The early impacts of COVID-19 epidemic on severe acute malnutrition and its evolving challenges in Bangui, Central African Republic (CAR)

Hema Corrieten YENDRAPATI
MPH, 2018-2020 (M2)

Practicum Location:
ACTION CONTRE LA FAIM (ACF) - France

Professional advisor:
Elise LESIEUR
Senior Nutrition and Health Advisor
ACTION CONTRE LA FAIM (ACF)

Academic advisors:
Martine BELLANGER,
Dean, EHESP

Jean Baptiste Simon COMBES,
Biostatistics, EHESP

« The greatest danger for most of us is not that our aim is too high and we miss it, but that it is too low and we reach it »

- *Michelangelo 1475-1564*

Table of Contents

Acknowledgements :

This thesis is the result of a challenging journey, which was only possible with the support and guidance of many.

Having a dream of being a missionary doctor as a 4-yr old child, I certainly did not imagine a day of preparing and defending a thesis, 24 years later. With pleasure I remember this roadmap that had led me this far through different countries and countless experiences.

Coming to France to pursue Master fo Public Health, I would like to thank Dr. Martine Bellanger for her friendly, open-hearted support in two years of my course and in the planning of my present research. Not only were the discussions about life interesting, but also her guidance in french quotes, superb. Professor Florece Bodeau-Livinec, Virgine Le-Strat, Yvonne and Mathilde (their e-mails about almost everything), the entire MPH team, my classmates and colleagues, many thanks for your considerations, support, guidance and being a back bone to not just the program but also to me. « je suis enfin diplômé »

The past six months would not have been the same without the amazing team at Action Contre la Faim. I was blessed to work with them. I thank them immensely for the never-ending support and expertise extended during the course of this internship. Whether it was at the workplace, during confinement or de-confinement, there was never a dull moment. Distinct gratefulness to Elise Lesieur, senior nutrition and health advisor at ACF, for being a lighthouse, for her constant supervision through dedicated skype calls and unending reviews over my drafts. Thanking the ACF team of experts for also giving their insights into my project.

To my life-coach and my hero, dad (Dr. Y.A.V. Joseph), I owe it all to you. Thanks is a small word.

To my endless music playlist, a borrowed guitar and internet, you've kept my sanity through the confinement.

But words fall short and with utmost humility, I owe my existence to the One who created me.

Acronyms :

SAM – Severe Acute Malnutrition

ARI - Acute Respiratory Infections

Covid-19 – Coronavirus disease 2019

OTP – Outpatient Treatment Program

IPF – In-Patient Facility

CAR – Central African Republic

ACF – Action Contre la Faim / Action Against Hunger

WHO – World Health Organization

HoD – Head of Department

PPE – Personal Protective Equipment

PNC – Pre-Natal Care

RUTF – Ready-to-Use Therapeutic Food

CMAM – Community based Management of Acute Malnutrition

HCoV – Human Coronavirus

PCR – Polymerase Chain Reaction

CDC – Center for Disease Control and Prevention, US

NGO – Non Governmental Organization

LMICs – Low-income and Middle Income Countries

UNICEF – United Nations Children's Fund

MUAC – Mid-Upper Arm Circumference

Abstract :

The early impacts of COVID-19 epidemic on severe acute malnutrition and its evolving challenges in Bangui, Central African Republic (CAR).

Background : In 2016, an estimated 155 million children under the age of 5 years were suffering from undernutrition while 41 million were overweight or obese. On the other hand, as the pandemic of covid-19 spreads, new data emerges everyday and understanding of the disease improves a little more. The identification of coronavirus in high-risk immunocompromised malnourished children is essential as there is a lot of information that is yet unknown about the novel coronavirus (covid-19). Hence, the main objective of the study is to assess for any early changes and explore the challenges encountered in the admission and treatment outcomes of SAM children in outpatient and inpatient facilities due to covid-19, managed by Action Contre la Faim (ACF) in Bangui, CAR.

Methods : This study documents the general characteristics in admission rates, treatment outcomes of 8 outpatient treatment programs (OTPs) and 3 in-patient faciltiies (IPFs) in Bangui during two periods of comparison i.e. Jan-May 2019 vs Jan-May 2020 (as a general trend), and Aug-Sep 2019 (before covid) vs. Jan-May 2020 (initial covid period). Quantitative data was analyzed and z-test was performed between the proportions in specific comparison periods. Additionally, 6 qualitative interviews with program managers and head of departments from different countries (Pakistan, Afghanistan, Bangladesh and CAR) was done to know the experiences of nutrition experts in ACF missions that reflected their perceptions of the impact of covid-19 in their country and the consequences of this impact on malnourished children.

Results and discussion : As a general trend similar pattern of admission rates and treatment outcomes was observed in the periods of comparison (Jan-May 2019 vs Jan-May 2020). During the covid-19 epidemic, there was an increase in the admissions and treatment outcomes for the periods in comparison (Aug-Dec 2019 vs. Jan-May 2020 – without and with covid periods respectively) but this increase was not statistically significant. Although, the initial impact of covid-19 epidemic on the OTPs and IPFs is not statistically present, it leads to one of the biggest limitation of this study that it is probably too early to note the impacts statistically. With minimal resoucies available in CAR, especially in terms of testing and diagnosing covid-19 among SAM children, any change in the aspect of health services may only be noticed at a later phase when the other sectors of health and economy are exhausted. Additionally, there were no disruption of health services in OTPs and IPFs as noted both quantitatively and qualitatively and this led to a continuinty in the provision of health care amidst covid-19 epidemic. Qualitative interviews from CAR revealed no specific changes in the health seeking behavior of people even with the rising cases of covid-19 epidemic in the country directing towards the fact that behavioral change in people takes longer time. Furthermore, adaptation and continuation of health services were reiterated by the participants. Humanitarian professionals through qualitative interviews also anticipated the secondary impacts of the epidemic such as food insecurity, hygiene measures, economy fall and others to have its impact on the health services in the near future.

Conclusion : This study aimed at assessing the early trends and exploring the challenges within the health facilities in Bangui, CAR. The study found that there was no statistically significant early impact of covid-19 on SAM children but the increase in the number of new admissions and their treatment outcomes cannot be ignored and should be studied further in the upcoming months to see how the trends evolve with the epidemic. Protocols for suspecting and identifying covid-19 in malnourished children in resource-limited countries with the known challenge of testing is essential.

Keywords: covid-19, malnutrition, health services, outpatient treatment programs, inpatient facilities, covid-19 testing, admission rates, treatment outcomes,

Résumé :

Les premiers impacts de l'épidémie de COVID-19 sur la malnutrition aiguë sévère et ses défis évolutifs à Bangui, République Centrafricaine (RCA).

Contexte : En 2016, on estime que 155 millions d'enfants de moins de 5 ans souffraient de sous-alimentation et que 41 millions étaient en surpoids ou obèses. D'autre part, à mesure que la pandémie de covid-19 se propage, de nouvelles données apparaissent chaque jour et la compréhension de la maladie s'améliore un peu plus. L'identification du coronavirus chez les enfants immunodéprimés à haut risque souffrant de malnutrition est essentielle, car de nombreuses informations sont encore inconnues sur le nouveau coronavirus (covid-19). Par conséquent, l'objectif principal de l'étude est d'évaluer tout changement précoce et d'explorer les défis rencontrés dans l'admission et les résultats du traitement des enfants MAS dans les établissements de soins ambulatoires et hospitaliers en raison du covid-19, géré par Action Contre la Faim (ACF) à Bangui, en RCA.

Méthodes : Cette étude documente les caractéristiques générales des taux d'admission et des résultats de traitement de 8 programmes de traitement ambulatoire (OTP) et de 3 établissements de soins hospitaliers (IPF) à Bangui au cours de deux périodes de comparaison, à savoir janvier-mai 2019 contre janvier-mai 2020 (tendance générale), et août-septembre 2019 (avant covid) contre janvier-mai 2020 (période initiale covid). Les données quantitatives ont été analysées et un test z a été effectué entre les proportions dans des périodes de comparaison spécifiques. En outre, 6 entretiens qualitatifs avec des responsables de programmes et des chefs de départements de différents pays (Pakistan, Afghanistan, Bangladesh et RCA) ont été réalisés afin de connaître les expériences des experts en nutrition des missions de l'ACF qui reflétaient leurs perceptions de l'impact de la covid-19 dans leur pays et des conséquences de cet impact sur les enfants malnutris.

Résultats et discussion : La tendance générale est la même pour les taux d'admission et les résultats des traitements au cours des périodes de comparaison (janvier-mai 2019 contre janvier-mai 2020). Pendant l'épidémie de covid-19, on a observé une augmentation des admissions et des résultats des traitements pour les périodes de comparaison (août-déc 2019 contre janvier-mai 2020 - sans et avec la période de covid respectivement), mais cette augmentation n'était pas statistiquement significative. Bien que l'impact initial de l'épidémie de covid-19 sur les OTP et les IPF ne soit pas statistiquement présent, il en résulte une des plus grandes limites de cette étude, à savoir qu'il est probablement trop tôt pour en noter les impacts statistiquement. Avec les ressources minimales disponibles en RCA, notamment en termes de dépistage et de diagnostic de la covid-19 chez les enfants MAS, tout changement dans l'aspect des services de santé ne pourra être remarqué qu'à un stade ultérieur, lorsque les autres secteurs de la santé et de l'économie seront épuisés. En outre, il n'y a pas eu de perturbation des services de santé dans les ANP et les IPI, comme cela a été noté tant quantitativement que qualitativement, ce qui a conduit à une continuité dans la fourniture des soins de santé au milieu de l'épidémie de covid-19. Les entretiens qualitatifs réalisés en RCA n'ont révélé aucun changement spécifique dans le comportement des personnes en matière de santé, même si la hausse des cas d'épidémie de covid-19 dans le pays montre que le changement de comportement des personnes prend plus de temps. En outre, les participants ont réitéré l'importance de l'adaptation et de la poursuite des services de santé. Les professionnels de l'humanitaire ont également anticipé, par le biais d'entretiens qualitatifs, les impacts secondaires de l'épidémie tels que l'insécurité alimentaire, les mesures d'hygiène, la chute de l'économie et d'autres qui auront un impact sur les services de santé dans un avenir proche.

Conclusion : Cette étude visait à évaluer les premières tendances et à explorer les défis au sein des établissements de santé à Bangui, en RCA. L'étude a révélé qu'il n'y avait pas d'impact précoce statistiquement significatif du covid-19 sur les enfants MAS, mais l'augmentation du nombre de nouvelles admissions et de leurs résultats de traitement ne peut être ignorée et devrait être étudiée plus en détail dans les prochains mois pour voir comment les tendances évoluent avec l'épidémie. Il est essentiel de mettre en place des protocoles permettant de suspecter et d'identifier le covid-19 chez les enfants malnutris dans les pays aux ressources limitées où le dépistage est un défi connu.

Mots clés : covid-19, malnutrition, services de santé, programmes de traitement ambulatoire, établissements hospitaliers, dépistage du covid-19, taux d'admission, résultats du traitement.

1. BACKGROUND:

Severe acute malnutrition (SAM) is defined as a weight-for-height measurement of 70% or more below the median, or three standard deviations (SD) or more below the mean National Center for Health Statistics reference values, and is called « wasted (marasmus) » (1); or the presence of bilateral pitting edema of nutritional origin, which is called « edematous malnutrition (kwashiorkor) » or a mid-upper-arm circumference of less than 110mm in children aged 6 months to 5 years (2).

In 2020, 1 in 9 children are hungry or undernourished and 1 in 3 children are overweight or obese (3). In 2016, an estimated 155 million children un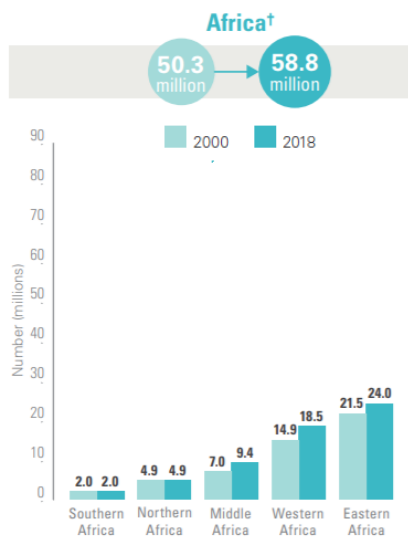der the age of 5 years were suffering from undernutrition while 41 million were overweight or obese. Around 45% of deaths among children under 5 years of age are linked to undernutrition (4). Although undernutrition trends have improved in the past few years and at a plateau in most of the countries but due to lack of coverage for severe acute malnutrition, the rates have been falling in Africa, especially in the number of children under 5 years. According to the UNICEF, WHO, Worldbank group joint estimates from 2000 to 2018 shows that the number of stunted children has risen from 50.3 million to 58.8 million children in Africa *(as seen in Fig 1)* (5).

Figure 1 : UNICEF, WHO, World Bank Group joint malnutrition estimates, 2019.

