020	1 349 895	37.67	1 792 495	7 223 850	9 293 158 [*]	5 899 605	8 543 728 ⁱ	5 899 605
	2021	17 912 956	60.31	2 083 177	5 930 410	4 428 207	3 618 614	4 169 317	3 618 614
	2022	1 724 157	59.91	1 614 938	8 128 865	6 404 240	5 005 921	5 363 280	4 078 547
Liberia	2020	–	22.20	–	–	1 790 171 ^s	621 695	1 790 171 ⁱ	621 695
	2021	3 026 693	60.81	–	2 158 290	785 485	835 087	785 485	785 485
	2022	245 464	62.20	–	794 026	555 691 ^s	593 895	555 691 [#]	555 691
Madagascar	2020	398 266	47.35	981 936	1 950 471	1 667 856	1 667 856	1 667 856	1 667 856
	2021	13 569 611	54.20	885 814	4 345 213	1 918 587	1 947 787	1 918 587	1 921 755
	2022	2 308 865	72.61	990 154	4 224 253	1 612 781	1 612 781	1 612 781	1 612 781
Malawi	2020	926 690	40.94	2 379 659	16 258 123	7 957 086 ^s	7 095 977	7 957 086 ⁱ	7 095 977
	2021	9 134 777	58.92	2 407 351	13 075 023	8 433 158	6 723 831	8 433 158	6 723 831
	2022	1 206 639	61.84	2 363 146	10 711 306	5 438 760	4 257 729	5 438 760	4 257 729
Mali	2020	8 680 286	79.23	503 043	2 927 529	3 516 929	2 629 557	3 516 929	1 793 074
	2021	3 113 190	73.00	233 663	3 267 184	1 924 709	3 153 865	1 924 709	2 126 004
	2022	1 457 284	60.07	273 864	5 386 462	5 386 462	5 386 462	2 446 785	2 446 785
Mauritania	2020	1 632 858	26.16	–	–	760 ^s	760	760 [#]	760
	2021	10 029	47.15	–	0	439 943	342	20 760	342
	2022	–	11.18	–	–	–	–	–	–
Mayotte	2020	–	–	–	–	–	–	–	–
	2021	–	–	–	–	–	–	–	–
	2022	–	–	–	–	–	–	–	–
Mozambique	2020	24 534 223	72.00	6 880 851	21 425 892	17 808 682	11 132 323	17 808 682	11 132 323
	2021	1 606 570	67.92	6 484 733	24 986 825	18 756 461	9 979 416	18 756 461	9 979 416
	2022	6 978 504	55.02	5 683 813	27 978 200	17 178 580	12 281 121	17 178 580	12 281 121
Namibia	2020	–	–	1 017 366	258 145	13 636	13 636	13 636	13 636
	2021	–	–	288 039	263 202	13 738	13 738	13 738	13 738
	2022	–	–	833 498	362 797	11 849	11 849	11 849	11 849
Niger	2020	8 595 289	72.43	–	5 915 007	6 394 751	4 773 512	6 394 751	4 773 512
	2021	5 356 900	73.51	–	689 230	5 064 124	3 349 226	5 064 124	3 349 226
	2022	11 041 701	85.22	–	6 010 843	4 075 610	4 478 917	4 075 610	4 478 917
Nigeria	2020	18 142 437	52.20	–	15 593 375	17 892 696	19 902 369	17 892 696	19 902 369
	2021	19 366 570	46.75	–	40 314 426	40 314 426	22 634 148	40 314 426	22 634 148
	2022	43 876 340	51.99	–	19 102 990	19 110 886	23 704 759	19 110 886	23 704 759
Rwanda	2020	6 218 902	61.34	5 043 795	2 449 765	1 815 731	1 048 450	1 815 731	1 048 450
	2021	585 928	67.51	5 170 303	2 300 270	1 087 155	1 059 628	1 087 155	1 059 628
	2022	5 087 493	69.12	5 231 805	2 057 026	790 539	822 300	790 539	822 300
Sao Tome and Principe	2020	11 107	–	69 902	165 100	1 772 [^]	1 772	1 772 [#]	1 772
	2021	8 143	–	27 174	156 757	2 515	2 515	2 515	2 515
	2022	130 258	–	–	224 319	3 979	3 979	3 979	3 979
Senegal	2020	581 648	74.30	793 026	3 324 538	2 274 274	445 313	2 274 274	442 413
	2021	1 342 541	48.32	803 093	4 736 075	1 177 667	536 850	1 177 667	520 738
	2022	7 673 253	65.23	570 283	4 258 375	759 738	335 939	759 738	335 939

Annex 4 – D. Commodities distribution and coverage, 2020–2022									
WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first- line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
AFRICAN									
Sierra Leone	2020	4 807 339	69.42	–	429 467	1 302 117 ^s	658 948	1 302 117 [†]	658 948
	2021	452 249	71.71	629 659	–	6 706 736 ^s	3 394 004	6 706 736 [†]	3 394 004
	2022	2 402 910	56.18	652 232	5 085 629	3 530 769	3 205 820	1 711 129	3 205 820
South Africa	2020	–	–	1 830 342	435 600	16 028 ^s	20 190	16 028	16 028
	2021	–	–	1 704 233	385 700	16 853 ^s	5 889	16 853	5 889
	2022	–	–	1 621 439	392 200	28 632 ^s	7 280	28 632	7 176
South Sudan ¹	2020	4 273 644	65.76	–	280 150	220 548	822 563	195 878	822 563
	2021	1 685 771	69.87	263 856	92 482	2 736 840	1 618 709	1 634 805	1 618 709
	2022	1 083 679	57.22	–	148 887	2 090 105	2 090 105	401 196	401 196
Togo	2020	438 739	86.92	–	–	1 525 721	1 525 721	1 525 721	1 525 721
	2021	453 410	92.53	–	2 332 983	1 772 609	1 772 609	1 772 609	1 772 609
	2022	513 230	82.70	–	2 911 059	2 143 050	2 143 050	2 143 050	2 143 050
Uganda	2020	25 700 519	73.21	4 671 960	30 622 125	26 674 975 ^s	14 656 782	26 674 975 [†]	14 656 782
	2021	1 410 031	75.08	4 466 905	31 081 269	31 746 773	13 522 685	31 746 773	14 772 475
	2022	2 571 399	56.00	6 876 371	39 905 700	31 783 140	14 789 397	31 783 140	14 789 397
United Republic of Tanzania ²	2020	19 684 506	67.41	2 510 463	41 180 225	10 343 471 [*]	7 763 785	10 314 557 [†]	7 759 228
	2021	8 264 964	71.83	2 869 266	28 277 414	11 665 860 ^s	5 868 238	11 665 860 [†]	5 868 238
	2022	10 189 596	70.35	1 144 624	18 461 070	7 456 200 ^s	4 612 098	7 456 200 [†]	4 612 098
Mainland	2020	19 386 472	–	2 285 089	40 821 350	10 314 557 ^s	7 759 228	10 314 557 [†]	7 759 228
	2021	7 513 065	–	2 655 998	27 850 825	11 665 860	5 868 238	11 665 860	5 868 238
	2022	10 072 101	–	914 608	17 989 050	7 456 200	4 612 098	7 456 200	4 612 098
Zanzibar	2020	298 034	–	225 374	358 875	–	–	–	–
	2021	751 899	–	213 268	426 589	–	6 350	–	–
	2022	117 495	–	230 016	472 020	28 914	4 557	–	–
Zambia	2020	6 179 374	52.36	11 157 421	28 988 900	7 473 255	7 473 255	7 473 255	7 473 255
	2021	821 850	50.88	10 744 047	37 006 526	19 431 927	7 159 243	19 431 927	7 159 243
	2022	916 872	27.20	8 800 546	41 192 375	20 919 990	5 899 632	20 919 990	5 899 632
Zimbabwe	2020	727 377	45.53	3 528 051	2 932 248	443 164 ^s	443 164	443 164 [#]	443 164
	2021	1 227 112	45.34	3 113 471	2 289 531	133 926	–	133 926	–
	2022	3 068 781	56.18	3 048 913	1 761 655	138 899	137 260	138 899	137 260
AMERICAS									
Belize	2020	0	–	45 100	10 000	54	0	0	0
	2021	10 205	–	42 901	15 000	54	0	0	0
	2022	0	–	51 702	15 000	54	0	0	0
Bolivia (Plurinational State of)	2020	91 700	–	29 228	–	12 093	12 093	12 093	12 093
	2021	23 500	–	–	–	9 959	9 959	9 959	9 959
	2022	129 000	–	179 128	15 288	10 362	10 320	622	646
Brazil	2020	173 850	–	148 897	148 200	172 047	172 047	23 691 [#]	23 691
	2021	144 250	–	202 715	154 050	148 240	137 289	34 952 [#]	34 952
	2022	38 144	–	246 745	253 100	131 253 [^]	131 253	106 460	43 072
Colombia	2020	78 313	–	242 748	153 867	81 368	39 879	39 879	39 879
	2021	208 296	–	245 984	95 867	73 974	36 531	36 531	36 531
	2022	–	–	–	125 000	78 295	78 295	62 321	62 321
Costa Rica	2020	–	–	6 895	5 175	141 [^]	141	–	–
	2021	3 300	–	27 756	–	504 [^]	504	12 [#]	12
	2022	–	–	16 557	–	444	444	13	13
Dominican Republic	2020	11 500	–	37 821	7 570	829 [^]	829	1 [#]	1
	2021	28 500	–	107 375	26 839	291	291	3 [#]	3
	2022	22 471	–	20 201	28 243	992	337	57	7
Ecuador	2020	4 983	–	17 276	41 968	–	2 001	–	243
	2021	43 159	–	1 435 556	54 450	5 380	2 450	1 493	499
	2022	26 126	–	168 165	92 801	6 950	–	1 483	–

Annex 4 – D. Commodities distribution and coverage, 2020–2022									
WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first- line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
AMERICAS									
French Guiana	2020	–	–	–	–	–	–	–	–
	2021	–	–	–	–	–	–	–	–
	2022	–	–	–	–	–	–	–	–
Guatemala	2020	197 944	–	13 386	16 000	1 058	1 058	–	–
	2021	381 291	–	12 401	161 675	1 265	1 265	–	–
	2022	180 156	–	–	73 000	1 831	1 831	32	32
Guyana	2020	1 816	–	–	22 175	32 958	32 958	13 980	13 980
	2021	95 058	–	–	26 622	36 844	36 844	14 010	14 010
	2022	–	–	–	42 025	38 076	21 738	11 847	8 015
Haiti	2020	971 530	–	–	226 374	21 856	21 856	–	–
	2021	19 159	–	–	180 751	9 513	9 513	–	–
	2022	23 275	–	–	206 960	12 396	12 396	–	–
Honduras	2020	20 255	–	181 715	10 350	913	–	12	–
	2021	18 863	–	124 554	14 605	1 657	–	12	–
	2022	70 165	–	101 386	46 758	4 719	3 580	14	0
Mexico	2020	13 301	–	72 759	–	368	369	0	0
	2021	17 673	–	142 618	4 500	275	275	0	0
	2022	4 447	–	29 018	4 600	245	245	0	0
Nicaragua	2020	61 520	–	226 731	–	25 530 [^]	25 530	702 [#]	702
	2021	61 766	–	237 663	–	23 323 [^]	23 323	1 521	–
	2022	188 294	–	309 674	–	16 108	16 108	1 231	–
Panama	2020	–	–	12 492	2 500	1 538	1 582	5	5
	2021	–	–	20 719	40 000	3 539	3 539	0	0
	2022	–	–	6 297	38 500	12 386	6 064	83	83
Peru	2020	93 067	–	–	–	34 721	34 721	3 198 [#]	3 198
	2021	20 267	–	–	–	18 140	18 140	3 595 [#]	3 595
	2022	–	–	–	–	360 373	26 652	4 170 [#]	4 170
Suriname	2020	6 864	–	–	17 250	236 [^]	236	127 [#]	127
	2021	10 059	–	–	14 625	76 [^]	76	8 [#]	8
	2022	17 877	–	–	5 175	61 [^]	61	7 [#]	7
Venezuela (Bolivarian Republic of)	2020	73 605	–	–	115 417	231 384	231 384	48 292	48 292
	2021	36 362	–	–	257 626	194 057	194 057	32 582	32 582
	2022	251 337	–	–	270 082	151 458	151 458	22 059	22 059
EASTERN MEDITERRANEAN									
Afghanistan	2020	3 140 845	–	–	337 840	153 403 ^s	103 466	153 403 [†]	100 136
	2021	195 273	–	–	468 330	11 681 ^s	84 873	11 681	82 141
	2022	2 131 863	–	–	377 150	9 517 ^s	124 429	9 517	120 424
Djibouti	2020	145 392	39.16	28 496	268 147	215 507 ^s	69 029	215 507 [†]	69 029
	2021	19 984	20.43	116 961	100 000	76 380	56 081	76 380	56 081
	2022	247 839	10.37	67 077	163 843	53 163 ^s	39 034	53 163 [†]	39 034
Iran (Islamic Republic of)	2020	10 543	–	73 846	53 371	6 491 ^s	1 051	6 491 [†]	126
	2021	8 135	–	47 762	25 025	2 856	999	2 856	151
	2022	4 514	–	117 347	39 223	24 648	5 677	24 648	1 335
Pakistan	2020	1 515 426	–	120 610	3 616 500	428 738	347 500	99 425	347 500
	2021	147 880	–	307 272	3 721 655	422 798	365 626	123 617	87 825
	2022	6 217 715	–	–	4 377 545	1 114 012	355 888	500 926	355 888
Saudi Arabia	2020	–	–	129 105	165 000	37 930 [*]	3 265	31 990 [†]	3 231
	2021	–	–	95 754	165 000	30 390 [*]	2 616	20 030 [†]	2 023
	2022	–	–	175 285	580 000	48 108	4 319	33 602	3 079
Somalia	2020	1 565 552	22.52	283 665	554 500	–	–	–	27 333
	2021	79 895	21.65	80 622	647 500	180 840	–	180 840	–
	2022	2 794 142	17.27	–	–	–	–	–	11 550

Annex 4 – D. Commodities distribution and coverage, 2020–2022									
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EASTERN MEDITERRANEAN									
Sudan	2020	5 003 295	70.81	3 901 092	3 520 950	7 366 648	4 733 626	7 366 648	4 733 626
	2021	791 079	64.83	3 870 477	4 490 200	6 923 194	3 993 620	6 923 194	3 993 620
	2022	18 758 082	56.00	23 307	2 759 325	6 419 778	3 819 140	6 419 778	3 819 140
Yemen	2020	1 769 759	–	762 755	–	–	–	–	–
	2021	1 769 759	–	1 499 738	–	–	–	–	–
	2022	900 955	–	1 529 755	859 825	294 729	169 373	294 729	–
SOUTH-EAST ASIA									
Bangladesh	2020	1 316 909	–	–	805 166	6 130 [^]	6 130	4 885 [#]	4 885
	2021	961 156	–	–	823 336	7 294	7 294	5 340	5 340
	2022	741 258	–	–	1 678 200	12 360	12 360	12 042	12 042
Bhutan	2020	122 670	–	122 406	42 675	293 [§]	54	293 [†]	8
	2021	13 294	–	120 166	28 345	656	23	0	5
	2022	12 702	–	118 341	1 064	–	–	–	–
Democratic People's Republic of Korea	2020	–	–	402 861	354 097	–	1 819	–	–
	2021	–	–	–	–	2 357	2 357	–	–
	2022	–	–	–	374 627	2 136	2 136	–	–
India	2020	1 698 023	–	23 950 862	20 000 000	4 447 618 [§]	186 532	4 447 618 [†]	119 087
	2021	16 197 740	–	16 159 858	–	335 062	161 753	335 062	101 566
	2022	1 259 541	–	11 565 430	5 486 970	501 339	176 522	429 665	101 070
Indonesia	2020	3 448 169	–	38 332	613 300	1 208 253 [§]	241 181	1 208 253 [†]	241 181
	2021	50 350	–	131 818	2 894 125	3 583 329	299 148	3 583 329	299 148
	2022	2 564 666	–	161 335	2 153 150	3 619 541	412 783	3 619 541	412 783
Myanmar	2020	569 016	–	17 381	2 944 555	34 132 [§]	15 572	34 132 [†]	15 572
	2021	315 874	–	1 618	–	33 157 [§]	15 127	33 157 [†]	15 127
	2022	553 019	–	21 566	1 815 650	26 416	30 573	26 416	30 573
Nepal	2020	72 561	–	41 235	202 300	8 249 [*]	430	2 180 [†]	39
	2021	134 085	–	43 500	325 075	15 647	391	9 539	92
	2022	122 581	–	415 160	287 974	24 630	512	11 580	119
Thailand	2020	102 150	–	219 162	69 912	26 766 [*]	3 341	3 910 [†]	175
	2021	130 873	–	159 097	144 925	361 459	3 254	4 505	86
	2022	50 000	–	169 676	125 750	25 146	10 140	5 646	321
Timor-Leste	2020	176 785	–	116 949	137 668	1 664 [§]	14	1 664 [†]	14
	2021	52 886	–	76 574	122 955	0	0	0	0
	2022	44 320	–	68 288	134 400	2	2	2	2
WESTERN PACIFIC									
Cambodia	2020	1 205 286	–	–	1 069 200	37 143	9 176	37 143	9 176
	2021	603 528	–	–	851 240	100 483	4 270	100 483	4 270
	2022	324 372	–	–	988 755	66 720	4 106	66 720	4 106
Lao People's Democratic Republic	2020	100 518	–	2 333	1 667 795	11 251 [*]	3 498	11 185 [†]	3 477
	2021	46 353	–	5 606	749 710	16 252	3 852	16 252	3 870
	2022	1 045 215	–	0	398 970	5 948	2 152	5 948	2 323
Malaysia	2020	123 115	–	305 688	–	2 830	2 830	2 829	2 829
	2021	119 584	–	324 018	–	3 676	3 676	3 663	3 663
	2022	89 780	–	171 867	–	2 806	2 806	2 802	2 802
Papua New Guinea	2020	1 579 301	–	200	3 139 420	1 258 396 [§]	750 439	1 258 396 [†]	750 254
	2021	1 626 031	–	–	3 398 965	1 368 984	164 757	1 488 984	164 757
	2022	1 057 089	–	–	3 567 954	1 578 510	899 510	1 578 510	899 510
Philippines	2020	329 412	–	476 804	77 645	54 372 [*]	5 987	20 830 [†]	4 890
	2021	205 704	–	497 569	262 895	3 999	3 999	3 735	3 735
	2022	392 126	–	545 352	241 880	3 150	3 150	3 150	3 150

Annex 4 – D. Commodities distribution and coverage, 2020–2022									
WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first- line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
WESTERN PACIFIC									
Republic of Korea	2020	–	–	–	–	386	385	–	–
	2021	–	–	–	–	294	294	–	–
	2022	–	–	–	–	420	420	–	–
Solomon Islands	2020	7 530	–	–	275 000	241 203	87 477	239 064 [†]	86 319
	2021	182 926	–	–	–	328 587 [§]	118 643	328 587 [†]	118 643
	2022	–	–	–	–	336 932 [§]	121 656	336 932 [†]	121 656
Vanuatu	2020	–	–	–	59 825	6 285 [*]	496	503 [†]	496
	2021	37 090	–	–	2 164	42 501	304	42 501	304
	2022	62 359	–	–	76 562	1 141	1 141	1 141	1 141
Viet Nam	2020	53 155	–	433 405	531 795	9 220 [*]	1 733	7 231 [†]	818
	2021	1 486 700	–	262 297	389 745	9 569	467	193	209
	2022	151 093	–	304 446	372 093	14 208	455	271	271
Data as of 3 October 2023									
ACT: artemisinin-based combination therapy; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; RDT: rapid diagnostic test; WHO: World Health Organization.									
“–” refers to data not available.									
¹ In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).									
² Where national data for the United Republic of Tanzania are unavailable, refer to Mainland and Zanzibar.									
[*] Any first-line courses delivered (including ACT) are calculated.									
[^] The number of malaria cases treated with any first-line treatment courses (including ACT) has been used as a proxy for any first-line treatment courses delivered (including ACT), or the country reports the number of patients treated rather than the number of treatment courses delivered.									
[§] ACT treatment courses delivered are used to replace missing data for any first-line treatment courses delivered (including ACT).									
[†] ACT treatment courses delivered are calculated.									
[#] The number of malaria cases treated with ACT has been used as a proxy for ACT treatment courses delivered, or the country reports the number of patients treated rather than the number of treatment courses delivered.									

Annex 4 – E. Household survey results, 2018–2022, a. Compiled through STATcompiler

WHO region Country	Source	% of households					% of population	
		with at least one ITN	with at least one ITN for every two persons who stayed in the household the previous night	with IRS in the past 12 months	with at least one ITN and/or IRS in the past 12 months	with at least one ITN for every two persons and/or IRS in the past 12 months	with access to an ITN	who slept under an ITN last night
AFRICAN								
Benin	2017–2018 DHS	91.5	60.5	8.7	92.0	63.8	77.2	71.1
Burkina Faso	2017–2018 MIS	75.3	41.4	–	–	–	54.5	44.1
Burkina Faso	2021 DHS	82.8	32.8	–	–	–	64.1	61.3
Cameroon	2018 DHS	73.4	40.7	–	–	–	58.5	53.9
Côte d'Ivoire	2021 DHS	72.1	51.2	–	–	–	65.0	51.8
Gambia	2019–2020 DHS	77.3	36.3	–	–	–	60.8	37.8
Ghana	2019 MIS	73.7	51.8	5.8	75.0	54.7	66.7	43.2
Guinea	2018 DHS	43.9	22.0	–	–	–	30.7	22.7
Guinea	2021 MIS	63.3	16.7	–	–	–	41.9	33.4
Kenya	2020 MIS	49.0	28.7	–	–	–	39.6	34.9
Kenya	2022 DHS	54.2	37.1	–	–	–	49.6	42.7
Liberia	2019–2020 DHS	54.7	25.2	–	–	–	39.7	39.0
Madagascar	2021 DHS	69.1	30.1	–	–	–	48.4	48.8
Mali	2018 DHS	89.8	54.8	–	–	–	75.2	72.9
Mali	2021 MIS	90.9	44.0	–	–	–	72.2	67.7
Mauritania	2019–2021 DHS	32.2	8.0	–	–	–	19.5	10.9
Mozambique	2018 MIS	82.2	51.2	–	–	–	68.5	68.4
Niger	2021 MIS	96.0	58.1	–	–	–	80.2	78.2
Nigeria	2018 DHS	60.6	29.8	–	–	–	47.5	43.2
Nigeria	2021 MIS	56.0	25.4	–	–	–	43.1	36.4
Rwanda	2019–2020 DHS	66.4	34.3	–	–	–	50.8	47.7
Senegal	2018 DHS	76.6	39.0	2.1	76.8	40.1	62.2	51.6
Senegal	2019 DHS	81.0	56.8	2.4	81.5	57.7	74.2	62.5
Senegal	2020–2021 MIS	75.3	33.8	3.3	76.3	36.1	57.8	46.4
Sierra Leone	2019 DHS	67.9	25.0	–	–	–	46.8	50.6
Uganda	2018–2019 MIS	83.0	53.9	10.1	84.2	58.7	71.5	59.2
Zambia	2018 DHS	78.3	40.9	35.3	83.3	60.4	59.9	46.4

% of ITNs	% of pregnant women		% of children <5 years				% of children <5 years with fever in the past 2 weeks			
that were used last night	who slept under an ITN	who took 3+ doses of IPTp	who slept under an ITN	with moderate or severe anaemia	with a positive RDT	with a positive microscopy blood smear	for whom advice or treatment was sought	who had blood taken from a finger or heel for testing	who took antimalarial drugs	who took an ACT among those who received any antimalarial
73.4	79.3	13.7	76.3	43.8	36.3	39.1	53.1	17.7	17.5	37.0
76.0	58.2	57.7	54.4	50.1	20.2	16.9	73.5	48.8	51.1	79.4
90.7	71.0	56.8	67.4	42.8	28.0	14.0	74.9	65.0	–	48.5
76.2	61.0	31.9	59.8	31.0	24.0	–	61.0	21.4	32.7	21.2
58.4	64.2	34.6	58.5	42.0	37.3	26.0	59.1	38.4	–	38.6
55.0	44.2	52.2	44.0	20.7	0.4	–	64.2	27.3	3.5	46.7
50.1	48.7	61.0	54.1	27.9	23.0	14.1	69.0	34.1	45.9	84.5
64.0	28.1	35.7	26.6	43.8	–	–	62.3	20.5	24.8	18.2
72.0	39.4	50.3	38.2	45.5	33.7	17.4	61.1	28.0	31.4	38.0
80.2	39.8	22.0	42.0	21.3	4.4	3.0	63.6	35.5	20.2	91.0
71.4	44.9	12.5	51.2	–	–	–	69.5	33.4	–	84.0
74.7	46.5	40.3	44.3	41.6	–	–	80.9	49.0	52.1	41.2
77.3	54.9	31.0	55.6	20.2	7.5	–	44.6	19.9	15.3	54.7
88.7	83.7	28.3	79.1	56.7	18.9	–	52.8	16.4	18.7	31.0
90.6	75.9	34.4	73.4	48.7	19.4	–	60.0	23.3	31.2	14.8
42.0	11.7	10.2	11.9	54.9	1.1	–	31.4	5.8	15.3	19.0
85.4	76.4	40.6	72.7	55.2	38.9	–	68.6	47.9	32.7	98.6
81.1	90.1	25.0	85.7	49.2	28.9	–	67.0	31.9	39.2	77.0
80.6	58.0	16.6	52.2	41.1	36.2	22.6	72.8	13.8	43.5	52.0
75.1	49.6	31.0	41.2	43.1	39.6	22.3	62.8	24.3	20.3	73.9
78.0	56.1	–	55.6	15.2	2.7	0.9	62.3	40.7	8.1	92.4
74.5	55.7	22.4	56.4	–	–	–	52.8	13.8	5.1	24.0
68.2	68.1	19.6	65.4	–	–	–	50.0	15.7	1.4	–
81.4	52.5	37.7	46.5	67.3	–	–	63.0	21.7	2.7	1.7
89.5	63.8	35.7	59.1	37.9	–	–	75.4	61.3	55.9	31.9
74.3	65.4	41.0	60.3	25.0	18.2	9.8	87.0	50.7	62.5	87.7
64.2	48.9	58.7	51.6	29.5	–	–	77.2	63.0	34.9	96.9

Annex 4 – E. Household survey results, 2018–2022, a. Compiled through STATcompiler								
WHO region Country	Source	% of households					% of population	
		with at least one ITN	with at least one ITN for every two persons who stayed in the household the previous night	with IRS in the past 12 months	with at least one ITN and/or IRS in the past 12 months	with at least one ITN for every two persons and/or IRS in the past 12 months	with access to an ITN	who slept under an ITN last night
EASTERN MEDITERRANEAN								
Jordan	2017–2018 DHS	–	–	–	–	–	–	–
Pakistan	2017–2018 DHS	3.6	0.6	5.1	8.4	5.7	2.0	0.2
SOUTH-EAST ASIA								
India	2019–2021 DHS	7.9	4.0	–	–	–	5.8	3.8
Nepal	2022 DHS	–	–	–	–	–	–	–
WESTERN PACIFIC								
Papua New Guinea	2016–2018 DHS	68.5	45.2	–	–	–	57.9	46.0
ACT: artemisinin-based combination therapy; DHS: demographic and health survey; IPTp: intermittent preventive treatment in pregnancy; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; MIS: malaria indicator survey; RDT: rapid diagnostic test; WHO: World Health Organization. “–” refers to not applicable or data not available. Sources: Nationally representative household survey data from DHS and MIS, compiled through STATcompiler – https://www.statcompiler.com/ .								

