Master of Public Health

Master international de Santé Publique

A Scabies Epidemic:

A cross-sectional study investigating the diagnostic and treatment practices of physicians in Brittany, France

Jacqueline GENOW

MPH | M2
2012-2013

EHESP, Département d'Epidémiologie
et des Biostatistiques, Hôpital Hôtel-Dieu
Paris, France

Professional and Academic Advisor

Pascal Crépey, PhD
Professor of Biostatistics

EHESP, Département d'Epidémiologie
et des Biostatistiques, Hôpital Hôtel-Dieu
Paris, France

Acknowledgements

I am deeply grateful to Pascal Crépey, my thesis supervisor, for giving this opportunity to work with him and for all his guidance and support during my practicum. This internship was a specific challenge for me, in that it was my first experience in a primarily French working environment. Pascal's trust and confidence helped me to reach a new level in French and for that I cannot thank him enough.

I would like thank Remi Demillac for his kindness and support during the IDEA program, as well as the entire team at InVS-Cire Ouest for their help in making this project possible.

I owe many thanks to Thierry Ancelle of EHESP and Brigitte Helynck of InVS for their patience and guidance during the IDEA program. Thank you for welcoming me as a part of your team.

Additionally, I would like to thank Guillaume Jeannerod, Curtis Broderick, and the entire team at Epiconcept for their outstanding technical support and dedication to the field of epidemiology.

To all the students and facilitators that participated in the IDEA program, thank you for everything you contributed to making the 29th IDEA program a great success and for giving me an unbelievable experience I will not forget.

Last, but certainly not least, I am grateful for the support of my friends, family, and my loving boyfriend, Laurent.

Abstract

***Background*:** Scabies is a highly contagious and pervasive skin infection that has affected human societies for over 2500 years with a current global prevalence of 300 million cases. Scabies is transmitted by direct, skin-to-skin contact, and is highly contagious. In 2011, the French National Institute for Public Health Surveillance of has been monitoring a rapid increase of scabies cases in the Brittan region of France.

Objectives: Gain insight on the management practices of scabies cases for general practitioners, pediatricians, and dermatologists in the Bretagne region of France in terms of diagnosis, prescription of preventive and curative treatments, and follow-up procedures.

Methods: A cross-sectional survey was conducted of 1200 private practice physicians in the Brittany region. The sample was stratified by type of physician (dermatologists, general practitioners, and pediatricians), urban/rural zone, and by the four departments in region. The survey was developed and conducted during the 29th annual field epidemiology training program (IDEA) in Rennes, France from the 2nd to 19th of April, 2013.

***Results*:** Scabies incidence was estimated at approximately 12 200 cases over the last 7 months. This is an increase from the recently estimated incidence of 10 000 cases per year by the Regional Health Agency of Brittany. A multivariate logistic regression analysis was used to compare physicians' compliance to the recent national recommendations concerning the treatment and management of scabies. Dermatologists were the only group, regardless of other factors, that followed all the national recommendations. General practitioners (OR=0.049, 95%CI [0.01, 0.22]) and pediatricians (OR=0.056, 95%CI [0.01, 0.32])) showed a significant inverse association with following national treatment protocol. Work experience was not significantly associated when compared to the reference group - inexperienced workers (<10 years), although having 10 to 30 years (OR=1.53, 95%CI [0.60, 3.88]) or more than 30 years (OR=1.37, 95%CI [0.46, 4.11]) of experience had a slight positive association.

Conclusion: The scabies epidemic is still continuing and is an important issue in France. There is an evident need for better reporting of cases and proper surveillance of scabies. Physicians managing cases of scabies are not in compliance with national recommendations, but most are willing to receive additional information for themselves and their patients. Furthermore, the use of prescription drug sales, specifically Ivermectin, as an indicator for tracking an increase in scabies incidence could be a future path for investigation.

Keywords: Scabies, France, Infectious disease, Ivermectin, InVS, IDEA

Resumé

***Contexte**:* Affectant l'Homme depuis de 2500 ans, la gale est une infection de la peau hautement contagieuse et envahissante qui touche encore aujourd'hui 300 millions de personnes. La gale est très contagieuse et se transmet par contact direct peau à peau ou contact avec des matériaux infectés (vêtements, literie, ...). En 2011, l'Institue National de veille Sanitaire (INvS) a enregistré une augmentation rapide du nombre de cas de gale dans la région bretonne Française.

Objectifs: Obtenir une vision de la prise en charge des cas de gale par les médecins généralistes, pédiatres et dermatologues de la région bretonne Française en terme de diagnostiques, prescription de traitement préventifs et curatifs et procédures de suivie.

Méthodes: Une étude transversale a été conduite auprès de 1200 praticiens opérant dans la région Bretonne. Les échantillons ont été stratifiés par type de praticien (médecins généralistes, pédiatres et dermatologues), par zone urbaine/rurale et par départements de cette région. L'étude a été développées et conduite pendant le 29 ème cours international pour le développement de l'épidémiologie appliquée (IDEA) s'étant tenu à Rennes, France entre le 2 et 19 Avril 2013.

Résultats: L'incidence de la gale a été approximativement estimée à 12 200 cas sur les 7 derniers mois. Ceci est une augmentation par rapport à la récente estimation de l'Agence Régionale de Santé de Bretagne prévoyant 10 000 cas par an. Une régression logistique multivariable a été utilisé pour comparer les pratiques des médecins avec les recommandations nationales qui ont été récemment publiés pour la gestion des cas de gale. Les dermatologues furent le seuls groupe qui, dans tous les cas, suivirent les recommandations nationales. Les médecins généralistes (OR=0.049, 95%CI [0.01, 0.22]) et les pédiatres (OR=0.056, 95%CI [0.01, 0.32]) ont montrés une association inverse avec les protocoles de traitement nationaux. L'expérience professionnelle, quand comparée avec le groupe de référence qui était le groupe des praticiens inexpérimentés (< 10 ans d'expérience) n'a pas pu être associée avec un meilleur suivi des recommandations. Cependant, l'étude à montrée qu'une expérience de 10 à 30 ans (OR=1.53, 95%CI [0.60, 3.88]) ou de plus de 30 ans (OR=1.37,95%CI [0.46, 4.11]) a une légère association positive avec le suivi des recommandations nationales.

Conclusion: L'épidémie de gale continue et est un problème important en France. Il y a un besoin évident d'un meilleur rapport et d'une meilleure surveillance des cas de gale. Les médecins prenant en charge les cas de gale ne suivent pas les recommandations nationales mais sont très favorable à l'obtention d'informations complémentaires pour eux et leurs patients. De plus, utilisant les ventes de certains médicaments, comme le Ivermectine, comme un indicateur pour traquer une augmentation des cas de gale pourrait être une piste d'investigation.

Mots Clés : La gale, France, maladies infectieuse, Ivermectine, InVS, IDEA

List of Abbreviations

ARS – Agence régionale de santé
CDC – Centers for Disease Control and Prevention
CIRE Ouest – Cellule Inter-Régionale d'Épidémiologie
CPAM – Caisse primaire d'assurance maladie
Ddass – Direction départementale des Affaires sanitaires et sociales
Ehpad – Etablissements hébergeant des personnes âgées dépendantes
HCSP – Haut Conseil de Santé publique
IDEA – Cours international pour le développement de l'épidémiologie appliquée
INSEE – Institut National de la Statistique et des Études Économiques
InVS – Institut de veille sanitaire
URPS/MLB – Union Régionale des Professionnels de Santé / Médecins Libéraux Bretagne
WHO – World Health Organization

Table of Contents

1 Introduction

1.1 Scabies

Scabies is a highly contagious and pervasive skin infection that has affected human societies for over 2500 years with a current global prevalence of 300 million cases (1). Scabies is caused by the female variant of the arthropod, mite species: *Sarcoptes scabei* var *hominis* – an obligate human parasite that burrows tunnels and colonizes the superficial layers of the epidermis (Figure 1A, p. 7). Scabies is found worldwide, affecting people of both sexes, of all ages and all social backgrounds (2). The successful transmission of scabies results from prolonged, direct skin-to-skin contact, with sexual contact being very common mode of transmission (3). Additionally with severe cases, the parasite can be spread via direct contact with infested objects (e.g. stuffed animals, furniture made of absorbent materials, carpeting). Outbreaks are typically found in close-contact communities such as nurseries, schools, recreation centers, retirement homes and through frequent sexual contact (4). Current treatments against scabies include oral medication, as well as various medicated, topical products**.**

In 2011, Institut de veille sanitaire (InVS) - the French Institute of Public Health - released a report (5) on the situation of scabies in France indicating an increase in epidemic outbreaks. Over 800 episodes of scabies were identified by 20 different Ddass (Direction départementale des Affaires sanitaires et sociales) agencies between 2005 and 2009 for a total of 1620 cases. The average annual number of cases of scabies was estimated between 337 and 352 cases per 100 000 inhabitants. Sales of ivermectine and benzyl benzoate had increased 24 and 11 percent, respectively, per year between 2005 and 2009. The InVS report also highlighted a number of difficulties concerning the care and management of the disease, including diagnostic difficulties, delays in care and/or recurring infections, inconsistent treatment practices and low adherence. Other problems included the diminishing roles and responsibilities concerning scabies outbreak surveillance between different relevant actors.