The emphasis on nutritional well-being for all, particularly the most vulnerable, has a heightened significance in the face of a new global threat. With ageing, malnutrition, immunosuppression, and co-morbid states, the immune system loses the ability to adapt to novelty viruses (6). Undernourished people have weaker immune systems, and maybe at a greater risk of severe illness due to the virus (7). A recent modelling exercise of various estimates of the potential impact of covid-19-related economic deterioration, food insecurity and interruption of programs of community-based detection and management of malnutrition suggests that the prevalence of wasting could increase by 10-50% with an excess of $\sim 40,000 - 2,000,000$ child deaths (8). Hence, the need for more equitable, resilient and sustainable food and health systems has never been more urgent (7).

1.1. MALNUTRITION

Nutritional status affects every aspect of a child's health, including growth and psycho-social development, physical activity and response to serious illness (9). Although mild and moderate types of childhood malnutrition are more prevalent, their significance in childhood

morbidity and mortality is less well recognized (10). Moreover, the risk of death is directly correlated with the degree of malnutrition (11). Severe acute malnutrition (SAM) in children results in unacceptably high mortality rates of ≤500,000 deaths/ year worldwide(12), although undernutrition underpins ~45% of deaths in children under the age of five (13). Epidemiological and experimental oberservations have proven that malnourished children are more susceptible to infectious diseases, therefore, malnutrition is considered a strong risk factor for higher morbidity and mortality rates in infectious diseases (14). But, malnutrition is rarely cited as being among the leading causes of death. This is due in part of the conventional way that the cause of death data are reported, analyzed and compiled from records in which a single proximate cause of death is reported (15).

13 million children under the age of 5 years have SAM and the disorder is associated with 1-2 million preventable child deaths each year (1). The causes of malnutrition are so complex that even in areas where food is plentiful, malnutrition may be evident (16). However, to point out, the causes are essentially poverty, social exlusion, poor public health and most cases can be prevented by economic development and public-health measures designed to increase dietary quantity and quality alone, with no need for clinical input (17). The consequences of malnutrition are increased risk of infection, death, and delayed cognitive development, leading to low adult incomes, poor economic growth and intergenerational transmission of poverty. Children who are born with low birth weight and have intrauterine growth retardation, are at increased risk of morbidity and mortality and other forms of malnutrition compared to healthy infants. They also tend to develop non-communicable diseases such as diabetes and hypertension in adult life (18). Interventions for reducing malnutrition must therefore begin before birth. Prenatal care (PNC) programs, which typically identify high-risk mothers, and include nutritional and educational interventions such as information and advice on food hygiene, diet, and lifestyle advice are designed to deal with factors that are most likely to be associated with stunting (19).

Owing to its severity, the conventional method of treating SAM has been as hospital-in-patients or in specialized inpatient nutrition facilities and outpatient programs through primary health care. WHO has recommended standardized treatment of SAM, in three phases : stabilization, rehabilitation and follow-up. Community-based ambulatory treatment, with in-patient care reserved for the most severe cases is increasingly being implemented and have shown favorable outcomes (20). It is estimated that 80% of children with SAM could be treated without admission to hospital, with hospitalization reserved for stabilization of those with particularly severe SAM or its complications (21). Community-based management of acute malnutrition (CMAM) protocol, which includes simplified screening at community level, referral to health facility by a health worker, decentralized provision of care, RUTF (Ready-to-Use

Therapeutic Food) provision and community mobilization, resulting in comparatively better population coverage (22). On the other hand, children with complications such as with different comorbidities, severe edema, low weight, less than 6 months of age and absence of appetite still need to be admitted to in-patient stabilization centers, before being discharged to outpatient care once they are able to eat RUTF, their medical complications controlled and their edema beginning to resolve (20). The treatment of SAM therefore, occupies a position between clinical medicine and public health (17).

1.2. RELATIONSHIP BETWEEN MALNUTRITION AND INFECTIONS:

The malnutrition-infection complex can be viewed under two aspects, malnutrition compromising the host defense and infection either aggravating a previously existing deficient nutritional status or triggering malnutrition through disease pathogenesis and prognosis (23). Malnutrition magnifies the severity of infectious diseases, as it impairs child development and lowers nutritional reserves, compromising the immune system, thereby increasing disease risk. Once the nutritional status is compromised, the vicious cycle of malnutrition and infection continues and the child remains at a higher risk for additional morbidity and possible mortality (24). Determining whether the malnutrition-related risk of death varies for different diseases also has implications for the implementation and evaluation of programs designed to ensure the survival of children (15). On the other hand, the relationship of malnutrition on immune suppression and infection is complicated by the profound effects of a number of infections on nutrition itself (24). Children with malnutrition have reduced ability to fight infection and are more likely to die from common diseases such as malaria, respiratory infections and diarrheal diseases (18). A large and strictly controlled inpatient study in France pinpoints malnutrition as an independent risk factor for nosocomial infections, which account for 6-10% of all in-hospital deaths worldwide (25).

1.3. MALNUTRITION AND RESPIRATORY INFECTIONS:

Acute respiratory infections (ARIs) are the leading cause of morbidity and pneumonia represents one of the main causes of death in children younger than 5 years of age (26). A strong and consistent relation was observed between the nutritional status and death from acute lower respiratory infection (15). Pneumonia occurs most frequently during the first 2-3 years of life when immunocompetence is impaired and when children are first being exposed to pathogens. Up to two-thirds of malnourished children that are hospitalized are diagnosed with pneumonia (9). Despite the availabiliy of antibiotics, mortality and morbidity rates remain high, especially in high-risk groups like malnourished children (27). On the other hand, children who were immunized for age were less likely to suffer from ARIs as compared to those incompletely immunized (28).

Malnutrition may also be a consequence of repeated respiratory infections, common in young children (29). Therefore, pnemonia and malnutrition are two of the biggest killers in childhood disease (30).

1.4. MALNUTRITION AND CORONAVIRUSES:

Before the emergence of severe acute respiratory syndrome-related coronavirus (SARS-CoV), human coronaviruses (HCoVs) were generally thought to cause mild, self-limited infections of the upper respiratory tract. However, it is now known that HCoVs can cause severe disease in immunocompromised individuals. Viral etiologies are somehow underestimated in cases of severe pneumonia in the resource-limited countries with limited diagnostic facilities. The etiological roles of novel viruses remain undefined (31). According to a study in US, children whose only detectable respiratory virus was a coronavirus, inclusive of different subtypes were most likely to have underlying chronic disease than were children co-infected with another respiratory virus (32).

As the pandemic of covid-19 spreads, new data emerges everyday and understanding of the disease improves a little more. Although reports associated with children are growing, it is still scare(33). With the early research conducted in children in Madrid, Spain, 2% of the covid-19 affected children are younger than 18 years and 60% of the confirmed infections in children required admission ; although the study also highlights its limitation that the testing might have been biased towards moderate-to-severely suspected/ confirmed patients (34). Another study from China stated that a lower risk of exposure in children or incomplete identification due to mild or asymptomatic disease in children is possible, rather than resistance to infection (35). However, clinical manifesations of covid-19 in children may be less severe but children at all ages are vulnerable to covid-19, in particular, the infants (36).

Recently, in some countries like Italy, UK, France, Spain, US and Belgium – there were surprisingly high number of children with symptoms similar to Kawasaki disease. All the children were in contact at some point with the coronavirus. The patients had either a PCR test « positive but weak » or a positive serological test (antibody) that showed contact with the virus - 3 or 4 weeks prior. In the adult form of covid-19, a cytokine storm (inflammatory response of the body) arrived at the start of second week and in children, this exaggerated inflammatory response came in later by the third or fourth week. This unusual incidence rate of Kawasaki disease among children suggests a link with the covid-19 (37). A lancet study in a tertiary pediatric center in Paris, further supports that covid-19 could be a trigger for Kawasaki disease and indicates the potential timing of an increase in incidence of the disease in covid-19 pandemic. It further suggests that children can develop severe forms of covid-19

and physicians should prepare to manage an increase in the incidence of Kawasaki disease, depending on the magnitude of the local covid-19 outbreak (38).

There are various challenges and equivalently various recommended adaptations in order to detect covid-19 among vulnerable populations (malnutrition). When testing capacity is limited, an alternative is to use the WHO classification for levels of transmissions which would be based on the number of suspected or reported cases and not on testing itself (39). Population-based studies required to define the burden of disease caused by novel coronaviruses are less documented (40) and may not be as appropriate as for the adults due to its syndromic approach. As noted above, SAM children with complications usually present with infections and comorbid conditions (mostly respiratory infections) in the inpatient facitllies which may overlap or mask the true diagnosis of covid-19 in children unless tested.

2. PROJECT TOPIC :

Experience with the past epidemics like the 2014 West African Ebola outbreak and SARS has shown that indirect effects of an outbreak – e.g. medical supply chain disruptions, declining utilization and provision of health services, healthcare resources and personnel reallocation – can be severe, sometimes outpacing the direct impact of the outbreak itself (41). Furthermore, mortality rates for covid-19 appear to be low in children and in women of reproductive age, but these groups might be disproportionately affected by the disruption of routine services, particularly in low-income and middle-income countries (LMICs)(8).

In managing outbreaks, data on cases and outcomes are crucial to forecast the demand that will be made on the health system (42). The identification of coronavirus in high-risk immunocompromised malnourished children is essential as there is a lot of information that is yet unknown about the novel coronavirus (covid-19). Given the current complex landscape, a key notion is to keep a track on the identified or suspected malnourished children with covid-19 that are mostly detected with the help of the NGO teams on field due to the limitations of testing and substantially provide quality care not just in the health facility but also once discharged or as outpatient. Due to these numerous factors, this window of opportunity can be utilized to focus on identification, effectively provide tools for monitoring and evaluate these measures specifically in malnourished children. Additionally, it is absolutely necessary to have an interpretation of the trends of health facilities that treat SAM children be analyzed, to know the direct impacts and in some areas, the delayed secondary impacts on the healthcare provision, utilization and management of SAM children in the present covid-19 epidemic.

It is critical to ensure that the nutritional needs of vulnerable children are met in order to avoid exacerbating disparities in health and educational attainment for the years to come.

Given the uncertainties about the risk of covid-19 in malnourished children and the inherent logistic difficulties of diagnosing and tracking patients in the community, this project focuses on understanding the early impacts of covid-19 epidemic on SAM children and the challenges faced in Bangui, Central African Republic (CAR). CAR was chosen as the country of choice due to the nutrition programs that already existed and their available data on different types of undernutrition in different outpatient treatment programs and inpatient facilities from 2019 up until May 2020. This study also examined and assessed for any early trends seen in the healthcare utilization and management of SAM children in both the outpatient departments and inpatient facilities.

2.1 CURRENT SITUATION IN CENTRAL AFRICAN REPUBLIC:

The Central African Republic (CAR) is a landlocked country in Central Africa with an estimated total population of 5.18 million in 2019 (43). CAR is one of the poorest countries in Africa, with two-thirds of the population living on less than one US dollar (USD) per day and health indicators are among the worst globally (44). In 2017, nearly 2.5 million people were in urgent need of humanitarian aid. Furthermore, undernutrition is a major problem with 39 out of 71 health sub-prefectures showing rates of SAM above the emergency threshold (2%) and pockets of undernutrition continue to grow (45). The SAM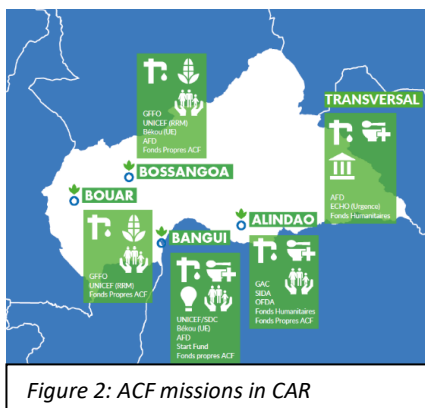 prevalence in CAR in 2010, was about 2-4% which is very concerning, particularly as kwashiorkor has a higher case-fatality ratio than marasmus (46). In 2018, the neonatal mortality rate was as high as 26.13% (47). The high but stable excess mortality and SAM prevalence suggest a chronic and silent crisis in CAR (46). Distance, community awareness of feeding programs and the way in which rejections are handled at program clinics are reported as the main reasons for incomplete coverage in outpatient nutritional care (48).

Figure 2: ACF missions in CAR

The national health system, which was already fragile and dysfunctional before the crisis in 2013, has also collapsed in recent years due to the destruction of public infrastructure and poor coordination between health levels. Despite all these constraints, humanitarian organizations working in the field are nevertheless helping to provide basic services in line with the health sector's transition policy (49). ACF is the one of the non-governmental organizations in Bangui that caters to the needs of malnutrition and water, sanitation and hygiene activities (as seen in fig 2).

Action Contre la Faim (ACF) began its activites in Central African Republic in 2005 with an anthropological nutritional survey in the city of Bangui. In July 2006, a program to recieve the vegetable production in Bangui and a program to detect and treat severe and moderate

acute malnutrition was started. Presently, it is now with a team of 306 people supporting 194,464 beneficiaries out of a total population of 4.7 million in the country (50). The organization's primary missions are in Bangui, which is the largest city and also the capital city of the country. The main interventions of ACF are in nutrition and health, food security and livelihoods, mental health, care practices, gender and protection, and water, sanitation and hygiene (WASH) services (50).