% of ITNs	% of pregnant women		% of children <5 years				% of children <5 years with fever in the past 2 weeks			
that were used last night	who slept under an ITN	who took 3+ doses of IPTp	who slept under an ITN	with moderate or severe anaemia	with a positive RDT	with a positive microscopy blood smear	for whom advice or treatment was sought	who had blood taken from a finger or heel for testing	who took antimalarial drugs	who took an ACT among those who received any antimalarial
–	–	–	–	10.6	–	–	68.4	–	–	–
11.6	0.4	–	0.4	–	–	–	81.4	–	9.2	3.3
58.5	4.2	–	4.4	38.8	–	–	79.9	13.6	25.2	6.0
–	–	–	–	18.7	–	–	–	–	–	–
67.9	49.0	23.5	51.5	–	–	–	49.5	24.6	21.3	3.3
Data as of 22 September 2023										

Annex 4 - E. Household survey results, 2018–2022, b. Compiled through WHO calculations

WHO region Country	Survey	Fever prevalence	Health sector where treatment was sought							Diagnostic testing coverage in each health sector	
		Overall	Public excluding community health workers	Community health workers	Formal medical private excluding pharmacies	Pharmacies or accredited drug stores	Informal private	No treatment seeking	Trained provider	Public excluding community health workers	Community health workers
AFRICAN											
Burkina Faso	2021 DHS	22 (21, 24)	71 (68, 73)	0 (0, 0)	2 (1, 3)	0 (0, 0)	3 (2, 4)	24 (22, 27)	73 (71, 75)	85 (83, 87)	–
Cameroon	2018 DHS	16 (14, 17)	20 (17, 23)	1 (0, 1)	12 (9, 15)	12 (9, 14)	21 (18, 24)	37 (33, 41)	43 (39, 47)	52 (44, 61)	–
Côte d'Ivoire	2021 DHS	17 (16, 19)	43 (39, 46)	1 (0, 2)	4 (3, 5)	10 (8, 13)	11 (9, 13)	35 (31, 38)	56 (52, 60)	71 (67, 76)	36 (15, 65)
Gambia	2019 DHS	15 (14, 17)	45 (41, 49)	0 (0, 1)	7 (5, 10)	13 (10, 16)	1 (0, 2)	35 (31, 39)	64 (60, 68)	42 (37, 48)	–
Ghana	2019 MIS	30 (27, 33)	34 (30, 38)	0 (0, 1)	20 (17, 24)	14 (10, 18)	3 (1, 5)	30 (26, 35)	67 (63, 71)	78 (72, 83)	–
Guinea	2021 MIS	23 (21, 25)	43 (37, 48)	4 (3, 6)	6 (4, 10)	5 (3, 7)	7 (5, 10)	38 (33, 43)	56 (51, 61)	54 (48, 60)	42 (26, 61)
Kenya	2020 MIS	17 (16, 19)	43 (36, 51)	0 (0, 1)	9 (6, 14)	11 (9, 15)	1 (0, 3)	36 (30, 42)	63 (57, 69)	60 (49, 70)	–
Kenya	2022 DHS	17 (16, 18)	41 (38, 43)	0 (0, 1)	17 (15, 19)	12 (11, 14)	1 (1, 2)	30 (28, 33)	69 (66, 71)	50 (46, 53)	–
Liberia	2019 DHS	26 (23, 28)	39 (35, 44)	0 (0, 0)	14 (11, 17)	26 (22, 31)	7 (5, 9)	19 (16, 22)	76 (72, 79)	82 (77, 87)	–
Madagascar	2021 DHS	12 (11, 13)	35 (32, 38)	0 (0, 0)	8 (6, 10)	1 (0, 1)	2 (2, 3)	55 (51, 58)	43 (40, 47)	46 (41, 51)	–
Mali	2018 DHS	16 (15, 17)	24 (21, 27)	3 (2, 5)	2 (1, 3)	7 (5, 9)	23 (19, 27)	42 (38, 46)	36 (33, 39)	46 (39, 53)	37 (22, 56)
Mauritania	2020 DHS	17 (16, 18)	25 (22, 28)	0 (0, 1)	2 (1, 3)	4 (3, 5)	2 (1, 2)	68 (65, 71)	31 (28, 34)	11 (8, 15)	–
Mozambique	2018 MIS	31 (28, 35)	64 (57, 70)	4 (2, 7)	0 (0, 1)	0 (0, 1)	1 (1, 3)	31 (26, 37)	68 (62, 73)	72 (67, 76)	41 (13, 76)
Nigeria	2018 DHS	24 (23, 25)	27 (25, 29)	1 (1, 1)	38 (36, 40)	5 (4, 6)	4 (3, 5)	26 (25, 28)	70 (68, 72)	35 (32, 38)	9 (4, 18)
Rwanda	2019 DHS	19 (18, 20)	44 (41, 46)	11 (9, 13)	5 (3, 6)	5 (4, 6)	1 (1, 2)	37 (34, 40)	62 (59, 65)	64 (59, 68)	68 (61, 75)
Senegal	2019 DHS	16 (14, 17)	42 (37, 47)	0 (0, 1)	3 (2, 4)	4 (2, 6)	2 (1, 4)	50 (44, 55)	48 (43, 53)	32 (26, 38)	–
Sierra Leone	2019 DHS	17 (16, 18)	66 (62, 69)	1 (1, 3)	2 (1, 3)	6 (5, 8)	1 (1, 2)	25 (22, 27)	74 (71, 77)	78 (74, 82)	31 (13, 58)
Uganda	2018 MIS	27 (24, 30)	33 (29, 37)	7 (5, 9)	38 (34, 41)	12 (10, 15)	1 (1, 1)	13 (11, 15)	86 (84, 88)	84 (79, 88)	77 (68, 83)
Zambia	2018 DHS	16 (15, 17)	69 (66, 72)	3 (2, 5)	4 (3, 6)	0 (0, 1)	1 (0, 2)	23 (20, 26)	76 (73, 79)	78 (73, 82)	83 (64, 93)

Notes:
The analysis is presented as point estimate (95% confidence interval).
Figures with fewer than 30 children in the denominator were removed.
“–” refers to not applicable or data not available.

Diagnostic testing coverage in each health sector				Antimalarial treatment coverage in each health sector							ACT use among antimalarial treatment in each health sector		
Formal medical private excluding pharmacies	Pharmacies or accredited drug stores	Informal private	Trained provider	Public excluding community health workers	Community health workers	Formal medical private excluding pharmacies	Pharmacies or accredited drug stores	Self-treatment	No treatment seeking	Trained provider	Public	Private	Informal private
56 (33, 77)	–	19 (12, 30)	84 (82, 86)	76 (73, 78)	–	50 (34, 67)	–	20 (11, 33)	11 (8, 14)	75 (72, 77)	49 (45, 53)	63 (46, 78)	46 (18, 77)
54 (43, 65)	11 (7, 19)	8 (5, 15)	42 (36, 48)	58 (49, 66)	–	48 (38, 58)	33 (24, 43)	46 (38, 54)	12 (9, 16)	48 (43, 54)	25 (17, 35)	21 (15, 27)	15 (8, 27)
69 (52, 82)	16 (8, 27)	14 (8, 25)	60 (56, 65)	51 (46, 56)	59 (25, 86)	70 (48, 85)	18 (11, 27)	14 (8, 24)	7 (5, 11)	46 (42, 51)	39 (32, 47)	44 (30, 59)	21 (4, 62)
54 (33, 73)	27 (19, 36)	–	40 (35, 45)	5 (3, 8)	–	5 (1, 18)	6 (3, 14)	–	1 (0, 4)	5 (3, 7)	71 (51, 85)	–	–
30 (22, 39)	8 (4, 16)	3 (0, 28)	50 (45, 55)	63 (56, 70)	–	55 (46, 63)	57 (44, 69)	50 (24, 76)	18 (14, 24)	59 (54, 65)	88 (80, 93)	86 (77, 92)	–
35 (21, 52)	7 (2, 19)	7 (3, 18)	47 (42, 53)	55 (48, 61)	70 (49, 85)	26 (15, 42)	23 (12, 40)	24 (14, 38)	9 (6, 13)	50 (44, 56)	53 (46, 60)	53 (36, 70)	–
54 (33, 74)	5 (2, 13)	–	49 (41, 57)	4 (2, 9)	–	8 (3, 19)	4 (1, 15)	–	1 (0, 2)	5 (3, 8)	–	–	–
53 (47, 59)	15 (11, 19)	10 (4, 22)	44 (41, 47)	29 (26, 32)	–	30 (25, 35)	21 (17, 26)	17 (7, 36)	5 (4, 7)	28 (25, 30)	89 (85, 92)	76 (67, 83)	–
66 (54, 77)	25 (19, 32)	38 (25, 53)	60 (55, 65)	72 (67, 76)	–	62 (51, 72)	42 (31, 53)	76 (67, 83)	22 (17, 29)	59 (54, 64)	40 (33, 46)	47 (38, 56)	34 (19, 52)
26 (17, 37)	–	4 (1, 11)	42 (38, 46)	32 (27, 37)	–	13 (7, 22)	–	10 (7, 14)	6 (4, 9)	28 (24, 32)	55 (46, 63)	–	–
16 (5, 38)	8 (3, 17)	5 (3, 9)	36 (30, 42)	61 (54, 68)	56 (38, 72)	29 (11, 57)	17 (9, 30)	5 (2, 10)	4 (3, 6)	50 (44, 57)	35 (27, 43)	20 (9, 38)	–
25 (11, 49)	16 (7, 34)	2 (0, 14)	13 (10, 17)	48 (42, 54)	–	60 (22, 89)	51 (35, 66)	–	2 (2, 4)	49 (43, 55)	21 (15, 29)	15 (6, 35)	–
–	–	–	70 (65, 74)	47 (40, 53)	57 (44, 70)	–	–	–	10 (6, 17)	47 (41, 53)	98 (97, 99)	–	–
8 (6, 9)	11 (7, 16)	3 (1, 5)	18 (17, 20)	64 (61, 66)	57 (39, 73)	51 (48, 53)	37 (32, 43)	23 (17, 31)	19 (17, 21)	55 (53, 56)	54 (50, 57)	50 (46, 53)	35 (22, 50)
67 (54, 78)	31 (21, 42)	–	62 (58, 66)	9 (6, 12)	40 (32, 49)	10 (5, 20)	7 (3, 16)	–	1 (0, 2)	13 (11, 17)	92 (84, 97)	–	–
13 (4, 37)	10 (2, 37)	0 (0, 0)	29 (24, 35)	3 (2, 6)	–	0 (0, 0)	2 (0, 14)	–	0 (0, 0)	3 (2, 5)	–	–	–
78 (50, 93)	23 (13, 36)	18 (6, 44)	73 (69, 76)	73 (68, 77)	71 (39, 91)	81 (59, 92)	57 (44, 69)	46 (17, 77)	23 (18, 30)	72 (67, 76)	31 (27, 36)	33 (23, 45)	–
48 (43, 53)	20 (15, 28)	34 (15, 60)	58 (54, 62)	72 (66, 76)	90 (84, 93)	72 (67, 77)	54 (42, 66)	–	30 (23, 37)	70 (66, 74)	89 (84, 93)	87 (82, 91)	–
79 (65, 89)	–	–	78 (73, 82)	42 (37, 47)	86 (72, 93)	54 (41, 67)	–	–	10 (7, 13)	44 (40, 49)	97 (95, 98)	94 (76, 99)	–

Data as of 2 October 2023

ACT: artemisinin-based combination therapy; DHS: demographic and health survey; MIS: malaria indicator survey; WHO: World Health Organization.

Sources: Nationally representative household survey data from DHS and MIS, compiled through WHO calculations.

Annex 4 – F. Population denominator for case incidence and mortality rate, and estimated malaria cases and deaths, 2000–2022								
WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Djibouti ¹	2000	556 465	1 300	1 731	2 100	1	4	8
	2001	574 055	1 400	1 786	2 200	1	4	8
	2002	591 783	1 400	1 841	2 300	1	4	8
	2003	604 743	1 400	1 881	2 300	1	4	8
	2004	613 714	1 500	1 909	2 300	1	4	9
	2005	623 078	1 500	1 938	2 400	1	4	9
	2006	635 142	1 500	1 976	2 400	–	29	–
	2007	648 827	1 600	2 018	2 500	1	5	9
	2008	662 093	1 600	2 060	2 500	1	5	9
	2009	675 754	–	2 686	–	3	6	10
	2010	689 325	–	1 010	–	1	2	3
	2011	702 532	1 700	2 185	2 700	2	5	10
	2012	715 646	1 700	2 226	2 700	2	5	10
	2013	728 736	–	1 684	–	–	17	–
	2014	741 735	–	9 439	–	–	28	–
	2015	754 613	–	9 473	–	11	24	37
	2016	767 363	–	13 822	–	14	30	46
	2017	780 091	–	14 810	–	12	26	38
	2018	792 813	–	24 845	–	21	43	65
	2019	805 409	–	49 402	–	47	97	150
	2020	817 529	–	73 535	–	64	129	190
	2021	829 078	–	58 916	–	57	118	180
	2022	840 546	–	40 648	–	39	81	120
Egypt ^{1,2}	2000	71 371 368	–	0	–	–	0	–
	2001	72 854 264	–	0	–	–	0	–
	2002	74 393 760	–	0	–	–	0	–
	2003	75 963 320	–	0	–	–	0	–
	2004	77 522 424	–	0	–	–	0	–
	2005	79 075 312	–	0	–	–	0	–
	2006	80 629 672	–	0	–	–	0	–
	2007	82 218 752	–	0	–	–	0	–
	2008	83 844 784	–	0	–	–	0	–
	2009	85 501 064	–	0	–	–	0	–
	2010	87 252 416	–	0	–	–	0	–
	2011	89 200 056	–	0	–	–	0	–
	2012	91 240 376	–	0	–	–	0	–
	2013	93 377 888	–	0	–	–	0	–
	2014	95 592 320	–	0	–	–	0	–
	2015	97 723 800	–	0	–	–	0	–
	2016	99 784 032	–	0	–	–	0	–
	2017	101 789 384	–	0	–	–	0	–
	2018	103 740 768	–	0	–	–	0	–
	2019	105 618 672	–	0	–	–	0	–
	2020	107 465 136	–	0	–	–	0	–
	2021	109 262 176	–	0	–	–	0	–
	2022	110 990 104	–	0	–	–	0	–
Iran (Islamic Republic of) ^{1,2,5}	2000	669 208	–	19 716	–	–	4	–
	2001	680 750	–	19 303	–	–	2	–
	2002	687 409	–	15 558	–	–	2	–
	2003	693 817	–	23 562	–	–	5	–
	2004	705 119	–	13 821	–	–	1	–
	2005	716 564	–	18 966	–	–	1	–
	2006	727 725	–	15 909	–	–	1	–
	2007	738 381	–	15 712	–	–	3	–
	2008	748 580	–	8 349	–	–	3	–
	2009	758 834	–	4 345	–	–	0	–
	2010	769 567	–	1 847	–	–	0	–
	2011	779 461	–	1 632	–	–	0	–
	2012	789 482	–	756	–	–	0	–
	2013	801 065	–	480	–	–	0	–
	2014	816 408	–	358	–	–	0	–
	2015	835 084	–	167	–	–	0	–
	2016	850 556	–	81	–	–	0	–
	2017	862 796	–	57	–	–	0	–
	2018	874 155	–	0	–	–	0	–
	2019	883 820	–	0	–	–	0	–
	2020	891 232	–	0	–	–	0	–
	2021	897 698	–	0	–	–	0	–
	2022	904 101	–	1 439	–	–	0	–

Annex 4 – F. Population denominator for case incidence and mortality rate, and estimated malaria cases and deaths, 2000–2022								
WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Iraq ^{1,2}	2000	3 201 751	–	1 860	–	–	0	–
	2001	3 305 336	–	1 265	–	–	0	–
	2002	3 413 194	–	952	–	–	0	–
	2003	3 518 947	–	347	–	–	0	–
	2004	3 621 663	–	155	–	–	0	–
	2005	3 730 828	–	47	–	–	0	–
	2006	3 757 729	–	24	–	–	0	–
	2007	3 725 915	–	2	–	–	0	–
	2008	3 798 389	–	2	–	–	0	–
	2009	3 937 575	–	0	–	–	0	–
	2010	4 064 433	–	0	–	–	0	–
	2011	4 209 147	–	0	–	–	0	–
	2012	4 402 378	–	0	–	–	0	–
	2013	4 612 634	–	0	–	–	0	–
	2014	4 777 043	–	0	–	–	0	–
	2015	4 908 515	–	0	–	–	0	–
	2016	5 030 732	–	5	–	–	0	–
	2017	5 150 750	–	0	–	–	0	–
	2018	5 276 791	–	0	–	–	0	–
	2019	5 403 257	–	0	–	–	0	–
	2020	5 532 407	–	0	–	–	0	–
	2021	5 659 366	–	0	–	–	0	–
	2022	5 784 495	–	0	–	–	0	–
Morocco ^{1,2,3}	2000	28 554 416	–	3	–	–	0	–
	2001	28 930 096	–	0	–	–	0	–
	2002	29 301 816	–	19	–	–	0	–
	2003	29 661 270	–	4	–	–	0	–
	2004	30 033 124	–	1	–	–	0	–
	2005	30 431 902	–	0	–	–	0	–
	2006	30 833 022	–	0	–	–	0	–
	2007	31 232 632	–	0	–	–	0	–
	2008	31 634 992	–	0	–	–	0	–
	2009	32 042 876	–	0	–	–	0	–
	2010	32 464 864	–	0	–	–	0	–
	2011	32 903 700	–	0	–	–	0	–
	2012	33 352 168	–	0	–	–	0	–
	2013	33 803 528	–	0	–	–	0	–
	2014	34 248 604	–	0	–	–	0	–
	2015	34 680 456	–	0	–	–	0	–
	2016	35 107 264	–	0	–	–	0	–
	2017	35 528 116	–	0	–	–	0	–
	2018	35 927 512	–	0	–	–	0	–
	2019	36 304 408	–	0	–	–	0	–
	2020	36 688 772	–	0	–	–	0	–
	2021	37 076 584	–	0	–	–	0	–
	2022	37 457 972	–	0	–	–	0	–
Oman ^{1,2}	2000	2 344 253	–	6	–	–	0	–
	2001	2 374 653	–	2	–	–	0	–
	2002	2 403 659	–	6	–	–	0	–
	2003	2 431 600	–	6	–	–	0	–
	2004	2 468 855	–	0	–	–	0	–
	2005	2 515 192	–	0	–	–	0	–
	2006	2 560 649	–	0	–	–	0	–
	2007	2 605 700	–	4	–	–	0	–
	2008	2 651 028	–	0	–	–	0	–
	2009	2 697 537	–	0	–	–	0	–
	2010	2 881 914	–	0	–	–	0	–
	2011	3 206 870	–	0	–	–	0	–
	2012	3 535 579	–	0	–	–	0	–
	2013	3 816 680	–	0	–	–	0	–
	2014	4 009 267	–	0	–	–	0	–
	2015	4 191 776	–	0	–	–	0	–
	2016	4 398 070	–	0	–	–	0	–
	2017	4 541 854	–	0	–	–	0	–
	2018	4 601 157	–	0	–	–	0	–
	2019	4 602 768	–	0	–	–	0	–
	2020	4 543 399	–	0	–	–	0	–
	2021	4 520 471	–	0	–	–	0	–
	2022	4 576 298	–	0	–	–	0	–

Annex 4 – F. Population denominator for case incidence and mortality rate, and estimated malaria cases and deaths, 2000–2022

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
REGIONAL SUMMARY								
Total	2000	3 001 414 051	227 000 000	243 162 939	263 000 000	835 000	864 120	905 000
	2001	3 056 062 602	230 000 000	248 022 760	271 000 000	841 000	873 249	918 000
	2002	3 111 195 346	227 000 000	245 060 872	267 000 000	811 000	841 020	885 000
	2003	3 166 333 422	232 000 000	249 406 543	271 000 000	783 000	812 716	856 000
	2004	3 221 394 588	232 000 000	250 274 973	277 000 000	774 000	807 577	866 000
	2005	3 276 812 144	232 000 000	249 288 650	273 000 000	738 000	769 523	819 000
	2006	3 333 153 669	226 000 000	243 987 230	268 000 000	745 000	776 058	826 000
	2007	3 390 445 978	223 000 000	240 342 889	262 000 000	723 000	753 655	796 000
	2008	3 448 145 295	223 000 000	239 408 007	259 000 000	686 000	715 882	757 000
	2009	3 506 520 927	227 000 000	245 078 110	267 000 000	692 000	725 898	775 000
	2010	3 565 651 119	229 000 000	247 100 666	272 000 000	668 000	702 810	755 000
	2011	3 625 240 330	225 000 000	241 354 770	263 000 000	633 000	664 758	707 000
	2012	3 684 763 844	221 000 000	237 422 927	257 000 000	590 000	618 989	660 000
	2013	3 743 249 585	215 000 000	231 712 576	251 000 000	560 000	590 620	633 000
	2014	3 800 947 857	209 000 000	229 546 409	253 000 000	551 000	587 666	643 000
	2015	3 858 500 504	211 000 000	230 667 647	254 000 000	548 000	585 919	645 000
	2016	3 917 041 833	214 000 000	232 095 976	253 000 000	546 000	582 429	645 000
	2017	3 976 267 205	219 000 000	237 356 307	258 000 000	545 000	579 821	644 000
	2018	4 034 803 196	215 000 000	232 051 420	253 000 000	545 000	581 210	656 000
	2019	4 092 700 842	213 000 000	232 508 463	255 000 000	537 000	576 156	660 000
	2020	4 149 685 354	221 000 000	243 760 479	271 000 000	587 000	630 869	747 000
	2021	4 203 557 677	220 000 000	244 328 658	272 000 000	568 000	610 110	726 000
	2022	4 255 985 477	225 000 000	248 685 377	278 000 000	566 000	608 364	738 000

Data as of 23 October 2023

NMP: national malaria programme; WHO: World Health Organization.

“–” refers to not applicable.

¹ The number of indigenous malaria cases registered by the NMPs is reported here without further adjustments for the entire time series (since 2017 for Timor-Leste and since 2021 for the Dominican Republic, French Guiana, Guatemala, Honduras, Nepal, Panama and Viet Nam).

² The number of indigenous malaria deaths registered by the NMPs is reported here without further adjustments.

³ Certified malaria free countries are included in this listing for historical purposes.

⁴ South Sudan became an independent state on 9 July 2011 and a Member State of WHO on 27 September 2011. South Sudan and Sudan have distinct epidemiological profiles comprising high transmission and low transmission areas, respectively. For this reason, data up to June 2011 from the Sudanese high transmission areas (10 southern states which correspond to contemporary South Sudan) and low transmission areas (15 northern states which correspond to contemporary Sudan) are reported separately.

⁵ In 2022, the Islamic Republic of Iran reported 1439 locally acquired cases, including indigenous cases.

Note: Population denominator for incidence and mortality rate is based on the United Nations population, times the proportion of the population at risk at baseline.