1.2 Study Justification

Since January 1st, 2011, more than 450 episodes of scabies have been reported to Agence régionale de santé (ARS) - Bretagne, the majority coming from school environments. A small amount of episodes (6), occurring in more than eight schools, displayed a significant geographic distribution, an epidemic duration of more than three months, and risk factors for transmission via multiple environments. This episode of community-based scabies identified several challenges to effectively managing this type of occurrence:

- The cost of certain treatments and disinfection products are not reimbursed by the national French health insurance agency - Caisse primaire d'assurance maladie (CPAM) – which

limits the access to treatment for low-income families, notably the ability to provide repeated treatments.

- The management of medical consultations, including the lack of consensus between different practitioners on the best methods of treatment.
- An overall lack of knowledge concerning siblings who attend different educational institutions and whether they are in the geographical area of the outbreak, specifically if they have been exposed to the infection.
- Problems with evaluating treatment application methods and treatment adherence.
    - Observed lack of compliance with treatment protocols or the misuse of products, which can aid in the continual spread of the parasite.
- The refusal of some parents to treat the whole family due to adverse side-effects of certain skin treatments.
- Difficulties of designing and implementing a broad exploratory study in terms of the spatiotemporal spread of the epidemic.

In order to reduce the overall number of scabies episodes, including clustered cases in Brittany, all of the challenges identified in the national report and in the regional investigations should be addressed.

The InVS national report describes three targets for future research:

- Working with families to improve adherence to treatment for all individuals (cases, contacts) and the living environment.
- Encourage physicians to improve the collective and comprehensive care for cases and contacts
- Improve schools' coordination between the various actors involved (i.e. principal, school doctors and nurses, local public health authorities, etc) and increase effectiveness of the proposed measures.

1.3 Study Objectives

The number of reported scabies cases has been steadily increasing in recent years, an increase that can also be observed among the sales of specific scabies treatments. However, the lack of a surveillance indicator for the disease prevents health authorities from foreseeing and measuring the scale of the phenomenon.

1.3.1 Main Objective

To gain insight on the management practices of scabies cases for general practitioners, pediatricians, and dermatologists in the Bretagne region of France in terms of diagnosis, prescription of preventive and curative treatments, and follow-up procedures.

1.3.2 Secondary Objectives

- Estimate the frequency of consultations given for scabies
- Determine whether knowledge of these practices can improve the monitoring of the scabies epidemic via anti-scabies drug sales (i.e. Ascabiol, Spregal, and Ivermectine)?
- Describe the prescription habits of Ivermectine for other pathogens besides scabies (pediculosis, other parasites) and the frequency of this type of prescription.
- Determine whether diagnostic and treatment practices vary depending on type of physician, geographical location or urbanization level.
    - Differences in cases, contacts, or environmental treatment
- Understand and access the perceptions and existing knowledge physicians have about scabies (i.e. risk factors, current treatment recommendations).

2 Epidemiological data – The burden of disease

2.1 Monitoring and Surveillance

Currently in France, there is no specific surveillance system in place to estimate the incidence of the scabies in the general population. Additionally, it is not mandatory to report newly identified cases of disease (7). The reporting of cases to ARS lacks a standardized protocol for what should be reported and differs greatly between community-based cases and cases occurring in health care settings.

Community-based cases include isolated cases of scabies or clustered cases. Clustered cases can occur in households, nurseries, schools, sporting clubs, and certain work environments. In terms of surveillance, there are no regulations in place mandating the reporting of new incidences of scabies. Physicians or other members of the community, instead of reporting cases, are more likely to request information or support from local public health authorities if the situation appears complex or if there appears to be foreseeable difficulties in case management.

Cases occurring in health care settings are recorded as part of mandated reporting of nosocomial infections. All reported nosocomial infections are registered in a central database which is managed by InVS (8). It is important to note that nursing homes and other establishments for the elderly (EHPAD in France) are not considered as health care facilities, and therefore are not required to report nosocomial cases.

A case of scabies can only be reported as ‘nosocomial’ if it occurs more than three weeks after admission. Conversely, infections acquired during a shorter period cannot, however, be excluded as possibly originating from inside a health care environment (7).

2.2 Impact of scabies in France

InVS has monitored the recent trends of scabies episodes in France by analyzing the sales of anti-scabies treatments and medications from 2005 to 2009 (9). The data provided by the National Security Agency of Medicines and Health Products - Agence nationale de sécurité du medicament et des produits de santé (ANSM) - showed that Ascabiol ® sales had increased from 283 to 402 bottles per 100 000 people per year, which equates to a 10% increase per year. Sales of ivermectine treatments increased 22% with between 216 and 495 boxes per 100 000 people per year. The incidence was estimated at approximately 328 cases of scabies per 100 000 per year. It was concluded that scabies incidence had truly increased in France.

2.3 Impact of scabies abroad

- In the United Kingdom, the records from two samples of 60 and 91 general practitioners between the years1971 and 2003 gives insight into the incidence of scabies over the past three decades. The records show that the number of consultations for scabies were 370, 120, 340, 470 and 233 consultations /100 000 per year for the years 1971, 1981, 1991, 2000, and 2003, respectively (10,11).
- In Belgium, a comprehensive study of all general practitioners, dermatologists, and pediatricians was conducted in the city of Ghent, located in the Flemish region of Belgium. The study recorded an incidence rate of 28 cases / 100 000 per year, but with a very low response rate (4%) among all physicians surveyed (12).
- In the United States, the private insurance records between 2001 and 2005 of over five million insurance holders and their families were used to evaluate the incidence of scabies. The incidence rate was estimated at approximately 69 cases / 100 000 per year over the given time period. The findings were based on the number of insurance claims for consultations and individual drug purchases (13).

2.4 Scabies in specific populations or settings

2.4.1 Special Consultations

The proportion of scabies cases among people who utilize specialized medical services (i.e. dermatology, testing for sexually transmitted infections, or medical treatment while abroad) varies depending on the type of service, where the service was received, time period of treatment and types of patients.

- **Private dermatologists in France:** In a survey of practicing dermatologists in 2000, scabies was not a top 20 cause of consultation (14).
- **Hospital-based dermatologists in France:** A 2003 survey concerning consultations in the dermatology departments of three French university teaching hospitals, notes that skin

parasites (including scabies) accounted for only 1% of diagnoses in 7296 external consultants examined (15).

- **Medical care while abroad:** Between 2002 and 2003, there were 17 cases / 165 consultations in Paris (10% prevalence) due to people travelling from abroad or unsuccessfully receiving care for scabies abroad (16).

2.4.2 Health care facilities and Ephad

A scabies outbreak can be considered an epidemic when two cases of scabies occur less than six weeks apart in the same community (17), therefore in collective living situations, such as in hospitals, nursing homes and long-term care facilities, a scabies epidemic can occur very rapidly.

Several studies have documented outbreaks of scabies in these types of collective living environments (18–21). Frequently, many residents and caregivers are affected by the outbreak, which can severely disable the institution due to lack of staff and poor case management. Holness et el. discusses how scabies often manifests atypically in the elderly, leading to delays in diagnosis and therefore large numbers of affected individuals and contacts (21).

These types of institutions are often difficult isolate, due to shared bedrooms and living spaces, if an outbreak was to occur. Additionally, proper hygiene measures are commonly misunderstood by residents and their families, thus difficult to enforce and follow-up.

In France, between 2002 and 2010, InVS reported 272 episodes of nosocomial scabies with an average of 7.5 cases per episode equating to ~2041 total cases. During this period the number of cases per episode increased from nearly eight to over 67 cases per episode with the proportion of reports concerning scabies among all listed reports of nosocomial infections increased from 1 to 4% ($p < .05$)(9).

In general, elderly or immune-compromised patients are the main source of transmission to other patients and caregivers in a health care setting (22–24).

2.5 Prevalence by age and sex

A study by Down et al. conducted in England demonstrated that the incidence of scabies could decrease with age: 53 cases / 100 000 people per year for children 0-4 years, 60 cases / 100 000 per year in 5-15 year olds, 34 cases / 100 000 per year in the 15-44 year age group and finally 21 cases / 100 000 per year for people aged 45 years and older (10).