However, the struggle in CAR, intensifies against the background of an alarming spread of covid-19. On March 14, 2020, the cou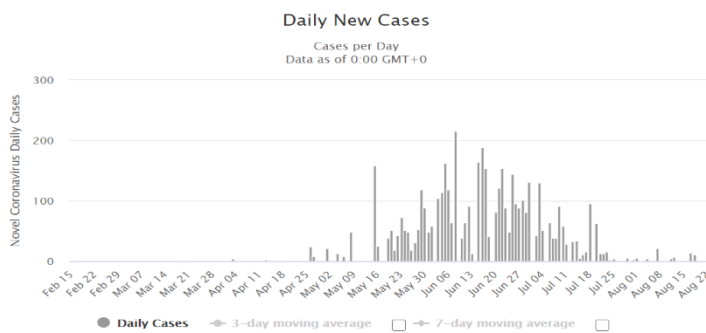ntry's first covid-19 case was confirmed with the patient being identified as a 74-year old Italian man who returned to CAR from Milan, Italy and within the next 15 days six more cases were confirmed (51). In April and May, there were 44 and 961 new cases confirmed, respectively (52) (53). In June, the number of new cases

Figure 3 – Daily new covid-19 cases in CAR.
Source: https://www.worldometers.info/coronavirus/country/central-african-republic/

drastically rose to 2734 confirmed cases and death toll to 47 (54). While CAR is still trying to recover from the crisis it has been in since 2013, and with consistent reconciliation measures between the government authorities and the armed groups until Feb 2019, the humanitarian situation remains particularly critical even in the context of the present covid-19 epidemic (25% of the population displaced and 63% in need of humanitarian assistance) (55). As the covid-19 pandemic is exacerbating the already existing vulnerabilities in CAR, it is essential to understand this impact, though it is quite early in time and nature, especially in malnourished children, in order to place the prevention measures and balance the humanitarian support.

3. OBJECTIVES :

3.1 GENERAL OBJECTIVE :

The main objective of the study is to assess for any early changes and explore the challenges encountered in the admission and treatment outcomes of SAM children in outpatient and inpatient facilities due to covid-19, managed by Action Contre la Faim (ACF) in Bangui, CAR.

3.2 SPECIFIC OBJECTIVES :

- To describe the general characteristics of nutrition programs in CAR.
- To assess for any change in the admission rates and treatment outcomes from Jan-May 2019 vs. Jan-May 2020 in CAR to know the general trend.

- To assess for any change in admission rates and treatment outcomes from Aug-Dec 2019 (before covid-19) vs. Jan-May 2020 (initial covid-19 period) in CAR.
- To identify possible challenges encountered in the outpatient and inpatient facilities due to the covid-19 epidemic.

4. MATERIALS AND METHODS

4.1. STUDY DESIGN :

This is a mixed study, wherein quantitatively, collection and analyzation of data from outpatient treatment programs and inpatient facilities of ACF missions was done. This helped in giving a reality view of the past and the current situation in these OTPs and IPFs. Assessment of trends observed based on the quantitative data was done. Additionally, a qualitative sub-study was also done. This was to understand the experiences of the program managers and head of departments (HoDs) on their experiences and observations on the impact of covid-19 in their country, the consequences of this impact on malnourished children and finally to know the different mechanisms adapted in the delivery of health services (OTPs and IPFs). Informed consent from the participants in the qualitative study was taken.

4.2 STUDY AREA AND STUDY POPULATION :

The research stems from different outpatient treatment programs (OTPs) and inpatient facilities (IPFs) located in Bangui region. Among the 10 OTPs managed by ACF, only 8 OTPs were selected for this study due to the consistent data available for these OTPs and 3 IPFs in Bangui were also included.

The analysis targeted all patients that were registered at the OTPs and IPFs for the year 2019 and 2020. All the patients were categorized based on the age groups as 6-23 mo's, 24-59mo's and >59 mo's for OTPs and <6mo's, 6-59mo's and >59mo's in the IPFs. However, comorbidity indicators (like presence of ARIs etc) were not available monthly but as an aggregated report at the end of the year 2019 which made it difficult to estimate the additional burden due to covid-19.

As shown in *table 1*, within the 8 OTPs, there were *n=2919* new admissions in the OTPs with 54.23% female (1585/2919) and 45.70% male (1334/2919) in the year 2019. For the year 2020, there were *n=1327* new admissions in the OTPs with 55.61% female (738/1327) and 44.38% male (589/1327) upto May 2020. As shown in *table 2*, within the 3 IPFs, there were *n=2948* new admissions in the 3 inpatient facilities with 51.32% female (1513/2948) and 48.67% male (1435/2948) in the year 2019. And for the year 2020, there were *n=1145* new admissions in the IPFs with 52.66% female (603/1145) and 47.33% male (542/1145) upto May 2020.

Age group	Jan - Dec 2019				Jan - May 2020			
	Female (n)	Female (%) by age group	Male (n)	Male (%) by age group	Female (n)	Female (%) by age group	Male (n)	Male (%) by age group
6-23m	1147	72,37%	910	68,22%	577	78,18%	458	77,76%
24-59m	385	24,29%	368	27,59%	138	18,70%	116	19,69%
>59m	53	3,34%	56	4,20%	23	3,12%	15	2,55%
Total	1585		1334		738		589	

Table 1 : Number of new admissions in 8 OTPs for the year 2019 and upto May 2020 in Bangui, CAR, managed by ACF

Age group	Jan - Dec 2019				Jan - May 2020			
	Female (n)	Female (%) by age group	Male (n)	Male (%) by age group	Female (n)	Female (%) by age group	Male (n)	Male (%) by age group
<6m	70	4,63%	72	5,02%	27	4,48%	45	8,30%
6-59m	1296	85,66%	1212	84,46%	542	89,88%	480	88,56%
>59m	147	9,72%	151	10,52%	34	5,64%	17	3,14%
Total	1513		1435		603		542	

Table 2 : Number of new admissions in 3 IPFs for 2019 and upto May 2020 in Bangui, CAR, managed by ACF.

For the qualitative sub-part, 6 semi-structured in-depth interviews were conducted with program managers and head of departments (HoDs) from CAR, Pakistan, Bangladesh and Afghanistan in French and English. Each interview lasted for 40-60 mins. The interviews were analyzed for further understanding of the impacts of covid-19 on malnourished children both in the context of CAR region and also as a general perspective to know the impacts of covid-19 in other missions of ACF. Informed consent was taken from the participants for recording the interview and anonymity was established, thereby making it impossible to re-identify study participants. Interviewer did not have any prior relationship with the participants apart from being familiar with the covid-19 situation.

4. 3. DATASETS :

This study was based on the datasets shared by the *ACF mission* in CAR. This study uses all the data from January 2019 to May 2020 for both outpatient treatment programs and inpatient facilities. The datasets include the general characteristics such as age, gender and the location of the OTPs and the IPFs. They also include the number of the new admissions categorized by different types such as new admission based on edema, MUAC/ anthropometric measurements or relapse cases. Additionally, the different treatment outcomes such as recovery rate, abandonment, death and transfer to an OTP or to another facility are also mentioned. An example of the dataset from CAR can be found in *annexure (a)*. The records available are monthly datasets from the different OTPs and IPFs and hence, one of the limitations of this study is the lack of individual treatment outcomes and the inability to segregate the new admissions and the corresponding treatment outcomes based on

individual age groups or gender. Due to the absence of covid-19 testing and the difficulties in diagnosing and tracking of the patients, most of the data available has the above mentioned indicators with no mention of the transfer of patients to another facility due to suspicion of covid-19 cases.

Additionally, 6 interviews were conducted to know the observations and experiences of program managers of ACF missions that reflected their observations on the impact of covid-19 in their country and the consequences of this impact on malnourished children. An example of the questionnaire used for the interview can be found in *annexure (b)*. This data included different mechanisms adapted in the delivery of health services especially in the outpatient and inpatient facilities for malnourished children.

4.4. DATA MANAGEMENT AND ANALYSIS:

Initially, familiarization of the quantitative data was done by re-organizing the available monthly datasets into analyzable datasheets. The next step involved fracturing the data and combining different categories. Prevalence of malnutrition from January 2019 upto May 2020 was established and described based on age group and gender (*table 1 and 2*). The treatment outcomes for 2019 upto May 2020 were extracted (*see results*).

In the present study there were primarily two periods in comparison. i) Jan-May 2019 vs Jan-May 2020 – this was to establish the general trend and functionality of the OTPs and IPFs due to similar seasonal variations. ii) Aug-Dec 2019 (before covid-19) vs. Jan-May 2020 (initial covid-19 period) – this was to establish if there were any early changes seen due to covid-19 epidemic by comparison of before and during the initial epidemic period respectively. As the outbreak of covid-19 was declared as a public health emergency of international concern by January 30, 2020, the specific period (Jan-May 2020) was considered for data analysis (56).

General characteristics and trends were then described using frequency and proportions for categorical variables. *z-test* was then performed between the proportions in comparison periods i.e. for initial covid trend (Aug-Dec 2019 – before covid-19 vs. Jan-May 2020 – initial covid-19 period). All statistical tests were performed using R studio with Version 1.3.959 (© 2009-2020 RStudio, PBC).

Qualitative interviews were also transcribed, translated into English (if the interview was done in French) and analyzed. Qualitative interviews were then grouped into two subsets i) CAR region and ii) outside of CAR (Pakistan, Bangladesh, Afghanistan). Interviews were performed until all possible participants were reached and interviewed.

4.5. VARIABLES :

Age: Age was defined as the completed number of months and was divided into 3 categories : In the OTPs, age was categorized as 6-23mo's, 24-59mo's and >59mo's. In the IPFs, age was categorized as <6mo's, 6-59mo's and >59mo's. Admission rates and treatment outcomes were analyzed by age categories.

Admission rates : New admissions were categorized based on the presence or absence of edema, MUAC or anthropometric measurements, and if the admission was based on a relapse of previously treated malnutrition. Admission rates were analyzed by the age categories.

Treatment outcomes : Treatment outcomes were categorized based on the recovery rate, transfer-out to OTP or another IPF, abandonment, non-respondent and death. Medical reference was an additional category in IPFs, however, the reason for medical reference is not known or not mentioned in the datasets. One of the drawbacks of this variable is also that it does not correspond to a specific admission in the OTP or IPF but is calculated as a monthly aggregated number. Hence, this variable was analyzed by age categories and by the different types of treatment outcomes.

5. RESULTS :

5.1. CHARACTERISTICS OF THE OTPs IN BANGUI, CAR :

In 2019, ACF covered 18 outpatient treatment programs from January to June. During the later half of the year 2019, 5 OTPs were given to another non-governmental organization that has its complete autonomy today. Since 2020, 2 more OTPs were under the supervision of ACF in Bangui, CAR. There were 3 more OTPs that did not have consistent data from January 2019 up until May 2020. Therefore, 8 OTPs were finally selected for this study due to their available monthly datasets from January 2019 to May 2020 and for the purpose of having consistent data through out the comparison period. The following are the different characteristics of the 8 selected OTPs in Bangui, CAR based on their a) Admissions, b) Treatment outcomes, c) The general trend observed in all the OTPs, d) The trend observed in these OTPs (collectively) before and during the the initial covid-19 period and e) Comparison among the 8 OTPs before and during the initial covid-19 period.
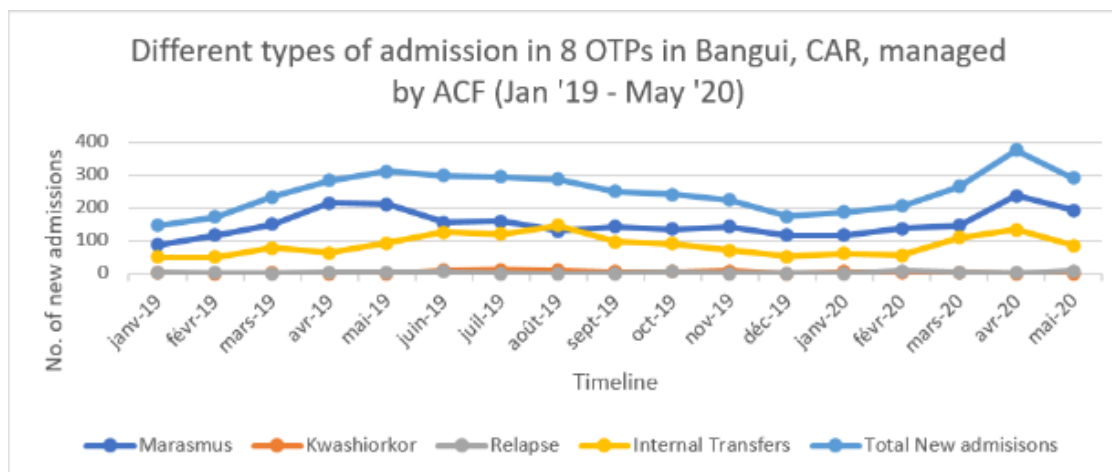
Fig 4: Different types of admissions in 8 outpatient treatment programs of Bangui, CAR, managed by ACF in 2019 upto May 2020.