Annex 4 – G. Population denominator for case incidence and mortality rate, and reported malaria cases by place of care, 2022

WHO region Country/area	Population			
	UN population	At risk (low + high)	At risk (high)	Number of people living in active foci
AFRICAN				
Angola	35 588 988	35 588 988	35 588 988	–
Benin	13 352 864	13 352 864	13 352 864	–
Botswana*	2 630 296	1 743 834	110 788	–
Burkina Faso	22 673 762	22 673 762	22 673 762	–
Burundi	12 889 576	12 889 576	12 889 576	–
Cabo Verde	593 149	154 219	0	0
Cameroon	27 914 536	27 914 536	19 819 321	–
Central African Republic	5 579 144	5 579 144	5 579 144	–
Chad	17 723 316	17 529 246	11 937 539	–
Comoros	836 774	836 774	398 137	469 420
Congo	5 970 424	5 970 424	5 970 424	–
Côte d’Ivoire	28 160 542	28 160 542	28 160 542	–
Democratic Republic of the Congo	99 010 208	99 010 208	96 039 902	–
Equatorial Guinea	1 674 908	1 674 908	1 674 908	–
Eritrea	3 684 032	3 684 032	2 615 663	–
Eswatini	1 201 670	336 468	0	–
Ethiopia	123 379 920	83 898 346	33 559 338	–
Gabon	2 388 992	2 388 992	2 388 992	–
Gambia	2 705 992	2 705 992	2 705 992	–
Ghana	33 475 870	33 475 870	33 475 870	–
Guinea	13 859 341	13 859 341	13 859 341	–
Guinea-Bissau	2 105 566	2 105 566	2 105 566	–
Kenya	54 027 488	54 027 488	37 924 595	–
Liberia	5 302 681	5 302 681	5 302 681	–
Madagascar	29 611 714	29 611 714	25 989 609	–
Malawi	20 405 316	20 405 316	20 405 316	–
Mali	22 593 590	22 593 590	20 594 509	–
Mauritania	4 736 139	4 736 139	3 053 294	–
Mozambique	32 969 518	32 969 518	32 969 518	–
Namibia	2 567 012	2 037 566	1 184 958	–
Niger	26 207 976	26 207 976	26 207 976	–
Nigeria	218 541 216	218 541 216	166 917 410	–
Rwanda	13 776 698	13 776 698	13 776 698	–
Sao Tome and Principe	227 380	227 380	227 380	–
Senegal	17 316 448	17 316 448	17 216 532	8 098
Sierra Leone	8 605 718	8 605 718	8 605 718	–
South Africa*	59 893 884	5 989 388	2 395 755	6 724 632
South Sudan ¹	10 913 164	10 913 164	10 913 164	–
Togo	8 848 699	8 848 699	8 848 699	–
Uganda	47 249 584	47 249 584	47 249 584	–
United Republic of Tanzania	65 497 748	65 497 748	4 781 336	–
Mainland	61 788 786	61 788 786	45 105 814	–
Zanzibar	1 799 550	1 799 550	1 102 836	128 000
Zambia	20 017 676	20 017 676	20 017 676	–
Zimbabwe	16 320 537	12 851 231	4 670 285	–
AMERICAS				
Bolivia (Plurinational State of)	12 224 110	5 545 712	305 358	–
Brazil	215 313 504	43 708 641	4 952 211	–
Colombia	51 874 024	11 484 390	5 212 302	2 601 009
Costa Rica*	5 180 829	1 813 290	51 808	28 049
Dominican Republic	11 228 821	6 185 059	158 888	–
Ecuador	18 001 000	10 201 167	808 255	95 338
French Guiana*	304 557	168 505	28 111	–
Guatemala*	17 843 908	13 470 723	2 434 444	50 750
Guyana	808 726	808 726	88 264	–
Haiti	11 584 996	10 350 267	2 808 087	–
Honduras	10 432 860	9 450 085	2 659 127	200 265

Public sector		Private sector		Community level	
Presumed	Confirmed	Presumed	Confirmed	Presumed	Confirmed
1 362 550	7 803 931	–	–	–	54 929
42 333	1 994 564	54 021	480 125	–	–
–	446 ³	–	–	–	–
253 714	10 425 100	289 715	711 304	–	279 155
5 680	6 125 480	1 044	651 748	–	1 340 207
–	27	–	0	–	–
29 424	1 614 157	25 871	1 222 543	–	490 681
182 642	1 848 595	30 797	278 923	–	119 732
211 443 ³	1 383 930 ³	–	–	–	287 130
–	14 583	–	1 927	–	4 171
216 863 ³	353 299 ³	–	–	–	11 167
239 336	6 561 551	23 542	403 614	–	1 180 426
2 041 143	27 349 509 ⁴	–	–	–	–
27 142	71 204	–	–	–	–
790	44 209	–	–	–	20 854
–	189	–	180	–	0
101 340	1 675 180	–	57 382	–	–
54 507	45 783	–	–	–	–
–	117 606	–	1 203	–	295
113 299	2 749 077	43 939	763 479	60 114	1 726 680
1 897 449	2 070 228	–	98 259	–	306 287
–	171 370	–	12 013	–	1 773
341 616 ⁵	4 890 691 ⁵	–	–	–	–
48 815	382 237	14 557	216 070	–	98 377
12 832	1 623 292	942	56 255	–	–
24 907	3 435 518	–	–	–	790 643
217 421	3 360 922	5 918	75 767	9 532	334 737
88 819 ⁵	41 901 ⁵	–	–	–	–
12 299	11 101 635	–	21 727	6 110	1 264 097
–	10 851	–	19	–	979
446 928	4 699 386	–	100 678	–	366 348
1 526 749	21 465 429	391 312	1 584 976	–	–
–	195 205	–	179 080	–	482 943
–	3 512	–	–	–	467
21 517	281 355	1 819	15 217	10 310	61 461
82 563	1 563 083	11 904	173 583	–	31 753
–	7 280	–	–	–	–
2 757 544 ⁴	1 752 468 ⁴	–	–	253 387	775 189
–	1 185 564	–	308 700	–	728 679
504 811	13 845 161	322 590	2 271 726	–	3 068 584
3 510	3 001 406	2 023	659 313	–	489
3 510	2 998 313	2 023	658 338	–	–
–	3 093	–	975	–	489
191 705	5 958 308	–	–	–	2 168 521
–	60 765	–	1 191	–	79 120
–	7 781	–	281	–	2 268
–	151 530 ³	–	–	–	–
–	73 561 ³	–	–	–	–
–	462 ⁵	–	–	–	–
–	167 ⁵	–	–	–	170
–	1 666 ⁵	–	–	–	–
–	51 ³	–	–	–	–
–	1 856 ⁵	–	–	–	–
–	18 988	–	49	–	1 732
–	6 666	–	2 381	–	5 710
–	1 715	–	38	–	1 827

Annex 4 – G. Population denominator for case incidence and mortality rate, and reported malaria cases by place of care, 2022

WHO region Country/area	Population			
	UN population	At risk (low + high)	At risk (high)	Number of people living in active foci
AMERICAS				
Mexico	127 504 128	2 703 088	127 504	21 336 688
Nicaragua	6 948 392	6 114 585	241 706	535 537
Panama*	4 408 581	2 953 749	189 190	71 176
Peru	34 049 588	13 373 316	1 704 522	–
Suriname*	618 040	91 285	26 242	–
Venezuela (Bolivarian Republic of)	28 301 696	14 150 848	5 869 347	16 341 747
EASTERN MEDITERRANEAN				
Afghanistan	41 128 772	31 754 639	11 198 641	–
Djibouti	1 120 849	840 547	393 508	–
Iran (Islamic Republic of)	88 550 568	904 101	0	663 952
Pakistan	235 824 864	231 841 782	68 193 476	–
Saudi Arabia	36 408 820	3 904 183	0	0
Somalia	17 597 512	17 597 512	8 956 606	–
Sudan	46 874 204	46 874 204	40 733 683	–
Yemen	33 696 616	21 688 510	5 297 813	–
SOUTH-EAST ASIA				
Bangladesh	171 186 368	18 448 800	2 162 145	–
Bhutan	782 455	579 017	101 719	–
Democratic People’s Republic of Korea	26 069 416	10 191 412	1 464 422	2 014 936
India	1 417 173 120	1 324 206 563	171 917 271	–
Indonesia ²	275 501 344	275 501 344	17 615 556	22 475 294
Myanmar*	54 179 304	47 203 653	8 893 742	–
Nepal	30 547 580	8 871 460	1 596 579	103 354
Thailand ²	71 697 032	13 605 229	1 587 372	314 833
Timor-Leste	1 341 296	1 261 502	454 264	0
WESTERN PACIFIC				
Cambodia	16 767 842	11 928 400	8 069 673	23 581
Lao People’s Democratic Republic	7 529 475	3 917 856	3 917 856	43 612
Malaysia ²	33 938 220	1 357 529	1 018 147	2 969
Papua New Guinea	10 142 619	10 142 619	9 534 062	–
Philippines ²	115 559 008	67 068 869	7 875 375	411 258
Republic of Korea*	51 815 808	3 627 107	0	–
Solomon Islands	724 273	717 030	717 030	–
Vanuatu	326 740	326 740	284 018	–
Viet Nam	98 186 856	72 362 633	6 674 252	86 350
REGIONAL SUMMARY				
African	1 143 030 056	1 043 260 570	824 159 350	7 202 150
Americas	556 627 760	152 573 436	27 665 366	41 260 559
Eastern Mediterranean	501 202 205	355 405 478	134 773 727	663 952
South-East Asia	2 048 477 915	1 699 868 980	205 793 070	24 908 417
Western Pacific	334 990 841	171 448 784	38 090 416	567 770
Total	4 584 328 777	3 422 557 247	1 230 481 926	74 602 848

RDT: rapid diagnostic test; UN: United Nations; WHO: World Health Organization.

“–” refers to not applicable or data not available.

* Confirmed cases are corrected for double counting of microscopy and RDTs.

¹ In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

² Figures include non-human malaria cases.

³ Figures reported for the public sector include cases detected in the private sector.

Public sector		Private sector		Community level	
Presumed	Confirmed	Presumed	Confirmed	Presumed	Confirmed
–	244	–	–	–	–
–	16 158 ⁴	–	–	–	–
–	7 173 ⁵	–	–	–	–
–	27 785	–	–	–	–
–	61 ⁵	–	–	–	–
–	151 458 ⁴	–	–	–	–
145	92 134	–	3 862	23	29 624
–	39 561	–	1 087	–	–
–	5 677	–	–	–	–
435	1 205 262	13	619 134	–	–
–	4 319 ³	–	–	–	–
11 900 ⁴	11 550 ⁴	–	–	–	–
2 412 374	1 355 789	–	–	–	–
38 282	114 079	8 383	24 036	–	17 012
–	3 177	–	51	–	15 018
–	6	–	–	–	–
–	2 136	–	–	–	–
–	101 300 ⁵	–	–	–	75 222
–	319 951	–	59 555	–	64 024
–	157 538 ⁵	–	–	–	–
–	428	–	84	–	–
–	6 024	–	2 060	–	2 070
–	2	–	–	–	–
–	1 818	–	–	–	2 235
–	1 343	–	137	–	860
–	2 807 ³	–	–	–	–
123 270	899 510	–	–	–	–
–	238	–	19	–	2 988
–	428 ³	–	–	–	–
40 461	100 995	–	–	–	–
–	913	–	–	–	230
–	164	–	–	–	291
13 061 691	151 285 987	1 258 705	10 347 002	339 453	16 075 874
0	467 322	0	2 749	0	11 707
2 463 136	2 828 371	8 396	648 119	23	46 636
0	590 562	0	61 750	0	156 334
163 731	1 008 216	0	156	0	6 604
15 688 558	156 180 458	1 267 101	11 059 776	339 476	16 297 155

Data as of 9 October 2023

⁴ Figures reported for the public sector include cases detected at the community level.

⁵ Figures reported for the public sector include cases detected at the community level and in the private sector.

Note: Figures include imported cases.

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
South Sudan ⁴	Suspected cases	–	–	–	–	2 492 473
	Presumed and confirmed	900 283	1 473 653	1 125 039	1 855 501	2 433 991
	Confirmed	900 283	112 024	225 371	262 520	71 377
	Microscopy examined	–	–	–	–	27 321
	Microscopy positive	900 283	112 024	225 371	262 520	18 344
	RDT examined	–	–	–	–	102 538
	RDT positive	–	–	–	–	53 033
Togo	Suspected cases	2 035 303	906 276	1 590 266	1 550 804	2 255 010
	Presumed and confirmed	1 441 199	519 452	909 129	965 832	1 524 339
	Confirmed	1 019 029	506 764	909 129	965 832	1 524 339
	Microscopy examined	478 354	502 977	579 507	560 538	621 119
	Microscopy positive	206 071	224 619	260 535	272 984	310 207
	RDT examined	1 134 779	390 611	1 010 759	990 266	1 633 891
	RDT positive	812 958	282 145	648 594	692 848	1 214 132
Uganda	Suspected cases	15 320 926	12 362 291	16 845 771	26 145 615	19 201 136
	Presumed and confirmed	13 217 617	11 991 843	13 591 932	16 541 563	13 724 345
	Confirmed	1 666 582	316 241	2 662 258	1 502 362	3 631 939
	Microscopy examined	3 705 284	385 928	3 466 571	3 718 588	2 048 185
	Microscopy positive	1 628 595	134 726	1 413 149	1 502 362	578 289
	RDT examined	64 607	300 761	2 449 526	7 387 826	7 060 545
	RDT positive	37 987	181 515	1 249 109	–	3 053 650
United Republic of Tanzania ²	Suspected cases	15 452 268	15 442 493	14 659 506	15 177 829	25 197 621
	Presumed and confirmed	12 893 899	10 165 442	8 478 109	8 587 728	7 403 952
	Confirmed	1 279 362	2 151 236	1 987 629	1 554 690	680 407
	Microscopy examined	3 701 608	5 800 195	7 077 411	6 888 029	727 130
	Microscopy positive	1 277 388	1 813 654	1 772 736	1 481 759	572 289
	RDT examined	136 123	1 628 092	1 091 615	1 256 762	17 746 946
	RDT positive	1 974	337 582	214 893	72 931	108 118
	Imported cases	–	–	–	719 [§]	1 583 [§]
Mainland ²	Suspected cases	15 180 191	14 986 775	14 122 756	14 649 872	24 880 179
	Presumed and confirmed	12 819 556	10 160 953	8 474 952	8 585 128	7 399 316
	Confirmed	1 277 024	2 146 747	1 984 698	1 552 444	678 207
	Microscopy examined	3 637 659	5 656 907	6 931 025	6 804 085	592 320
	Microscopy positive	1 277 024	1 813 179	1 772 062	1 481 275	571 598
	RDT examined	–	1 315 662	701 477	813 103	17 566 750
	RDT positive	–	333 568	212 636	71 169	106 609
	Imported cases	–	–	–	–	–
Zanzibar ²	Suspected cases	272 077	455 718	536 750	527 957	317 442
	Presumed and confirmed	74 343	4 489	3 157	2 600	4 636
	Confirmed	2 338	4 489	2 931	2 246	2 200
	Microscopy examined	63 949	143 288	146 386	83 944	134 810
	Microscopy positive	364	475	674	484	691
	RDT examined	136 123	312 430	390 138	443 659	180 196
	RDT positive	1 974	4 014	2 257	1 762	1 509
Zambia	Imported cases	–	–	–	719	1 583
	Suspected cases	–	–	–	–	7 859 740
	Presumed and confirmed	4 229 839	4 607 908	4 695 400	5 465 122	5 972 933
	Confirmed	–	–	–	–	4 077 547
	Microscopy examined	–	–	–	–	–
	Microscopy positive	–	–	–	–	–
	RDT examined	–	–	–	–	5 964 354
Zimbabwe ²	RDT positive	–	–	–	–	4 077 547
	Suspected cases	912 618	480 011	734 997	1 128 954	1 504 682
	Presumed and confirmed	648 965	321 901	277 736	423 702	572 944
	Confirmed	249 379	321 901	277 736	423 702	550 696
	Microscopy examined	–	10 004	7 823	13 949	28 745
	Microscopy positive	249 379	1 966	773	1 069	2 420
	RDT examined	513 032	470 007	727 174	1 115 005	1 453 689
	RDT positive	249 379	319 935	276 963	422 633	548 276
	Imported cases	–	–	–	–	–

2015	2016	2017	2018	2019	2020	2021	2022
3 814 332	566 043	5 391 360	6 405 779	5 258 306	–	4 038 950	9 874 633
3 789 475	555 957	4 054 795	4 697 506	4 064 662	1 805 371*	3 149 649	5 538 588
24 371	7 619	1 488 005	98 843	1 903 742	661 922*	2 017 227	2 527 657
22 721	6 954	800 067	1 204	4 689	33 656	300 439	3 593 783
11 272	2 357	335 642	634	1 237	16 535	173 612	259 472
26 507	10 751	2 024 503	1 805 912	3 092 697	280 150	2 606 089	3 269 919
13 099	5 262	1 152 363	98 209	1 902 505	192 095	1 843 615	2 268 185
2 356 048	2 577 029	2 747 984	3 009 800	3 531 375	–	3 091 060	3 536 879
1 610 711	1 746 334	1 756 582	2 002 877	2 406 091	–	1 845 368^†	2 222 943*
1 610 711	1 746 334	1 756 582	2 002 877	2 406 091	–	1 845 368^†	2 222 943*
643 815	501 516	482 664	446 404	492 629	–	623 623	545 147
317 578	231 919	209 626	229 267	269 526	–	245 956	197 157
1 712 233	2 075 513	2 265 320	2 563 396	3 038 746	–	2 332 983	2 911 059
1 293 133	1 514 415	1 546 956	1 773 610	2 136 565	–	1 617 949	2 017 505
22 952 246	27 257 784	22 319 643	17 111 650	25 756 835	27 434 176	25 048 071	30 886 839
13 696 889	14 008 604	11 667 831	8 522 824	15 592 793	17 475 040*	15 144 755*	20 012 873*
7 412 747	9 735 849	11 667 831	5 759 174	13 982 362	16 329 136*	14 336 387*	19 185 472*
3 684 722	4 492 090	5 515 931	1 606 330	4 691 859	4 284 114	4 029 037	4 850 295
1 248 576	1 542 091	1 694 441	458 909	1 622 576	1 647 933	1 513 116	1 867 654
12 983 382	18 492 939	16 803 712	12 741 670	19 454 545	22 004 158	20 210 666	25 155 167
6 164 171	8 193 758	9 973 390	5 300 265	12 359 786	12 548 724	11 131 747	15 006 036
20 829 480	17 881 657	20 276 522	22 784 288	20 981 250	22 471 902	20 794 633	19 062 775
8 406 354	6 624 054	5 988 136	6 558 257 [£]	6 575 185 [£]	6 346 069 [£]	4 632 180 [£]	3 666 741*
4 902 828	5 762 462	5 744 907	6 392 846 [£]	6 485 437 [£]	6 308 276 [£]	4 623 393 [£]	3 661 208*
673 223	1 386 389	2 888 538	3 015 052	1 840 897	1 696 487	1 534 975	1 151 121
412 702	1 262 679	916 742	831 903	366 673	296 052	229 485	174 640
16 652 731	15 633 676	17 144 755	19 603 825	18 861 368	20 620 288	19 210 871	17 898 920
4 490 126	4 499 783	4 828 165	5 221 811	5 546 911	5 681 861	4 227 333	3 355 968
2 550 [§]	–	–	1 754 [§]	3 286 [§]	4 314 [§]	4 319 [§]	6 244
20 451 119	17 526 829	19 930 496	22 440 865	20 570 343	22 009 560	20 273 766	18 629 918
8 400 537	6 617 261	5 982 270	6 554 247*	6 568 222*	6 331 881*	4 625 830*	3 662 184*
4 898 211	5 755 669	5 739 863	6 389 514*	6 478 474*	6 294 088*	4 617 043*	3 656 651*
532 118	1 285 720	2 826 948	2 937 666	1 768 635	1 627 724	1 480 697	1 113 993
411 741	1 261 650	915 887	830 668	364 890	293 049	228 379	174 276
16 416 675	15 379 517	16 861 141	19 338 466	18 711 960	20 344 043	18 784 282	17 510 392
4 486 470	4 494 019	4 823 976	5 219 714	5 541 731	5 670 676	4 222 089	3 351 775
–	–	–	–	–	–	–	2 951
378 361	354 828	346 026	343 423	427 029	462 342	520 867	432 857
5 817	6 793	5 866	4 010	6 963	14 188*	6 350	4 557
4 617	6 793	5 044	3 332	6 963	14 188*	6 350	4 557
141 105	100 669	61 590	77 386	72 262	68 763	54 278	37 128
961	1 029	855	1 235	1 783	3 003	1 106	364
236 056	254 159	283 614	265 359	149 408	276 245	426 589	388 528
3 656	5 764	4 189	2 097	5 180	11 185	5 244	4 193
2 550	–	–	1 754	3 286	4 314	4 319	3 293
8 116 962	9 627 862	10 952 323	10 055 407	11 340 409	15 491 235	13 957 528	16 376 877
5 094 123	5 976 192	6 054 679	5 195 723	5 360 020	8 698 304	7 159 243	8 318 534
4 184 661	4 851 319	5 505 639	5 039 679	5 147 350	8 121 215	6 769 142	8 126 829
–	–	–	180 697	275 323	398 195	446 750	416 225
–	–	–	49 855	78 474	128 291	117 585	98 782
7 207 500	8 502 989	10 403 283	9 718 666	10 852 416	14 513 049	13 120 677	15 768 947
4 184 661	4 851 319	5 505 639	4 989 824	5 068 876	7 992 924	6 651 557	8 028 047
1 693 630	1 499 675	1 828 301	1 293 392	1 324 299	1 389 065	922 001	985 957
484 794	384 029	767 069	264 018	308 173	447 381	133 137	141 076
484 794	316 989	471 798	264 018	308 173	447 381	133 137	141 076
55 192	102 566	–	2 771	–	–	–	–
2 415	2 986	3 522	–	–	–	–	–
1 638 438	1 330 069	1 533 030	1 290 621	1 297 197	1 356 433	904 833	967 891
482 379	314 003	468 276	264 018	308 173	447 381	133 137	141 076
180	358	768	672	–	–	–	–

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Argentina ^{1,2,3}	Suspected cases	2 547	7 872	7 027	4 913	5 691
	Presumed and confirmed	121	28	16	11	15
	Confirmed	121	28	16	11	15
	Microscopy examined	2 547	7 872	7 027	4 913	5 691
	Microscopy positive	121	28	16	11	15
	RDT positive	–	–	–	–	–
	Imported cases	55	28	16	11	15
Belize ^{1,2,3}	Suspected cases	27 366	22 996	20 789	25 351	24 122
	Presumed and confirmed	150	79	37	26	19
	Confirmed	150	79	37	26	19
	Microscopy examined	27 366	22 996	20 789	25 351	24 122
	Microscopy positive	150	79	37	26	19
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	–	7	4	4	0
	Relapse cases	–	0	0	2	0
Bolivia (Plurinational State of) ²	Suspected cases	140 857	150 662	132 904	144 049	124 900
	Presumed and confirmed	13 769	7 143	7 415	7 342	7 401
	Confirmed	13 769	7 143	7 415	7 342	7 401
	Microscopy examined	133 463	143 272	121 944	133 260	124 900
	Microscopy positive	12 252	6 108	6 293	6 272	7 401
	RDT examined	7 394	7 390	10 960	10 789	–
	RDT positive	1 517	1 035	1 122	1 070	–
	Imported cases	–	–	–	–	–
Brazil ²	Suspected cases	2 711 433	2 477 821	2 349 341	1 893 018	1 756 460
	Presumed and confirmed	334 668	267 146	242 758	206 206*	162 929*
	Confirmed	334 668	267 146	242 758	206 206*	162 929*
	Microscopy examined	2 711 432	2 476 335	2 325 775	1 873 518	1 744 640
	Microscopy positive	334 667	266 713	237 978	174 048	142 744
	RDT examined	1	1 486	23 566	19 500	11 820
	RDT positive	1	433	4 780	3 719	1 384
	Imported cases	–	–	–	8 923	4 856
	Relapse cases	–	–	–	27 660	20 185
Colombia ²	Suspected cases	521 342	418 032	416 767	327 055	403 532
	Presumed and confirmed	117 650	64 436*	60 179	51 722*	40 768
	Confirmed	117 650	64 436*	60 179	51 722*	40 768
	Microscopy examined	521 342	396 861	346 599	284 332	325 713
	Microscopy positive	117 637	60 121	50 938	44 293	36 166
	RDT examined	–	21 171	70 168	42 723	77 819
	RDT positive	13	4 188	9 241	7 403	4 602
	Imported cases	–	–	–	–	–
Costa Rica ²	Suspected cases	15 599	10 690	7 485	16 774	4 420
	Presumed and confirmed	137	17	8	6	6
	Confirmed	137	17	8	6	6
	Microscopy examined	15 599	10 690	7 485	16 774	4 420
	Microscopy positive	137	17	8	6	6
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	4	6	1	4	5
	Relapse cases	0	0	0	2	1
Dominican Republic ²	Suspected cases	469 052**	477 555	506 583	502 683	416 729
	Presumed and confirmed	2 482^	1 616	952	579	496
	Confirmed	2 482^	1 616	952	579	496
	Microscopy examined	469 052	421 405	415 808	431 683	362 304
	Microscopy positive	2 482	1 616	952	579	496
	RDT examined	26 585	56 150	90 775	71 000	54 425
	RDT positive	932	–	–	–	–
	Imported cases	–	–	–	106	37
	Relapse cases	–	–	–	–	0
Ecuador ²	Suspected cases	488 830	460 785	459 157	397 628	370 825
	Presumed and confirmed	1 888	1 233	560	378	242
	Confirmed	1 888	1 233	560	378	242
	Microscopy examined	481 030	460 785	459 157	397 628	370 825
	Microscopy positive	1 888	1 233	560	378	242
	RDT examined	7 800	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	–	14	14	10	–
	Relapse cases	–	0	2	0	–