3 Transmission

3.1 Direct

The parasite reservoir is essentially human with no observable zoonosis. Transmission occurs by direct, “skin against skin”, contact with only 5 – 15 female mites on average resulting in a scabies

infection (25). The incubation period before symptoms occur is three to six weeks for primary infestation but may be as short as one to three days in cases of reinfestation (26).

Risk factors favoring the transmission of scabies are via close living quarters, sexual contact, urban environments, young children, elderly adults in collective living. In terms of seasonal trends, scabies transmission tends to increase in cooler environments (4,27).

3.2 Indirect

A controversial 1941 study conducted by the British military demonstrates how scabies can be transmitted indirectly via bedding, linens, clothing, and fabric and leather furniture (28). Volunteers, who were scabies-free prior to the experiment, were kept in isolated rooms and then put in direct contact with blankets and undergarments previously used by scabies patients. These results can be extended to other household items not necessarily included in this study such as children's toys, carpeting, upholstery in the house and vehicles etc.

4 Entomology

The life cycle takes about 10 to 15 days (Figure 1). After mating, the male dies and the female burrows into the epidermis where she will eat cellular debris produced by the enzymes she secretes. A mite's burrow into the skin may range from 0.5 mm to 5 mm / day (Figure 2A-C).

A few hours after beginning to burrow into the skin, the female will start to lay eggs at a rate of two to three eggs per day (Figure 2B). During her lifetime, (~ 30 days) a female can produce up to 40 eggs. The larvae hatch in two to four days after spawning and migrate to the surface of the skin where they burrow new trenches in the skin. The larvae mature over the next eight to ten days and the cycle continues (29).

The survival of mites in the environment is an important element in the control and prevention of scabies, in terms of limiting the risk of secondary infections and re-infestation. Mites can survive for 24 to 36 hours at room temperature and average humidity and remain capable of infestation and epidermal burrowing (26). A study investigating the prevalence of scabies in the home environment collected dust samples from 32 homes with infect patients. Scabies mites were found in 44% of the households with 64% of positive samples containing live mites. Mites were recovered mostly from bedroom floors and overstuffed chairs and couches (30).

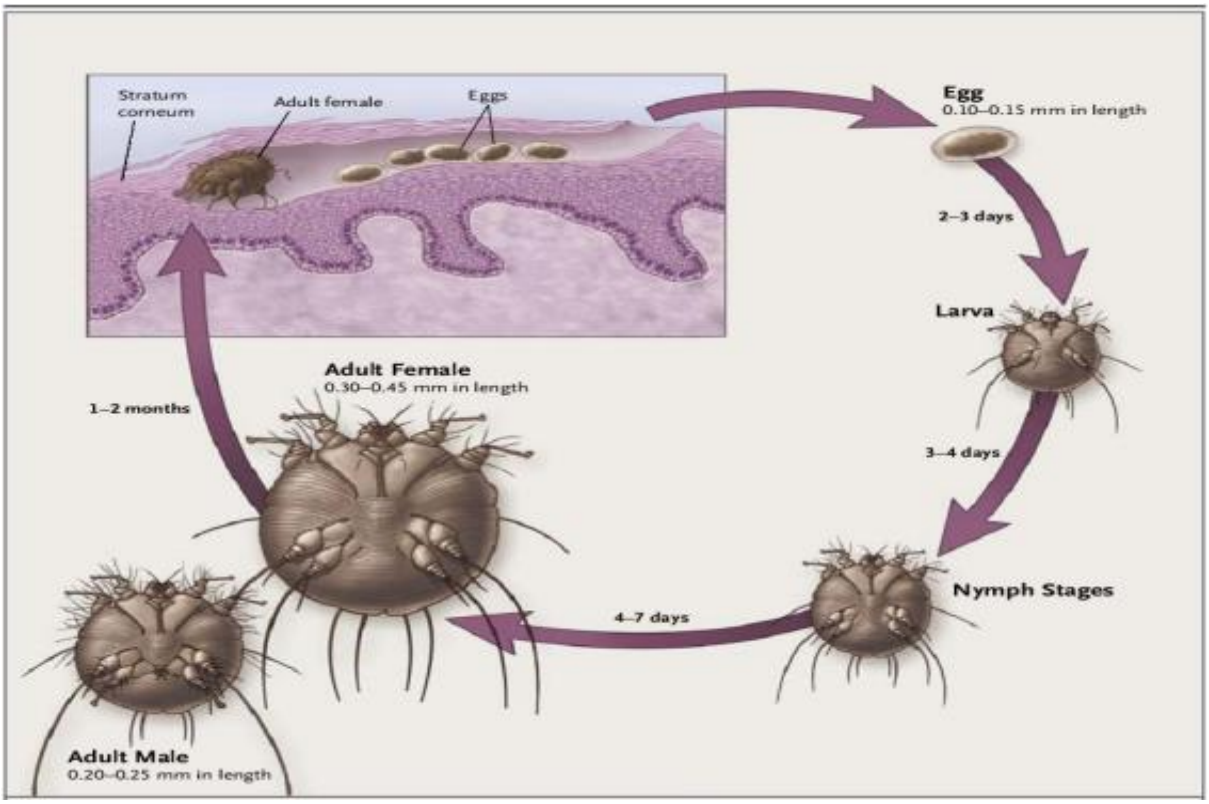


Figure 1 *– Parasitic life cycle of scabies* ***(30)***

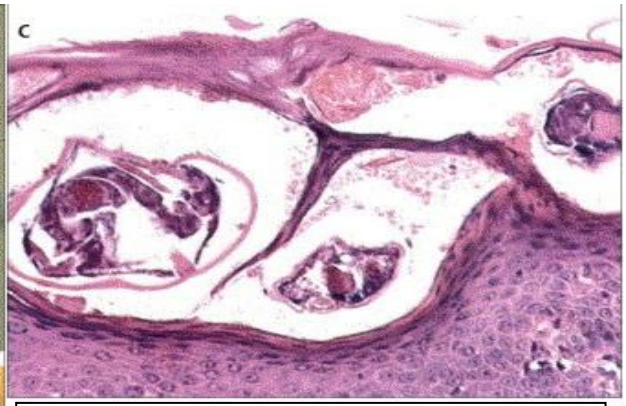


Figure 2 *– S. scabiei during the life cycle*

(A) Microscopic section of S scabiei mite showing eight legs and the bite apparatus.

(B) Skin scraping upon treatment with 10% potassium hydroxide showing eggs, nymphs (*), and scybalae (faecal pellets).

(C) Histological section (haematoxylin and eosin stain) showing a burrow with the scabies mite in the upper epidermis.

(Hengge et al.,The Lancet Infectious Disease, 2006; 6(12) 769-79)

5 Diagnosis

5.1 Physical Manifestations

Classical scabies manifests through nocturnal itching or pruritus, and the symmetrical distribution of papules, pustules, and excoriations. The rash appears usually in areas, such as inter-digital webs, nipples, or around the genitals. In addition to the external genitals and the webbing between fingers, rashes can also be found on feet, wrists, elbows, back, and buttocks (31). Norwegian scabies or crusted scabies is a severe form of the disease in which the number of mites can range from hundreds even millions per infected host and is found typically in individuals with HIV or other immunodeficiency conditions (26,32).

The diagnosis of scabies is problematic, and can be complicated by low numbers of observable mites, atypical clinical manifestations, and possible confusion with other skin diseases such as allergic dermatitis, fungal infections, or insect bites (33). Scabies very commonly develops atypically and can be hard to identify.

5.2 Diagnostic Tools

5.2.1 Clinical Diagnostics

Generally, the majority of cases treated by general practitioners are of common or classic scabies; therefore, the diagnosis is often conducted by an interrogation of the patient regarding common risk factors (i.e. recent exposure, immunodeficiency, cases among relatives or sexual partners), and persistent night itching. Additionally, a search for visible lesions or eczema is normally conducted (7). In practice, most diagnoses are made using clinical signs and symptoms (e.g. presence of itching, characteristic lesions, household contact with itch)(34).

5.2.2 Parasitological Exam

Parasitological exam is a minor invasive procedure that requires either physically removing the parasite from an unexcoriated burrow using a surgical blade or a sterile needle, taking a biopsy from a papule, or using skin scrapings (e.g. under fingernails) (35). The exam allows the physician to view the mite, eggs, larvae and / or feces by microscopic examination of the specific lesions affected by the itching (36).