From *figure 4*, it is noted that since May 2019, there has been a slight reduction in the number of new admissions in 8 OTPs. From Jan-May 2019 and Jan-May 2020, there is an increasing trend observed. The pattern of admissions in both periods (Jan-May 19' vs. Jan-May 20') is similar. Among the different types of admissions, the number of marasmus admissions are higher in both the comparison periods i.e., 68.15% in 2019 and 62.92% in 2020 *(refer to table 3)*. Maramsus admissions follow an almost similar pattern to the overall admission trend. Kwashiorkor and relapse contribute to less than 2% in both the years 2019 and 2020 *(refer to table 3)*.

b. Treatment outcomes in OTPs :
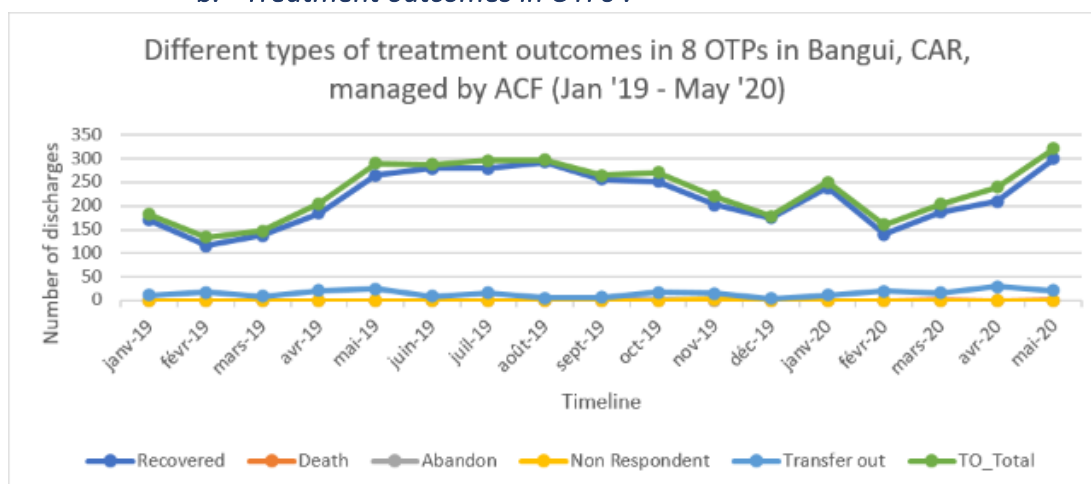
Figure 5: Different types of treatment outcomes in OTPs in Bangui, CAR, managed by ACF in 2019 upto May 2020.

From *figure 5*, it is noted that among the different types of treatment outcomes, the recovery rate is parallel to the overall treatment outcomes. There is a decrease in recovery rate observed from Jan-Feb 2019 and 2020 and increasing trend in recovery observed from Feb-May in both 2019 and 2020 which is also corresponds to the peak of admissions in April-

May (*as seen in figure 4*). Whereas, the other types of treatment outcomes are similar all throughout. Death, abandoned and non-respondent cases rarely occured.

During the covid-19 epidemic, there is an increase in the number of admission cases (*figure 4*) and subsequently increased recovered cases (*figure 5*) from Jan–May 2020 as compared to the previous period Aug-Dec 2019. Most of the admission cases were due to Marasmus while relapse cases were rarely present. Among the different treatment outcomes, death, abandoned and non-respondent cases rarely occured during the covid-19 epidemic.

c. General trend observed in all the OTPs:

GENERAL TREND IN THE OUTPATIENT TREATMENT PROGRAMS						
Categories		**Jan-May 2019**		**Jan-May 2020**		**Change in the comparison period**	**p-value (<0.05)**
		(n1)	Proportion (p1)	(n2)	Proportion (p2)	%	
NEW ADMISSIONS	Marasmus	783	68,15%	835	62,92%	6,64%	0.43251
	Kwashiorkor	10	0,87%	17	1,28%	70,00%	0.47608
	Relapse	18	1,57%	24	1,81%	33,33%	0.48803
	Internal Transfer	338	29,42%	451	33,99%	33,43%	0.43644
	Overall New Admissions	1149		1327		15,49%	
TREATMENT OUTCOMES	Recovered	873	91,13%	1075	91,41%	23,14%	0.49202
	Death	0	0,00%	2	0,17%	0,00%	0.46414
	Abandon	0	0,00%	0	0,00%	0,00%	
	Nonrespondent	0	0,00%	0	0,00%	0,00%	
	Transfer out	85	8,87%	99	8,42%	16,47%	0.48803
	Overall treatment outcomes	958		1176		22,76%	

Table 3: General trend in all 8 OTPs of Bangui, CAR, managed by ACF.

From *table 3*, it is seen that the overall admission rate increased by 15.49% in 2020 as compared to the corresponding period in 2019. Similarly, the overall treatment outcomes also increased by 22.76%. However, this increase seen in the overall admission rate and treatment outcomes is not statistically significant.

d. Trend in all the OTPs observed before and during initial covid-19 period:

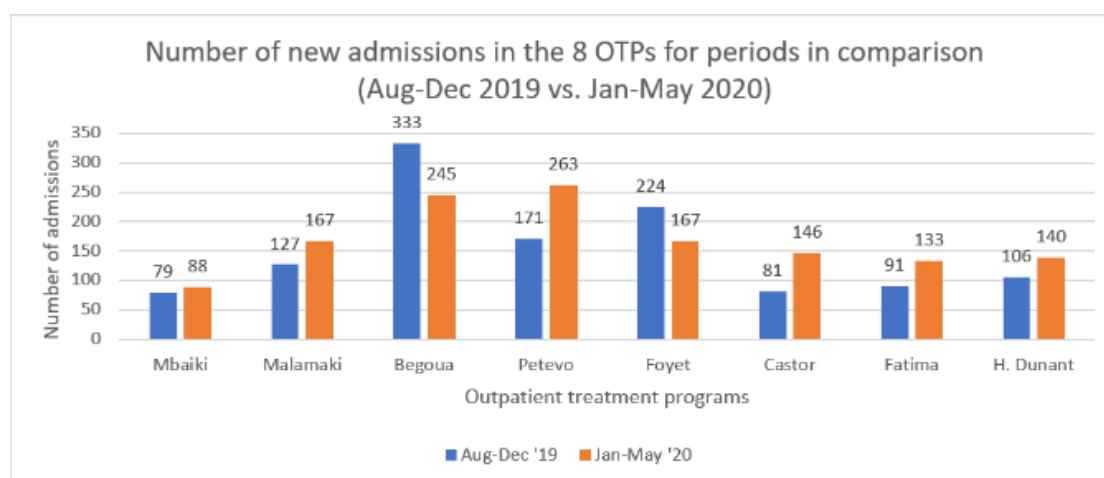| TREND IN THE OUTPATIENT TREATMENT PROGRAMS BEFORE AND DURING INITIAL COVID PERIOD						
Categories		**Aug-Dec 2019**		**Jan-May 2020**		**Change in comparison period**	**p-value (<0.05)**
		(n1)	Proportion (p1)	(n2)	Proportion (p2)	%	
NEW ADMISSIONS	Marasmus	670	56,97%	835	62,92%	24,63%	0.42465
	Kwashiorkor	34	2,89%	17	1,28%	-50,00%	0.42858
	Relapse	12	1,02%	24	1,81%	100,00%	0.4562
	Internal Transfer	460	39,12%	451	33,99%	-1,96%	0.43251
	Overall New Admissions	1176		1327		12,84%	
TREATMENT OUTCOMES	Recovered	1179	95,54%	1075	91,41%	-8,82%	0.39743
	Death	1	0,08%	2	0,17%	100,00%	0.48405
	Abandon	3	0,24%	0	0,00%	-100,00%	0.4562
	Nonrespondent	3	0,24%	0	0,00%	-100,00%	0.4562
	Transfer out	48	3,89%	99	8,42%	106,25%	0.38209
	Overall treatment outcomes	1234		1176		-4,70%	

Table 4: Trend in all the 8 OTPs before and during initial covid period, CAR, managed by ACF.

From *table 4*, it is seen that the overall admission rate increased by 12.84% but admissions due to Kwashiorkor decreased by 50% and relapse cases doubled in number. On the other hand, due to decrease in the recovery rate in 2020 by 8.82%, the overall treatment outcomes decreased by 4.70%. However, in both the admisisons and the treatment outcomes, this change observed was not statistically significant. Therefore, the initial impact of covid-19 epidemic in the outpatient treatment programs is not statistically significant.

e. *Comparison among 8 OTPs before and during the initial covid-19 period:*

ADMISSION TRENDS IN 8 OTPs IN BANGUI, CAR, MANAGED BY ACF													
Outpatient treatment programs	Categories	Aug-Dec 2019		Jan-May 2020		Change in comparison period	Outpatient treatment programs	Categories	Aug-Dec 2019		Jan-May 2020		Change in comparison period
		(n)	Proportion	(n)	Proportion	%			(n)	Proportion	(n)	Proportion	%
MBAIKI	Marasmus	67	84,81%	69	78,41%	2,99%	FOYET	Marasmus	121	54,02%	113	67,66%	-6,61%
	Kwashiorkor	0	0,00%	1	1,14%	0,00%		Kwashiorkor	46	20,54%	6	3,59%	-86,96%
	Relapse	2	2,53%	6	6,82%	200,00%		Relapse	0	0,00%	2	1,20%	0,00%
	Internal Transfer	10	12,66%	12	13,64%	20,00%		Internal Transfer	57	25,45%	46	27,54%	-19,30%
	Overall New Admissions	79		88		11,39%		Overall New Admissions	224		167		-25,45%
MALAMAKI	Marasmus	69	54,33%	88	52,69%	27,54%	CASTOR	Marasmus	65	80,25%	124	84,93%	90,77%
	Kwashiorkor	1	0,79%	2	1,20%	100,00%		Kwashiorkor	1	1,23%	1	0,68%	0,00%
	Relapse	2	1,57%	2	1,20%	0,00%		Relapse	3	3,70%	1	0,68%	0,00%
	Internal Transfer	55	43,31%	75	44,91%	36,36%		Internal Transfer	12	14,81%	20	13,70%	66,67%
	Overall New Admissions	127		167		31,50%		Overall New Admissions	81		146		80,25%
BEGOUA	Marasmus	77	23,12%	68	27,76%	-11,69%	FATIMA	Marasmus	77	84,62%	109	81,95%	41,56%
	Kwashiorkor	12	3,60%	4	1,63%	-66,67%		Kwashiorkor	2	2,20%	1	0,75%	-50,00%
	Relapse	1	0,30%	4	1,63%	300,00%		Relapse	2	2,20%	3	2,26%	0,00%
	Internal Transfer	243	72,97%	169	68,98%	-30,45%		Internal Transfer	10	10,99%	20	15,04%	100,00%
	Overall New Admissions	333		245		-26,43%		Overall New Admissions	91		133		46,15%
PETEVO	Marasmus	112	65,50%	158	60,08%	41,07%	H DUNANT	Marasmus	82	77,36%	118	84,29%	43,90%
	Kwashiorkor	2	1,17%	2	0,76%	0,00%		Kwashiorkor	6	5,66%	0	0,00%	-100,00%
	Relapse	1	0,58%	3	1,14%	200,00%		Relapse	1	0,94%	3	2,14%	0,00%
	Internal Transfer	56	32,75%	100	38,02%	78,57%		Internal Transfer	17	16,04%	19	13,57%	11,76%
	Overall New Admissions	171		263		53,80%		Overall New Admissions	106		140		32,08%

Table 5 : Comparison of different types of admission trends observed before and during initial covid-19 epidemic among different outpatient treatment programs managed by ACF in Bangui, CAR.

Figure 6: Number of new admisisons in the 8 OTPS for periods in comparison (Aug-Dec 2019 vs. Jan-May 2020).

From *table 5*, it is observed that 6 outpatient treatment programs namely Mbaiki (11.39%), Malamaki (31.50%), Petevo (53.80%), Castor (80.25%), Fatima (46.15%) and H. Dunant (32.08%) have an increased overall admission rate for the periods in comparison (Aug-Dec 2019 vs. Jan-May 2020). 2 OTPs namely Begoua and Foyet have reduced admission rates by 26.43% and 25.45% respectively. Mbaiki has the least number of admissions while Begoua has the highest number of admisisons (*as seen from table 5 or figure 6*).

5.2. CHARACTERISTICS OF INPATIENT FACILITIES IN BANGUI, CAR :

Within the inpatient facilities, 4 inpatient facilities were managed by ACF in 2019 and 3 inpatient facilities in 2020. Therefore, these 3 inpatient facilities were finally selected for this study due to their available monthly datasets. The following are the different characteristics of the IPFs in Bangui, CAR based on a) Admissions, b) Treatment outcomes, c) The general trend in all the IPFs, d) The trend in these IPFs (collectively) before and during the initial covid-19 period, e) Comparison among the 3 IPFs before and during the initial covid-19 period.