2015	2016	2017	2018	2019	2020	2021	2022
3 862	3 479	2 114	345	2 850	1 268	439	1 077
11	9	16^	28	22	13	13	10
11	9	16^	28	22	13	13	10
3 862	3 479	2 114	345	2 850	1 268	439	1 077
11	9	16	28	22	13	13	10
–	–	2	–	–	–	–	–
11	9	18	23	22	13	13	10
26 367	20 936	26 995	17 642	19 731	10 711**	10 893**	28 121
13^A‡	5	9^A‡	7	2	0	0	0
13^A‡	5	9^A‡	7	2	0	0	0
26 367	20 936	26 995	17 642	19 731	10 711	10 893	10 514
13	5	9	7	2	0	0	0
–	–	–	–	–	114	7 278	16 299
5	–	3	–	–	0	0	0
4	1	2	4	2	0	0	0
0	0	0	0	0	0	0	0
159 167	155 407	151 697	139 938	137 473	136 795	139 279	155 466
6 907	5 553	4 587	5 354	9 357	12 187	9 959	10 330
6 907	5 553	4 587	5 354	9 357	12 187	9 959	10 330
159 167	155 407	151 697	139 938	110 028	–	–	–
6 907	5 553	4 334	5 261	8 118	8 507	7 404	7 692
–	–	–	–	27 445	–	–	–
–	–	253	93	1 239	3 680	2 555	2 638
33	11	15	12	19	7	15	9
1 590 403	1 364 912	1 696 063	1 800 465	1 591 308	1 232 321	1 234 266	1 391 127
169 390*	152 160*	238 517*	244 042*	190 745*	172 419*	163 585*	151 530*
169 390*	152 160*	238 517*	244 042*	190 745*	172 419*	163 585*	151 530*
1 573 538	1 341 639	1 656 685	1 754 244	1 539 938	1 163 048	1 138 847	1 151 314
139 844	124 210	184 876	181 968	146 868	127 403	119 735	113 752
16 865	23 273	39 378	46 221	51 370	69 273	95 419	80 477
3 318	5 034	9 549	12 606	10 586	17 785	20 651	17 502
4 932	5 068	4 867	6 816	4 165	1 811	1 365	2 254
23 229	22 916	44 092	49 469	33 286	27 213	23 199	20 276
328 434	296 091	254 380	208 538	295 406	212 399	239 060	222 903
55 866*	83 227*	54 102*	63 143*	80 415*	76 236*	73 979*	73 561
55 866*	83 227*	54 102*	63 143*	80 415*	76 236*	73 979*	73 561
316 451	242 973	244 732	195 286	283 471	202 736	222 155	195 291
48 059	57 515	38 349	42 810	47 806	40 155	34 114	59 811
11 983	53 118	9 648	13 252	11 935	9 663	16 905	27 612
3 535	5 655	5 056	3 407	3 703	5 284	5 396	13 750
7 785	618	1 297	1 948	2 306	466	733	864
7 373**	5 160**	9 680**	9 000**	10 631	7 754**	12 383**	10 946**
8 [‡]	13 [‡]	25 [‡]	152^	149	141^	232^	462^
8 [‡]	13 [‡]	25 [‡]	152^	149	141^	232^	462^
7 373	5 160	9 680	9 000	10 631	4 200	2 001	10 946
8	13	25	110	149	141	232	409
3	2	3	700	–	3 647	12 383	20 093
3	2	3	44	–	93	128	398
8	9	13	38	45	34	27	36
0	0	0	2	4	4	12	5
317 257**	251 245	226 988**	132 775**	143 366**	59 826**	48 139**	77 709
661 [‡]	755 [‡]	398 [‡]	484^	1 314^	829^	291	337
661 [‡]	755 [‡]	398 [‡]	484^	1 314^	829^	291	337
317 257	228 795	226 988	132 775	143 366	59 843	48 139	49 466
661	487	398	322	1 314	829	17	0
7 659	22 450	87 397	42 425	55 000	7 570	26 839	28 243
129	80	74	221	1 313	241	274	337
30	65	57	87	37	3	7	17
0	3	0	23	3	–	–	–
261 824	311 920	306 894	237 995**	177 742	163 990	184 862	122 820
686^A‡	1 424	1 380^A‡	1 806^	1 909	2 089*	2 436*	1 666*
686^A‡	1 424	1 380^A‡	1 806^	1 909	2 089*	2 436*	1 666*
261 824	311 920	306 894	237 995	177 742	163 607	149 568	122 504
686	1 424	1 380	1 589	1 428	1 618	1 778	1 213
–	–	–	6 782	–	383	35 294	316
6	–	6	217	481	383	467	315
59	233	105	153	106	67	70	42
–	–	–	–	–	65	183	138

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
El Salvador ^{1,2,3}	Suspected cases	115 256	100 883**	124 885	103 748	106 915
	Presumed and confirmed	26	15^	20	7	8
	Confirmed	26	15^	20	7	8
	Microscopy examined	115 256	100 883	124 885	103 748	106 915
	Microscopy positive	26	15	20	7	8
	RDT examined	–	1	–	–	–
	RDT positive	–	1	–	–	–
	Imported cases	9	8	7	1	2
French Guiana ²	Suspected cases	14 373	14 429	13 638	22 327	14 651
	Presumed and confirmed	1 632^†	1 209^†	900^†	875*	448
	Confirmed	1 632^†	1 209^†	900^†	875*	448
	Microscopy examined	14 373	14 429	13 638	22 327	14 651
	Microscopy positive	1 085	720	523	321	242
	RDT examined	–	–	–	–	–
	RDT positive	944	704	499	551	206
	Imported cases	–	–	–	–	–
	Relapse cases	–	–	–	–	–
Guatemala ²	Suspected cases	237 075	195 080	186 645	153 731	250 964**
	Presumed and confirmed	7 384*	6 817	5 346	6 214	4 931
	Confirmed	7 384*	6 817	5 346	6 214	4 931
	Microscopy examined	235 075	195 080	186 645	153 731	250 964
	Microscopy positive	7 198	6 817	5 346	6 214	4 931
	RDT examined	2 000	–	–	–	50 025
	RDT positive	–	–	–	–	–
	Imported cases	–	–	–	–	2
Guyana ²	Suspected cases	212 863	201 693**	196 622	205 903	142 843
	Presumed and confirmed	22 935	29 471^	31 601^	31 479	12 354
	Confirmed	22 935	29 471^	31 601^	31 479	12 354
	Microscopy examined	212 863	201 693	196 622	205 903	142 843
	Microscopy positive	22 935	29 471	31 601	31 479	12 354
	RDT examined	–	35	–	–	–
	RDT positive	–	35	55	–	–
	Imported cases	–	–	–	–	–
	Relapse cases	–	–	–	–	–
Haiti	Suspected cases	270 427	184 934	167 772	171 409	261 403
	Presumed and confirmed	84 153	34 350	27 866	26 543	17 696
	Confirmed	84 153	34 350	27 866	26 543	17 696
	Microscopy examined	270 427	184 934	167 726	165 823	134 766
	Microscopy positive	84 153	34 350	27 866	26 543	10 893
	RDT examined	–	–	46	5 586	126 637
	RDT positive	–	–	–	–	6 803
Honduras ²	Suspected cases	152 961**	152 451*	155 165*	144 436**	151 420**
	Presumed and confirmed	9 745	7 618^	6 439^	5 364^	3 380^
	Confirmed	9 745	7 618^	6 439^	5 364^	3 380^
	Microscopy examined	152 961	152 451	155 165	144 436	151 420
	Microscopy positive	9 745	7 618	6 439	5 364	3 380
	RDT examined	1 500	4 000	4 000	237	1 427
	RDT positive	–	49	10	64	102
	Imported cases	–	–	–	–	2
	Relapse cases	–	–	–	–	–
Mexico ²	Suspected cases	1 192 081	1 035 424	1 025 659	1 017 508	900 578
	Presumed and confirmed	1 233	1 130	842	499	666
	Confirmed	1 233	1 130	842	499	666
	Microscopy examined	1 192 081	1 035 424	1 025 659	1 017 508	900 578
	Microscopy positive	1 233	1 130	842	499	666
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	7	6	9	4	10
	Relapse cases	0	0	0	0	0
Nicaragua ²	Suspected cases	554 414	536 105	552 722	539 022	605 357
	Presumed and confirmed	692	925	1 235	1 196	1 163
	Confirmed	692	925	1 235	1 196	1 163
	Microscopy examined	535 914	521 904	536 278	519 993	605 357
	Microscopy positive	692	925	1 235	1 196	1 163
	RDT examined	18 500	14 201	16 444	19 029	–
	RDT positive	–	–	–	–	–
	Imported cases	–	–	–	34	21

2015	2016	2017	2018	2019	2020	2021	2022
89 267	81 904	70 022	52 216**	89 992	18 868	12 415	22 235
9	14	4	2^	3	0	4	1
9	14	4	2^	3	0	4	1
89 267	81 904	70 022	52 216	89 992	18 868	12 415	22 235
9	14	4	2	3	0	4	1
–	–	–	1	–	–	–	–
–	–	–	1	–	–	–	–
4	1	3	2	3	0	4	1
11 558	9 430	–	–	–	6 238	–	5 322**
434	258	597	546	212 [§]	154	143	51^
434	258	597	546	212 [§]	154	143	51^
11 558	9 430	–	–	–	6 238	–	4 600
297	173	468	546	178	120	122	38
–	–	–	–	–	–	–	736
137	85	129	–	34	34	21	27
60	41	43	–	36	14	37	15
0	0	0	–	–	–	32	15
295 246**	333 535**	372 158**	438 833**	427 239**	319 660**	369 252	454 272
5 540^	5 001*	4 124†	3 021†	2 072^	1 058†	1 273	1 856*
5 540^	5 001*	4 124†	3 021†	2 072^	1 058†	1 273	1 856*
295 246	333 535	372 158	438 833	427 239	319 660	369 252	381 272
5 538	4 854	3 744	3 021	2 072	1 058	1 273	1 811
6 500	74 859	170 325	75 300	61 275	16 000	–	73 000
1 298	1	2 078	1 748	1 309	292	–	–
2	1	3	3	3	0	–	–
132 941	117 483	100 348	101 346	103 836	72 821**	89 809	93 879
9 984	11 108^†	13 936^	17 038^	18 826	17 230^	20 850*	20 769
9 984	11 108^†	13 936^	17 038^	18 826	17 230^	20 850*	20 769
132 941	110 891	100 105	95 986	85 736	49 496	63 165	73 726
9 984	10 906	13 734	15 607	13 840	8 932	11 785	15 106
–	6 592	243	5 360	18 100	27 116	26 622	20 153
–	1 724	242	3 570	4 986	10 025	9 065	5 663
–	411	–	–	184	51	64	39
–	0	–	–	–	–	–	–
330 603	459 959	330 738**	287 522**	266 675	245 202	198 881	230 117
17 583^†	21 430^†	19 135†	8 828†	10 687	22 996*	9 513^	14 757
17 583^†	21 430^†	19 135†	8 828†	10 687	22 996*	9 513^	14 757
69 659	61 428	62 539	59 803	35 144	7 855	18 130	23 157
5 224	4 342	2 119	1 586	765	1 446	674	831
260 944	398 531	301 812	253 001	231 531	226 374	180 751	206 960
12 702	23 325	18 309	8 232	9 922	21 541	9 333	13 926
152 730**	173 651**	148 160**	142 780**	142 870**	10 350	165 853	159 584
3 555^	4 097^	1 283†	653†	391^	913^	1 657^	3 580*
3 555^	4 097^	1 283†	653†	391^	913^	1 657^	3 580*
150 854	167 836	148 160	142 780	142 870	–	151 244	138 052
3 555	4 097	1 283	653	391	913	1 657	3 321
4 928	20 745	25 870	31 556	18 754	10 350	14 609	21 532
79	657	263	454	193	539	968	259
0	3	10	21	61	98	105	36
0	0	0	3	0	0	19	4
867 853**	798 568**	644 174**	548 247	531 471**	242 200	298 496	376 185
551†	596†	765^	803^	641†	369	275	244
551†	596†	765^	803^	641†	369	275	244
867 853	798 568	644 174	548 247	531 471	242 200	298 496	372 714
551	596	765	836	641	369	275	215
7	6	6	–	161	–	–	3 471
7	6	6	–	3	–	–	29
34	45	29	23	22	10	31	77
0	0	5	10	1	2	2	3
604 418	554 415	663 132	831 077**	1 029 288	947 451	1 158 806	1 616 617
2 308	6 284	10 952	15 934^	13 226	31 763	23 323	16 158*
2 308	6 284	10 952	15 934^	13 226	25 530	23 323	16 158*
604 418	553 615	660 452	831 077	1 001 225	884 821	1 158 806	–
2 308	6 284	10 952	15 934	12 337	18 799	16 684	10 361
–	800	2 680	44 905	28 063	56 397	–	–
–	–	–	2 885	889	6 731	6 639	5 747
29	12	3	17	26	25	64	50

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Panama ²	Suspected cases	141 038	116 588	107 711	93 624	80 701
	Presumed and confirmed	418	354	844	705	874
	Confirmed	418	354	844	705	874
	Microscopy examined	141 038	116 588	107 711	93 624	80 701
	Microscopy positive	418	354	844	705	874
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	–	–	–	9	10
	Relapse cases	–	–	–	0	0
Paraguay ^{1,2,3}	Suspected cases	62 178	48 611	31 499	24 806	24 832
	Presumed and confirmed	29	10	15	11	8
	Confirmed	29	10	15	11	8
	Microscopy examined	62 178	48 611	31 499	24 806	24 832
	Microscopy positive	29	10	15	11	8
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	9	9	15	11	8
Peru ²	Suspected cases	744 627**	702 894**	758 723**	863 790**	864 413**
	Presumed and confirmed	31 545 [‡]	25 005 [‡]	31 436	48 719	65 252
	Confirmed	31 545 [‡]	25 005 [‡]	31 436	48 719	65 252
	Microscopy examined	744 627	702 894	758 723	863 790	864 413
	Microscopy positive	31 545	25 005	31 436	48 719	65 252
	RDT examined	23	58	562	858	1 634
	RDT positive	1	34	–	–	–
	Imported cases	–	–	–	–	–
Suriname ^{2,3}	Suspected cases	17 902	16 160	22 134	19 736	33 097
	Presumed and confirmed	1 771*	795*	569*	729	401
	Confirmed	1 771 [†]	795*	569*	729	401
	Microscopy examined	16 533	15 135	17 464	13 693	17 608
	Microscopy positive	1 574	751	306	530	98
	RDT examined	1 369	1 025	4 670	6 043	15 489
	RDT positive	190	20	248	199	303
	Imported cases	–	–	–	204	–
	Relapse cases	–	–	–	–	–
Venezuela (Bolivarian Republic of) ²	Suspected cases	400 495	382 303	410 663	476 764	522 617
	Presumed and confirmed	45 155	45 824	52 803	80 320	91 918
	Confirmed	45 155	45 824	52 803	80 320	91 918
	Microscopy examined	400 495	382 303	410 663	476 764	522 617
	Microscopy positive	45 155	45 824	52 803	80 320	91 918
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	–	–	–	1 677	1 210
	Relapse cases	–	–	–	–	–
EASTERN MEDITERRANEAN						
Afghanistan	Suspected cases	865 181	936 252	847 933	817 606	881 515
	Presumed and confirmed	392 864	482 748	391 365	326 593	317 608
	Confirmed	69 798	77 549	54 840	52 965	106 478
	Microscopy examined	524 523	531 053	511 408	507 145	514 466
	Microscopy positive	69 397	77 549	54 840	46 114	83 920
	RDT examined	17 592	–	–	36 833	155 919
	RDT positive	401	–	–	6 851	22 558
Djibouti	Suspected cases	–	354	1 412	7 189	39 284
	Presumed and confirmed	1 010	230	27	1 684	9 439
	Confirmed	1 010	–	25	1 684	9 439
	Microscopy examined	–	124	1 410	7 189	39 284
	Microscopy positive	1 010	–	22	1 684	9 439
	RDT examined	–	–	–	–	–
	RDT positive	–	–	3	–	–
Iran (Islamic Republic of) [‡]	Suspected cases	614 817	530 470	479 655	385 172	468 513
	Presumed and confirmed	3 031	3 239	1 629	1 374	1 243
	Confirmed	3 031	3 239	1 629	1 374	1 243
	Microscopy examined	614 817	530 470	479 655	385 172	468 513
	Microscopy positive	3 031	3 239	1 629	1 374	1 243
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	1 184	1 529	842	853	867
	Relapse cases	–	–	19	14	11

2015	2016	2017	2018	2019	2020	2021	2022
64 511	50 772	38 270**	23 383**	22 171	14 809	18 779**	44 785**
562 ^{^‡}	811 ^{^‡}	689 [^]	715 [^]	1 597**	2 206***	4 364 [‡]	7 173 [^]
562 ^{^‡}	811 ^{^‡}	689 [^]	715 [^]	1 597**	2 206***	4 364 [‡]	7 173 [^]
64 511	50 772	38 270	23 383	18 217	7 027	6 105	25 732
562	811	689	715	1 209	1 358	649	628
–	–	829	1 141	3 954	7 782	17 239	29 319
3	5	689	424	388	2 109	4 253	6 800
16	42	40	31	15	10	7	31
0	0	0	0	130	135	192	467
6 687**	3 192**	8 014**	–	11 415	11 221	11 073**	11 183**
8 [^]	10 [^]	5 [^]	0	2	1	4 [^]	3 [^]
8 [^]	10 [^]	5 [^]	0	2	1	4 [^]	3 [^]
6 687	3 192	8 014	–	11 336	11 196	11 073	11 183
8	10	5	0	1	1	4	3
10	1	1 267	–	79	25	153	49
1	1	2	–	1	0	3	3
8	10	5	0	2	1	4	3
865 980**	566 230	388 699**	304 785**	243 240	–	412 933	279 778
66 609 [‡]	56 671	55 367 [‡]	45 619 [‡]	24 483	15 847	18 140	27 785
66 609 [‡]	56 671	55 367 [‡]	45 619 [‡]	24 483	15 847	18 140	27 785
865 980	566 230	388 699	304 785	243 240	–	412 933	278 546
66 609	56 671	55 367	45 619	24 483	15 847	18 140	26 553
18 133	–	13 924	160 000	–	–	–	1 232
463	–	2 325	1 000	–	–	–	1 232
–	48	57	176	159	25	65	0
15 236	23 444	22 302	19 836	20 743	14 057**	16 597**	11 466**
376	332	551 ^{^‡}	235	215	244 [^]	77 [^]	61
376	332	551 ^{^‡}	235	215	244 [^]	77 [^]	61
15 083	14 946	12 536	11 799	13 702	13 798	16 592	11 445
345	321	412	218	209	238	77	51
153	8 498	9 766	8 037	7 041	14 043	16 513	11 433
31	11	160	17	6	6	76	10
295	251	414	198	111	88	53	60
0	3	0	7	0	3	0	0
625 174	852 556	1 144 635	699 130	1 104 736	725 591	600 242	553 872
137 996	301 466	525 897	522 059*	492 753*	232 757*	194 057	151 458*
137 996	301 466	525 897	522 059*	492 753*	232 757*	194 057	151 458*
625 174	852 556	1 144 635	699 130	1 040 683	655 707	342 616	283 790
137 996	301 466	525 897	404 924	398 285	197 466	113 863	81 002
–	–	–	–	64 053	69 884	257 626	270 082
–	–	–	48 117	64 053	69 884	80 194	70 456
1 594	1 948	2 941	2 125	1 848	1 356	829	1 544
–	58 390	111 360	106 886	87 029	31 308	12 806	14 274
939 964	1 055 368	1 143 511	1 240 523	1 008 487	943 267	917 108	954 750
383 008	436 017	413 536	299 863	174 894	105 445	86 370	125 788
119 859	241 233	313 086	248 689	173 860	105 295	86 263	125 620
538 789	598 556	611 904	665 200	561 160	449 875	483 806	596 883
103 377	151 528	194 866	104 960	71 389	38 923	35 149	59 891
138 026	262 028	431 157	524 149	446 293	389 994	433 195	357 699
16 482	89 705	118 220	143 729	102 471	66 372	51 114	65 729
10 586	19 492	75 594	104 800	214 101	268 147**	218 591	213 680
9 557	13 822	14 810	25 319	49 402*	73 535	58 916	40 648
9 473	13 822	14 810	25 319	49 402*	73 535	58 916	40 648
10 502	19 492	24 504	–	–	42 250	50 157	49 837
1 764	2 280	1 283	–	–	11 633	13 210	10 084
–	–	51 090	104 800	214 101	268 147	168 434	163 843
7 709	11 542	13 527	25 319	49 402	73 535	45 706	30 564
610 337	418 125	383 397	477 914**	455 855**	388 232	275 419*	604 963**
799	705	939	625 [‡]	1 190	1 051 [^]	999	5 677
799	705	939	625 [‡]	1 190	1 051 [^]	999	5 677
610 337	418 125	383 397	477 914	454 322	334 861	275 419	568 492
799	705	939	625	1 190	1 046	994	5 665
–	–	–	64 061	101 803	53 371	25 025	39 223
–	–	–	436	1 089	516	5	2 229
632	611	868	602	1 107	878	821	4 238
2	3	0	3	0	2	0	0

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
EASTERN MEDITERRANEAN						
Pakistan	Suspected cases	8 601 835	8 418 570	8 902 947	7 682 166	8 375 256
	Presumed and confirmed	4 281 356	4 065 802	4 285 449	3 465 620	3 655 975
	Confirmed	240 591	334 589	290 781	274 648	264 867
	Microscopy examined	4 281 346	4 168 648	4 497 330	3 786 216	4 179 468
	Microscopy positive	220 870	287 592	250 526	183 091	183 180
	RDT examined	279 724	518 709	410 949	704 978	804 680
	RDT positive	19 721	46 997	40 255	91 557	81 687
Saudi Arabia ^{2,3}	Suspected cases	944 723	1 062 827	1 186 179	1 309 783	1 249 752
	Presumed and confirmed	1 941	2 788	3 406	2 513	2 305
	Confirmed	1 941	2 788	3 406	2 513	2 305
	Microscopy examined	944 723	1 062 827	1 186 179	1 309 783	1 249 752
	Microscopy positive	1 941	2 788	3 406	2 513	2 305
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	1 912	2 719	3 324	2 479	2 254
Somalia	Suspected cases	223 981	99 403	53 658	88 734	92 103
	Presumed and confirmed	24 833	41 167	23 202	9 135 [^]	26 419
	Confirmed	24 833	3 351	6 817	7 407 [^]	11 246
	Microscopy examined	20 593	26 351	–	19 542	12 450
	Microscopy positive	5 629	1 627	–	841	245
	RDT examined	203 388	35 236	37 273	67 464	64 480
	RDT positive	19 204	1 724	6 817	7 407	11 001
Sudan	Suspected cases	2 398 239	2 929 578	2 438 467	2 197 563	–
	Presumed and confirmed	1 465 496	1 214 004	964 698	989 946	1 207 771
	Confirmed	720 557	506 806	526 931	592 383	1 068 506
	Microscopy examined	–	–	–	–	–
	Microscopy positive	625 365	506 806	526 931	592 383	579 038
	RDT examined	1 653 300	2 222 380	2 000 700	1 800 000	788 281
	RDT positive	95 192	–	–	–	489 468
Yemen	Suspected cases	835 018	804 401	888 952	927 821	821 618
	Presumed and confirmed	198 963	142 152	165 687	149 451	122 812
	Confirmed	106 697	90 954	112 359	102 778	86 707
	Microscopy examined	645 463	645 093	685 406	723 691	643 994
	Microscopy positive	78 269	60 751	71 300	63 484	51 768
	RDT examined	97 289	108 110	150 218	157 457	141 519
	RDT positive	28 428	30 203	41 059	39 294	34 939
EUROPEAN						
Armenia ^{1,2}	Suspected cases	31 026	–	–	–	–
	Presumed and confirmed	1	0	4	0	1
	Confirmed	1	–	4	0	1
	Microscopy examined	31 026	–	–	–	–
	Microscopy positive	1	–	4	–	1
	Imported cases	1	–	4	0	1
Azerbaijan ^{1,2}	Suspected cases	456 652	449 168	497 040	432 810	399 925
	Presumed and confirmed	52	8	4	4	2
	Confirmed	52	8	4	4	2
	Microscopy examined	456 652	449 168	497 040	432 810	399 925
	Microscopy positive	52	8	4	4	2
	Imported cases	2	4	1	4	2
Georgia ²	Suspected cases	2 368	2 032	1 046	192	440
	Presumed and confirmed	0	6	5	7	5
	Confirmed	0	6	5	7	5
	Microscopy examined	2 368	2 032	1 046	192	440
	Microscopy positive	0	6	5	7	5
	Imported cases	0	5	4	7	5
Kyrgyzstan ^{1,2}	Suspected cases	30 190	27 850	18 268	54 249	35 600
	Presumed and confirmed	6	5	3	4	0
	Confirmed	6	5	3	4	0
	Microscopy examined	30 190	27 850	18 268	54 249	35 600
	Microscopy positive	6	5	3	4	0
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	3	5	3	4	0
Tajikistan ^{1,2}	Suspected cases	173 523	173 367	209 239	213 916	200 241
	Presumed and confirmed	116	100	54	25	7
	Confirmed	116	100	54	25	7
	Microscopy examined	173 523	173 367	209 239	213 916	200 241
	Microscopy positive	116	100	54	25	7
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	4	22	11	10	5