Confirmation via a parasitological diagnostic is preferred before a clinical diagnosis of scabies is determined, if resources permit. In practice, parasitological exams are occasionally problematic mostly due to poor sensitivity from low mite counts in classic scabies cases (32).

5.2.3 Dermatoscopy

Dermatoscopy is a relatively recent tool used for diagnosing scabies. Used predominately by dermatologists to detect cancerous lesions in patients, dermatoscopy allows for the inspection of skin lesions unobstructed by skin surface reflections. This technique can be used to positively

identify scabies mites in affected areas and is quite reliable, but it is limited by the cost of the equipment and requires special training to make an accurate diagnosis.

The exam is extremely efficient, allowing for several sites to be searched in minutes, and can used in validate the parasitological sample (36). It is non-invasive, making it particularly useful for children..

5.3 Diagnosis Recommendations

Relying solely on one diagnostic test should be avoided. Currently, there is an absence of a true ‘gold standard’, such as a practical immunological test, and although PCR testing is being developed (37), the practicality of the diagnostic is still uncertain. Without a gold standard the ability to define true negatives (e.g. definitively exclude scabies as diagnosis) remains limited. It would be more justified to treat scabies in the presence of classical symptoms, apparent lesions characteristic of scabies, and information based on an epidemiological context, even in the absence of parasitological exam confirmation(7).

5.4 Differential Diagnosis

Differential diagnoses can occur with early infestations mainly mimicking other forms of dermatitis, such as atopic dermatitis, generalized eczema, senile pruritus, allergic drug reactions, viral exanthema, pediculosis, or rosacea.

6 Treatment

6.1 General

The treatment is based on the use of acaricides via systemic or topical treatments. Acaricides interfere with the nervous system of mites (larvae, nymphs and adults) causing paralysis and death. They are not active on the eggs, but can kill young larvae as treatment continues(38). It is important to note that although the time between the laying and hatching of the eggs is only a few days, some larvae are born late and may continue the infestation if the active ingredient concentrations are no longer sufficient in the epidermis. This is one reason why a second treatment may be considered necessary and is often recommended.

6.2 Types of Medication

6.2.1 Topical

Table 1: *List of topical scabies medications*

Active Chemical	***Brand Names*****
Benzyl benzoate 10–25% lotions	Ascabiol
Crotamiton 10% cream	Eurax
Esdepallethrine 0-63% aerosol	Spregal
Lindane 1% lotion or cream	Elenol & Scabecid 1%
Malathion 0-5% lotion	Prioderm
Permethrin 5% cream	Nix

** - Brand names relevant to this study

Topical treatments have long been the main line of treatment against scabies. In general, practical use and clinical preference of each drug widely varies and the majority of research studies are heterogeneous in terms of products, countries, group of treated patients, with or without contact subjects, and the method of treatment application (Table 1) (39).

The 2007 Cochrane systematic review of scabies treatments gave the strongest endorsement to the use of topical permethrin as the treatment producing the best results when used as prescribed. Permethrin has low toxicity and is cost effective, more so than other treatments, but the Cochrane Review also concluded that data were insufficient to compare the effectiveness of either benzyl benzoate or crotamiton with lindane or permethrin (40).

Additionally, topical therapy has varying effects on the scabies mite, and drug resistance is rapidly emerging around the globe. Furthermore, because the mite shares biochemical pathways with humans, many of the therapeutic options pose a risk of toxicity to the patient (34).

6.2.2 Systemic

The Cochrane review also recommended oral ivermectin as an effective and successful treatment against scabies when topical treatments have failed (40). Moreover, most comparative studies have shown oral ivermectin to be an equivalent treatment for common scabies, as opposed to conventional topical scabicidal treatments (benzyl benzoate, lindane, permethrin) following one or two oral doses of 200 µg/kg(41).

6.3 Treatment Recommendations

Topical treatments such as lindane, benzyl benzoate, crotamiton, malathion, and permethrin are commonly used either as a sole treatment method or in combination with another, usually with oral ivermectin (38). Multiple studies have noted that most lindane-based products, along with malathion (Prioderm), and ivermectin (Stromectol) are prescribed not only against scabies, but against many other skin infestations and irritations, such as pediculosis (31,34,42).

7 Recommendations in France

7.1 Treatments

Due to the increased risk of scabies outbreaks in France, HCSP has recently released a number of recommendations for physicians to aid in controlling the scabies epidemic(7). In terms of specific treatment, HCSP endorses the use of benzyl benzoate (Ascabiol) as it is the most used topical treatment by physicians in France (26). The report also recommends the use of systemic ivermectin (Stromectol) as an additional line of treatment or in combination with benzyl benzoate (Ascabiol), per the physician's discretion. Finally, HCSP argues that two rounds of treatment should be recommended to patients due to the overall inefficacy of topical treatments in killing scabies eggs after one round, poor drug adherence, and in coherence with Anglo-Saxon countries, as well as, the Cochrane Review who recommend two rounds of permethrin (Nix), which is not used in France.

7.2 Contacts and Environment

Concerning the treatment of contacts, HCSP recommends treating all those included in the first circle of contacts, including those having direct skin contact with cases (i.e. sexual contacts), as well as those living in the same residence and anyone providing nursing care to the case.

In terms of treating the infested living environment, HCSP recommends treating all laundry (i.e. clothes, bedding, towels etc.) via disinfection with an acaricide, machine washing laundry at 60°C, or leaving laundry in a bag in a temperature greater than 20°C for a minimum of 72 hours. In addition to treating laundry, one should completely vacuum all furniture, carpeting, stuffed toys, and all other fabric covered surfaces (7).

8 Materials and Methods

8.1 IDEA

The IDEA course, Cours International pour le Développement de l'Épidémiologie Appliquée, is held annually at the EHESP campus in Rennes. The course recently concluded its 29th consecutive year, which took place the 2nd to19th of April, 2013. The program is designed to guide healthcare professionals in applying practical and theoretical methods of epidemiology to their everyday practices.

IDEA is organized in partnership with InVS, the MPH program at Institute Pasteur-CNAM, the French armed services and EPITER, a French association dedicated to the development of field epidemiology. This year's partners also included ARS-Bretagne and the InVS Western Regional team – CIRE Ouest (Cellule Inter-Régionale d'Épidémiologie - West). The program draws public health professionals from numerous domains whose activity is focused on epidemiology such as, physicians, pharmacists, water and sanitation engineers, nurses, researchers, and students.

The main objectives of the program include:

- The mastering of basic statistics, understanding how to conduct an outbreak investigation, and the importance of disease surveillance, in addition to descriptive and analytic epidemiology
- Conducting a public health survey on a relevant and timely topic
- Adequately communicating to the public the results and impact of the study.

This year 30 IDEA students organized, designed, and implemented a descriptive, cross-sectional survey focused on the augmenting scabies epidemic in France. The survey was in response to the need for more information by ARS-Bretagne, InVS-CIRE Ouest, and EHESP, on the management of scabies by private physicians in the Brittany region.

8.2 Sampling

All preparations to the physician database, including sampling, were completed by March 2013, prior to the start of the IDEA program.

8.2.1 Sample Selection

The study population was selected from the URPS-MLB (Union Régionale des Professionnels de Santé / Médecins Libéraux Bretagne) database containing all private practicing physicians in the Brittany region of France. Three types of physicians were included in the study, general practitioners, pediatricians, and dermatologists, based on the likelihood of treating cases of scabies.

In total, the database consisted of 3295 private practicing physicians, after duplicates and physicians working in hospitals were removed.

8.2.2 Sample Size

The sample size was dependent on many factors. It was important to take into consideration the proportion of doctors who were aware of the current recommendations for the diagnosis and management of scabies cases and their direct contacts a priori. The current proportion was unknown; therefore the sample size was based on a worst case scenario of around 50% of doctors being aware of the HCSP recommendations.

During the program, data collection occurred over a 2 to 3 day period. Additionally, an expected participation rate of 30% from all physicians was determined. This was based on other low response rates previously observed in similar surveys in the Auvergne region (43). The time constraint, along with the projected response rate from physicians was considered. Finally, the statistical power and measurement error was set at 80 and 5 percent, respectively. Taking into account all the circumstances, the sample size was fixed to 1200 health professionals. This allowed for a minimum of 360 completed surveys in order to obtain the desired statistical power. With 30 students conducting the survey, 40 surveys per student was assumed as a feasible amount to administer during the data collection period.