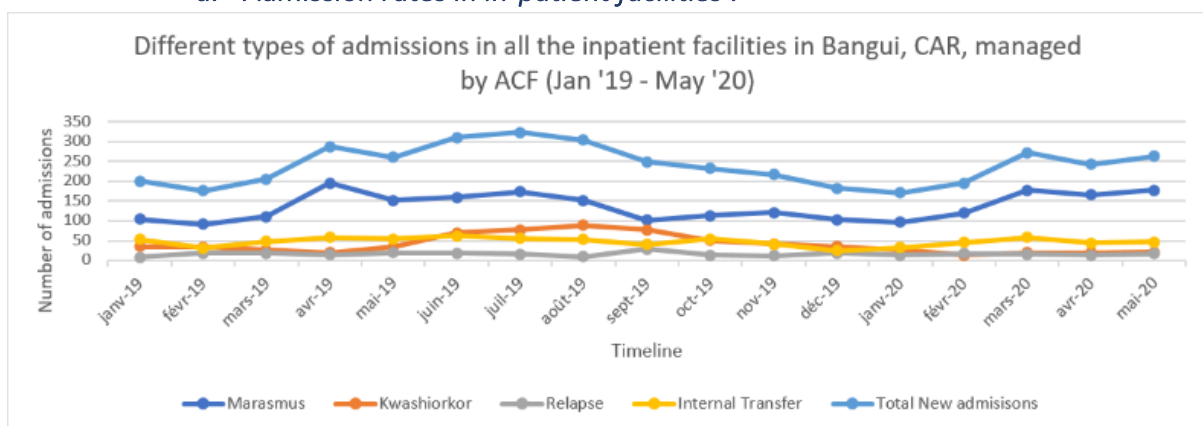### a. Admission rates in in-patient facilities :

Fig 7: Different types of admissions in all the inpatient facilities of Bangui, CAR, managed by ACF.

From *figure 7*, it is observed that the overall admission pattern from Jan-May 2019 and Jan-May 2020 is similar. There is a decreasing trend from July-Dec 2019 in the overall new admissions in inpatient facilities. Among the different types of new admissions, marasmus cases follow a similar pattern to the overall admission pattern and contribute to the majority of the overall new admissions i.e., 57.82% in Jan-May 2019 and 64.36% in Jan-May 2020 (*refer to table 6*). Number of Kwasiorkor cases were similar in the periods of comparison.
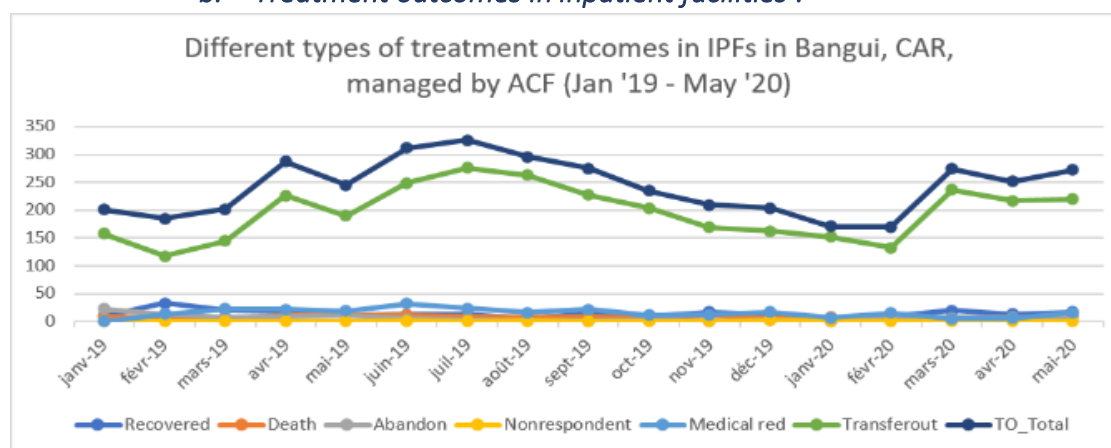
Figure 8: Different types of treatment outcomes in IPFs in Bangui, CAR, managed by ACF.

From *figure 8*, it is observed that most of the cases are transfered out (transferred from the IPFs to the OTPs for further management) i.e., 74.73% in Jan-May 2019 and 84.20% in Jan-May 2020 (*refer to table 6*) and is proportional to the total treatment outcomes. The rest of the treatment outcomes like death, abadoned, non-respondent, medical reference constitute to about 25% in Jan-May 2019 and 15% in Jan-May 2020. They follow similar patterns in both the periods of comparison.

During the covid-19 epidemic, the admission rates increased from Jan-May 2020 as compared to the previous period of Aug-Dec 2019 (*figure 7*). Subsequently, the treatment outcomes increased in the same comparison periods (*figure 8*). Among the different types of new admissions, marasmus cases contribute to the majority i.e., 49.91% in Aug-Dec 2019 and 64.36% in Jan-May 2020 (*table 7*). The different types of treatment outcomes were found to be similar in both the periods of comparison.

c. General trend in all the inpatient facilities :

GENERAL TREND IN THE INPATIENT FACILITIES						
Categories		**Jan-May 2019**		**Jan-May 2020**		**Change in comparison period**	**p-value (<0.05)**
		(n1)	Proportion (p1)	(n2)	Proportion (p2)	%	
NEW ADMISSIONS	Marasmus	654	57,82%	737	64,37%	12,69%	0.41683
	Kwashiorkor	151	13,35%	102	8,91%	-32,45%	0.41294
	Relapse	81	7,16%	78	6,81%	-3,70%	0.49202
	Internal Transfer	245	21,66%	228	19,91%	-6,94%	0.4721
	Overall Admissions	1131		1145		1,24%	
TREATMENT OUTCOMES	Recovered	95	8,48%	61	5,36%	-35,79%	0.42465
	Death	43	3,84%	37	3,25%	-13,95%	0.48006
	Abandon	66	5,89%	31	2,72%	-53,03%	0.40129
	Non-respondent	1	0,09%	2	0,18%	100,00%	0.48405
	Medical Reference	78	6,96%	49	4,30%	-37,18%	0.42858
	Transfer out	837	74,73%	959	84,20%	14,58%	0.35569
	Overall treatment outcomes	1120		1139		1,70%	

Table 6 : General trend in the inpatient facilities

From *table 6*, it is seen that the overall admission rate is almost the same (+1.24% in the comparison periods of Jan-May 2019 vs Jan-May 2020). However, Marasmus cases increased by 12.69% and Kwashiorkor cases decreased by 32.45%, this change in the values is statistically insignificant. It is also seen that the overall treatment outcomes is almost similar (+1.70% in the comparison periods of Jan-May 2019 vs. Jan-May 2020). Though there was a decrease in the number of recovered (-35.79%), death (-13.95%), abandoned (-53.03%) and medical reference (-37.18%) cases, this change in the comparison periods was not statistically significant.

d. Trend in all the IPFs before and during the initial covid-19 period :

TREND IN THE INPATIENT FACILITIES BEFORE AND DURING INITIAL COVID PERIOD						
Categories		**Aug-Dec 2019**		**Jan-May 2020**		Change in the comparison period	p-value (<0.05)
		(n)	Proportion	(n)	Proportion	%	
NEW ADMISSIONS	Marasmus	591	49,92%	737	64,37%	24,70%	0.32276
	Kwashiorkor	295	24,92%	102	8,91%	-65,42%	0.24825
	Relapse	83	7,01%	78	6,81%	-6,02%	0.49601
	Internal Transfer	215	18,16%	228	19,91%	6,05%	0.4721
	Overall New Admissions	1184		1145		-3,29%	
TREATMENT OUTCOMES	Recovered	62	5,08%	61	5,36%	-1,61%	0.49202
	Death	40	3,28%	37	3,25%	-7,50%	0.5
	Abandon	9	0,74%	31	2,72%	244,44%	0.40517
	Non-respondent	3	0,25%	2	0,18%	-33,33%	0.49202
	Medical Reference	80	6,56%	49	4,30%	-38,75%	0.43644
	Transfer out	1026	84,10%	959	84,20%	-6,53%	0.5
	Overall treatment outcomes	1220		1139		-6,64%	

Table 7 : Trend in the inpatient facilities before and during the initial covid period

From *table 7*, it is observed that the overall admission rate during the initial covid period in all the inpatient facilities decreased by 3.29%. However, Marasmus cases increased by 24.70%, Kwashiorkor cases decreased by 65.42% and relapse decreased by 6.02%, this change in the different admission types is not statistically significant. Similarly, the overall treatment outcomes also decreased by 6.64% in these inpatient facilities. This decrease was seen in all the different types of treatment outcomes except abandoned cases. But this change in the treatment outcomes was not statistically significant.

e. Comparison among the 3 IPFs before and during the covid-19 period :

ADMISSION TRENDS IN INPATIENT FACILITIES MANAGED BY ACF						
Inpatient facilities	Categories	Aug-Dec 2019		Jan-May 2020		Change in comparison period
		(n)	Proportion	(n)	Proportion	%
CPB	Marasmus	466	49,84%	623	64,49%	33,69%
	Kwashiorkor	208	22,25%	80	8,28%	-61,54%
	Relapse	80	8,56%	68	7,04%	-15,00%
	Internal Transfer	181	19,36%	195	20,19%	7,73%
	Overall New Admissions	935		966		3,32%
HMED	Marasmus	35	38,46%	56	62,92%	19,15%
	Kwashiorkor	34	37,36%	15	16,85%	25,00%
	Relapse	0	0,00%	3	3,37%	200,00%
	Internal Transfer	22	24,18%	15	16,85%	-40,00%
	Overall New Admissions	91		89		4,71%
BEGOUA	Marasmus	90	56,96%	68	60,71%	-24,44%
	Kwashiorkor	53	33,54%	9	8,04%	-83,02%
	Relapse	3	1,90%	11	9,82%	0,00%
	Internal Transfer	12	7,59%	24	21,43%	100,00%
	Overall New Admissions	158		112		-29,11%

Table 8: Comparison of admission trends before and during the initial covid-19 epidemic among the 3 inpatient facilities managed by ACF in Bangui, CAR.

From *table 8*, it is noted that CPB has the highest number of admissions as compared to HMED and Begoua for the periods in comparison (Aug-Dec 2019 vs. Jan-May 2020). In CPB and HMED, the admission rate is almost similar whereas in Begoua, there is a reduction in the rate of admission by 29.11%.

5.3. QUALITATIVE INTERVIEWS :

6 qualitative interviews were done with the program managers and HoDs from CAR, Pakistan, Aghanistan and Bangladesh. These interviews were grouped into two subsets – CAR region and outside of CAR (Pakistan, Bangladesh, Afghanistan).

a. CAR region :

Two interviews were done from CAR. One was a program manager and the other interview was with the head of nutrition department on the field in Bangui. One interview was held in English and the other one was held in French and the transcript was subsequently transcribed and translated. All possible sources (emails, skypecalls etc) for interviewing the program managers was made. But due to non-availability of staff members with the exisiting workload on the field along with team reduction linked towards entering the country, only two intervews were done.

According to both these participants, media coverage on covid-19 awareness was helpful especially with the use of radio messages. « *People were somehow waiting for covid-*

19 to reach CAR and it happened in mid-March, which is surprising because we did not expect people to know about covid-19 »

In the OTPs, handwashing techniques were taught and implemented sincerely at the entrance of the OTPs but there were no separate triage areas to screen people. All the OTPs in Bangui were functional throughout as the government had only announced the shutdown of public gatherings. Similarly, all the IPFs were also functioning in their normal capacity. In June 2020 (after the studied period), *« …when our in-charge of the nutrition unit tested positive for covid-19, the ACF recommendation is to close the center in order to protect the staff members as a priority. So he stayed at home and recovered while the others were not sure if they wanted to come to work anymore. I think because of this reason, there must have been a reduced screening in June..yes, there were limited number of children in the facility. But it is an OTP. And if we close it down, people cannot go anywhere… so we took all the necessary precautions, checked for services, estimated the PPEs, made sure the staff was okay and we could still function… ».*

There were no specific changes seen in the health seeking behavior of people even with rising cases of covid-19 in the country. *« As soon as the child is feeling well, the parents leave the IPF… either they want to go back to the fields and work or the mother has other children to take care of, so its difficult to manage the child entirely in the IPF and that is where the OTP supports…But we don't really know of what happens to these children. Do they visit the OTP as a regular follow-up ? We don't know... I think some children are missed in this transition, but majority of them manage to come to the OTP »* which suggest that similar difficulties have always been identified by the health staff for caretaker to complete the treatment of their child.

There were no tests performed on malnourished children to confirm covid-19. There were no advanced laboratory diagnostics in place. *« We do not test the children for covid-19. We only have an x-ray machine, some rapid tests for malaria…it is difficult to even suspect covid-19 in these children because of their existing malnourished state… »* and *« CPB is the biggest available inpatient facility, It always has around 100-150 new admissions/ month…and it is directly attached to the pediatric hospital in Bangui, so if there be any tests for covid-19 in children, then it should be here. And there is no test available here… so you can imagine that it is impossible to have tests for covid-19 in children »* People had to be reminded several times of the prevention measures at the OTPs and IPFs and constant dissemination of leaflets at the centers were done. The program managers also mentioned about the hike in prices of basic food commodities since March, which may lead to lasting impacts in the region.