2015	2016	2017	2018	2019	2020	2021	2022
8 943 120	8 216 519	8 200 987	7 226 725	8 157 351	7 172 956	7 789 443	13 051 047
3 778 090	2 126 497	2 209 708	1 069 052	413 533	372 416	400 316	1 824 844
203 859	329 005	369 817	374 510	413 533	371 828	399 097	1 824 396
4 620 326	5 091 840	4 539 957	4 324 570	4 855 044	3 607 265	4 231 801	6 742 977
138 130	157 554	132 580	119 099	125 804	83 859	86 319	474 654
748 563	1 327 187	1 821 139	2 207 613	3 302 307	3 564 489	3 556 423	6 307 622
65 729	171 451	237 237	255 411	287 729	287 969	312 778	1 349 742
1 306 700	1 267 933	1 073 998	1 015 953	1 118 706 ^{**}	703 048 ^{**}	642 818	764 822
2 620	5 382	3 151	2 711	2 152 [‡]	3 658	2 616 [^]	4 319
2 620	5 382	3 151	2 711	2 152 [‡]	3 658	2 616 [^]	4 319
1 306 700	1 267 933	1 073 998	1 015 953	1 118 706	403 972	429 910	206 975
2 620	5 382	3 151	2 711	2 152	3 658	1 091	2 608
–	–	–	–	1 118 706	399 076	212 908	557 847
–	–	–	–	2 152	3 205	1 525	1 711
2 537	5 110	2 974	2 517	2 029	3 453	2 470	4 045
119 008	205 753	228 912	253 220	332 935 ^{**}	337 965	376 167	348 740
39 169	58 021	37 156	31 030	65 375 [‡]	27 333 [*]	50 648	23 450 [*]
20 953	35 628	35 138	31 021	39 687 [‡]	27 333 [*]	12 967	11 550 [*]
–	–	–	–	59 494	–	32 175	25 182
–	–	–	–	11 615	–	4 463	4 174
100 792	183 360	226 894	253 211	332 935	337 965	298 929	311 658
20 953	35 628	35 138	31 021	39 687	27 333	8 504	7 376
4 101 841	4 199 740	3 691 112	9 760 505	7 642 050	8 211 933	8 145 586	7 957 950
1 102 186	897 194	1 642 058	3 627 586	3 568 941	3 412 499	3 960 655	3 768 163 [*]
586 827	566 015	800 116	1 648 683	1 752 011	1 698 394	1 647 745	1 355 789 [*]
3 586 482	3 236 118	2 426 329	6 668 355	4 797 856	5 568 277	4 742 722	4 665 151
586 827	378 308	588 100	1 262 210	1 408 242	1 262 841	1 309 893	1 137 726
–	632 443	422 841	1 113 247	1 027 264	929 551	1 056 085	823 287
–	187 707	212 016	386 473	343 769	435 553	337 852	218 063
711 680	1 217 602	1 659 798	779 312	1 283 681	1 280 190 ^{**}	1 573 986	1 592 228
104 831	145 627	143 333	233 143	216 763	202 671	244 857	201 792
76 259	99 700	143 333	157 900	165 899	164 066	180 339	155 127
561 644	960 860	1 070 020	419 415	841 358	791 049	772 511	695 371
42 052	45 886	28 936	64 233	104 350	97 008	83 436	62 281
121 464	210 815	589 778	284 654	391 459	450 541	736 957	850 192
34 207	53 814	114 397	93 667	61 549	67 058	96 903	92 846
1 213	465	350	320	–	121	–	–
2	2	2	6	0	3	–	2
2	2	2	6	–	3	–	–
1 213	465	350	320	–	121	–	–
2	2	2	6	–	3	–	–
2	2	2	6	–	3	–	2
405 416	465 860	373 562	358 009	–	–	–	–
1	1	1	2	0	0	0	1
1	1	1	2	0	0	–	–
405 416	465 860	373 562	358 009	–	–	–	–
1	1	1	2	0	–	–	–
1	1	1	2	0	0	0	1
294	318	416	286	335	237	–	–
6	7	9	9	8	4	0	–
6	7	9	9	8	4	–	–
294	318	416	286	335	237	–	–
6	7	9	9	8	4	–	–
5	7	8	9	8	4	–	–
75 688	62 537	8 459	7 709	46 384	18 717	–	–
1	6	2	0	1	0	0	–
1	6	2	0	1	0	–	–
75 688	62 537	8 459	7 709	46 384	18 717	–	–
1	6	2	0	1	0	–	–
0	0	0	–	–	–	–	–
0	0	0	–	–	–	–	–
0	0	0	–	–	–	–	–
1	6	2	0	1	0	–	–
188 341 ^{**}	198 766 ^{**}	191 284 ^{**}	–	209 830	159 124	–	–
4 [^]	1 [^]	3 [^]	0	3	0	0	1
4 [^]	1 [^]	3 [^]	–	3	0	–	–
188 341	198 766	191 284	–	207 821	159 124	–	–
4	1	3	–	3	0	–	–
42 056	34 570	41 218	–	2 009	–	–	–
4	1	3	–	–	–	–	–
4	1	3	–	3	0	0	1

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
EUROPEAN						
Türkiye ²	Suspected cases	507 841	421 295	337 830	255 125	189 854
	Presumed and confirmed	90	132	595	285	254
	Confirmed	90	132	595	285	254
	Microscopy examined	507 841	421 295	337 830	255 125	189 854
	Microscopy positive	90	132	595	285	254
	Imported cases	81	128	376	251	249
Turkmenistan ^{1,2}	Suspected cases	81 784	–	–	–	–
	Presumed and confirmed	0	0	0	0	0
	Confirmed	0	0	0	0	0
	Microscopy examined	81 784	–	–	–	–
	Microscopy positive	–	–	–	–	–
	Imported cases	0	0	0	0	0
Uzbekistan ^{1,2}	Suspected cases	921 364	886 243	805 761	908 301	812 347
	Presumed and confirmed	6	1	1	3	1
	Confirmed	6	1	1	3	1
	Microscopy examined	921 364	886 243	805 761	908 301	812 347
	Microscopy positive	6	1	1	3	1
	Imported cases	2	1	1	3	1
SOUTH-EAST ASIA						
Bangladesh ²	Suspected cases	467 767	390 930	372 806	418 755	630 181
	Presumed and confirmed	62 378	52 601	29 518	26 891	57 480
	Confirmed	55 873	51 773	29 518	26 891	57 480
	Microscopy examined	308 326	270 253	253 887	290 496	418 519
	Microscopy positive	20 519	20 232	9 901	7 303	13 628
	RDT examined	152 936	119 849	118 919	128 259	211 662
	RDT positive	35 354	31 541	19 617	19 588	43 852
	Imported cases	–	–	–	–	–
Bhutan ^{2,3}	Suspected cases	54 760	44 494	42 512	31 632	33 586
	Presumed and confirmed	487	207	82	45	48
	Confirmed	436	194	82	45	48
	Microscopy examined	54 709	44 481	42 512	31 632	33 586
	Microscopy positive	436	194	82	45	48
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	–	–	0	23	34
Democratic People's Republic of Korea	Relapse cases	–	–	0	–	0
	Suspected cases	27 019	27 857	40 925	72 719	38 878
	Presumed and confirmed	15 392	18 104	23 537	15 673	11 212
	Confirmed	13 520	16 760	21 850	14 407	10 535
	Microscopy examined	25 147	26 513	39 238	71 453	38 201
	Microscopy positive	13 520	16 760	21 850	14 407	10 535
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
India	Imported cases	–	–	–	–	–
	Suspected cases	119 279 429	119 470 044	122 170 278	127 891 198	138 628 331
	Presumed and confirmed	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	Confirmed	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	Microscopy examined	108 679 429	108 969 660	109 044 798	113 109 094	124 066 331
	Microscopy positive	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	RDT examined	10 600 000	10 500 384	13 125 480	14 782 104	14 562 000
	RDT positive	–	–	–	–	–
Indonesia ^{2,5}	Suspected cases	1 591 179	1 212 799	1 900 725	1 708 161	1 550 296
	Presumed and confirmed	465 764	422 447	417 819	343 527	252 027
	Confirmed	465 764	422 447	417 819	343 527	252 027
	Microscopy examined	1 335 445	962 090	1 429 139	1 447 980	1 300 835
	Microscopy positive	465 764	422 447	417 819	343 527	252 027
	RDT examined	255 734	250 709	471 586	260 181	249 461
	RDT positive	–	–	–	–	–
	Imported cases	–	–	–	–	–
Myanmar ²	Suspected cases	1 277 568	1 210 465	1 424 004	1 300 556	1 567 095
	Presumed and confirmed	693 124	567 452	481 242	333 871	205 658
	Confirmed	420 808	465 294	481 204	333 871	205 658
	Microscopy examined	275 374	312 689	265 135	138 473	151 258
	Microscopy positive	103 285	91 752	75 220	26 509	12 010
	RDT examined	729 878	795 618	1 158 831	1 162 083	1 415 837
	RDT positive	317 523	373 542	405 984	307 362	193 648
	Imported cases	–	–	–	–	–
	Relapse cases	–	–	–	–	–

2015	2016	2017	2018	2019	2020	2021	2022
211 740	144 499	115 557	95 877	59 429	54 586	–	–
224	209	214	238	279	135	–	–
224	209	214	238	279	135	–	–
211 740	144 499	115 557	95 877	59 429	54 586	–	–
224	209	214	238	279	135	–	–
221	208	214	237	277	133	–	–
83 675	85 536	84 264	85 722	78 903	71 887	–	–
0	0	0	0	3	0	0	–
0	0	0	0	3	0	–	–
83 675	85 536	84 264	85 722	78 903	71 887	–	–
–	–	–	0	3	0	–	–
0	0	0	0	3	0	–	–
800 912	797 472	655 112	650 616	669 373	552 458	–	–
0	0	0	0	1	2	0	–
0	0	0	0	1	2	–	–
800 912	797 472	655 112	650 616	669 373	552 458	–	–
0	0	0	0	1	2	–	–
0	0	0	0	1	2	–	–
786 830	993 589	986 442	1 300 691	1 507 230	1 416 473	1 470 849	1 632 840
39 719	27 737	29 247	10 523	17 225	6 130	7 294	18 246
39 719	27 737	29 247	10 523	17 225	6 130	7 294	18 246
527 659	573 540	613 304	800 251	750 657	611 307	370 589	460 668
6 621	3 217	3 325	1 135	1 311	262	458	906
259 171	420 049	373 138	500 440	756 573	805 166	1 100 260	1 172 172
33 098	24 520	25 922	9 388	15 914	5 868	6 836	17 340
129	109	19	41	6	2	6	13
74 087	118 841	120 667	133 498	119 975	31 522	25 510	42 205
104	74	51 ^A	54	42 ^A	54	23	6
104	74	51 ^A	54	42 ^A	54	23	6
26 149	23 442	22 885	19 778	18 973	6 246	8 742	12 146
84	59	51	49	38	46	23	6
47 938	95 399	97 782	113 720	101 002	25 276	16 768	30 059
20	15	11	5	37	8	0	0
70	56	38	34	30	9	13	3
0	0	0	0	0	0	1	0
91 007	205 807	189 357	685 704	461 998	357 778	45 711	378 989
7 409	5 113	4 626	3 698	1 869	1 819	2 357	2 136
7 022	5 033	4 603	3 698	1 869	1 819	2 357	2 136
29 272	22 747	16 835	28 654	3 255	3 681	45 711	11 673
7 010	4 890	4 463	3 446	886	1 162	2 357	2 056
61 348	182 980	172 499	657 050	458 743	354 097	0	367 316
12	143	140	252	983	657	0	80
–	–	–	–	–	–	–	0
140 841 230	144 539 608	125 977 799	124 613 482	134 230 349	97 177 024	114 400 959	152 523 919
1 169 261	1 087 285	844 558	429 928	338 494	186 532	161 753	176 522
1 169 261	1 087 285	844 558	429 928	338 494	186 532	161 753	176 522
121 141 970	124 933 348	110 769 742	111 123 775	113 969 785	73 294 318	87 951 904	117 785 803
1 169 261	1 087 285	306 768	230 432	132 750	65 468	67 604	75 222
19 699 260	19 606 260	15 208 057	13 489 707	20 260 564	23 882 706	26 440 073	34 264 089
–	–	537 790	199 496	205 744	121 064	94 149	101 300
1 567 450	1 457 858	1 441 679	1 700 094	2 491 516	1 940 676	2 128 771	3 395 811
217 025	218 450	261 617	222 345	250 646	254 055	304 607	443 530
217 025	218 450	261 617	222 345	250 646	254 055	304 607	443 530
1 224 504	1 092 093	1 045 994	1 322 026	1 899 437	1 367 987	1 399 683	1 743 771
217 025	218 450	261 617	190 782	212 997	192 769	216 744	293 356
342 946	365 765	395 685	378 068	592 079	516 167	640 609	1 612 968
–	–	–	31 563	37 649	61 286	87 863	150 174
–	–	–	11	61	38	27	67
2 657 555	3 185 245	3 368 697	3 183 758	3 708 802**	3 665 239**	1 958 385**	2 660 341**
182 465 ^A	110 146	85 019	76 518	56 414 ^A	58 836	79 001 ^A	157 538 ^A
182 465 ^A	110 146	85 019	76 518	56 414 ^A	58 836	79 001 ^A	157 538 ^A
98 014	122 078	107 242	58 126	50 902	57 950	43 929	128 630
6 453	6 717	4 648	2 577	1 054	2 167	2 669	5 399
2 559 541	3 063 167	3 261 455	3 125 632	3 666 973	3 627 732	1 919 075	2 546 083
176 163	103 429	80 371	73 941	55 590	57 009	76 377	153 071
–	–	–	–	–	9	1	5
–	–	–	–	–	140	12	65

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
SOUTH-EAST ASIA						
Nepal ²	Suspected cases	213 353	188 702	276 752	168 687	200 631
	Presumed and confirmed	96 383	71 752	71 410	37 336	26 556
	Confirmed	3 894	3 414	3 230	1 974	1 499
	Microscopy examined	102 977	95 011	152 780	100 336	127 130
	Microscopy positive	3 115	1 910	1 659	1 197	1 499
	RDT examined	17 887	25 353	55 792	32 989	48 444
	RDT positive	779	1 504	1 571	777	–
	Imported cases	–	1 079	1 026	–	667
Sri Lanka ^{1,2}	Suspected cases	1 001 107	985 060	957 155	1 249 846	1 078 884
	Presumed and confirmed	736	175	93	95	49
	Confirmed	736	175	93	95	49
	Microscopy examined	1 001 107	985 060	948 250	1 236 580	1 069 817
	Microscopy positive	736	175	74	93	45
	RDT examined	–	–	8 905	13 266	9 067
	RDT positive	–	–	19	2	4
	Imported cases	52	51	70	95	49
Thailand ^{2,5}	Suspected cases	1 777 977	1 450 885	1 272 324	1 927 585	1 833 061
	Presumed and confirmed	32 480	24 897	46 895	41 602	41 218
	Confirmed	32 480	24 897	46 895	41 602	41 218
	Microscopy examined	1 695 980	1 354 215	1 130 757	1 830 090	1 756 528
	Microscopy positive	22 969	14 478	32 569	33 302	37 921
	RDT examined	81 997	96 670	141 567	97 495	76 533
	RDT positive	9 511	10 419	14 326	8 300	3 297
	Imported cases	–	–	–	–	–
Timor-Leste ^{2,3}	Relapse cases	–	–	–	–	–
	Suspected cases	–	143 690	118 120	122 008	86 597
	Presumed and confirmed	119 074	36 153	6 148	1 042	347
	Confirmed	48 139	19 735	5 208	1 025	342
	Microscopy examined	–	–	–	–	–
	Microscopy positive	–	–	–	–	–
	RDT examined	48 042	127 272	117 180	121 991	86 592
	RDT positive	48 139	19 735	5 208	1 025	342
	Imported cases	–	–	–	–	–
	Relapse cases	–	–	–	–	–
WESTERN PACIFIC						
Cambodia ^{2,6}	Suspected cases	411 104	356 606	300 344	207 483	356 027
	Presumed and confirmed	181 857	106 905	74 628	46 890	70 304
	Confirmed	96 464	106 905	69 551	44 069	69 178
	Microscopy examined	90 175	86 526	80 212	54 716	48 591
	Microscopy positive	14 277	13 792	10 124	4 598	5 288
	RDT examined	235 536	270 080	215 055	149 946	306 310
	RDT positive	82 187	93 113	59 427	39 471	63 890
	Imported cases	–	–	–	–	–
China ^{1,2,3}	Relapse cases	–	–	–	–	–
	Suspected cases	7 118 649	9 190 401	6 918 770	5 555 001	4 403 633
	Presumed and confirmed	9 973	4 498	2 716	4 246	3 080
	Confirmed	7 108	3 367	2 603	4 205	3 080
	Microscopy examined	7 115 784	9 189 270	6 918 657	5 554 960	4 403 633
	Microscopy positive	7 108	3 367	2 603	4 205	3 080
	Imported cases	2 118	2 059	2 399	4 051	3 026
Lao People's Democratic Republic ²	Suspected cases	340 119	244 956	336 783	359 143	313 859
	Presumed and confirmed	22 879	17 532	46 153	39 589	50 674
	Confirmed	22 879	17 532	46 153	39 589	50 674
	Microscopy examined	212 202	167 125	192 594	225 795	153 198
	Microscopy positive	6 619	6 223	13 206	11 487	10 629
	RDT examined	127 917	77 831	144 189	133 348	160 661
	RDT positive	16 260	11 309	32 947	28 102	40 045
	Imported cases	–	–	–	–	–
Malaysia ^{2,3,5}	Relapse cases	–	–	–	–	–
	Suspected cases	1 619 074	1 600 439	1 566 872	1 576 012	1 443 958
	Presumed and confirmed	6 650	5 306	4 725	3 850	3 923
	Confirmed	6 650	5 306	4 725	3 850	3 923
	Microscopy examined	1 619 074	1 600 439	1 566 872	1 576 012	1 443 958
	Microscopy positive	6 650	5 306	4 725	3 850	3 923
	Imported cases	831	1 142	924	865	766
	Relapse cases	–	–	–	32	0

2015	2016	2017	2018	2019	2020	2021	2022
131 654	146 705	165 640**	256 020	224 726	158 776	159 912**	371 296
19 171^	10 687	3 610^	3 031	710	430	373^	512
1 112^	1 009	1 293^	1 293	710	430	373^	512
63 946	84 595	163 323	160 904	92 367	31 304	24 221	82 917
1 112	1 009	1 293	1 158	102	29	18	404
49 649	52 432	97 870	93 378	131 631	127 228	159 635	287 974
725	–	449	135	608	401	373	108
521	502	670	539	579	357	359	476
1 157 366	1 090 743	1 104 333	1 149 897	1 164 914**	820 210	680 386	808 827
36	41	57	52	54^	30	26	37
36	41	57	52	54^	30	26	37
1 142 466	1 072 396	1 089 290	1 129 070	1 164 914	810 205	673 744	795 287
35	40	57	52	54	30	26	37
14 900	18 347	15 043	20 827	20 745	10 005	6 642	13 540
1	1	–	0	2	0	0	0
36	41	57	48	53	30	25	37
1 537 430	1 619 174	1 268 976	976 482	937 053	800 012	651 385	674 142
27 385	17 800	11 440	6 750	5 421	3 940	3 279	10 154
27 385	17 800	11 440	6 750	5 421	3 940	3 279	10 154
1 358 953	1 302 834	1 117 648	908 540	856 893	716 060	546 749	558 021
17 980	11 301	7 154	5 171	4 170	2 792	2 227	6 994
178 477	316 340	151 328	67 942	80 160	83 952	104 636	116 121
9 405	6 499	4 286	1 579	1 251	1 148	1 052	3 160
9 890	5 724	4 020	1 618	1 342	798	800	3 726
0	0	–	–	–	0	1	57
90 818	114 383	115 008	144 061	217 129	103 614**	122 955**	166 167
80	95	30	8	9	14 ⁱ	0	2
80	94	30	8	9	14 ⁱ	0	2
–	–	–	–	–	35 256	27 731	31 767
–	–	–	–	–	14	0	2
90 818	114 382	115 008	144 061	217 129	103 614	122 955	134 400
80	94	30	8	9	3	0	0
–	10	13	7	9	7	0	2
–	1	1	0	0	0	0	0
332 613	298 108	376 702	282 295	596 009	790 800	832 846	974 311
68 109	43 380	76 804	62 582	32 197	9 964	4 382	4 053
68 109	43 380	76 804	62 582	32 197	9 964	4 382	4 053
49 357	42 802	38 188	42 834	38 964	20 956	4 705	7 129
7 423	3 695	5 908	8 318	2 635	693	235	399
283 256	255 306	338 514	239 461	557 045	769 844	828 141	967 182
60 686	39 685	70 896	54 264	29 562	9 271	4 147	3 654
–	–	–	–	1	2	0	6
–	–	–	–	0	0	1 978	1 609
4 052 616	3 194 915	2 409 286	1 904 290	1 680 801	1 274 340	–	–
3 279	3 151	2 672	2 511	2 487	1 051	–	820
3 251	3 151	2 666	2 511	2 482	1 051	–	820
4 052 588	3 194 915	2 409 280	1 904 290	1 680 796	1 274 340	–	–
3 251	3 151	2 666	2 511	2 482	1 051	–	820
3 212	3 149	2 663	2 511	2 486	1 050	–	819
284 361	240 505	234 365	287 984	567 650	576 026	643 583	844 865
36 078	15 509	8 435	9 038	6 692	3 498	3 926	2 340
36 078	15 509	8 435	9 038	6 692	3 498	3 926	2 340
133 363	113 198	116 343	89 811	128 387	87 957	63 095	67 534
6 198	2 367	1 575	1 093	898	297	185	64
150 998	127 307	118 022	198 173	439 263	488 069	580 488	777 331
29 880	13 142	6 860	7 945	5 794	3 201	3 741	2 276
–	–	–	0	0	4	28	59
–	–	–	2	0	0	0	5
1 066 470	1 153 108	1 046 163	1 070 356	1 072 252	901 799	519 557	866 447
2 311	2 302	4 114	4 630	3 941	2 839	3 688	2 807
2 311	2 302	4 114	4 630	3 941	2 839	3 688	2 807
1 066 470	1 153 108	1 046 163	1 070 356	1 072 252	901 799	519 557	866 447
2 311	2 302	4 114	4 630	3 941	2 839	3 688	2 807
435	428	423	485	630	177	111	291
–	0	0	0	0	0	0	0

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
WESTERN PACIFIC						
Papua New Guinea	Suspected cases	1 505 393	1 279 140	1 113 528	1 520 167	1 015 615
	Presumed and confirmed	1 379 787	1 151 343	878 371	1 176 874	707 716
	Confirmed	93 956	84 060	150 195	316 125	314 036
	Microscopy examined	198 742	184 466	156 495	139 972	83 257
	Microscopy positive	75 985	70 603	67 202	70 658	68 118
	RDT examined	20 820	27 391	228 857	519 446	538 678
	RDT positive	17 971	13 457	82 993	245 467	245 918
Philippines ^{2,5}	Suspected cases	314 788	329 665	360 126	353 823	339 319
	Presumed and confirmed	19 648	9 648	9 107	8 926	6 099
	Confirmed	19 102	9 583	8 086	7 720	6 087
	Microscopy examined	301 031	327 060	332 063	317 360	287 725
	Microscopy positive	18 560	9 552	7 133	5 826	3 618
	RDT examined	13 211	2 540	27 042	35 257	51 582
	RDT positive	542	31	953	1 894	2 469
	Imported cases	–	–	–	–	68
	Relapse cases	–	–	–	–	–
	Suspected cases	–	–	–	–	–
Republic of Korea ²	Presumed and confirmed	1 772	838	555	443	635
	Confirmed	1 772	838	555	443	635
	Microscopy examined	–	–	–	–	–
	Microscopy positive	1 772	838	555	443	635
	RDT examined	–	–	–	–	–
	RDT positive	–	–	–	–	–
	Imported cases	56	64	47	50	78
Solomon Islands	Relapse cases	–	–	4	–	–
	Suspected cases	284 931	254 506	249 520	245 014	233 803
	Presumed and confirmed	95 006	80 859	57 296	53 270	51 649
	Confirmed	39 704	26 657	24 383	25 609	18 404
	Microscopy examined	212 329	182 847	202 620	191 137	173 900
	Microscopy positive	35 373	23 202	21 904	21 540	13 865
	RDT examined	17 300	17 457	13 987	26 216	26 658
Vanuatu ²	RDT positive	4 331	3 455	2 479	4 069	4 539
	Suspected cases	55 161	38 150	39 047	32 716	40 333
	Presumed and confirmed	20 982	7 263	4 812	2 883	1 314
	Confirmed	9 817	6 179	4 532	2 883	1 314
	Microscopy examined	29 180	19 183	16 981	15 219	18 135
	Microscopy positive	4 013	2 077	733	767	190
	RDT examined	14 816	17 883	21 786	17 497	22 198
	RDT positive	5 804	4 102	3 799	2 116	1 124
	Imported cases	–	–	–	–	–
	Relapse cases	–	–	–	–	–
Viet Nam ²	Suspected cases	2 803 918	3 312 266	3 436 534	3 115 804	2 786 135
	Presumed and confirmed	54 297	45 588	43 717	35 406	27 868
	Confirmed	17 515	16 612	19 638	17 128	15 752
	Microscopy examined	2 760 119	2 791 917	2 897 730	2 684 996	2 357 536
	Microscopy positive	17 515	16 612	19 638	17 128	15 752
	RDT examined	7 017	491 373	514 725	412 530	416 483
	RDT positive	–	–	–	–	–
	Imported cases	–	–	–	–	–
REGIONAL SUMMARY (presumed and confirmed malaria cases)						
African		104 478 030	102 278 324	113 761 255	125 732 311	135 095 910
Americas		677 583	495 221	471 841	468 931	410 975
Eastern Mediterranean		6 369 494	5 952 130	5 835 463	4 946 316	5 343 572
European		271	252	666	328	270
South-East Asia		3 085 804	2 504 444	2 144 568	1 681 812	1 696 800
Western Pacific		1 792 851	1 429 780	1 122 080	1 372 377	923 262
Total		116 404 033	112 660 151	123 335 873	134 202 075	143 470 789

RDT: rapid diagnostic test; WHO: World Health Organization.

“–” refers to not applicable or data not available.

* The country reported double counting of RDTs and microscopy but did not indicate the number of cases double counted. Confirmed cases have not been corrected.

** Suspected cases are less than presumed + microscopy examined + RDT examined due to double counting of tests by microscopy and RDT.

^ Confirmed cases are corrected for double counting of microscopy and RDTs.

† Confirmed cases reported through outpatients are used instead of laboratory confirmed cases.

‡ Confirmed cases reported through outpatients + inpatients are used instead of laboratory confirmed cases.

§ Data are available for Zanzibar only.

¶ Imported cases are not included in total confirmed cases.

* Incomplete laboratory data. Confirmed cases reported by the country exceed microscopy positive + RDT positive.