8.2.3 Stratification

Of the 3295 eligible physicians, a sample of 1200 was randomly selected from the main database and stratified on three variables: type of physician, department, and urban/rural zone. In terms of specialization, general practitioners represented the majority at 3038 physicians (92%) with dermatologists and pediatricians making up the remaining 146 and 111 physicians, respectively. The Brittany region is divided into four departments: Finistère (29), Côtes d'Armor (22), Morbihan (56), and Ille-et-Vilaine (35) (Appendix I). The number of physicians was adequately dispersed throughout each of the four departments, with Côtes d'Armor having slightly less overall (16.8%).

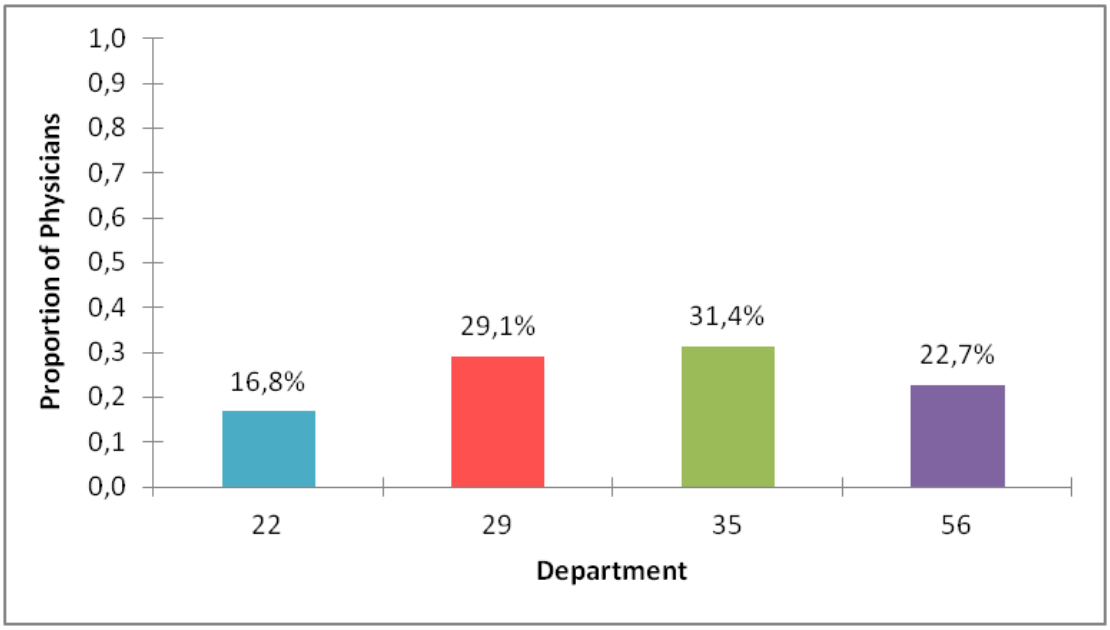


Figure 3: *Distribution of physicians between the departments of Brittany, France*

There was a misrepresentation of physicians working in urban environments, with only 17.9% (N=588) of the population coming from a rural zone. Of the 588 rural physicians, there was only one pediatrician and dermatologist each, the rest were general practitioners. When stratified over all 24 possible strata, six strata were without values and two strata were with only one physician (Figure 4), therefore a stratified sample consisting of the remaining 16 strata was chosen to ensure an equal representation of our variables.

	FILTRE_COM_TYPE and FILTRE_DPT_CODE							
	RURAL				URBAIN			
SPECIALITE_LIB	22	29	35	56	22	29	35	56
Dermatologie et vénéréologie				1	19	45	52	29
Médecine Générale	150	145	128	163	368	740	813	531
Pédiatrie	1				15	28	42	25

Figure 4: *Stata Output Table – Distribution among strata*

8.2.4 Sampling Rates, Weighting, and Randomization

As a result of the low amount of specialized physicians in each stratum, all 145 dermatologists and 110 pediatricians were included in the sample. The remaining 945 general practitioners were distributed equally at 118 physicians per stratum. This specific amount maximizes the sampling rates of rural GPs, without completely diminishing the number of physicians among urban strata. Sampling weights were then applied according to the disproportionate distribution of sampling rates in each stratum (Appendix II).

The randomization of each GP stratum and final database compilation was conducted via the use of macros created in Microsoft Excel VBA coding language.

8.3 Data Collection

8.3.1 Teaching Workshops

In order to effectively use the implementation of a survey as a pedagogical tool, it was decided to break up the process into teaching workshops. The group of 30 students was divided into three smaller groups of 10, with two to three program facilitators per group. Each workshop outline listed goals that needed to be completed by the end of the session. The format of the workshops enabled the three groups to work on overlapping parts of the given task. At the conclusion of each session, each group would then send a reporter to meet with the facilitators to discuss and produce a final result, according to that workshop's specific goals. The questionnaire preparation, data analysis and communication of the results were split into five workshops over the course of the three week program.

8.3.2 Questionnaire Development

Based on the literature, a first draft of the questionnaire was prepared by the EHESP team in Paris and was then revised by the InVS-CIRE Ouest team in Rennes, prior to the start of IDEA. During the workshops, the draft was used as tool for facilitators to guide the students during the questionnaire development.

The goals of each workshop were:

- **Workshop I**: Define the main and secondary objectives of the survey, choose the appropriate study type, and define the study place and population (c*f. 1.3, 8.2)*.
- **Workshop II**: Identify and define the variables and indicators that need to be collected (Table 2), and develop an analysis plan (Appendix III).

Table 2: *Workshop II – Variables and Indicators*

Variables	***Indicators***
Estimate the number of scabies cases since the beginning of the school year	• Number of diagnosed cases • Number of diagnosed profuse cases
Describe diagnostic practices for a suspected scabies case	• Type of diagnostic measure used • Refer to specialist
Describe treatment practices for a scabies case and their environment	• Topical, Oral or both treatments given • Number of treatment rounds • Treatment of case living environment • Method used to treat environment • Mandates an absence from work or school
Describe methods used to identify and treat contacts of cases	• Systematically treats contacts • Which contacts are treated • Medication used to treat contacts
Describe the perception of scabies	• Situations in which scabies is associated
Describe the prescription practices anti-scabies medication for other pathologies	• The use of Ivermectin for other pathologies • Frequency of prescription • Types of medication
Comparison of practices to HCSP recommendations	• Knowledge of national recommendations • Physicians who want more information • Other specializations (homeopath, etc.)

- **Workshop III**: Develop formal questions based on the variables and indicators while in accordance with the analysis plan and decide on the organization and layout of the questionnaire.
    - The specific objectives of the study were divided into three parts, per the analysis plan, along with corresponding variables (Table 3). Each group worked on two different parts, in order to have a majority consensus of the final product.

Table 3: *Main parts of the questionnaire and corresponding number of variables*

Part I	Diagnostic practices (case + contacts) **(1 v)** Treatment practices (case + contacts) **(6 v)**
Part II	Characteristics of the individual and the disease **(2v + 4v)**
Part III	Perception of scabies by physicians **(3v)** Scabies drugs for non-scabies cases **(1v)** Knowledge of HCSP recommendations **(7v)**

The main goal of workshops was to create a clear and concise questionnaire that addressed the set objectives and could be administered over the phone. In order to ensure participation from physicians, it was important that duration of the interview did not exceed 10 minutes. The final draft of the questionnaire (Appendix IV) consisted of 19 total questions, many with additional, answer dependant sub-questions.

8.3.3 Demographic and Administrative Questions

In addition to the survey questions, socio-demographic information such as gender and employment duration will be collection, as well as, information on the type of work environment and outside specializations (i.e. homeopathic medicine, sports doctor, etc.). The current practices of physicians' vis-à-vis the management of scabies cases and their contacts, in addition to their attitudes towards the disease is important in order to change their involvement if needed (i.e. perception of their role, what they are willing to do, the tools they need etc.).

Furthermore, response variables were added, either Refused, Unavailable, or Refused after topic introduction, in order to calculate response rates for statistical analysis. The questionnaire included neither directly personal nor indirectly personal identification data.

Finally, two short scripts were added to the questionnaire. The first script was used if the physician's secretary answered the call. It stated that the inquiry was for an academic survey and asked to be redirected to the selected physician if possible or if an appointment could be made for later in the week. If the secretary forwarded the call to the physician or if they answered directly, the

second script was designed to assist the interviewers in giving a fluid, but brief introduction of the study.

8.4 Survey Administration

The telephone questionnaire was administered anonymously by the students from Monday to Wednesday during the 2nd week of the IDEA training program. The students were instructed to call each physician a maximum of three times in order to optimize the response rate. A flowchart illustrating the interview process was provided to aid the inexperience students and to save time (Appendix V). Data collection was conducted using a call bank installed by EHESP IT personnel.