Therefore, through these interviews with the humanitarian health professionals there was reitaration of the fact that the health services were not interrupted even with the emergence of covid-19 epidemic alongside the fact that the early impacts may not be as visible

but with elapsed time these changes might be more visible. This is also one of the lessons learnt during the 2013 Ebola outbreak when majority of the mortality rate was not due to the outbreak itself but later when the facilities were closed and people had no access or limited access to healthcare. In today's covid-19 context, adaptation to UNICEF guidelines on continuation of services in CAR was witnessed among both the OTPs and IPFs in Bangui based on the qualitative interviews.

b. Outside CAR :

Out of the four interviews made outside of CAR, two interviews from Pakistan team, one interview each from Bangladesh and Afghanistan teams were done. In all these three countries, there was a complete lockdown in place which affected the nutrition programs essentially the OTPs more than the IPFs. Several preventive measures of social distancing, handwashing, masks and curfew hours for movement were put in place in these 3 countries but the reality as mentioned by the program managers in all these 3 countries is different as people do not follow these measures. « *people believed about covid-19 only after their family members were affected, so there is a lot of fear and stigma associated with it … the patient turnover has reduced substantially… also the government is diverting all attention towards covid-19 and the existing disease burden is being neglected* » - ACF, Pakistan

Although the health services of OTPs were mostly affected by the lockdown in these countries and there was a discontinuity in the functioning capacity, there was always enough of drug supplies and nutrition stock left in the warehouses, this way, there was no shortage on the stock supply. *« in the basic health facilities, all the OTPs and most of the nutrition programs in the rural areas were closed down in the beginning when covid began in February in Pakistan… we had some stock left and the lockdown did not last very long so our stock was used up and we had just enough otherwise there would be huge shortage »* - ACF, Pakistan.

Therefore, program managers anticipated the secondary impacts of the epidemic such as food shortages in the long run especially in Bangladesh, as the refugee camps had food programs in place and outside the refugee camps food prices were hiked and it was difficult to have constant food supply *« there is a revised criteria of admission now for malnourished children and we only admit on the basis of MUAC. Before we had weekly OTP visits but to avoid frequent movements, people now come to the facility once in two weeks which has greatly affected the performance level.and we have restrictions on staff by the government the usual was 21 staff/ day but now we only have 3 staff/ day. It has greatly affected our functioning »* – ACF, Bangladesh.

Humanitarian professionals stressed about the added burden of covid-19 on humanitarian grounds rather than the sole burden of covid-19 epidemic. Overlooking and

ignoring the already existing disease burden is what happens in the face of a new epidemic threat *« Even though covid is here, the other problems are also here… they did not disapper and it will be difficult to recover later »* - Bangladesh and *« we need to know the disease pattern of covid with SAM.. this will help in case management and follow-up. It is the most important lesson for us now. It will open a chapter for us in the future as we don't know anything about how covid looks like in malnourished children »* - ACF, Afghanistan.

Hence, it was noted that all the other 3 countries faced troubles in terms of provision of healthcare due to the lockdowns and the local governmental rules with disruptions seen in the OTPs more than the IPFs. However, this disruption was not long lasting rather short-lived which helped in recovering the loss of services very quickly. As suggested by all the humanitarian professionals, it is the need of the hour on humanitarian grounds to diagnose and treat covid-19 in SAM children in a clinical perspective and as a public health view to be able to adapt to the latest protocols during epidemics keeping in view not to disrupt provision of health-care under any circumstance.

6. DISCUSSION :

6.1 OVERALL FINDINGS :

The covid-19 pandemic is undermining nutritional access across the world, particularly in the low-income and middle-income countries (LMICs). Malnutrition on the other hand, could exacerbate the effects of covid-19 in mothers and children or at the same time, more children could become malnourished due to the deteriorating quality of their diets, interruptions in nutrition and other essential services. The worst consequences however, are borne by the young children (57).

In a country like Central African Republic (CAR) where there are only three ventilators in the entire country (58) and 1 hospital bed available for 1,000 population (59), the struggle against covid-19 has intensified against the background of the high malnutrition cases (about 41% of the population suffering from chronic malnutrition in 2019 (60)) already existing in CAR. In addition, multilateral organizations and NGOs largely funded by bilateral agencies work in and out of arbitary regions and health zones on various health and nutrition initiatives for a fixed term with little or no coordination by the government and hence, an uncoordinated fragmentation of the health sector exists. But this cohort of large-scale international NGOs specialized in humanitarian health care service delivery also play an immense role in CAR providing maternal and child survival services in 60% of the country's conflict areas (61).

Lancet study in 2020 also emphasized the crucial need for the actions to protect child nutrition due to the unprecedented global social and economic crises triggered by the covid-19 pandemic posing grave risks to the nutritional status of young children especially in the

low-income and middle-income countries (LMICs). Without adequate action, the profound impact of the covid-19 pandemic on early life nutrition could have intergenerational consequences for child growth and development and life-long impacts on education, chronic disease risks, and overall human capital formation (62).

In order to observe and witness the reality in a country like CAR with minimal resources against a background of splintered health sector and the exponential trouble posed by covid-19, this study's main objective was to assess for any early changes and explore the challenges encountered in the admission and treatment outcomes of SAM children in the selected outpatient and inpatient facilities that are managed by ACF in Bangui, CAR.

a. Outpatient treatment programs :

In the outpatient treatment programs, it was noted that since May 2019, there has been a slight reduction in the number of admissions among the 8 OTPs (*figure1*). One possible reason for some of the OTPs to not function properly in the later half of the year 2019 was recognized during periodical reviews by ACF missions as lack of motivation from the local health staff and difference in the payments among the health staff members leading to less screening of children and ultimately less number of admissions, as also noted in the qualitative interview. *« We tried to survey and find out how our health staff was performing and everyone agreed that they lacked motivation and the primary reason for this was the difference in the payments »* - *Technical Referrant, ACF, CAR*. This, to some extent directs towards the aspect of the inconsistencies in the provision of care rather than the reduced health-seeking behavior of the people alone. In view of the health-seeking behavioral pattern of people in general, the period from May – August is usually considered as the lean season where despite the estimated food assistance given by the humanitarian organisations, there is still a starvation phase noticed in the community. Hence, during the lean season a reduction in the number of admissions is usually expected. Additionally, it is also the seasonal time for agricultural planting and harvesting and people give more importance to the livelihood and economy than their own health.

The pattern of the different types of admissions, however, is similar in the periods of comparison i.e Jan-May 2019 vs. Jan-May 2020. The treatment outcomes were on par with the overall admissions suggesting that the functional capacity of the OTPs were fully utilized as usual. There was no shut-down of OTPs noted in Bangui, CAR during the covid-19 epidemic. Furthermore, this could also suggest that the performance of the staff could be consistent in the comparison period (Jan-May 2019 vs. Jan-May 2020), inspite of the epidemic, which probably led to the consistency in the treatment outcomes. Although these

changes in the admission rates and treatment outcomes were not statistically significant (*table 3*).

All the 8 OTPs were functional even during the lockdown period of covid-19 epidemic in Bangui unlike other countries like Pakistan, Afghanistan and Bangladesh where-in OTPs were closed initially, causing disruptions in the provision of health services in these countries. Qualitative interview revealed that, basic handwashing practices were followed in all the OTPs, but there was no triage or isolation setup done in the OTPs. *« We only teach them handwashing methods at the entrance to the OTPs. It is just a small OTP. There is no big triage or isolation area like the hospitals but we are trying. It is difficult to see people practice it in everyday life »* - *Nutrition Advisor.* According to the estimates of UNICEF in July 2020, about 6,000 children could die every day in the world from preventable causes over the next six months due to both direct and indirect covid-19-related disruptions in essential health services. Hence, UNICEF's response to covid-19 focuses on the strategic priority of continuing access to essential health, HIV & nutrition services to women, children and vulnerable communities, including case management (63). ACF also developed a similar strategy focussing on ensuring continuity of its health and nutrition programs in Bangui, in the face of the current epidemic.

Additionally, in the present context of covid-19 epidemic, it is observed that the overall admission rate increased by 12.84% in all the 8 OTPs combined. Although the overall new admissions and treatment outcomes increased in Jan-May 2020 (early covid-19) as compared to the previous period of Aug-Dec 2019 (before covid-19), these changes observed in the OTPs were not statistically significant (*refer to table 4).* The initial impact of covid-19 epidemic on the OTPs is not statistically present but this also leads to one of the biggest limitation of this study that it is probably too early to note the impacts statistically. But these changes in the admission rates and treatment outcomes cannot be denied and must be studied in the next few months to see if these trends observed are similar at a later phase, opening doors for further research. Covid-19 remains difficult to be identified or suspected, diagnosed and tested in health facilities within CAR, with several possible differential diagnoses among children, the lack of knowledge from the health staff and the lack of diagnostic centers. Any change in the aspect of health-services may only be noticed at a near future after adequate screening or triaging of patients by trained health staff with available diagnostics. It is worthwhile to also note that it is an added challenge to correctly identify or suspect covid-19 epidemic among children, more-over among malnourished children who frequently present with overlapping infections (more commonly respiratory infections). In a few months of time, secondary impacts of the epidemic like food insecurity, hygiene measures and limited financial resources could

be an added reason for a changed pattern in health-seeking behavior on top of the existing epidemic in the country.

To understand further the differences in the functioning of the 8 OTPs, these OTPs were also studied in detail for their unit-level performance. It was observed that 6 out of 8 OTPs had increase in the overall admission rates for the periods in comparison i.e. Aug-Dec 2019 (before covid-19) vs. Jan-May 2020 (initial covid-19). According to the ACF missions, there were strengthening of community screening programs for nutrition in Bangui since April 2019. But due to lack of motivation of staff during the later half of 2019, the screening programs had reduced in number. With the resurgence of covid-19 epidemic and with the awareness of covid-19 being spread rapidly in the world, the health staff in CAR re-started the nutritional screening programs. Additionally, with the covid-19 pandemic, funding was also available for CAR and the staff members were better paid (as premiums) than before. This could also be the reason for the staff to re-start their screening activities in the communities. To note, passive screening somehow strengthened the screening programs by the health workers in most OTPs except Malimaka (one of the 8 OTPs). Despite a better performance by the health staff, there was relatively low number of admissions in M'Baiki (which has the least number of admissions) as compared to other OTPs (*refer to table 5 or figure 6*). Qualitative interview revealed that this was due to relocation issues of this center to a nearby community for rehabilitation purposes. « *The most drop in admissions that we have seen is in M'baiki, it is an OTP. It had relocated in the Henri Dunant compound for rehabilitation and due to this, the conseqeunce was a drop in active screening by the RECOs and even a drop in attendance of the health staff* » - *Nutrition Advisor, ACF.* On the other hand, only 2 OTPs – Begoua and Foyet had reduced admission rates by 26.43% and 25.45% respectively. Although there was an increase in the number of nutritional screening programs in these 2 communities, there was a reduction in the number of new admissions due to unknown reasons. But the health staff believe that this reduction was not related to the proportion of SAM in the community based on their screening data. « *We had a lot of passive screening in the community. We should have seen an increase in admission rate. But just because it is low, it does not mean that there is low prevalence in these communities or that we have treated SAM here* » - *Nutrition Advisor, ACF.* One of the OTPs namely Castor had 80% increase in the admission rate as ACF started this OTP in 2019 January (where there was no OTP before) and later on, the staff in this OTP were trained both for active and passive screening of malnutrition, and these efforts strengthened during the covid-19 epidemic.

Hence, in the outpatient treatment programs, it is noted that there was no disruption of services inspite of the covid-19 epidemic (as recommended by UNICEF) or in other words, covid-19 epidemic did not have a significant impact (even statistically) on the admission rates

and treatment outcomes in the OTPs among SAM children. Although the overall admission rate increased in all the OTPs but at a unit-level performance there are various factors (geographical, seasonal, psycho-social and financial) to be considered.

b. Inpatient facilities :

In the inpatient facilities, it is observed that the overall admission rate from Jan-May 2019 vs. Jan-May 2020 is similar and marasmus contributes to the majority of the overall new admissions i.e. 57.82% in Jan-May 2019 and 64.36% in Jan-May 2020 (*table 6*). Furthermore, among the treatment outcomes, most of the cases are transferred out i.e. 74.73% in Jan-May 2019 and 84.20% in Jan-May 2020 (*table 6*). This indicates a stable admission rate and treatment outcomes in the IPFs and that the treatment outcomes were on par with the admission rate. For the year 2019, there is a decreasing trend observed from Jul-Dec 2019 in the overall new admissions in inpatient facilities. This could probably be due to the fact that the peak of admissions usually ocurs from April to July due to the high number of malaria cases. The lean season usually occurs in May/June to August/ September and this could be one of the factors for decreased admission numbers in the IPFs. However, this change in the rates of admission in IPFs was not statistically significant in our study and also follow similar trends in OTPs where most of the children are diagnosed.

During the covid-19 epidemic, it was observed (*table 7*) that the overall admission rate in the IPFs decreased by 3.29% in the comparison period Aug-Dec 2019 (before covid-19) vs. Jan-May 2020(early covid-19). Similar to the admission rate, the treatment outcomes also had a decrease by 6.64% in these IPFs but this decrease in admission and treatment outcomes were not statistically significant.

Furthermore, among the 3 IPFs that were included in this study, it was noted that CPB had the highest number of admissions as compared to HMED and Begoua for the periods in comparison (Aug-Dec 2019 vs Jan-May 2020). There was a reduction in the rate of admission in Begoua by 29.11% due to unknown reasons (this community also has an OTP and in the results it was also noted to have reduced rate of admissions, as mentioned above). Among the 3 inpatient facilities, CPB is the largest inpatient facility and is directly linked to a pediatric hospital in Bangui and hence, it is expected to have the highest number of admissions. CPB in itself is part of the major hospital in Bangui (and in the country) and has an increased opportunity to transfer its cases from the inpatient facility to the hospital or vice-versa. Previously, in CPB there was an isolation ward which was mainly utilized for measles and communicable diseases but has now been converted to a covid-19 isolation ward. But until May 2020, there have been no reported or suspected covid-19 cases among children in CPB noting the fact that this facility does not have any testing options available for covid-19.