** Unresolved data quality issues between total confirmed and total classified cases.

2015	2016	2017	2018	2019	2020	2021	2022
996 660	1 246 456	1 432 082	1 513 776	1 279 574	1 589 675	1 473 179	1 766 390
620 785	785 120	892 235	940 693	646 648	932 973	755 598	1 022 780
346 431	534 819	488 878	516 249	646 648	750 254	651 963	899 510
112 864	146 242	139 910	121 766	72 636	50 564	48 691	51 533
64 719	80 472	70 449	59 652	39 684	26 925	20 632	21 355
609 442	849 913	888 815	967 566	1 206 938	1 356 392	1 320 853	1 591 587
281 712	454 347	418 429	456 597	606 964	723 329	631 331	878 155
315 010	321 848	398 759	443 997	343 174	235 560	222 002	290 324
11 445	6 690	6 806	4 641	5 778	6 120	4 297	3 245
11 410	6 680	6 806	4 641	5 778	6 120	4 297	3 245
224 843	255 302	171 424	122 502	170 887	103 488	107 525	94 352
5 694	2 860	889	569	1 370	1 229	641	387
90 132	66 536	227 335	321 495	172 287	132 072	114 477	195 972
5 716	3 820	5 917	4 072	4 408	4 891	3 656	2 858
85	55	69	82	95	26	35	34
0	–	0	0	1	3	1	0
–	673	515	576	559**	434	294**	444**
692 ^{A†}	673 ^{A†}	515 ^A	576 ^A	559 [‡]	390	294 ^A	428 ^A
692 ^{A†}	673 ^{A†}	515 ^A	576 ^A	559 [‡]	386	294 ^A	428 ^A
–	673	515	576	559	386	294	440
692	673	515	576	559	386	294	421
–	–	–	–	94	–	94	248
452	454	372	429	94	–	94	245
79	71	79	75	74	29	20	38
11	16	18	28	0	6	–	8
192 044	274 881	238 814	244 523	271 754	240 199	253 419	271 037
50 916	84 514	68 712	72 430	86 122	90 830	129 758	141 456
23 998	54 432	52 519	59 191	72 767	77 637	84 139	100 995
124 376	152 690	89 061	89 169	79 694	66 824	114 187	105 260
14 793	26 187	15 978	17 825	18 239	19 621	45 185	42 041
40 750	92 109	133 560	142 115	178 705	160 182	93 613	125 316
9 205	28 245	36 541	41 366	54 528	58 016	38 954	58 954
16 044	24 232	34 152	26 931	23 531	29 362	24 748	15 696
845	2 531	1 228	644	576	507	322	1 143
571	2 252	1 228	644	576	507	322	1 143
4 870	6 704	9 187	5 935	4 596	2 941	1 564	695
15	225	120	53	26	22	34	0
10 900	17 249	24 965	20 996	11 318	26 421	23 184	15 001
556	2 027	1 108	591	550	485	288	1 143
–	0	1	12	9	14	10	41
–	2	0	0	0	0	0	0
2 673 662	2 497 326	2 616 257	1 674 897**	1 969 919**	1 795 335**	1 316 542	1 416 684
19 252	10 446	8 411 ^A	6 870 ^A	5 987	1 733	467	455
9 331	4 161	4 548 ^A	4 813 ^A	4 765	1 422	467	455
2 204 409	2 082 986	2 009 233	1 674 897	1 914 379	1 521 490	852 340	1 182 837
9 331	4 161	4 548	4 813	4 765	1 309	448	439
459 332	408 055	603 161	492 270	504 431	532 088	218 230	233 847
–	–	1 594	1 848	3 243	1 168	19	16
–	–	–	1 681	1 565	46	90	43

Data as of 9 October 2023

Between 2010 and 2018, suspected cases were calculated based on the formula suspected = presumed + microscopy examined + RDT examined, unless reported retrospectively by the country. From 2019 onwards, suspected cases were reported by countries. If data quality issues were detected, suspected cases were recalculated applying the same formula used in 2010–2018.

¹ Certified malaria free countries are included in this listing for historical purposes.

² Cases include imported and/or introduced cases.

³ There were no indigenous cases in 2022.

⁴ In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

⁵ Figures include zoonotic malaria cases (*Plasmodium knowlesi*).

⁶ In 2022, more than one third of cases were due to relapses.

Annex 4 – I. Reported malaria cases by species, 2010–2022						
WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Algeria¹	Indigenous cases	1*	1*	55*	8*	0*
	Total <i>P. falciparum</i>	–	–	–	–	0
	Total <i>P. vivax</i>	–	–	–	–	0
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	–	0
	Imported cases	396	187	828	587	260
Angola	Indigenous cases	1 682 870	1 632 282	1 496 834	1 999 868	2 298 979
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Benin	Indigenous cases	–	422 968	705 839	1 090 602	1 309 238
	Total <i>P. falciparum</i>	–	68 745	–	–	1 044 235
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	0	–	–	–
	Total other cases	0	0	0	0	0
Botswana	Indigenous cases	1 046	432	193	456	1 346
	Total <i>P. falciparum</i>	1 046	432	193	456	1 346
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	30	30
Burkina Faso	Indigenous cases	804 539	428 113	3 858 046	3 769 051	5 428 655
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Burundi	Indigenous cases	1 763 447	1 575 237	2 166 690	4 178 338	4 726 299
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Cabo Verde	Indigenous cases	47	7*	1*	22*	26*
	Total <i>P. falciparum</i>	47	7	1	22	26
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	–	–	–	0
	Total other cases	0	–	–	–	–
	Imported cases	–	29	35	24	20
Cameroon	Indigenous cases	–	17 874	66 656	42 581	–
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Central African Republic	Indigenous cases	–	–	87 566	163 701	295 088
	Total <i>P. falciparum</i>	–	–	–	–	295 088
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	0
	Total other cases	0	0	0	0	0
Chad	Indigenous cases	200 448	181 126	7 710	754 565	914 032
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Comoros	Indigenous cases	36 538	24 856	49 840	53 156	2 203
	Total <i>P. falciparum</i>	33 791	21 387	43 681	45 687	2 203
	Total <i>P. vivax</i>	528	334	637	72	–
	Total mixed cases	0	0	–	–	0
	Total other cases	880	557	0	363	0
	Imported cases	–	–	–	–	–

2015	2016	2017	2018	2019	2020	2021	2022
0*	0*	0*	0*	0*	0*	0*	0*
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
727	420	446	1 241	1 014	2 725	1 164	1 292
2 769 305	3 794 253	3 874 892	5 150 575	7 054 978	7 343 696	8 325 921	7 858 860
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
1 721 626	1 610 790	1 933 912	1 975 812	2 895 878	2 516 646	2 634 063	2 474 689
1 268 347	1 324 576	1 696 777	1 768 450	2 895 878	2 516 646	2 634 063	2 474 689
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
284**	659**	1 847**	534*	169*	884*	703*	397**
278	640	1 831	534	169	884	703	397
–	–	4	–	–	–	–	0
–	12	3	0	0	0	0	0
–	–	–	–	–	–	–	–
48	64	62	51	103	69	26	49
7 015 446	9 779 411	10 557 260	10 278 970	5 877 426	10 600 340	11 791 638	11 415 559
–	–	–	–	5 877 426	10 248 510	11 791 638	11 415 559
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
5 428 710	8 793 176	8 795 952	4 966 511	9 959 533	4 720 103	6 615 714	8 117 435
–	–	–	–	–	3 963 662	5 424 395	8 117 435
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
7*	49*	423*	2*	0*	0*	0*	0*
7	49	423	2	0	0	0	0
–	–	–	–	0	0	0	0
0	0	0	0	0	0	0	0
–	–	–	–	0	0	0	0
20	28	23	18	39	10	20	26
1 193 281	2 476 153	2 244 788	2 257 633	2 819 803	2 890 193	3 335 174	3 327 381
592 351	1 675 264	1 191 257	1 249 705	2 318 830	2 890 193	3 335 174	3 327 381
–	–	–	–	–	–	–	–
–	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
598 833	1 239 317	411 913	972 119	2 416 960	1 740 970	2 002 149	2 247 250
598 833	1 032 764	383 309	972 119	2 416 960	1 740 970	2 002 149	2 247 250
–	–	–	–	–	–	–	–
–	–	–	–	0	0	–	0
0	0	0	0	0	0	0	0
787 046	1 294 768	1 962 372	1 364 706	1 632 529	1 544 194	1 418 539	1 671 060
–	–	–	–	1 480 402	–	1 418 539	0
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	–	0	0
1 884	1 467	3 896	15 613	17 599**	4 546*	10 537*	20 675**
1 300	1 066	2 274	15 613	17 599	4 546	10 537	20 675
–	–	–	–	–	–	–	0
0	0	0	0	0	0	0	0
0	0	0	0	–	–	–	–
–	–	–	–	98	0	10	6

Annex 4 – I. Reported malaria cases by species, 2010–2022						
WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Congo	Indigenous cases	–	37 744	120 319	43 232	66 323
	Total <i>P. falciparum</i>	–	37 744	120 319	43 232	66 323
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	0	0	–	0
	Total other cases	0	0	0	0	0
Côte d’Ivoire	Indigenous cases	62 726	29 976	1 140 627	2 524 326	3 712 831
	Total <i>P. falciparum</i>	–	–	–	2 506 953	3 712 831
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	0	0
	Total other cases	0	0	0	0	0
Democratic Republic of the Congo	Indigenous cases	2 417 780	4 561 981	4 791 598	6 719 887	10 288 519
	Total <i>P. falciparum</i>	2 417 780	4 561 981	4 791 598	6 719 887	10 288 519
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	0	0	–	–
	Total other cases	0	0	0	0	0
Equatorial Guinea	Indigenous cases	53 813	22 466	15 169	16 405	20 417
	Total <i>P. falciparum</i>	53 813	22 466	15 169	16 405	17 452
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Eritrea	Indigenous cases	35 982	34 848	21 815	21 317	50 534
	Total <i>P. falciparum</i>	9 785	10 263	12 121	12 482	23 787
	Total <i>P. vivax</i>	3 989	4 932	9 204	7 361	6 780
	Total mixed cases	63	94	346	1 391	166
	Total other cases	57	19	0	83	35
Eswatini	Indigenous cases	268	379**	409**	728**	389**
	Total <i>P. falciparum</i>	87	189	192	268	389
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	0	0	0	0
	Total other cases	0	–	–	–	–
Ethiopia	Imported cases	–	170	153	234	322
	Indigenous cases	1 196 829	1 480 360	1 692 578	2 645 454	2 118 815
	Total <i>P. falciparum</i>	732 776	814 547	946 595	1 687 163	1 250 110
	Total <i>P. vivax</i>	390 252	665 813	745 983	958 291	868 705
	Total mixed cases	73 801	–	–	–	–
Gabon	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
	Indigenous cases	13 936	–	19 753	28 982	31 900
	Total <i>P. falciparum</i>	2 157	–	–	26 432	26 117
	Total <i>P. vivax</i>	720	–	–	–	–
Gambia	Total mixed cases	55	–	–	0	0
	Total other cases	2 015	0	0	0	1 570
	Indigenous cases	116 353	268 020	313 469	242 513	168 256
	Total <i>P. falciparum</i>	64 108	190 379	271 038	240 792	99 976
	Total <i>P. vivax</i>	–	–	–	–	–
Ghana	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
	Indigenous cases	1 071 637	1 041 260	3 755 166	1 643 642	3 415 912
	Total <i>P. falciparum</i>	926 447	593 518	3 755 166	1 629 198	3 415 912
	Total <i>P. vivax</i>	–	–	–	–	–
Guinea	Total mixed cases	0	0	0	0	0
	Total other cases	102 937	31 238	0	0	0
	Indigenous cases	20 936	95 574	340 258	211 257	660 207
	Total <i>P. falciparum</i>	20 936	5 450	191 421	63 353	660 207
	Total <i>P. vivax</i>	–	–	–	–	–
Guinea-Bissau	Total mixed cases	–	–	–	0	–
	Total other cases	0	0	0	0	0
	Indigenous cases	50 391	71 982	50 381	54 584	97 424
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0

2015	2016	2017	2018	2019	2020	2021	2022
51 529	171 847	127 939	116 903	117 837	91 538	189 616	364 466
51 529	171 847	127 939	116 903	117 837	91 538	189 616	364 466
–	–	–	–	–	–	–	–
0	0	0	0	0	0	–	0
0	0	0	0	0	0	0	0
3 375 904	3 754 504	4 034 781	4 766 477	5 935 178	4 980 640	7 295 068	8 145 591
3 375 904	3 471 024	3 274 683	4 766 477	5 935 178	4 980 640	7 295 068	7 171 584
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
0	0	0	0	0	0	0	0
12 538 805	16 821 130	16 793 002	16 972 207	21 608 681	22 590 647	23 249 165	27 349 509
12 538 805	16 821 130	16 793 002	16 972 207	21 608 681	22 590 647	23 249 165	27 349 509
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	–	0	0
15 142	147 714	15 725	8 962	25 904	–	–	71 204
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	0	0	0
28 036	24 251	54 005	46 440	93 878	74 041	43 463	65 063
14 510	20 704	21 849	16 553	75 568	66 600	37 696	56 208
4 780	2 999	9 185	6 108	15 790	7 119	5 613	8 506
70	543	429	268	2 340	300	120	293
12	5	23	26	180	22	34	56
318*	250*	440*	686*	252***	243*	505**	214**
318	250	440	686	235	233	505	214
–	–	–	–	–	–	–	0
0	0	0	0	–	0	0	–
–	–	–	–	–	–	–	–
157	67	687	271	337	82	76	155
1 867 059	1 718 504	1 530 739	962 087	904 495	1 743 755	1 396 315**	1 731 097**
1 188 627	1 142 235	1 059 847	859 675	738 155	1 340 869	912 075	1 323 355
678 432	576 269	470 892	102 412	166 340	263 877	252 589	388 416
–	–	–	–	–	30 051	14 380	–
0	0	0	0	0	108 958	–	–
–	–	–	–	–	–	836	1 465
23 867	23 915	35 244	111 719	53 182	53 659	64 957	45 783
–	23 915	35 244	111 719	52 811	53 659	64 957	45 783
–	–	–	–	–	–	–	–
–	0	0	0	371	0	0	0
0	0	0	0	0	0	0	0
246 348	162 739	78 040	87 448	53 386	75 801	73 781	119 104
240 382	153 685	69 931	87 448	53 386	75 801	73 781	119 104
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	–	0	0
5 657 096	5 428 979	7 003 155	4 931 454	6 115 267	5 447 563	5 747 585	5 239 236
4 319 919	4 421 788	4 266 541	4 808 163	6 075 297	5 412 537	5 719 704	5 216 479
–	–	–	–	–	–	–	–
0	113 379	109 398	27 635	28 952	35 026	27 881	22 757
0	0	0	0	11 018	0	0	0
810 979	992 146	1 335 323	1 214 996	2 143 225	2 008 976	2 422 374	2 474 774
810 979	992 146	1 335 323	1 214 996	2 143 225	2 008 976	2 422 374	2 474 774
–	–	–	–	–	–	–	–
–	–	–	–	0	0	–	0
0	0	0	0	0	0	0	0
150 085	156 471	152 619	171 075	160 907	–	–	185 156
96 520	97 889	89 784	125 511	115 232	–	–	185 156
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	0	0	0

Annex 4 – I. Reported malaria cases by species, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Kenya	Indigenous cases	898 531	1 002 805	1 453 471	2 375 129	2 851 555
	Total <i>P. falciparum</i>	898 531	1 002 805	1 453 471	2 335 286	2 808 931
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Liberia	Indigenous cases	922 173	1 921 159	1 412 629	1 244 220	881 224
	Total <i>P. falciparum</i>	212 927	577 641	1 407 455	1 244 220	864 204
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	–	–	0	0
	Total other cases	0	0	0	0	0
Madagascar	Indigenous cases	202 450	224 498	402 900	433 450	470 212**
	Total <i>P. falciparum</i>	–	–	–	2 020	–
	Total <i>P. vivax</i>	–	–	–	24	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	–
	Imported cases	–	–	–	–	712
Malawi	Indigenous cases	–	304 499	1 564 984	1 280 892	2 905 310
	Total <i>P. falciparum</i>	–	–	1 564 984	1 280 892	2 905 310
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Mali	Indigenous cases	239 787	307 035	886 482	1 506 940	2 039 853
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Mauritania	Indigenous cases	1 994	2 926	1 888	1 587	15 835
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Mayotte	Indigenous cases	237***	50***	29***	11**	1*
	Total <i>P. falciparum</i>	138	38	21	9	1
	Total <i>P. vivax</i>	3	2	2	–	–
	Total mixed cases	–	–	4	–	–
	Total other cases	–	–	–	–	–
	Imported cases	236	51	47	71	14
Mozambique	Indigenous cases	1 522 577	1 756 874	1 853 276	3 282 172	7 407 175
	Total <i>P. falciparum</i>	878 009	663 132	927 841	2 998 874	7 117 648
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Namibia	Indigenous cases	556	1 525	194	4 775	15 692
	Total <i>P. falciparum</i>	556	1 525	194	4 775	15 692
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	0	0	0	–
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
Niger	Indigenous cases	642 774	838 585	2 329 260	2 373 591	3 963 768
	Total <i>P. falciparum</i>	601 455	757 449	2 185 060	2 306 354	3 828 486
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	17 123	21 370	22 399	46 068	78 102
	Total other cases	0	0	0	0	0
Nigeria	Indigenous cases	551 187	–	–	–	8 572 322
	Total <i>P. falciparum</i>	523 513	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0

2015	2016	2017	2018	2019	2020	2021	2022
2 041 277	3 064 796	3 607 026	2 318 090	5 019 389	4 069 277	4 270 769	4 890 691
1 499 027	2 783 846	3 215 116	1 521 566	5 019 389	3 659 170	3 828 757	4 470 791
–	–	–	–	–	–	–	–
–	–	–	–	0	0	0	0
0	0	0	0	0	0	0	0
941 711	1 191 137	1 093 115	–	915 845	–	912 436	696 684
–	809 356	–	–	915 845	–	912 436	696 684
–	–	–	–	–	–	–	–
0	0	0	–	0	–	–	0
0	0	0	0	0	0	0	0
938 490**	686 024	985 852	972 790	963 712**	1 948 739**	2 338 900**	1 679 547
–	–	2 224	–	–	1 948 739	–	–
–	–	5	–	–	–	–	–
–	–	15	–	–	–	–	0
–	0	0	0	–	–	–	0
1 167	–	–	–	7 116	1 732	203	–
3 661 238	4 827 373	4 947 443	5 865 476	5 184 107	7 139 065	6 948 500	4 226 161
3 585 315	4 730 835	4 901 344	5 830 741	5 153 779	7 057 864	6 880 537	4 173 988
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	–	0	0
2 454 508	2 311 098	2 277 218	2 345 475	3 221 535	2 666 266	3 204 130	3 771 426
–	–	–	–	3 165 483	2 666 266	3 204 130	3 771 426
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
22 631	29 156	20 105	30 609	14 869	12 425	18 660	41 901
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
1*	18*	9*	3*	–	–	–	–
–	12	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	0	–
10	10	10	44	–	–	–	–
8 222 814	9 690 873	9 892 601	10 304 472	11 734 926	11 318 685	10 095 807	12 387 459
7 718 782	8 520 376	8 921 081	9 292 928	11 734 926	11 318 685	10 095 807	12 387 459
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0
9 162*	19 510*	54 268*	30 567*	2 376*	12 291*	12 979*	10 301**
9 162	19 510	54 268	30 567	2 340	12 291	12 979	10 301
–	–	–	–	6	–	–	–
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
2 888	3 980	11 874	4 021	1 064	1 342	759	1 548
2 392 108	4 258 110	2 761 268	3 046 450	3 771 451	4 377 938	4 044 707	5 166 412
2 267 867	3 961 178	2 638 580	3 046 450	3 748 155	4 154 337	4 044 707	5 166 412
–	–	–	–	–	–	–	–
0	0	0	0	0	–	–	0
4 133	186 989	0	0	23 296	0	0	0
8 068 583	13 598 282	13 087 878	14 548 024	19 806 915	18 325 240	21 325 186	23 050 405
–	–	1 515 920	13 524 751	920 398	15 251 460	18 765 444	20 672 564
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	0

Annex 4 – I. Reported malaria cases by species, 2010–2022						
WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Rwanda	Indigenous cases	669 322	273 293	483 470	962 618	1 623 176
	Total <i>P. falciparum</i>	669 322	273 293	483 470	962 618	1 623 176
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	0	0	0
	Total other cases	0	0	0	0	0
Sao Tome and Principe	Indigenous cases	3 146	8 442	12 550	9 243	1 754
	Total <i>P. falciparum</i>	2 219	6 363	10 700	9 242	1 754
	Total <i>P. vivax</i>	14	4	1	1	–
	Total mixed cases	0	0	0	0	0
	Total other cases	0	6	0	0	0
	Imported cases	–	–	–	–	–
Senegal	Indigenous cases	330 331	274 119	294 385	366 687	265 624
	Total <i>P. falciparum</i>	330 331	274 119	294 385	366 687	265 624
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
Sierra Leone	Indigenous cases	934 028	644 018	1 537 322	1 701 958	1 374 476
	Total <i>P. falciparum</i>	218 473	30 670	1 537 322	1 701 958	1 374 476
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	0
	Total other cases	0	0	0	0	0
South Africa	Indigenous cases	8 060	9 866	6 621	8 645	11 705
	Total <i>P. falciparum</i>	2 181	4 206	4 565	8 645	11 563
	Total <i>P. vivax</i>	–	14	5	–	–
	Total mixed cases	12	0	0	0	0
	Total other cases	5	15	0	0	0
	Imported cases	–	–	–	–	–
South Sudan²	Indigenous cases	900 283	112 024	225 371	262 520	71 377
	Total <i>P. falciparum</i>	–	112 024	225 371	262 520	71 377
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Togo	Indigenous cases	1 019 029	506 764	909 129	965 832	1 524 339
	Total <i>P. falciparum</i>	1 018 801	506 741	909 120	965 824	1 524 322
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	0	0	0	0
	Total other cases	228	23	9	8	17
Uganda	Indigenous cases	1 666 582	316 241	2 662 258	1 502 362	3 631 939
	Total <i>P. falciparum</i>	1 603 335	316 241	2 662 258	1 502 362	3 631 939
	Total <i>P. vivax</i>	15 812	–	–	–	–
	Total mixed cases	47 435	0	0	0	0
	Total other cases	0	0	0	0	0
United Republic of Tanzania	Indigenous cases	1 279 362	2 151 236	1 987 629	1 554 117**	680 442**
	Total <i>P. falciparum</i>	1 279 362	2 151 236	1 987 428	1 554 117	680 442
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	0	201	–	–
	Total other cases	0	0	0	–	–
	Imported cases	–	–	–	719 [§]	1 583 [§]
Mainland	Indigenous cases	1 277 024	2 146 747	1 984 698	1 552 444	678 207
	Total <i>P. falciparum</i>	1 277 024	2 146 747	1 984 698	1 552 444	678 207
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
Zanzibar	Indigenous cases	2 338	4 489	2 931	1 673*	2 235*
	Total <i>P. falciparum</i>	2 338	4 489	2 730	1 673	2 235
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	0	201	–	–
	Total other cases	0	0	0	–	–
	Imported cases	–	–	–	719	1 583

2015	2016	2017	2018	2019	2020	2021	2022
2 505 794	3 380 568	5 940 533	4 231 883	3 612 822	2 043 392	1 163 670	857 228
2 505 794	3 380 568	5 940 533	4 231 883	3 612 822	2 043 392	1 163 670	857 228
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	–	0	0
2 056**	2 238	2 239**	2 937**	2 732**	1 933**	2 719**	3 970**
2 055	2 238	2 239	2 937	2 447	1 933	2 719	3 970
–	–	–	–	–	–	–	–
0	0	0	0	0	–	–	–
–	0	–	–	–	–	–	–
2	0	2	3	10	11	11	9
492 253	349 540	395 706	530 652**	354 663**	445 313	536 850	358 033
492 253	349 540	395 706	530 652	354 663	445 313	536 850	358 033
–	–	–	–	–	–	–	–
0	0	0	0	0	0	0	0
0	0	0	–	–	0	0	0
0	0	0	292	45	0	0	0
1 483 376	1 775 306	1 651 236	1 733 831	2 407 505	725 006	1 953 902	1 768 419
1 483 376	1 775 306	1 651 236	1 733 831	2 407 505	725 006	1 953 902	1 768 419
–	–	–	–	–	–	–	–
0	0	0	0	0	0	–	0
0	0	0	0	0	0	0	0
4 959	4 323	23 381*	9 562***	4 821***	4 463***	2 972***	2 043**
4 344	4 323	23 381	9 540	3 096	3 173	1 598	2 043
5	–	–	–	–	–	–	–
3	0	0	–	–	–	–	–
5	0	–	–	–	–	0	–
3 568	3 075	6 234	5 742	8 890	3 663	2 917	5 237
24 371	7 619	1 488 005	98 843	1 903 742	661 922	2 017 227	2 527 657
24 371	7 619	1 488 005	3 242	1 902 505	145 954	1 943 519	2 382 940
–	–	–	–	–	2 205	43 197	13 907
0	0	0	–	0	0	0	6 700
0	0	0	0	0	3 851	30 511	3 609
1 610 711	1 746 334	1 756 582	2 002 877	2 406 091	–	1 845 368^	2 222 943
1 610 568	1 746 101	1 756 331	2 002 712	2 402 967	–	1 845 368	2 222 943
–	–	–	–	–	–	–	–
0	0	0	0	0	–	–	0
143	233	251	165	3 124	–	709	–
7 412 747	9 735 849	11 667 831	5 759 174	13 982 362	16 329 136	14 336 387	19 185 472
7 137 662	9 385 132	11 667 831	5 759 174	13 982 362	16 329 136	14 336 387	19 185 472
–	–	–	–	–	–	–	–
0	0	0	0	0	–	–	0
0	0	0	0	0	–	0	0
4 900 278**	5 762 462	5 744 907	6 390 976**	6 480 021**	6 300 316**	4 619 074**	3 654 584
4 900 103	5 760 684	5 741 596	6 051 844	6 479 812	6 298 259	4 618 710	3 654 393
–	–	–	–	12	0	–	0
–	89	1 606	–	132	2 000	363	191
–	0	10	–	–	208	–	0
2 550 [§]	–	–	1 754 [§]	3 286 [§]	4 314 [§]	4 319 [§]	6 244
4 898 211	5 755 669	5 739 863	6 389 514	6 478 474	6 294 088	4 617 043	3 653 700**
4 898 211	5 755 669	5 739 863	6 050 382	6 478 474	6 294 088	4 617 043	3 653 700
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
0	0	0	0	0	–	0	–
–	–	–	–	–	–	–	2 951
2 067**	6 793	5 044	1 462*	1 547*	6 228*^	2 031*	884*
1 892	5 015	1 733	1 462	1 338	4 171	1 667	693
–	–	–	–	12	0	–	0
0	89	1 606	0	132	2 000	363	191
–	0	10	–	–	208	–	–
2 550	–	–	1 754	3 286	4 314	4 319	3 293