8.5 Data Entry

Data entry was conducted via Voozanoo™, an online platform for creating questionnaires and information systems, developed by EpiConcept. The use of Wepi™, another EpiConcept platform designed for epidemiological studies, was originally planned, but eventually was not utilized due to technical problems and the timeliness of the study. Restricted access to Voozanoo™ was shared with all participants via email and enabled access only to data entered by them. All completed, unreachable, and refused questionnaires were to be entered into the database.

8.6 Data Analysis – Workshop IV

Once all questionnaires had been entered, the database was exported to Microsoft Excel and the students returned to the three groups for the data analysis workshop. During this workshop, a descriptive analysis was performed according to the previously developed analysis plan. It should be noted that database management was not in the scope of the course, therefore the facilitators provided a quick cleaning of the database prior to the start of workshop IV. All analyses were weighted and completed using STATA statistical software, versions 10 and 11.

8.6.1 Step 1: Analysis Plan

The analysis plan was developed during the 2nd workshop and contained three major parts: Quality Control of the database, Descriptive Analysis, and Analytical Epidemiology.

8.6.1.1 Quality Control

The first step of data analysis includes the calculation of the response rate, as it is essential to the statistical power of the study results. Next, the student would have to determine if those who responded to the questionnaire were representative of the random sample, in terms of the given strata, as well as demographic factors, such as gender and time spent as a physician. Finally, the last step would be an analysis of the non-respondents, in terms of strata and demographic factors.

8.6.1.2 Descriptive Analysis

The descriptive analysis was conducted in three parts, using the categories described in workshop III (*cf.* 8.3.2-Table 3). Each of the three parts corresponded to a portion of questions.

Each group was given a part and was then allowed to disseminate the workload accordingly. The goal of the analysis was to give IDEA students a chance to familiarize themselves with STATA, as well as experiment with how to present data in various ways. This was a critical pedagogical step for facilitators in that it was important that students fully understood how to interpret outputs from descriptive analyses.

8.6.1.3 Analytical Epidemiology

The last part of the analysis plan required cross-tabulations of all individual characteristics with each stratum variable – type of physician, zone, and department. Individual characteristics were also to be cross-tabulated with all knowledge, perception, and diagnostic and treatment specific variables. As time permitted, the groups experimented with other tests and cross-tabulations. All statistical analyses were performed using the 'svyset' command in STATA, ensuring reduced variance across strata. Additionally, an alpha level of 0 .05 and 95% confidence intervals were utilized.

8.6.2 Step 2: Synthesis of Results

Once descriptive analyses and cross-tabulations were completed, each group discussed and decided upon what were the relevant results, compiled agreed upon figures and selected a reporter to gather the results from the two other groups. Each individual group was responsible for presenting the survey's findings using different methods, thus it was needed to identify the pertinent results best suited to their assigned presentation format.

8.7 Ethical Standards

A joint URPS-IDEA letter was sent directly to all 1200 selected URPS-MLB physicians notifying them of the survey. The purpose of the letter was to disclose the duration of the survey, the period during which they would be contacted for a telephone interview, and to ensure the anonymity of all responses. Additionally, all IDEA participants were required to respect the confidentiality of all physician contact information, along with all collected data. All personal physician information was excluded from the final database and only the given INSEE (Institut National de la Statistique et des Études Économiques) identification number was used.

8.8 Communication

The final workshop, which last two days, focused on the presentation of the study and results. The three groups were each given a different method of presentation. Group 1 was assigned to prepare an oral presentation that was to be given by one group member at the conference hosted by the EPITER on April 19, 2013, the final day of IDEA. Group 2 also prepared an oral presentation and assigned a group member who presented for a group of URPS/MLB physicians, as well as the entire IDEA program. Finally, Group 3 completed a printed brochure of the findings that was distributed to the GPs, pediatricians, and dermatologists of URPS-Bretagne.

A final report will be developed by the project partners and will be published in the Weekly Epidemiological Bulletin (*Bulletin épidémiologique hebdomadaire)*.

9 Results

9.1 Descriptive Analysis

9.1.1 Participation

At the conclusion of data collection 1091 physicians, 91% of the sample, had been contacted by the student interviewers. Out of the total, 371 physicians (36%) were unavailable, 395 refused (35%), nine had refused (1%) after the subject topic was introduced, and 316 physicians successfully completed the survey, resulting in a response rate of 28.4% (n = 317). The response rate differed between physicians practicing in rural zones (33%) compared to those from urban zones (26%), $F(1, 1082) = 5.12$, $p = 0.024$. In terms of specialization, a difference in response rates can be observed between physician types $F(1.98, 2144.98) = 4.65$, $p = 0.01$, e.g., dermatologists had lowest response rate of the three types of physicians.

9.1.2 Frequency of cases

During the seven month period from September 2012 to March 2013, 72.4% of physicians (n=221, 95%CI [66.4, 77.6] had diagnosed at least one case of scabies, with an average of 4.8 cases per physician (*Linearized SE* = 0.30, 95%CI [4.6, 5.7]). A cut-off point of 30 cases or below was used in the calculation of average cases per physicians. Five physicians, four dermatologists and one pediatrician, recorded 50 or more cases since September 2012. These observations were considered exceptional and were regarded as outliers. For physicians who saw cases of profuse scabies (n=51), the average was approximately 1.67 cases per physician (*Linearized SE* = 0.21, 95%CI [1.2, 2.1]). This is excluding two dermatologists who observed 21 and 40 cases of profuse scabies, respectively. Table 4 and 5 displays case distribution by physician type, and incidence rate estimates for scabies cases in Brittany, respectively.

Table 4: *Distribution of physicians who have diagnosed scabies since September 2012*

Dermatologists: 82%	➔	24 cases ***/*** physician
General Practitioners: 73%	➔	5 cases ***/*** physician
Pediatricians: 38%	➔	5 cases ***/*** physician

Table 5: *Estimation of scabies incidence in the Brittany region of France*

12 200 cases of scabies	**1 160 cases of profuse scabies**
95% CI [10 300,14 000]	95% CI [650, 1 660]

9.1.3 Diagnostic practices for cases

Clinical diagnostic measures alone were used by 68.9%, (n=195, 95%CI [62.3, 74.7]) of the physicians when diagnosing scabies cases, while 21.1% (n=66, 95% CI [16.1, 27.1]) of physicians used a dermatoscopy in addition to the clinical measures. A parasitological exam was utilized in place of the dermatoscopy by 9.2% (n=23, 95%CI [5.9, 14.2]) of physicians and finally, all three diagnostic measures were used by < 1.0% (n=7, 95%CI [0.38, 1.9]) of the sample population (Figure 5). Additionally, 58% (n=175, 95%CI [51.6, 64.2]) of GPs and pediatricians referred suspected scabies cases to a specialist.