Furthermore, these inpatient facilities depending on the size, the administration and location of the facility, were better able to adapt to the covid-19 epidemic response or in other words had the regular utilization of services within the IPFs inspite of the covid-19 epidemic. This could also be due to the lessons learnt from the 2013 Ebola outbreak in Central African Republic. WIth the additional staff on duty at CPB, it would be quicker to attend emergencies whenever necesssary acknowledging that CPB remains as the highest level of care for SAM children with complications in the country. *« CPB is the biggest inpatient facility that we have. The food and other conditions to stay in the facility are better compared to other facilities. There is easier transfer and referral of patients from this facility to the hospital if required for medical reasons. As there are more children in this facility, the turnover rate for transfer-out cases to the OTPs is also high »* - Nutrition Advisor, ACF

It is to be noted that in both the outpatient treatment programs and inpatient facilities, the trends are similar among the OTPs and IPFs respectively. With an increase or decrease in the rate of new admissions in the OTPs, it is proportionally related to the increase or decrease in the IPFs. Example as seen in Begoua wherein the decreased rate of new admissions by 26.43% in the OTP was also reflected as a decrease in the rate of new admissions by 29.11% in the IPF although the reasons for this decrease is not fully known. Additionally, the seasonal factors (lean season) along with the need for livelihood (during the harvest period) also play an important role in the health-seeking behaviour of people which is reflected in both the OTPs and IPFs.

One of the drawbacks with the available datasets both in the OTPs and IPFs is that the rate of follow-up of the recovered or transfered-out cases is not known. This could be helpful in establishing a better follow-up of the discharged cases from the IPFs and the OTPs, so as to completely cure and prevent the relapse of malnutrition in children. Additionally, having better data entry registries with clear mention of the comorbid conditions of the malnourished children will be more helpful for furture research. Lastly, there is also a lack of information on why medical references were made in the inpatient facilities. This information can be useful for further studies on improving the quality of inpatient care given to malnourished children.

Finally, through this study, it was noted that there are no significant (even statistically) early impacts of covid-19 epidemic in the outpatient and inpatient facilities that treat severe acute malnutrition with complications in children, but there are numerous challenges and adaptations that the country had to go through during this epidemic. Furthermore, at a country level, a nutrition program could be considered successful but when seen at a unit-level performance, there are various factors that come into play. Compared to other countries, the

nutrition admissions and treatment outcomes remain stable as compared to numerous countries in the same region where the number of admissions dropped from 5-30% according to UNICEF-West Africa regional office as also seen in Asia (*qualitative report in Bangladesh in this study suggests it).* This continuity of nutrition services may reduce the indirect consequences of the pandemic in terms of morbidity and mortality in young children.

6.2 STRENGTHS:

No study till date has documented covid-19 in severe acute malnourished children with complications. Therefore, this study helps in giving an overview of the initial impacts of the covid-19 epidemic on SAM children with complications in Central African Republic. Although this change is seen as increased proportions of admission rate and treatment outcomes, though it is statistically not significant, this increase in admission rates and treatment outcomes cannot be ignored as this could be further studied to know if the trends are similar in the upcoming months (during the peak of the epidemic and post-epidemic phase). It sheds light on the reality of the low-resource-equipped countries, with the limited available data and the absence of testing or diagnostics and equipments. This study serves as a substratum for future research on impacts of the covid-19 epidemic especially on SAM children with complications. This study was helpful in giving a reality-check on the workplan that CDC considers in partnership with ACF in Bangui, CAR to further study the trends of OTPs and IPFs concurrently with SAM and covid-19 children. Furthermore, research on before and after impacts of covid-19 can surface through this study.

6.3 LIMITATIONS:

In the initial stages of this study, the plan was to have a broader scope on studying the impacts of covid-19 on malnourished children and in this regard different countries managed by ACF-France were approached. However, due to the difficulties in obtaining the data from the other countries and due to little available data from CAR, only CAR was selected for this study. The availability of datasets even in CAR was at a stagnant level at particular period of time during the start of this study. Complete datasets for analysis were only available towards the last two months of the study. The quantitative datasets used in this study are monthly records of outpatient and inpatient facilities in Bangui. Hence it is nearly impossible to segregate the new admissions and the corresponding treatment outcomes at individual level based on the age and gender. The comorbid indicators were not available on par with the monthly dataset and hence assessing the additional burden due to covid-19 in SAM children with complications was not possible. Furthermore, due to the absence of covid-19 testing and

the difficulties of diagnosing and tracking of the patients, there is no mention of the transfer of patients to another OTP/ IPF / covid center due to the suspicion of covid-19 cases. Furthermore, there are no proper testing facilities for covid-19 available for malnourished children, neither in the OTPs nor in the IPFs. Qualitatively, it was difficult to contact the participants for a qualitative interview due to internet barriers and also due to the lockdown.

7. RECOMMENDATIONS:

Having individual data entries will be more helpful in targeting the problem as it will provide comprehensive understanding of the actual scenario. Coordination between the outpatient treatment programs (nutrition services) and inpatient facilties is recommended for better follow-up of the patients to prevent relapse and lost to follow-up and completely cure malnutrition. This in turn can reduce the relapse of malnutrition among recovered patients from OTPs and IPFs respectively. Additionally, transfer-in or transfer-out cases can be documented in a more systematic manner which can prevent overlapping of data for better analysis of services. It is also recommended to add further information on why medical references in inpatient facilities were carried out as it can be useful in improving the quality of inpatient services for SAM children. On the other hand, availability of comorbidity indicators at an individial level could help in understanding the syndromic trends in children which would further help in differentiating SAM children with complications (respiratory infections) vs. SAM children with covid-19. Suspicion and diagnoses of SAM and covid-19 among children could be better organized through this standardized manner without misusing the limited resources available.

In the present covid-19 context, as this study helped in formulating a reality-check on the workplan with CDC, further collaboration and partnership with CDC could help improve the identifcation and screening of covid-19 cases at admission and define the need to test asymptomatic children and children without the classic respiratory symptoms. Further protocols and decisions on SAM management and treatment and mitigation of covid-19 transmission in nutritional centers could be useful. Furthermore, it is recommended to have protocols for suspecting and identifying covid-19 in malnourished children not only based on a syndromic approach but keeping in view the resource-limited countries and the challenges in testing. Due to theminimal available resources, this approach could be limited to the IPFs (to begin-with and at a later stage be used at an OTP/community level). Secondary impacts of covid-19 (such as food insecurity, increase in the prices of food commodities etc) must also be studied in future research studies as sometimes, the secondary impacts can cause higher damage than the primary or the direct impact.

8. CONCLUSION :

This study aims to assess any early changes and explore the challenges due to covid-19 encountered in the admission and treatment outcomes of SAM children in outpatient and inpatient facilities, managed by ACF in Bangui. Description of general charactericterics of OTPs and IPFs were made based on the different types of admissions and treatment outcomes and also within the OTPs and IPFs. There was no statistically significant increase in the admission rate or the treatment outcomes noted in both OTPs and IPFs. Humanitarian professionals through the qualitative interviews in this study, anticipated the secondary impacts of the epidemic on the health services to be inevitable. There were several drawbacks and limitations observed in this study but the essential ones are the lack of covid-19 testing for SAM children with complications that blur the picture for health professionals. There is a lack in understanding the clear view of the link between covid-19 and undernutrition and the fact that it is too early to observe a significant impact on SAM and the management in CAR in three months since the start of the covid-19 epidemic in the country. Therefore, it is recommended to have protocols for suspecting and identifying covid-19 in malnourished children not only based on a syndromic approach but keeping in view the resource-limited countries and the challenges in testing and to continue this work to observe the impact of covid-19 in the upcoming months.

References :

1. Collins S, Dent N, Binns P, Bahwere P, Sadler K, Hallam A. Management of severe acute malnutrition in children. The Lancet. 2006 Dec 2;368(9551):1992–2000.

2. Management of severe malnutrition: a manual for physicians and other senior health workers. Rev Panam Salud Pública. 1999 Aug;6(2):146–7.

3. 2020_Global_Nutrition_Report.pdf.

4. Fact sheets - Malnutrition [Internet]. [cited 2020 Jul 22]. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition

5. WHO_NMH_NPH_02.8.pdf [Internet]. [cited 2018 Nov 26]. Available from: http://apps.who.int/iris/bitstream/handle/10665/67215/WHO_NMH_NPH_02.8.pdf;jsessionid=A212510B550966B22D8BD9AD4758AED5?sequence=1

6. Carsetti R, Quintarelli C, Quinti I, Piano Mortari E, Zumla A, Ippolito G, et al. The immune system of children: the key to understanding SARS-CoV-2 susceptibility? Lancet Child Adolesc Health. 2020 Jun;4(6):414–6.

7. The 2020 Global Nutrition Report in the context of Covid-19 [Internet]. Global Nutrition Report. 20:33:13.838246+00:00 [cited 2020 Jul 22]. Available from: https://globalnutritionreport.org/reports/2020-global-nutrition-report/2020-global-nutrition-report-context-covid-19/

8. Roberton T, Carter ED, Chou VB, Stegmuller AR, Jackson BD, Tam Y, et al. Early estimates of the indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study. Lancet Glob Health. 2020 Jul;8(7):e901–8.

9. Rodríguez L, Cervantes E, Ortiz R. Malnutrition and Gastrointestinal and Respiratory Infections in Children: A Public Health Problem. Int J Environ Res Public Health. 2011 Apr;8(4):1174–205.

10. Ahmed T, Haque R, Shamsir Ahmed AM, Petri WA, Cravioto A. Use of metagenomics to understand the genetic basis of malnutrition. Nutr Rev. 2009 Nov 1;67(suppl_2):S201–6.

11. Van den Broeck J, Eeckels R, Vuylsteke J. Influence of nutritional status on child mortality in rural Zaire. The Lancet. 1993 Jun 12;341(8859):1491–5.

12. Attia S, Versloot CJ, Voskuijl W, van Vliet SJ, Di Giovanni V, Zhang L, et al. Mortality in children with complicated severe acute malnutrition is related to intestinal and systemic inflammation: an observational cohort study. Am J Clin Nutr. 2016 Nov 1;104(5):1441–9.

13. WHO | Malnutrition is a world health crisis [Internet]. WHO. [cited 2020 Apr 7]. Available from: http://www.who.int/nutrition/topics/world-food-day-2019-malnutrition-world-health-crisis/en/

14. Woodward B. Protein, Calories, and Immune Defenses. Nutr Rev. 1998 Jan 1;56(1):S84–92.

15. Rice AL, Sacco L, Hyder A, Black RE. Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries. Bull World Health Organ. 2000;15.

16.   Rabiee F, Geissler C. Causes of Malnutrition in Young Children: Gilan, Iran. J Trop Pediatr. 1990 Aug 1;36(4):165–70.

17.   United Nations Children's Fund. Strategy for improved nutrition of children and women in developing countries. Indian J Pediatr. 1991 Jan 1;58(1):13–24.

18.   Tette EMA, Sifah EK, Nartey ET. Factors affecting malnutrition in children and the uptake of interventions to prevent the condition. BMC Pediatr. 2015 Nov 19;15(1):189.

19.   Forero-Ramirez N, Gamboa LF, Bedi A, Sparrow R. Child malnutrition and prenatal care: evidence from three Latin American countries. Rev Panam Salud Pública. 2014 Mar;35:163–71.

20.   Bachmann MO. Cost–effectiveness of community-based treatment of severe acute malnutrition in children. Expert Rev Pharmacoecon Outcomes Res. 2010 Oct 1;10(5):605–12.

21.   Statement_community_based_man_sev_acute_mal_eng.pdf [Internet]. [cited 2020 Jul 23]. Available from: https://www.who.int/nutrition/topics/Statement_community_based_man_sev_acute_mal_eng.pdf

22.   CTC-Field-Manual-Oct2006-508.pdf [Internet]. [cited 2020 Jul 23]. Available from: https://www.fantaproject.org/sites/default/files/resources/CTC-Field-Manual-Oct2006-508.pdf

23.   Borelli P, Blatt SL, Rogero MM, Fock RA. Haematological alterations in protein malnutrition. Rev Bras Hematol E Hemoter. 2004 Mar;26(1):49–56.

24.   Schaible UE, Kaufmann SHE. Malnutrition and Infection: Complex Mechanisms and Global Impacts. PLoS Med [Internet]. 2007 May [cited 2020 Apr 7];4(5). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1858706/

25.   Schneider SM, Veyres P, Pivot X, Soummer A-M, Jambou P, Filippi J, et al. Malnutrition is an independent factor associated with nosocomial infections. Br J Nutr. 2004 Jul;92(1):105–11.

26.   Cashat-Cruz M, Morales-Aguirre JJ, Mendoza-Azpiri M. Respiratory tract infections in children in developing countries. Semin Pediatr Infect Dis. 2005 Apr 1;16(2):84–92.

27.   Hammerschmidt S, Bethe G, Remane PH, Chhatwal GS. Identification of pneumococcal surface protein A as a lactoferrin-binding protein of Streptococcus pneumoniae. Infect Immun. 1999 Apr;67(4):1683–7.