Annex 4 – I. Reported malaria cases by species, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Zambia	Indigenous cases	–	–	–	–	4 077 547
	Total <i>P. falciparum</i>	–	–	–	–	4 077 547
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Zimbabwe	Indigenous cases	249 379	321 901	277 736	423 702	550 696
	Total <i>P. falciparum</i>	249 379	321 901	277 736	423 702	538 351
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	0	–	–	–
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
AMERICAS						
Argentina ¹	Indigenous cases	54*	0*	0*	0*	0*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	14	0	0	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	–	0	0	0	0
	Imported cases	55	28	16	11	15
Belize ¹	Indigenous cases	150	72*	33*	20*	19*
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	149	72	33	20	19
	Total mixed cases	1	–	–	–	–
	Total other cases	0	–	–	–	–
	Imported cases	–	7	4	4	0
Bolivia (Plurinational State of)	Indigenous cases	13 769	7 143	7 415	7 342	7 401
	Total <i>P. falciparum</i>	1 165	370	337	959	325
	Total <i>P. vivax</i>	12 569	6 756	7 067	6 346	7 060
	Total mixed cases	35	17	11	37	16
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
Brazil	Indigenous cases	334 668	267 146	242 758	169 623*^	137 888*^
	Total <i>P. falciparum</i>	47 407	32 029	31 913	26 178	21 295
	Total <i>P. vivax</i>	283 435	231 368	203 018	141 391	117 009
	Total mixed cases	3 642	3 606	7 722	2 090	939
	Total other cases	183	143	104	–	–
	Imported cases	–	–	–	8 923	4 856
Colombia	Indigenous cases	117 650	64 436	60 179	51 722	40 768
	Total <i>P. falciparum</i>	32 900	14 650	15 215	17 650	20 067
	Total <i>P. vivax</i>	83 255	44 701	44 283	33 345	20 129
	Total mixed cases	1 434	754	672	690	567
	Total other cases	48	16	9	11	5
	Imported cases	–	–	–	–	–
Costa Rica	Indigenous cases	110*	10*	7***	0*	0*
	Total <i>P. falciparum</i>	–	–	–	0	0
	Total <i>P. vivax</i>	110	10	5	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	0	0
	Imported cases	4	6	1	4	5
Dominican Republic	Indigenous cases	2 482	1 616	952	473*	459*
	Total <i>P. falciparum</i>	2 480	1 614	950	473	459
	Total <i>P. vivax</i>	2	2	2	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	–	–
	Imported cases	–	–	–	106	37
Ecuador	Indigenous cases	1 888	1 219*	544*	368*	242
	Total <i>P. falciparum</i>	258	290	78	160	40
	Total <i>P. vivax</i>	1 630	928	466	208	202
	Total mixed cases	–	–	–	–	–
	Total other cases	0	–	–	–	0
	Imported cases	–	14	14	10	–

2015	2016	2017	2018	2019	2020	2021	2022
4 184 661	4 851 319	5 505 639	5 039 679	5 147 350	8 121 215	6 769 142	8 126 829
4 184 661	4 851 319	5 505 639	5 039 679	5 147 350	8 121 215	6 769 142	8 126 829
–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	0
0	0	0	0	0	–	0	0
484 614**	316 631**	471 030**	263 346**	308 173	447 381	133 137	141 076
393 886	282 616	319 146	183 755	308 173	447 381	133 137	141 076
–	–	–	–	–	–	–	–
–	–	0	0	–	–	–	0
–	–	–	–	0	–	0	0
180	358	768	672	–	–	–	–
0*	0*	0*	0*	0*	0*	0*	0*
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
–	–	–	–	–	–	–	–
0	0	0	0	0	0	0	0
11	9	18	23	22	13	13	10
9*	4*	7*	3*	0*	0*	0*	0*
–	–	–	1	0	0	0	0
9	4	5	2	0	0	0	0
–	–	2	–	–	0	0	0
–	–	–	–	0	0	0	0
4	1	2	4	2	0	0	0
6 874*	5 542*	4 572**	5 342*	9 338*	12 180**	9 944*	10 321**
77	4	–	–	31	66	165	466
6 785	5 535	4 572	5 342	9 299	12 107	9 714	9 787
12	3	–	–	5	7	65	68
–	–	–	–	–	–	–	–
33	11	15	12	19	7	15	9
141 229*	124 177*	189 559*	187 757*	153 294*	143 395*	139 021*	129 000*
14 762	13 160	18 614	17 861	15 137	21 437	21 612	17 988
122 746	110 340	169 887	168 552	136 947	119 911	115 258	108 626
683	669	1 032	1 333	1 189	2 040	2 135	2 346
–	–	–	–	–	–	–	–
4 932	5 068	4 867	6 816	4 165	1 811	1 365	2 254
55 334*	82 609*	52 805*	61 195*	80 415*	75 770**	73 246**	72 697**
27 875	47 232	29 558	29 953	39 891	21 944	19 853	27 776
19 002	32 635	22 132	30 063	38 392	22 272	18 442	44 216
739	2 742	1 115	1 179	837	790	478	705
–	–	–	–	–	–	–	–
7 785	618	1 297	1 948	2 306	466	733	864
0*	4*	12*	70*	95*	90*	189***^	406*
0	–	–	9	8	2	171	379
0	4	12	61	87	88	15	27
–	–	–	–	–	–	–	0
0	–	–	–	–	–	–	–
8	9	13	38	45	34	27	36
631*	690*	341*	433*	1 291*	826*	284*	320*
631	690	341	433	1 291	826	284	320
–	–	–	–	–	–	–	0
–	–	–	–	–	–	–	0
–	–	–	–	–	–	–	–
30	65	57	87	37	3	7	17
627**	1 191*	1 275*	1 653*	1 803*	1 934*	2 175*	1 348*
209	403	309	149	211	214	445	198
418	788	963	1 504	1 592	1 715	1 728	1 150
–	–	3	–	–	5	2	0
–	–	–	–	–	–	–	–
59	233	105	153	106	67	70	42

Annex 4 – I. Reported malaria cases by species, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
El Salvador ¹	Indigenous cases	17*	7*	13*	6*	6*
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	17	7	13	6	6
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	–	–
	Imported cases	9	8	7	1	2
French Guiana	Indigenous cases	1 632^	1 209^	900^	875	448
	Total <i>P. falciparum</i>	987	584	382	304	136
	Total <i>P. vivax</i>	476	339	257	220	129
	Total mixed cases	561	496	381	348	182
	Total other cases	5	5	2	0	1
	Imported cases	–	–	–	–	–
Guatemala	Indigenous cases	7 384	6 817	5 346	6 214*	4 929*
	Total <i>P. falciparum</i>	30	64	54	101	24
	Total <i>P. vivax</i>	7 163	6 707	5 278	6 062	4 838
	Total mixed cases	5	3	14	51	67
	Total other cases	0	0	0	–	–
	Imported cases	–	–	–	–	2
Guyana	Indigenous cases	22 935	29 471	31 601	31 479	12 354
	Total <i>P. falciparum</i>	11 244	15 945	16 695	13 655	3 943
	Total <i>P. vivax</i>	8 402	9 066	11 225	13 953	7 173
	Total mixed cases	3 157	4 364	3 598	3 770	1 197
	Total other cases	132	96	83	101	41
	Imported cases	–	–	–	–	–
Haiti	Indigenous cases	84 153	34 350	27 866	26 543	17 696
	Total <i>P. falciparum</i>	84 153	32 969	25 423	20 957	17 696
	Total <i>P. vivax</i>	0	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
Honduras	Indigenous cases	9 745	7 618	6 439	5 364	3 378**
	Total <i>P. falciparum</i>	866	581	559	1 073	528
	Total <i>P. vivax</i>	8 759	7 013	5 856	4 245	2 813
	Total mixed cases	120	24	24	46	37
	Total other cases	0	–	–	–	–
	Imported cases	–	–	–	–	2
Mexico	Indigenous cases	1 226*	1 124*	833*	495*	656*
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	1 226	1 124	833	495	656
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	–	–
	Imported cases	7	6	9	4	10
Nicaragua	Indigenous cases	692	925	1 235	1 162*	1 142*
	Total <i>P. falciparum</i>	154	150	236	208	155
	Total <i>P. vivax</i>	538	775	999	954	985
	Total mixed cases	–	–	–	–	2
	Total other cases	0	0	0	–	–
	Imported cases	–	–	–	34	21
Panama	Indigenous cases	418	354	844	696*	864*
	Total <i>P. falciparum</i>	20	1	1	–	–
	Total <i>P. vivax</i>	398	353	843	696	864
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	–	–
	Imported cases	–	–	–	9	10
Paraguay ¹	Indigenous cases	20*	1*	0*	0*	0*
	Total <i>P. falciparum</i>	–	–	0	0	0
	Total <i>P. vivax</i>	20	1	0	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	0	0	0
	Imported cases	9	9	15	11	8

2015	2016	2017	2018	2019	2020	2021	2022
5*	12*	0*	0*	0*	0*	0*	0*
–	–	0	0	0	0	0	0
5	12	0	0	0	0	0	0
–	–	–	–	–	–	–	–
–	–	0	0	0	0	0	0
4	1	3	2	3	0	4	1
374**	217***	554**	546	212*	140**	74*	21***
61	55	62	49	17	3	1	0
194	95	368	496	193	137	72	9
119	67	124	–	–	0	0	–
–	–	–	1	–	–	–	–
60	41	43	–	36	14	37	15
5 538*	5 000**	4 121**	3 018*	2 069*	1 058*	1 273*	1 856*
43	4	0	0	0	0	0	7
5 487	4 849	3 741	3 018	2 069	1 058	1 273	1 824
8	0	0	–	0	0	–	9
–	–	–	–	–	–	–	–
2	1	3	3	3	0	–	–
9 984	10 697***^	13 936	17 038	18 642**	17 179***^	20 786**	20 730**
3 219	3 576	5 141	6 033	5 676	5 544	5 982	6 850
6 002	6 081	7 645	9 854	11 838	10 889	13 913	13 067
731	781	1 078	1 086	1 089	758	844	740
32	–	72	65	–	–	–	–
–	411	–	–	184	51	64	39
17 583	21 430	19 135	8 828	10 687	22 996	9 513	14 757
17 583	21 430	19 135	8 828	10 687	22 996	9 513	13 926
0	0	0	0	0	0	0	0
0	0	0	0	0	–	–	0
0	0	0	0	0	–	0	0
3 555	4 094**	1 273**	632**	330**	810****	1 542****	3 534****
902	1 310	128	55	11	223	622	1 139
2 626	2 744	1 145	576	319	576	879	2 350
27	40	0	1	0	11	8	–
–	–	–	–	–	–	–	–
0	3	10	21	61	98	105	36
517*	551*	736*	803*	618*	356*	242*	163*
–	–	–	–	–	–	–	–
517	551	736	803	618	356	242	162
–	–	–	–	–	0	0	0
–	–	–	–	–	–	–	–
34	45	29	23	22	10	31	77
2 279*	6 272*	10 949*	15 917*	13 200*	25 505*	23 259*	16 108**
338	1 285	1 836	1 319	2 399	11 250	10 454	4 879
1 937	4 965	9 080	14 553	10 678	13 421	12 364	10 960
4	22	33	45	123	834	441	–
–	–	–	–	–	–	–	–
29	12	3	17	26	25	64	50
546*	769*	649*	684*	1 756*^	1 948***	4 354****	7 102****
–	21	1	0	12	9	10	57
546	748	648	684	1 744	1 937	4 115	4 714
–	–	–	0	23	–	2	–
–	–	–	–	375	–	–	–
16	42	40	31	15	10	7	31
0*	0*	0*	0*	0*	0*	0*	0*
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
–	–	–	–	–	–	0	0
0	0	0	0	0	0	0	0
8	10	5	0	2	1	4	3

Annex 4 – I. Reported malaria cases by species, 2010–2022						
WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Peru	Indigenous cases	31 545	25 005	31 436^	48 719^	65 252*
	Total <i>P. falciparum</i>	2 291	2 929	3 399	7 890	10 416
	Total <i>P. vivax</i>	29 168	21 984	28 030	40 829	54 819
	Total mixed cases	83	89	102	213	–
	Total other cases	3	3	7	11	–
	Imported cases	–	–	–	–	–
Suriname	Indigenous cases	1 771	795	569	525**^	401
	Total <i>P. falciparum</i>	638	331	161	322	165
	Total <i>P. vivax</i>	817	382	180	322	78
	Total mixed cases	83	21	13	85	158
	Total other cases	36	17	2	–	0
	Imported cases	–	–	–	204 [§]	–
Venezuela (Bolivarian Republic of)	Indigenous cases	45 155	45 824	52 803	78 643*	90 708*
	Total <i>P. falciparum</i>	10 629	9 724	10 978	22 777	21 074
	Total <i>P. vivax</i>	32 710	34 651	39 478	50 938	62 850
	Total mixed cases	286	909	2 324	4 882	6 769
	Total other cases	60	6	23	–	–
	Imported cases	–	–	–	1 677	1 210
EASTERN MEDITERRANEAN						
Afghanistan	Indigenous cases	69 798	77 549	54 840	52 965	106 478
	Total <i>P. falciparum</i>	6 142	5 581	1 231	1 877	3 000
	Total <i>P. vivax</i>	63 255	71 968	53 609	43 369	58 362
	Total mixed cases	0	0	0	0	–
	Total other cases	0	0	0	0	0
Djibouti	Indigenous cases	1 010	–	25	1 684	9 439
	Total <i>P. falciparum</i>	1 010	–	20	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	0	–	0	0	–
	Total other cases	0	0	0	0	0
Iran (Islamic Republic of)	Indigenous cases	1 847*	1 632*^	756*^	480*^	358*^
	Total <i>P. falciparum</i>	166	152	44	72	21
	Total <i>P. vivax</i>	1 656	1 502	711	426	351
	Total mixed cases	25	56	32	22	4
	Total other cases	–	–	–	–	–
	Imported cases	1 184	1 529	842	853	867
Pakistan	Indigenous cases	240 591	334 589	290 781^	274 648	264 867
	Total <i>P. falciparum</i>	73 857	73 925	95 095	46 974	33 340
	Total <i>P. vivax</i>	143 136	205 879	228 215	215 655	221 816
	Total mixed cases	0	0	2 901	12 019	9 711
	Total other cases	0	0	0	0	0
Saudi Arabia	Indigenous cases	29*	69*	82*	34*	30*
	Total <i>P. falciparum</i>	29	69	82	34	30
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	–	–
	Imported cases	1 912	2 719	3 324	2 479	2 254
Somalia	Indigenous cases	24 833	3 351	6 817	7 407	11 246
	Total <i>P. falciparum</i>	5 629	1 724	6 817	830	462
	Total <i>P. vivax</i>	0	–	–	11	28
	Total mixed cases	0	–	–	–	–
	Total other cases	0	–	–	0	0
Sudan	Indigenous cases	720 557	506 806	526 931	592 383	1 068 506
	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
Yemen	Indigenous cases	106 697	90 954	112 359	102 778	86 707
	Total <i>P. falciparum</i>	77 271	59 689	109 504	102 369	86 428
	Total <i>P. vivax</i>	966	478	398	408	267
	Total mixed cases	30	7	2	0	12
	Total other cases	2	33	4	0	0

2015	2016	2017	2018	2019	2020	2021	2022
61 865*	56 623*	55 367*	45 443*	24 324*	15 822*	18 075*	27 785***
12 569	15 319	13 173	9 438	4 716	3 198	3 584	4 171
49 287	41 287	42 044	36 005	19 605	12 624	14 490	22 856
–	–	–	–	–	–	0	–
–	–	–	–	–	–	–	31
–	48	57	176	159	25	65	0
81*	78*	137**	37**	104**	156**	22*	0*
17	6	33	5	0	0	0	0
61	69	99	12	104	156	22	0
3	1	5	1	0	0	0	0
–	–	–	–	–	–	–	0
295	251	414	198	111	88	53	60
136 402*	240 613*	411 586*	404 924*	398 285*	190 314*^	174 409*	124 545*
24 018	46 503	69 076	71 504	64 307	33 887	23 428	20 114
100 880	179 554	316 401	307 622	308 132	151 783	143 287	99 309
11 491	14 531	26 080	25 789	25 846	11 795	7 693	5 121
–	–	–	–	–	–	–	–
1 594	1 948	2 941	2 125	1 848	1 356	829	1 544
119 859	241 233	313 086	248 689	173 860	105 295	86 263	125 620
4 004	6 369	6 907	6 437	2 701	2 691	3 921	4 462
82 891	132 407	154 468	166 583	170 747	102 316	82 094	120 785
–	311	403	473	412	288	248	373
0	0	0	0	0	0	0	0
9 473	13 822	14 810	25 319	49 402	73 535	58 916	40 648
–	11 781	9 290	16 130	36 025	46 537	44 385	30 346
–	2 041	5 381	9 189	13 377	26 998	14 531	9 858
–	0	0	–	–	–	–	444
0	0	0	0	0	0	0	0
167*	81*	57*	0*	0*	0*	0*	1 439 [‡]
8	0	2	0	0	0	0	197
157	79	55	0	0	0	0	1 218
1	2	–	0	0	0	0	24
–	–	–	0	0	0	0	–
632	611	868	602	1 107	878	821	4 238
203 859	329 005	369 817	374 510	413 533	371 828	399 097	1 824 396
28 311	43 821	54 407	55 639	87 169	74 899	94 543	584 943
167 460	260 477	300 623	314 572	323 355	293 077	301 169	1 178 058
8 088	24 707	14 787	4 299	3 009	3 852	3 385	61 395
0	0	0	0	0	0	0	0
83*	272*	177*	61*	38*	83*	0*	0*
83	270	172	57	38	83	0	0
–	2	5	4	–	–	0	0
0	0	0	0	0	0	0	0
–	–	–	–	–	–	0	0
2 537	5 110	2 974	2 517	2 029	3 453	2 470	4 045
20 953	35 628	35 138	31 021	39 687	27 333	12 967	11 550
–	–	2 657	–	36 766	–	10 919	10 788
–	–	825	–	2 921	–	2 048	762
–	–	–	–	0	–	0	0
0	0	0	0	0	–	0	0
586 827	566 015	800 116	1 648 683	1 752 011	1 698 394	1 647 745	1 355 789
–	333 009	580 145	1 286 915	1 363 507	1 272 738	1 182 363	1 091 532
–	82 175	58 335	143 314	194 904	170 202	175 590	124 730
–	32 557	82 399	187 270	193 600	143 066	160 222	0
0	0	0	0	0	–	0	23 621
76 259	99 700	143 333	157 900	165 899	164 066	180 339	155 127
75 898	45 469	109 849	112 823	163 941	162 318	173 922	150 404
334	347	1 833	970	1 802	1 684	4 343	4 134
27	70	2 322	63	114	3	46	16
0	0	0	69	42	61	2 028	0

Annex 4 – I. Reported malaria cases by species, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
EUROPEAN						
Armenia ¹	Indigenous cases	0*	–	0*	0*	0*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	0	–	0	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	0	–	0	0	0
	Imported cases	1	–	4	0	1
Azerbaijan ¹	Indigenous cases	50*	4*	3*	0*	0*
	Total <i>P. falciparum</i>	–	–	–	0	0
	Total <i>P. vivax</i>	50	4	3	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	0	0
	Imported cases	2	4	1	4	2
Georgia	Indigenous cases	0*	0*	0*	0*	0*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	0	0	0	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
	Imported cases	0	5	4	7	5
Kyrgyzstan ¹	Indigenous cases	3*	0*	0*	0*	0*
	Total <i>P. falciparum</i>	–	0	0	0	0
	Total <i>P. vivax</i>	3	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	–	0	0	0	0
	Imported cases	3	5	3	4	0
Tajikistan ¹	Indigenous cases	112*	78*	28*	4*	2*
	Total <i>P. falciparum</i>	1	5	–	–	–
	Total <i>P. vivax</i>	111	73	–	–	–
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	–	–
	Imported cases	4	22	11	10	5
Türkiye	Indigenous cases	0*	0*	0*	0*	0*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	0	0	0	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
	Imported cases	81	128	376	251	249
Turkmenistan ¹	Indigenous cases	0*	0*	0*	0*	0*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	0	0	0	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	0	0	0	0	0
	Imported cases	0	0	0	0	0
Uzbekistan ¹	Indigenous cases	3*	0*	0*	0*	0*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	3	0	0	0	0
	Total mixed cases	0	–	–	–	–
	Total other cases	–	0	0	0	0
	Imported cases	2	1	1	3	1
SOUTH-EAST ASIA						
Bangladesh	Indigenous cases	55 873	51 773	29 518	26 891	57 480
	Total <i>P. falciparum</i>	52 012	49 084	27 651	25 815	41 261
	Total <i>P. vivax</i>	3 824	2 579	1 699	983	3 348
	Total mixed cases	37	110	168	93	12 871
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
Bhutan	Indigenous cases	436	194	82*	15*	19*
	Total <i>P. falciparum</i>	140	87	33	6	11
	Total <i>P. vivax</i>	261	92	47	9	8
	Total mixed cases	35	15	–	–	–
	Total other cases	0	0	–	–	–
	Imported cases	–	–	0	23	34

2015	2016	2017	2018	2019	2020	2021	2022
0*	0*	0*	0*	0*	0*	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	0	–	–
0	0	0	–	–	–	–	–
0	0	0	0	0	0	–	–
2	2	2	6	–	3	–	2
0*	0*	0*	0*	0*	–	–	–
0	0	0	0	0	–	–	0
0	0	0	0	0	–	–	–
0	0	0	–	–	–	–	0
0	0	0	0	0	–	–	0
1	1	1	2	0	–	–	1
0*	0*	0*	0*	0*	0*	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	0	–	–
0	0	0	–	–	–	–	–
0	0	0	0	0	0	–	–
5	7	8	9	8	4	–	–
0*	0*	0*	0*	0*	0*	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	–	–	–
0	0	0	0	0	0	–	–
1	6	2	0	1	0	–	–
0*	0*	0*	0*	0*	0*	–	0*
0	0	0	0	0	0	–	0
0	0	0	0	0	0	–	0
0	0	0	–	–	–	–	–
0	0	0	0	0	0	–	0
4	1	3	–	3	0	–	1
0*	0*	0*	0*	0*	0*	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	0	–	–
0	0	0	–	–	–	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	0	–	–
221	208	214	237	277	133	–	–
0*	0*	0*	0*	–	–	–	–
0	0	0	0	–	–	–	–
0	0	0	0	–	–	–	–
0	0	0	–	–	–	–	–
0	0	0	0	–	–	–	–
0	0	0	0	3	0	–	–
0*	0*	0*	0*	0*	0*	–	–
0	0	0	0	0	0	–	–
0	0	0	0	0	0	–	–
0	0	0	–	–	–	–	–
0	0	0	0	0	0	–	–
0	0	0	0	1	2	–	–
39 590**	27 628**	29 228**	10 482**	17 219**	6 128**	7 288**	18 233**
26 453	17 269	23 315	8 470	14 752	4 744	4 992	11 980
4 000	3 297	4 442	1 672	2 126	1 245	1 953	5 856
9 137	7 062	1 471	340	341	139	343	–
–	–	–	–	–	–	–	–
129	109	19	41	6	2	6	13
34*	15*	11*	6*	2*	22*	9*	0*
13	1	0	1	0	0	1	0
21	13	11	5	2	22	7	0
0	1	0	0	0	0	1	0
–	–	–	–	–	–	–	0
70	56	38	34	30	9	13	3

Annex 4 – I. Reported malaria cases by species, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
SOUTH-EAST ASIA						
Democratic People's Republic of Korea	Indigenous cases	13 520	16 760	21 850*	14 407*	10 535*
	Total <i>P. falciparum</i>	0	0	0	0	0
	Total <i>P. vivax</i>	13 520	16 760	21 850	14 407	10 535
	Total mixed cases	0	0	–	–	–
	Total other cases	0	0	–	–	–
India	Indigenous cases	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	Total <i>P. falciparum</i>	830 779	662 748	524 370	462 079	720 795
	Total <i>P. vivax</i>	765 622	645 652	534 129	417 884	379 659
	Total mixed cases	3 585	2 256	9 325	1 767	1 751
	Total other cases	0	0	0	0	0
Indonesia	Indigenous cases	465 764	422 447	417 819	343 527	252 027
	Total <i>P. falciparum</i>	220 077	200 662	199 977	170 848	126 397
	Total <i>P. vivax</i>	187 583	187 989	187 583	150 985	107 260
	Total mixed cases	21 964	31 535	29 278	20 352	16 410
	Total other cases	2 547	2 261	981	1 342	1 960
	Imported cases	–	–	–	–	–
Myanmar	Indigenous cases	420 808	465 294	481 204	333 871	205 658
	Total <i>P. falciparum</i>	388 464	433 146	314 676	222 770	138 311
	Total <i>P. vivax</i>	29 944	28 966	135 386	98 860	61 830
	Total mixed cases	2 054	3 020	31 039	12 216	5 511
	Total other cases	346	162	103	25	6
	Imported cases	–	–	–	–	–
Nepal	Indigenous cases	3 894	2 335**	2 204**	1 974	832*
	Total <i>P. falciparum</i>	550	240	184	273	81
	Total <i>P. vivax</i>	2 349	1 208	888	1 659	693
	Total mixed cases	216	30	–	22	58
	Total other cases	0	–	–	0	–
Sri Lanka ¹	Imported cases	–	1 079	1 026	–	667
	Indigenous cases	684*	124*	23*	0*	0*
	Total <i>P. falciparum</i>	6	3	4	0	0
	Total <i>P. vivax</i>	668	119	19	0	0
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	0	0
Thailand	Imported cases	52	51	70	95	49
	Indigenous cases	32 480	24 897	46 895	41 602	41 218
	Total <i>P. falciparum</i>	9 401	5 710	11 553	14 449	13 743
	Total <i>P. vivax</i>	13 401	8 608	17 506	15 573	20 513
	Total mixed cases	147	147	–	196	588
	Total other cases	20	13	0	3 084	3 077
Timor-Leste	Imported cases	–	–	–	–	–
	Indigenous cases	48 139	19 735	5 208	1 025	342
	Total <i>P. falciparum</i>	36 239	14 261	1 962	373	118
	Total <i>P. vivax</i>	11 432	3 754	2 288	512	139
	Total mixed cases	468	1 720	958	140	85
	Total other cases	0	0	0	0	0
China ¹	Imported cases	–	–	–	–	–
	Indigenous cases	4 990*	1 308*	244*	83*	53*
	Total <i>P. falciparum</i>	1 269	57	16	11	6
	Total <i>P. vivax</i>	3 675	677	179	67	45
	Total mixed cases	26	1	5	1	–
	Total other cases	–	–	–	–	–
WESTERN PACIFIC						
Cambodia	Indigenous cases	96 464	106 905	69 551	44 069	69 178
	Total <i>P. falciparum</i>	8 213	7 054	14 896	7 092	8 332
	Total <i>P. vivax</i>	4 794	5 155	19 575	11 267	10 356
	Total mixed cases	1 270	1 583	4 971	2 418	6 464
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–
China ¹	Indigenous cases	4 990*	1 308*	244*	83*	53*
	Total <i>P. falciparum</i>	1 269	57	16	11	6
	Total <i>P. vivax</i>	3 675	677	179	67	45
	Total mixed cases	26	1	5	1	–
	Total other cases	–	–	–	–	–
	Imported cases	2 118	2 059	2 399	4 051	3 026