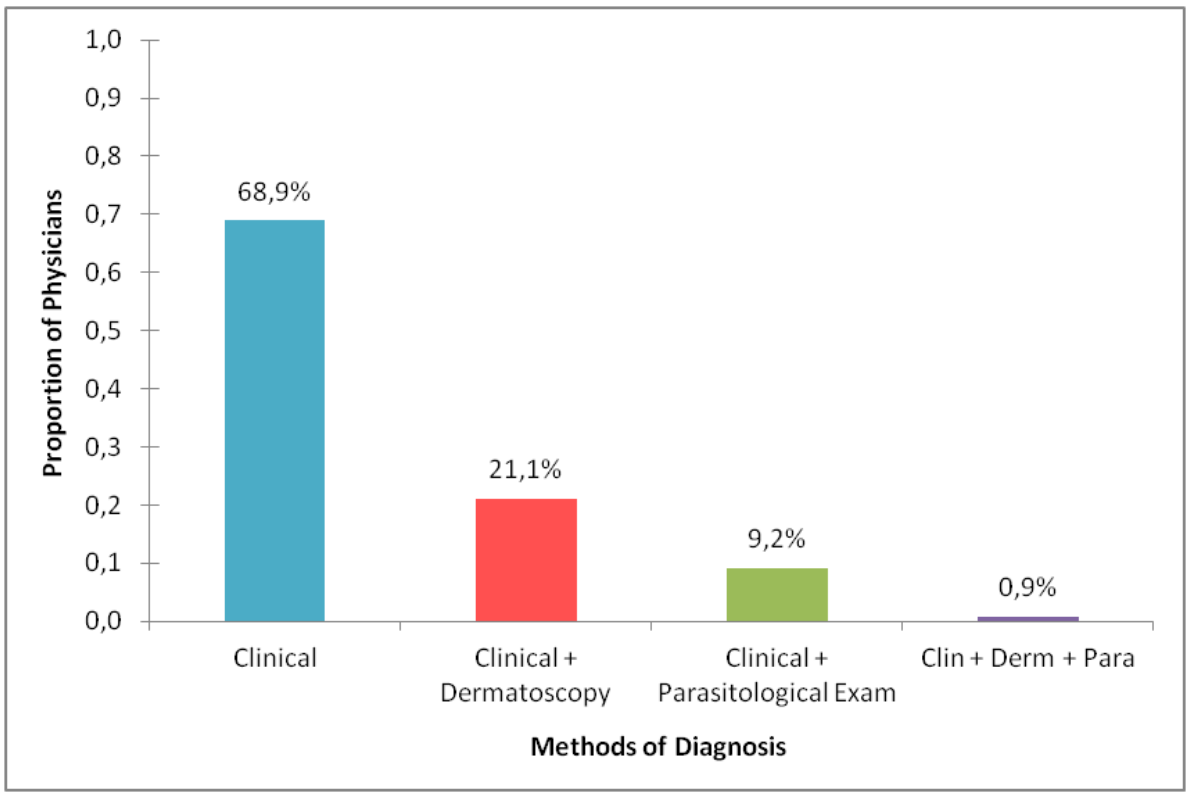


Figure 5: *Methods of Diagnosis for cases*

9.1.4 Types of treatment methods

Figure 6 illustrates the differences in the systematic prescription of scabicidal medication to cases, according to physician type. The overall average use of each drug by all physicians is included in the figure as a comparison marker.

The survey responses were divided into four categories: 1) The systematic use of only the oral treatment, Stromectol® 2) The prescription of only the topical treatments, Ascabiol® or Spregal® 3) The prescription of only Stromectol® and a topical treatment, simultaneously, or 4) Other combinations of the three categories, capturing the varying and not systematic prescription habits of physicians. Furthermore, there is a significant relationship between treatment preferences and physician type, $F(5.9, 1664.2) = 4.5578$, $p < 0.0001$.

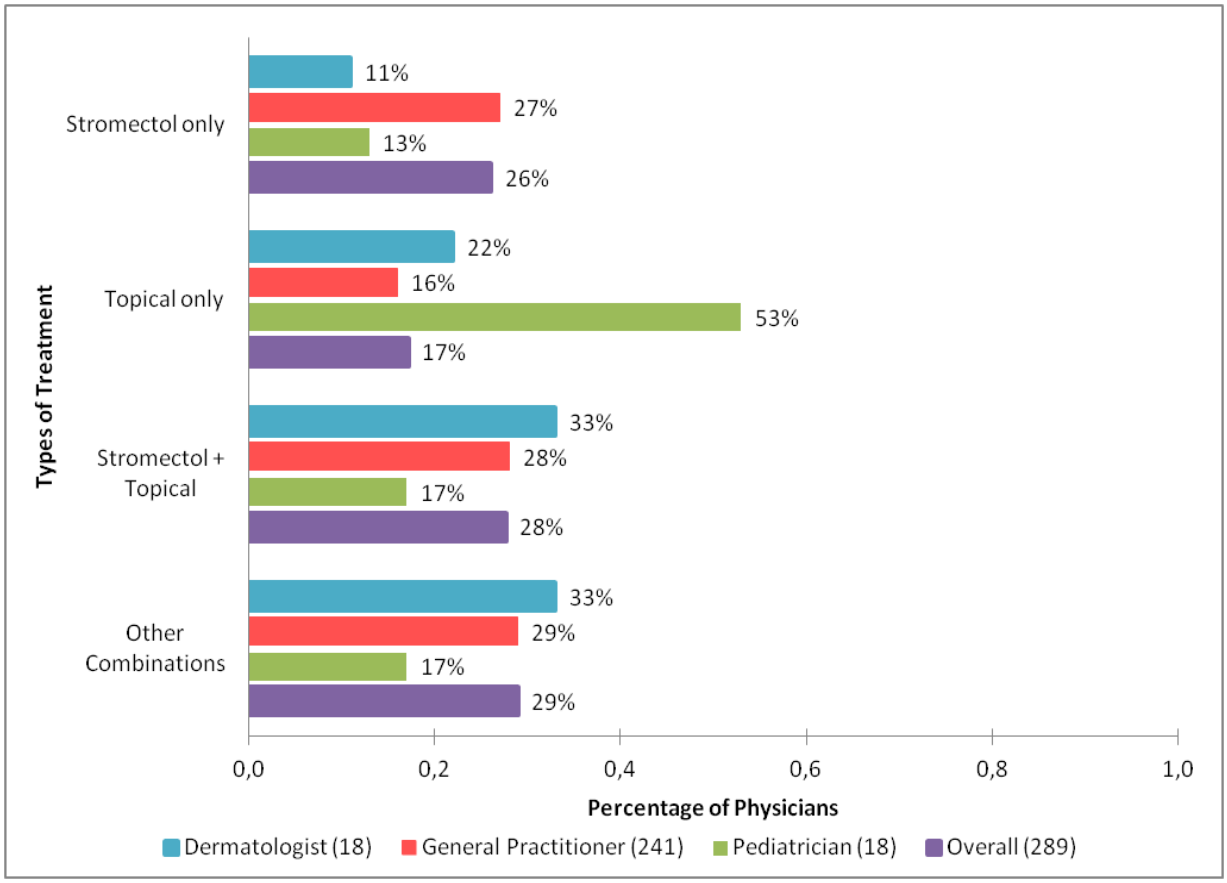


Figure 6: *Treatment categories with all physician types*

Overall, 51.7% (n=137, 95%CI [45.0, 58.4]) of physicians systematically prescribe one round of treatment, 33.8% (n=110, 95%CI [27.8, 40.4]) prescribe two rounds, and 14.5% (n=42, 95%CI [10.3, 20.1]) prescribe according to each case (Figure 7).

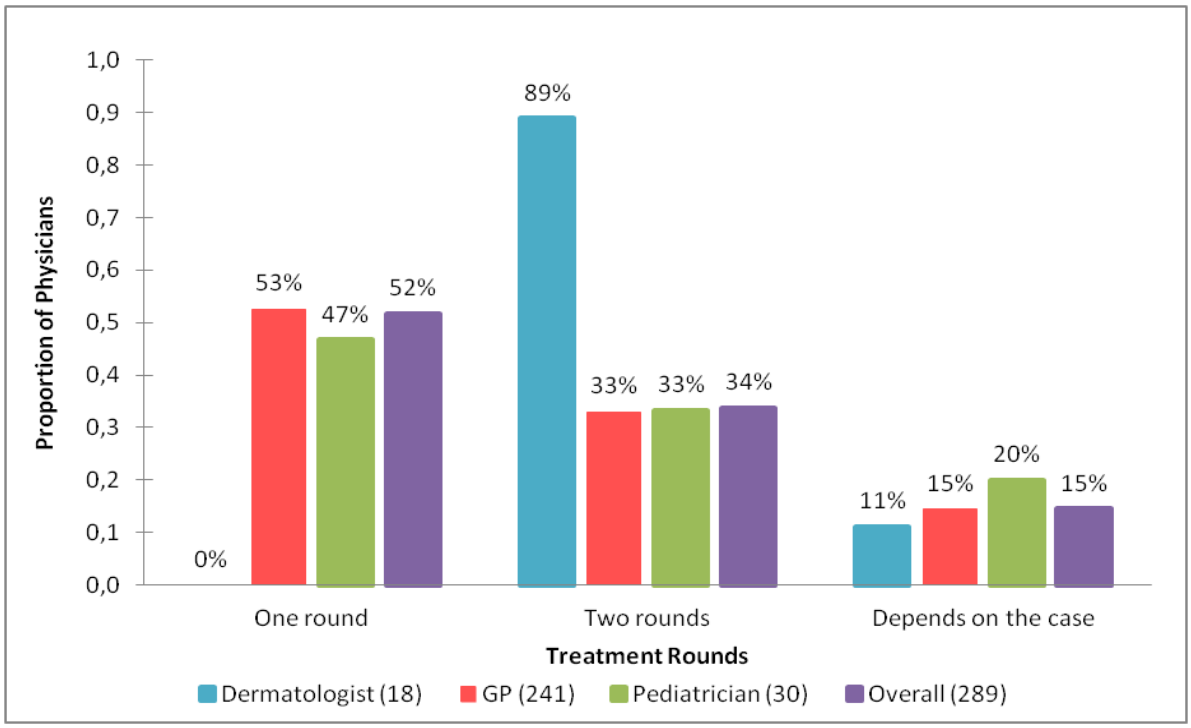


Figure 7: *Rounds of medication prescribed to cases*

In general, there was a significant difference between number of treatment rounds given and physician type, $F(3.9, 1091.5) = 6.13$, $p < 0.0001$, with dermatologists prescribing almost solely two rounds (88.9%) of treatment compared to only 33% of GPs and pediatricians.