28.   Risk-Factors-for-Severe-Acute-Lower-Respiratory-Tract-Infection-in-Under-Five-Children.pdf [Internet]. [cited 2020 Apr 8]. Available from: https://www.researchgate.net/profile/Sushil_Kabra/publication/11604122_Risk_Factors_for_Severe_Acute_Lower_Respiratory_Tract_Infection_in_Under-Five_Children/links/59a6da070f7e9b41b7891040/Risk-Factors-for-Severe-Acute-Lower-Respiratory-Tract-Infection-in-Under-Five-Children.pdf

29.   Cunha AL. Relationship between acute respiratory infection and malnutrition in children under 5 years of age. Acta Paediatr. 2000;89(5):608–9.

30. Chisti MJ, Tebruegge M, La Vincente S, Graham SM, Duke T. Pneumonia in severely malnourished children in developing countries - mortality risk, aetiology and validity of WHO clinical signs: a systematic review. Trop Med Int Health TM IH. 2009 Oct;14(10):1173–89.

31. Suzuki A, Lupisan S, Furuse Y, Fuji N, Saito M, Tamaki R, et al. Respiratory viruses from hospitalized children with severe pneumonia in the Philippines. BMC Infect Dis. 2012 Oct 23;12(1):267.

32. Kuypers J, Martin ET, Heugel J, Wright N, Morrow R, Englund JA. Clinical Disease in Children Associated With Newly Described Coronavirus Subtypes. Pediatrics. 2007 Jan 1;119(1):e70–6.

33. Liu W, Zhang Q, Chen J, Xiang R, Song H, Shu S, et al. Detection of Covid-19 in Children in Early January 2020 in Wuhan, China [Internet]. New England Journal of Medicine. Massachusetts Medical Society; 2020 [cited 2020 Jul 5]. Available from: https://www.nejm.org/doi/10.1056/NEJMc2003717

34. 10.1001@jamapediatrics.2020.1346.pdf [Internet]. Dropbox. [cited 2020 Jul 5]. Available from: https://www.dropbox.com/s/f79dzr7azxhtjux/10.1001%40jamapediatrics.2020.1346.pdf?dl=0

35. Wei M, Yuan J, Liu Y, Fu T, Yu X, Zhang Z-J. Novel Coronavirus Infection in Hospitalized Infants Under 1 Year of Age in China. JAMA. 2020 Apr 7;323(13):1313–4.

36. peds.2020-0702.full.pdf [Internet]. Dropbox. [cited 2020 Jul 5]. Available from: https://www.dropbox.com/s/hh89woz8cy4vy14/peds.2020-0702.full.pdf?dl=0

37. Children With Kawasaki-Like Disease Positive for COVID-19 [Internet]. Medscape. [cited 2020 Jul 5]. Available from: http://www.medscape.com/viewarticle/930201

38. Ouldali N, Pouletty M, Mariani P, Beyler C, Blachier A, Bonacorsi S, et al. Emergence of Kawasaki disease related to SARS-CoV-2 infection in an epicentre of the French COVID-19 epidemic: a time-series analysis. Lancet Child Adolesc Health [Internet]. 2020 Jul 2 [cited 2020 Jul 23];0(0). Available from: https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(20)30175-9/abstract

39. en-net | Rationale for COVID 19 programme adaptations (escalated question to the Wasting TWG) [Internet]. [cited 2020 Jul 5]. Available from: https://www.en-net.org/question/4021.aspx

40. Esper F, Weibel C, Ferguson D, Landry ML, Kahn JS. Evidence of a Novel Human Coronavirus That Is Associated with Respiratory Tract Disease in Infants and Young Children. J Infect Dis. 2005 Feb 15;191(4):492–8.

41. Child mortality and COVID-19 [Internet]. UNICEF DATA. [cited 2020 Jul 4]. Available from: https://data.unicef.org/topic/child-survival/covid-19/

42. Monitoring the COVID-19 pandemic in sub-Saharan Africa: focusing on health facility admissions and deaths [Internet]. The Union. [cited 2020 Jul 5]. Available from: https://www.theunion.org/news-centre/news/monitoring-the-covid-19-pandemic-in-sub-saharan-africa-focusing-on-health-facility-admissions-and-deaths

43. Central African Republic - total population 2014-2024 [Internet]. Statista. [cited 2020 Jul 4]. Available from: https://www.statista.com/statistics/728291/total-population-of-central-african-republic/

44. GHO | By country | Central African Republic - statistics summary (2002 - present) [Internet]. WHO. World Health Organization; [cited 2020 Jul 4]. Available from: https://apps.who.int/gho/data/?theme=country&vid=6100

45. Notre intervention en République Centrafricaine [Internet]. Action contre la Faim. [cited 2020 Jul 23]. Available from: https://www.actioncontrelafaim.org/missions/republique-centrafricaine/

46. Caleo GM, Sy AP, Balandine S, Polonsky J, Palma PP, Grais RF, et al. Sentinel site community surveillance of mortality and nutritional status in southwestern Central African Republic, 2010. Popul Health Metr. 2012 Sep 4;10(1):18.

47. Central African Republic [Internet]. [cited 2020 Jul 4]. Available from: https://www.who.int/data/maternal-newborn-child-adolescent/monitor

48. Guerrero S, Myatt M, Collins S. Determinants of coverage in Community-based Therapeutic Care programmes: towards a joint quantitative and qualitative analysis. Disasters. 2010;34(2):571–85.

49. ACTION CONTRE LA FAIM. 20180728_PUI_BGI_FB_Sant+® III_consortium_Plan de Communication_VF_Clean.docx. 2018.

50. Our intervention in Central African Republic [Internet]. Action contre la Faim. [cited 2020 Aug 11]. Available from: https://www.actioncontrelafaim.org/en/missions/central-african-republic/

51. WHO - Situation Report 72. 20200401-sitrep-72-covid-19.pdf [Internet]. 2020 [cited 2020 Aug 24]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200401-sitrep-72-covid-19.pdf?sfvrsn=3dd8971b_2

52. WHO - Situation Report 101. 20200430-sitrep-101-covid-19.pdf [Internet]. 2020 [cited 2020 Aug 24]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200430-sitrep-101-covid-19.pdf?sfvrsn=2ba4e093_2

53. WHO - Situation Report 133. 20200601-covid-19-sitrep-133.pdf [Internet]. 2020 [cited 2020 Aug 24]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200601-covid-19-sitrep-133.pdf?sfvrsn=9a56f2ac_4

54. WHO - Situation Report 163. 20200701-covid-19-sitrep-163.pdf [Internet]. [cited 2020 Aug 24]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200701-covid-19-sitrep-163.pdf?sfvrsn=c202f05b_2

55. EC Press release, Brussels. Coronavirus__EU_supports_Central_African_Republic_with__54_million_to_limit_socio-economic_risks.pdf. 2020.

56. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV) [Internet]. [cited 2020 Aug 24]. Available from: https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)

57. Fore HH, Dongyu Q, Beasley DM, Ghebreyesus TA. Child malnutrition and COVID-19: the time to act is now. The Lancet [Internet]. 2020 Jul 27 [cited 2020 Aug 11];0(0). Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31648-2/abstract

58. These countries have only a handful of ventilators [Internet]. Devex. 2020 [cited 2020 Aug 11]. Available from: https://www.devex.com/news/sponsored/these-countries-have-only-a-handful-of-ventilators-96970

59. Central African Republic Hospital bed density - Demographics [Internet]. [cited 2020 Aug 11]. Available from: https://www.indexmundi.com/central_african_republic/hospital_bed_density.html

60. Overview [Internet]. World Bank. [cited 2020 Aug 11]. Available from: https://www.worldbank.org/en/country/centralafricanrepublic/overview

61. The World Bank - Health System Support and Strengthening Project (P164953). 2018.

62. Headey D, Heidkamp R, Osendarp S, Ruel M, Scott N, Black R, et al. Impacts of COVID-19 on childhood malnutrition and nutrition-related mortality. The Lancet. 2020 Aug;396(10250):519–21.

63. UNICEF – Humanitarian Action for Children - Coronavirus (COVID-19) Global Response [Internet]. [cited 2020 Aug 29]. Available from: https://www.unicef.org/appeals/covid-2019.html

Annexure

a. Example of the dataset

UNITA - RAPPORT MENSUEL - PRISE EN CHARGE DE LA MALNUTRITION AIGUE SEVERE - UNTA-MAI 2020

CODE DE L'UNTA	MMB
NOM DE L'UNTA	MAMADOU MBAIKI
TYPE D'UNTA	UNTA
REGION	N°7
PREFECTURE	Bekou
DATE D'OUVERTURE	40817

Partenaire en charge de l'UNTA	ACTION CONTRE LA FAIM
Rapport préparé par	jerry NGOUANDZA
Période du rapport	du 01 / 05 /2020 au 31 / 05 / 2020
Date de soumission du rapport	6/5/2020
Nom/Code de l'UNT utilisé par l'UNTA	UNTCPB

Groupe d'âge	Sexe	Total au début du mois	Nouvelles admissions					Total des admissions UNTA	Transfert	Sorties					Total Déchargés	Total à la fin du mois
			P/T<-3Z Score ou PB<115 mm	Oedèmes	Rechutes	Réadmission après abandon	Transfert interne de l'UNT ou autre UNTA		Transfert interne vers UNT	Décès	Abandons Confirmés	Abandons non confirmés	Non répondants	Guéris		
6 - 23 mois	M	198	62	0	1	0	29	92	10	1	0	0	0	113	124	151
	F	247	93	0	5	0	39	137	7	0	0	0	0	137	144	228
	Total	445	155	0	6	0	68	229	17	1	0	0	0	250	268	379
24 - 59 mois	M	30	18	2	0	0	10	30	1	0	0	0	0	23	24	38
	F	45	21	0	2	0	8	31	2	0	0	0	0	22	24	47
	Total	75	39	2	2	0	18	61	3	0	0	0	0	45	48	85
> 59 mois	M	3	0	0	0	0	1	1	0	0	0	0	0	0	0	4
	F	15	0	0	0	0	0	1	1	1	0	0	0	5	6	7
	Total	18	0	0	0	0	1	1	1	1	0	0	0	5	6	11
Grand Total		538	194	2	8	0	87	291	21	2	0	0	0	300	322	475

Fig. a – Monthly dataset from CAR

	A Year	B Month	C Age_group	D Sex	E Beginning_	F NA_Wham	G NA_Edeme	H Int_transfe	I Relapse	J NA_Total	K Transfer_o	L TO_Death	M TO_Aband	N TO_Nonres	O TO_Recove	P TO_Total	Q End_month_adm	R
98	2020		5 6-23m	Male	198	62	0	29	1	92	10	1	0	0	113	124	166	
99	2020		5 6-23m	Female	247	93	0	39	5	137	7	0	0	0	137	144	240	
100	2020		5 24-59m	Male	30	18	2	10	0	30	1	0	0	0	23	24	36	
101	2020		5 24-59m	Female	45	21	0	8	2	31	2	0	0	0	22	24	52	
102	2020		5 >59m	Male	3	0	0	1	0	1	0	0	0	0	0	0	4	
103	2020		5 >59m	Female	15	0	0	0	0	0	1	0	0	0	5	6	9	

Fig. b – Transformed dataset for analyzation

b. *Sample questionnaire for the qualitative study*

Questions:

Main questions	Follow-up questions/ probes
1. List the different ways in which people are made aware of the epidemic and the disease (covid-19)?	• Governmental updates • Media / social media (posters, microphone announcements etc)
2. Describe the general views and reactions of people in your country about covid-19 ?	• The virus itself (coronavirus) - what do people think of the virus? (its origin, if zoonotic/not etc) • The disease (covid-19) - what do people think of the disease? (severity, transmission, cultural beliefs)
3. What are the government protocols and how did the people react to those rules?	• Confinement, isolation, social distancing, handwashing practices, behavioral changes /other quarantine measures
4. What are the most essential services that are affected due to covid-19?	• General services (stores, transport, etc) • Medical services (access to healthcare/ health-seeking behavior, drugs/ medications)
5. How did the outpatient/ inpatient facilties get affected in terms of utilization of services?	• Outpatient – increase/ decrease in consultations/ followups, accessibility to the nearest OTP, • Inpatient – increase/decrease in consultations/ followups, referrals/ transfer to other hospitals, diagnostic requirements, increase/ decrease in complicated cases
6. Different methods/ techniques adapted in providing care during the epidemic?	• Outpatient - hand hygiene, social distancing, offline/ family MUACs, drug supply etc) • Inpatient – hand hygiene in staff and patients, behavioral changes - social distancing, IPC measures by staff, drug supply
7. What are the challenges faced in providing quality care for malnourished children?	• Staff availability/ shortage, drug supply, lack of equipments – diagnostic and therapeutic, cultural beliefs (if any) on covid19
8. What are the methods of suspecting covid-19 in malnourished children and how are they treated?	• Based on signs and symptoms only or • Availability of lab diagnosis or • Referral methods/ transfer to other hospitals for complicated cases
9. What factors can cause a rise in malnutrition among children?	• Child immunity, nutrition centers being turned to covid centers, priority given to only covid and malnutrition neglected, discontinuity of treatment, confinement, shorage of drugs/ stock etc.
10. How to prevent the occurrence of covid among malnourished children?	• What area should be focused more? (covid19 or malnutrition or both) • Prevention of covid • Prevention of malnutrition itself
11. What recommendations can you give for better management of covid and malnutrition?	