2015	2016	2017	2018	2019	2020	2021	2022
7 022	5 033	4 603	3 698	1 869	1 819	2 357	2 136
0	0	0	0	0	0	0	0
7 022	5 033	4 603	3 598	1 869	1 819	2 357	2 136
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
1 169 261	1 087 285	844 558	429 928	338 494	186 532	161 753	176 522
774 627	706 257	525 637	204 733	154 645	117 567	100 442	98 306
390 440	375 783	315 028	222 730	181 514	67 444	60 187	75 452
4 194	5 245	3 893	2 465	2 295	1 520	1 124	2 762
0	0	0	0	0	1	0	2
217 017**	218 449**	261 557**	222 125**	250 553**	254 001**	304 579**	443 446**
103 315	118 844	143 926	116 035	142 036	141 807	152 724	152 899
94 267	81 748	95 694	84 862	86 742	83 743	114 301	101 300
13 105	16 751	18 899	18 383	18 707	25 148	31 893	14 646
1 387	1 106	1 818	2 585	3 057	3 288	5 658	–
–	–	–	11	61	38	27	67
182 465^	110 146	85 019	76 518	56 414^	58 827***^	79 000***^	157 533***
110 449	62 917	50 730	38 483	23 017	15 191	14 614	29 519
65 536	43 748	32 070	36 502	32 788	43 578	63 909	127 797
6 624	3 476	2 214	1 530	606	407	523	1 154
0	5	5	3	4	0	0	0
–	–	–	–	–	9 [§]	1 [§]	5
591*	507*	623*	493*	131***	73*	32*	36**
67	61	25	5	9	5	3	3
504	433	587	488	118	68	29	33
20	13	11	0	–	–	0	0
–	–	–	–	–	–	–	–
521	502	670	539	579	357	359	476
0*	0*	0*	0*	0*	0*	0*	0*
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
36	41	57	48	53	30	25	37
17 495**	12 076**	7 416**	5 110**	4 065**	3 123**	2 426**	6 263**
3 301	1 774	846	447	391	155	53	167
4 655	5 765	4 802	3 575	3 443	2 892	2 313	6 012
122	109	36	34	25	16	9	32
–	–	10	21	30	–	42	–
9 890	5 724	4 020	1 618	1 342	798	800	3 726
80	81*	16*	0*	0*	3*	0*	0*
33	46	4	0	0	2	0	0
24	7	3	0	0	0	0	0
23	28	9	0	0	1	0	0
0	–	–	0	0	–	0	0
–	10	13	7	9	7	0	2
68 109	43 380	76 804	62 582	32 196**	9 962**	4 382	4 047**
17 830	12 156	20 328	10 525	4 833	1 073	342	396
13 146	9 816	15 207	30 680	26 871	8 722	4 018	3 577
2 954	1 520	1 397	1 080	492	167	17	16
0	0	0	0	–	–	5	–
–	–	–	–	1	2	0	6
39*	1*	0*	0*	0*	0*	–	0*
1	0	0	0	0	0	–	0
26	1	0	0	0	0	–	0
0	0	0	0	0	0	–	0
–	–	0	0	0	0	–	0
3 212	3 149	2 663	2 511	2 486	1 050	–	819

Annex 4 – I. Reported malaria cases by species, 2010–2022

WHO region Country/area		2010	2011	2012	2013	2014
WESTERN PACIFIC						
Lao People's Democratic Republic	Indigenous cases	22 879	17 532	46 153	39 589	50 674
	Total <i>P. falciparum</i>	22 452	16 556	37 685	25 441	25 317
	Total <i>P. vivax</i>	403	962	7 594	13 067	23 763
	Total mixed cases	24	0	873	1 079	1 593
	Total other cases	0	10	0	2	0
	Imported cases	–	–	–	–	–
Malaysia	Indigenous cases	5 194*	3 954*	3 662*	1 028**	596**
	Total <i>P. falciparum</i>	1 344	973	894	422	177
	Total <i>P. vivax</i>	3 387	1 750	915	385	241
	Total mixed cases	145	120	48	42	33
	Total other cases	–	–	–	0	0
	Imported cases	831	1 142	924	865	766
Papua New Guinea	Indigenous cases	93 956	84 060	150 195	316 125	314 036
	Total <i>P. falciparum</i>	56 735	59 153	58 747	119 469	120 641
	Total <i>P. vivax</i>	13 171	9 654	7 108	7 579	78 846
	Total mixed cases	4 089	1 164	–	1 279	79 574
	Total other cases	1 990	632	0	0	2 125
	Imported cases	19 102	9 583	8 086	7 720	6 019**
Philippines	Total <i>P. falciparum</i>	11 824	6 877	4 774	4 968	3 760
	Total <i>P. vivax</i>	2 885	2 380	2 189	1 357	834
	Total mixed cases	214	166	–	83	235
	Total other cases	175	127	0	0	–
	Imported cases	–	–	–	–	68
	Indigenous cases	1 267*	505*	394*	383*	557*
Republic of Korea	Total <i>P. falciparum</i>	–	–	–	–	–
	Total <i>P. vivax</i>	–	–	–	383	557
	Total mixed cases	–	–	–	–	–
	Total other cases	–	–	–	–	–
	Imported cases	56	64	47	50	78
	Indigenous cases	39 704	26 657	24 383	25 609	18 404
Solomon Islands	Total <i>P. falciparum</i>	22 892	14 454	14 748	13 194	9 835
	Total <i>P. vivax</i>	12 281	8 665	9 339	11 628	7 845
	Total mixed cases	200	83	232	446	724
	Total other cases	0	0	0	0	0
	Indigenous cases	9 817	6 179	4 532	2 883	1 314
	Total <i>P. falciparum</i>	1 545	770	1 257	1 039	279
Vanuatu	Total <i>P. vivax</i>	2 265	1 224	1 680	1 342	703
	Total mixed cases	193	81	470	0	0
	Total other cases	10	2	0	0	0
	Imported cases	–	–	–	–	–
	Indigenous cases	17 515	16 612	19 638	17 128	15 752
	Total <i>P. falciparum</i>	12 763	10 101	11 448	9 532	8 245
Viet Nam	Total <i>P. vivax</i>	4 466	5 602	7 220	6 901	7 220
	Total mixed cases	286	909	970	695	287
	Total other cases	0	0	0	0	0
	Imported cases	–	–	–	–	–

P.: *Plasmodium*; RDT: rapid diagnostic test; WHO: World Health Organization.
“–” refers to not applicable or data not available.
* Reported indigenous cases.
** Indigenous cases = confirmed cases – imported cases.
*** Unclassified cases are reclassified as indigenous cases.
^ Data discrepancies between total indigenous cases and sum of species are due to the use of different data sources, differences in classification of mixed infections, failure to update species data following data audit or inability to adjust species for double counting of RDTs and microscopy.
§ Zanzibar only.
**** Indigenous cases = confirmed cases – imported and introduced cases.
§ No adjustment for imported and/or introduced cases due to incomplete information, data quality issues or use of different data sources for imported and introduced cases.

2015	2016	2017	2018	2019	2020	2021	2022
36 078	15 509	8 435	9 022****^	6 691****	3 489****	3 897****	2 272****
14 439	5 737	4 169	4 828#	2 168	1 573	1 339	473
20 815	9 441	4 104	4 099#	4 444	1 879	2 536	1 789
823	329	162	111#	79	37	22	–
0	0	0	2#	0	0	0	–
–	–	–	0	0	4	28	59
242**	266**	85**	0**	0**	0**	0**	0**
110	67	18	0	0	0	0	0
84	178	59	0	0	0	0	0
22	9	1	0	0	0	0	0
26	12	7	0	0	0	0	0
435	428	423	485	630	177	111	291
346 431	534 819	488 878	516 249	646 648	750 254	651 963	899 510
118 452	183 686	163 160	174 818	181 463	189 397	181 927	254 496
62 228	95 328	113 561	138 006	163 237	186 981	172 964	211 111
115 157	197 711	200 186	201 658	299 869	372 257	296 710	433 575
1 950	1 772	1 433	1 767	2 079	1 619	362	328
11 325**	6 625**	6 737**	4 559**	5 681**^	6 094**^	4 262**	3 211**
4 769	5 282	3 258	1 310	5 034	5 234	3 347	2 509
755	816	551	116	537	736	703	523
195	388	83	22	80	88	185	151
–	–	–	–	4	37	27	–
85	55	69	82	95	26	35	34
627*	602*	436*	501*	485*	356*	274*	382*
0	0	0	0	0	0	0	0
627	602	436	501	485	356	274	348
0	0	0	0	0	0	0	0
–	–	–	–	–	–	–	–
79	71	79	75	74	29	20	38
23 998	54 432	52 519	59 191	72 767	77 637	84 139	100 995
10 478	16 607	15 400	15 771	15 595	14 753	22 057	27 221
12 150	33 060	30 169	35 072	47 164	52 039	57 095	59 155
1 370	4 719	6 917	8 341	9 979	10 813	4 943	14 577
0	46	33	7	27	32	44	36
571	2 243****	1 227**	632**	567**	493**^	312**	1 102**
150	186	273	42	36	38	0	0
273	1 682	798	590	531	469	312	1 102
0	0	0	0	0	0	0	0
0	0	–	–	–	–	–	–
–	0	1	12	9	14	10	41
9 331	4 161	4 548	3 132*^	3 200**^	1 376*	377*	412**
4 327	2 323	2 858	2 966	3 110	792	142	234
4 756	1 750	1 608	1 751	1 514	573	233	163
234	73	70	83	33	11	0	1
14	15	12	–	–	–	–	–
–	–	–	1 681	1 565§	46	90	43

Data as of 10 October 2023

† Includes cases classified as indigenous and introduced. Due to the large number of cases, the country was unable to follow up and accurately distinguish between the two.
Species includes introduced cases.
Indigenous cases do not include non-human malaria cases or introduced cases.
¹ Certified malaria free countries are included in this listing for historical purposes.
² In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwaha/pdf_files/WHA66/A66_R21-en.pdf).

Annex 4 – J. Reported malaria deaths, 2010–2022

WHO region Country/area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AFRICAN													
Algeria ^{1,2}	1	0	0	0	0	0	0	0	0	0	0	0	0
Angola	8 114	6 909	5 736	7 300	5 714	7 832	15 997	13 967	11 814	18 691	11 757	13 676	12 474
Benin	964	1 753	2 261	2 288	1 869	1 416	1 646	2 182	2 138	2 589	2 440	2 990	2 955
Botswana	8	8	3	7	22	5	3	17	9	7	11	5	6
Burkina Faso	9 024	7 001	7 963	6 294	5 632	5 379	3 974	4 144	4 294	1 060	3 983	4 355	4 243
Burundi	2 677	2 233	2 263	3 411	2 974	3 799	5 853	4 414	2 481	3 316	2 276	2 292	2 374
Cabo Verde ²	1	1	0	0	1	0	1	2	0	0	0	0	0
Cameroon	4 536	3 808	3 209	4 349	4 398	3 440	2 639	3 195	3 256	4 510	4 121	3 782	2 481
Central African Republic	526	858	1 442	1 026	635	1 763	2 668	3 689	1 292	2 017	1 779	2 412	1 547
Chad	886	1 220	1 359	1 881	1 720	1 572	1 686	2 088	1 948	3 374	2 955	3 065	2 692
Comoros ²	53	19	17	15	0	1	0	3	8	0	7	3	0
Congo		892	623	2 870	271	435	733	229	131	107	99	252	951
Côte d’Ivoire	1 023	1 389	1 534	3 261	4 069	2 604	3 340	3 222	3 133	1 693	1 316	1 276	1 555
Democratic Republic of the Congo	23 476	23 748	21 601	30 918	25 502	39 054	33 997	27 458	18 030	13 072	18 636	22 729	24 880
Equatorial Guinea	30	52	77	66	–	28	109	–	–	15	–	–	71
Eritrea	27	12	30	6	15	12	21	8	5	3	3	6	5
Eswatini	8	1	3	4	4	5	3	20	2	3	2	7	4
Ethiopia	1 581	936	1 621	358	213	662	510	356	158	213	173	175	180
Gabon	182	74	134	273	159	309	101	218	591	314	224	244	215
Gambia	151	440	289	262	170	167	79	54	60	41	73	42	62
Ghana	3 859	3 259	2 855	2 506	2 200	2 137	1 264	599	428	336	308	277	151
Guinea	735	743	979	108	1 067	846	867	1 174	1 267	1 881	1 119	1 117	1 368
Guinea-Bissau	296	472	370	418	357	477	191	296	244	288	–	–	461
Kenya	26 017	713	785	360	472	15 061	603	–	–	858	742	753	219
Liberia	1 422	–	1 725	1 191	2 288	1 379	1 259	758	–	602	–	248	353
Madagascar	427	398	552	641	551	841	443	370	927	657	674	547	291
Malawi	8 206	6 674	5 516	3 723	4 490	3 799	4 000	3 613	2 967	2 341	2 517	2 368	1 829
Mali	3 006	2 128	1 894	1 680	2 309	1 544	1 344	1 050	1 001	1 454	1 698	1 480	1 498
Mauritania	60	66	106	46	19	39	315	67	–	–	–	–	–
Mozambique	3 354	3 086	2 818	2 941	3 245	2 467	1 685	1 114	968	734	563	408	423
Namibia	63	36	4	21	61	32	65	57	58	6	35	14	28
Niger	3 929	2 802	2 825	2 209	2 691	2 778	2 226	2 316	3 576	4 449	5 849	4 430	4 461
Nigeria	4 238	3 353	7 734	7 878	6 082	9 330	7 397	8 720	14 936	26 540	1 811	7 828	6 734
Rwanda	670	380	459	409	496	516	715	376	341	224	149	60	75
Sao Tome and Principe ²	14	19	7	11	0	0	1	1	0	0	0	1	0
Senegal	553	472	649	815	500	526	325	284	555	260	373	399	273
Sierra Leone	8 188	3 573	3 611	4 326	2 848	1 107	1 345	1 298	1 949	2 771	1 648	2 107	3 151
South Africa	83	54	72	105	174	110	34	301	69	79	38	56	29
South Sudan ³	1 053	406	1 321	1 311	–	–	–	3 483	1 191	4 877	244	4 220	4 429
Togo	1 507	1 314	1 197	1 361	1 205	1 127	847	995	905	1 275	929	809	905
Uganda	8 431	5 958	6 585	7 277	5 921	6 100	5 635	5 111	3 302	5 027	4 252	3 158	4 817
United Republic of Tanzania	15 915	11 806	7 828	8 528	5 373	6 315	5 046	3 685	2 753	1 171	2 569	1 925	1 538
Mainland	15 867	11 799	7 820	8 526	5 368	6 313	5 045	3 684	2 747	1 163	2 549	1 916	1 534
Zanzibar	48	7	8	2	5	2	1	1	6	8	20	4	4
Zambia	4 834	4 540	3 705	3 548	3 257	2 389	1 827	1 425	1 209	1 339	1 972	1 503	1 361
Zimbabwe	255	451	351	352	406	200	351	527	192	266	400	131	177

Annex 4 – J. Reported malaria deaths, 2010–2022

WHO region Country/area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AMERICAS													
Argentina ^{1,2}	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA
Belize ²	0	0	0	0	0	0	0	0	0	0	0	0	0
Bolivia (Plurinational State of) ²	0	0	0	0	1	0	0	0	0	0	0	0	0
Brazil	76	70	60	40	36	35	35	34	56	37	51	58	50
Colombia	42	23	24	10	17	18	36	19	9	3	5	11	16
Costa Rica ²	0	0	0	0	0	0	0	0	0	0	0	0	0
Dominican Republic ²	15	10	8	5	4	3	1	1	1	4	2	1	0
Ecuador	0	0	0	0	0	0	0	0	0	0	3	0	1
El Salvador ^{1,2}	0	0	0	0	0	0	0	0	0	0	0	NA	NA
French Guiana ²	1	2	2	3	0	0	0	0	0	0	0	–	0
Guatemala ²	0	0	0	1	1	1	0	0	0	0	0	0	0
Guyana	24	36	35	14	11	12	13	11	6	15	13	16	–
Haiti	8	5	6	10	9	15	13	12	19	7	11	16	5
Honduras ²	3	2	1	1	2	0	0	1	1	0	0	0	0
Mexico ²	0	0	0	0	0	0	0	0	0	0	0	0	0
Nicaragua ²	1	1	2	0	0	1	2	1	3	1	0	0	0
Panama ²	1	0	1	0	0	0	0	0	0	0	0	0	0
Paraguay ^{1,2}	0	0	0	0	0	0	0	0	0	0	0	0	0
Peru	0	1	7	4	4	5	7	10	4	5	1	6	6
Suriname ²	1	1	0	1	1	0	0	1	0	0	0	0	0
Venezuela (Bolivarian Republic of)	18	16	10	38	44	79	140	340	257	118	31	18	11
EASTERN MEDITERRANEAN													
Afghanistan ²	22	40	36	24	32	49	47	10	1	0	0	0	0
Djibouti	0	0	0	17	28	23	5	–	–	0	–	19	62
Iran (Islamic Republic of) ²	0	0	0	0	0	0	0	0	0	0	0	0	0
Pakistan	–	4	260	244	56	34	33	113	102	0	80	0	38
Saudi Arabia ²	0	0	0	0	0	0	0	0	0	0	0	0	0
Somalia	6	5	10	23	14	27	13	20	31	20	5	2	1
Sudan	1 023	612	618	685	823	868	698	1 534	3 129	1 663	701	1 679	1 760
Yemen	92	75	72	55	23	14	65	37	57	5	6	25	41
SOUTH-EAST ASIA													
Bangladesh	37	36	11	15	45	9	17	13	7	9	9	9	14
Bhutan ²	2	1	1	0	0	0	0	0	0	0	0	0	0
Democratic People’s Republic of Korea ²	0	0	0	0	0	0	0	0	0	0	0	0	0
India	1 018	754	519	440	562	384	331	194	96	77	93	90	83
Indonesia	432	388	252	385	217	157	161	47	34	49	32	48	71
Myanmar	788	581	403	236	92	37	21	30	19	14	10	11	20
Nepal ^l	6	2	0	0	0	0	3	0	0	0	0	1	0
Sri Lanka ^{1,2}	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand ⁴	80	43	37	47	38	33	27	15	15	13	3	0	1
Timor-Leste ²	58	16	6	3	1	0	0	0	0	0	0	0	0

Annex 4 – J. Reported malaria deaths, 2010–2022

WHO region Country/area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
WESTERN PACIFIC													
Cambodia ²	151	94	45	12	18	10	3	1	0	0	0	0	0
China ^{1,2}	19	33	0	0	0	0	0	0	0	0	0	NA	NA
Lao People's Democratic Republic	24	17	44	28	4	2	1	2	6	0	0	1	1
Malaysia ⁵	13	11	11	10	4	4	2	12	12	6	5	13	9
Papua New Guinea	616	523	381	307	203	163	306	273	216	180	188	201	282
Philippines ²	30	12	16	12	10	20	7	4	2	9	3	3	0
Republic of Korea ²	1	2	0	0	0	0	0	0	0	0	0	0	0
Solomon Islands	34	19	18	18	23	13	20	27	7	14	3	9	12
Vanuatu ²	1	1	0	0	0	0	0	0	0	0	0	0	0
Viet Nam ²	21	14	8	6	6	3	3	6	1	0	0	0	0
REGIONAL SUMMARY													
African	150 383	104 057	104 113	116 354	99 380	127 603	111 145	102 886	88 188	108 460	77 745	91 145	91 266
Americas	190	167	156	127	130	169	247	430	356	190	117	126	89
Eastern Mediterranean	1 143	736	996	1 048	976	1 015	861	1 714	3 320	1 688	792	1 725	1 902
South-East Asia	2 421	1 821	1 229	1 126	955	620	560	299	171	162	147	159	189
Western Pacific	910	726	523	393	268	215	342	325	244	209	199	227	304
Total	155 047	107 507	107 017	119 048	101 709	129 622	113 155	105 654	92 279	110 709	79 000	93 382	93 750
Data as of 4 October 2023													
E-2025: malaria eliminating countries for 2025; NA: not applicable; <i>P.</i> : <i>Plasmodium</i> ; WHO: World Health Organization. “–” refers to data not available. ¹ Certified malaria free countries are included in this listing for historical purposes. ² There were no indigenous deaths in 2022. ³ In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf). ⁴ The malaria death reported in 2022 was due to infection with <i>P. knowlesi</i> . ⁵ All malaria deaths reported between 2018 and 2021 and 11 deaths in 2017 were due to infection with <i>P. knowlesi</i> . Notes: There have been no indigenous deaths reported in the WHO European Region since 2010. Reported indigenous deaths are shown for countries where 100% of deaths have been investigated and classified, which may vary from year to year. The majority of these are E-2025 countries. For countries where case investigations are not carried out, all deaths are assumed to be indigenous.													

Annex 4 - K. Methods for Tables A-D-G-H-I-J

Annex 4 – A. Policy adoption, 2022

Information on existing policies and whether they were implemented in 2022 was reported by national malaria programmes (NMPs). Policy implementation in 2022 was adjusted for the following variables, based on whether supporting data were available and reported by NMPs to the world malaria report database: distribution of insecticide-treated mosquito nets (ITNs) or long-lasting insecticidal nets (LLINs) through antenatal care (ANC), the Expanded Programme on Immunization or mass campaigns, indoor residual spraying (IRS), intermittent preventive treatment of malaria in pregnancy (IPTp), seasonal malaria chemoprevention (SMC), rapid diagnostic tests (RDTs) used at community level and artemisinin-based combination therapies (ACTs) used for the treatment of *Plasmodium falciparum*. There are 39 countries with IPTp policies and 18 countries with SMC policies: a setting of “not applicable” was automatically assigned to countries where these interventions were not applied.

Annex 4 – D. Commodities distribution and coverage, 2020–2022

See notes for **Fig. 7.1**, **Fig. 7.2**, **Fig. 7.3** and **Fig. 7.6**. Data sources for the number of malaria cases treated with ACTs were from NMP reports captured in the world malaria report database or, where such data were unavailable, from reports submitted to the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund). Missing data for ACT distributions or any first-line treatment courses delivered (including ACTs) were calculated based on the ratio of distributions to the number of patients treated from the previous year, multiplied by the number of patients treated in the current year. Where these data were not available, the number of patients treated was used as a proxy for distributions. In some countries, numbers of ACT distributions were used to replace missing information on any first-line treatment courses delivered (including ACTs).

Annex 4 – G. Population denominator for case incidence and mortality rate, and reported malaria cases by place of care, 2022

Presumed and confirmed cases were reported by health sector (public, private and community). Where data could not be separated into health sectors, they are shown for the public sector, indicating which data have been combined. Presumed cases were reported through outpatient registers. Confirmed cases were reported through a laboratory, unless the country indicated that confirmed cases from the outpatient register should be used, owing to incomplete or inaccurate laboratory data. Confirmed cases were corrected for double counting of microscopy and RDTs where the exact number of double counted cases was known. If the health sector where double counting occurred was not indicated, then data were combined, adjusted and displayed in the public sector.

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2022

Presumed and confirmed cases were calculated based on the sum of confirmed cases from the laboratory (adjusted for double

counting) or the outpatient register (see notes on **Annex 4 – G**) and the presumed cases reported from the outpatient register. Confirmed cases include indigenous, imported, introduced, relapsing and recrudescant cases, as well as all species, including zoonotic malaria *P. knowlesi*. Between 2010 and 2018, suspected cases were calculated based on the formula “suspected = presumed + microscopy examined + RDT examined”, unless reported retrospectively by the country. From 2019 onwards, suspected cases were reported by countries. If data quality issues were detected, suspected cases were recalculated applying the formula used in 2010–2018. Suspected cases were adjusted for double counting of RDTs and microscopy examined, if indicated by the country (e.g. if 100% of patients were examined by microscopy and RDT, then suspected = presumed + RDT examined).

Annex 4 – I. Reported malaria cases by species, 2010–2022

Indigenous cases and species were reported based on the following: total confirmed cases, where no case investigations and case classifications had been carried out; total confirmed cases minus imported and introduced cases, where data were available; and reported indigenous cases for countries that were part of the malaria eliminating countries for 2025 (E-2025) initiative and where the number of cases classified equalled the total number of confirmed cases. *P. knowlesi* cases were excluded in all three approaches. For Costa Rica (2021) and South Africa (2018–2021), unclassified cases were reclassified as indigenous and added to the reported indigenous cases.

Annex 4 – J. Reported malaria deaths, 2010–2022

All malaria deaths were reported except those in E-2025 countries and other countries where 100% of cases are investigated and classified – in which case, indigenous deaths are shown. The proportion of cases that are investigated and classified can vary from year to year.

Notes



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