Additionally, 69.2% (n=196) of all physicians mandated a leave from work or school, with only 27% (n=79) requiring an additional consultation. More pediatricians prescribed additional visits (50%) compared to GPs (26.6%) and dermatologists (17.7%).

Finally, 8.5% (n=27, 95% CI [5.4,13.1]) of physicians prescribed Stromectol® for pathologies other than scabies – 3.5% were for lice, 3.3% were for other types of parasites, and the remaining 1.2% was not specified.

9.1.5 Treatment of contacts

Concerning the treatment of case contacts, 53.2% (n=167, 95% CI [46.7, 59.5]) of physicians treated close contacts of diagnosed cases, while 4.7% (n=14, 95% CI [2.6, 8.3]) of physicians equally treated all members living in the same household. All dermatologists who completed the survey treated case contacts, whereas only 56.3% of general practitioners and 50% of pediatricians had prescribed treatment for contacts. A significant difference between physician type and frequency of treating case contacts was observed, $F(1.9, 537.1) = 6.86$, $p < 0.001$.

The decision to treat contacts significantly varies based years of experience, $F(1, 280) = 9.29$, $p = 0.003$. Overall, 68.7% (n=78, 95% CI [58.6,77.4]) of physicians, who have worked 20 years or less, prescribed a treatment measure to case contacts, in contrast to only 48% (n=87, 95% CI [39.4,56.8]) of physicians with more than 20 years of experience.

Figure 8 illustrates the medication preferences for treating case contacts in comparison to the overall average. Stromectol® as the sole treatment was the most frequently method of treating case contacts, with 48.5% (n=78, 95% CI [39.6, 57.5]) physicians choosing this measure. When prescription habits are broken down by physician type, 43% of pediatricians prescribed solely topical treatments (Ascabiol® or Spregal®), which is close to double that of the overall usage.

In Figure 9, the distribution of treatment rounds given to case contacts by physician type is significantly different between types, $F(3.95, 640.5) = 3.34$, $p = 0.011$. Dermatologists generally tend to prescribe two rounds to contacts (55.6%, 95%CI [32.6, 76.4]), more often than general practitioners (19.1%, 95%CI [12.9, 27.3]), as they did with cases.

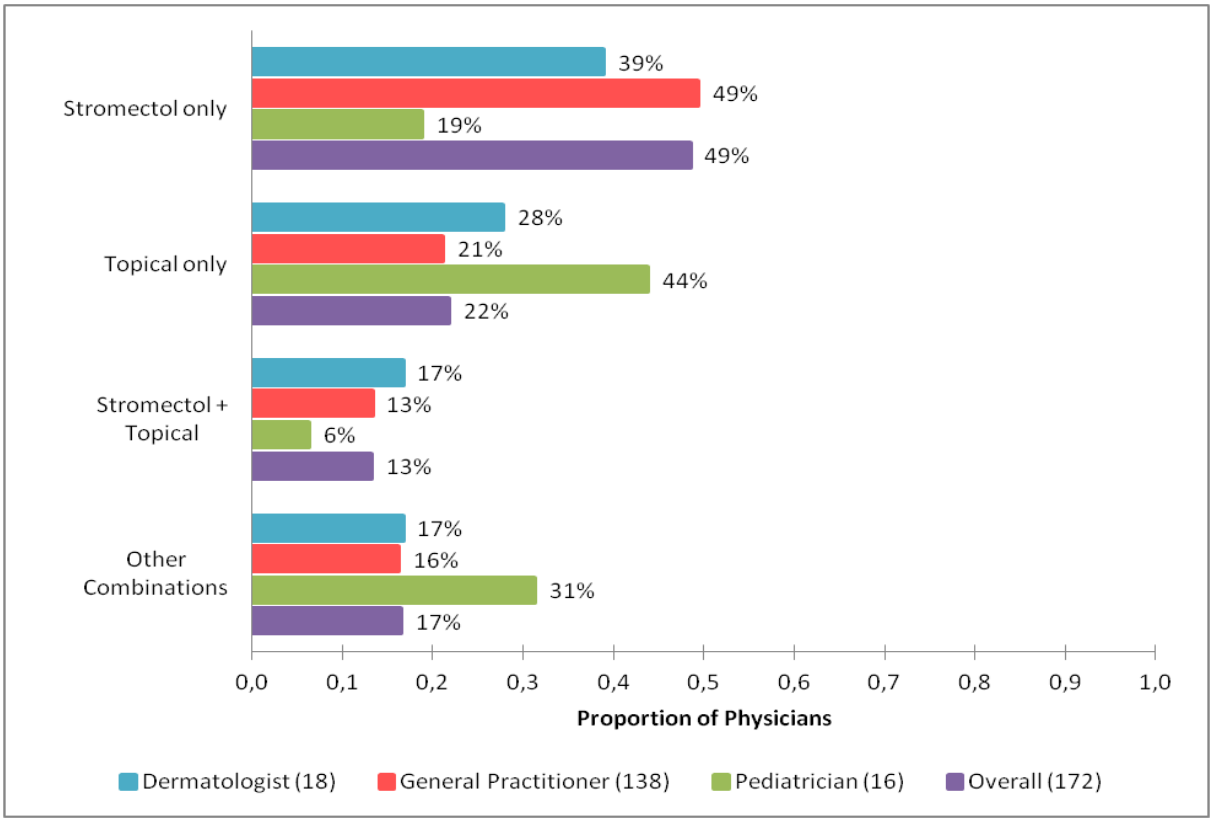


Figure 8: *Medication preferences for treating contacts*

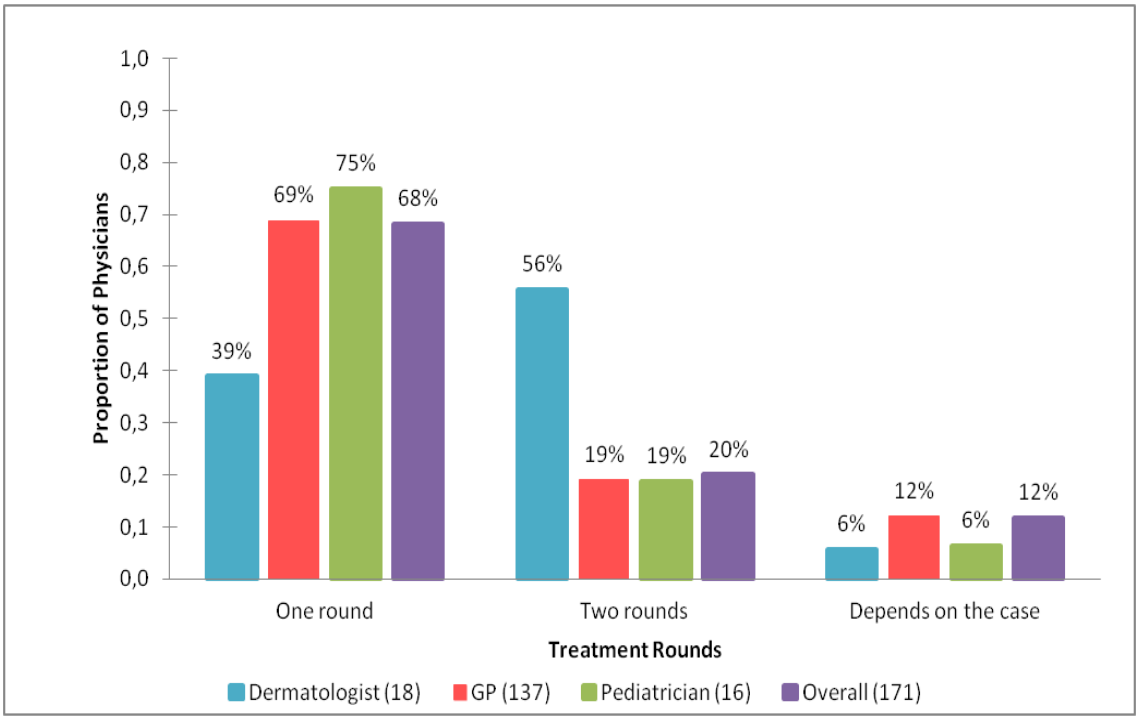


Figure 9: *The number of treatment rounds for contacts*

9.1.6 Treatment of the environment

Treatments for environments exposed to scabies were prescribed by 89.8% (n=284, 95% CI [85.24, 93.11]) of physicians. Figure 10 shows the frequency each method is prescribed by all physicians. There were no apparently differences in prescription tendencies between physicians.

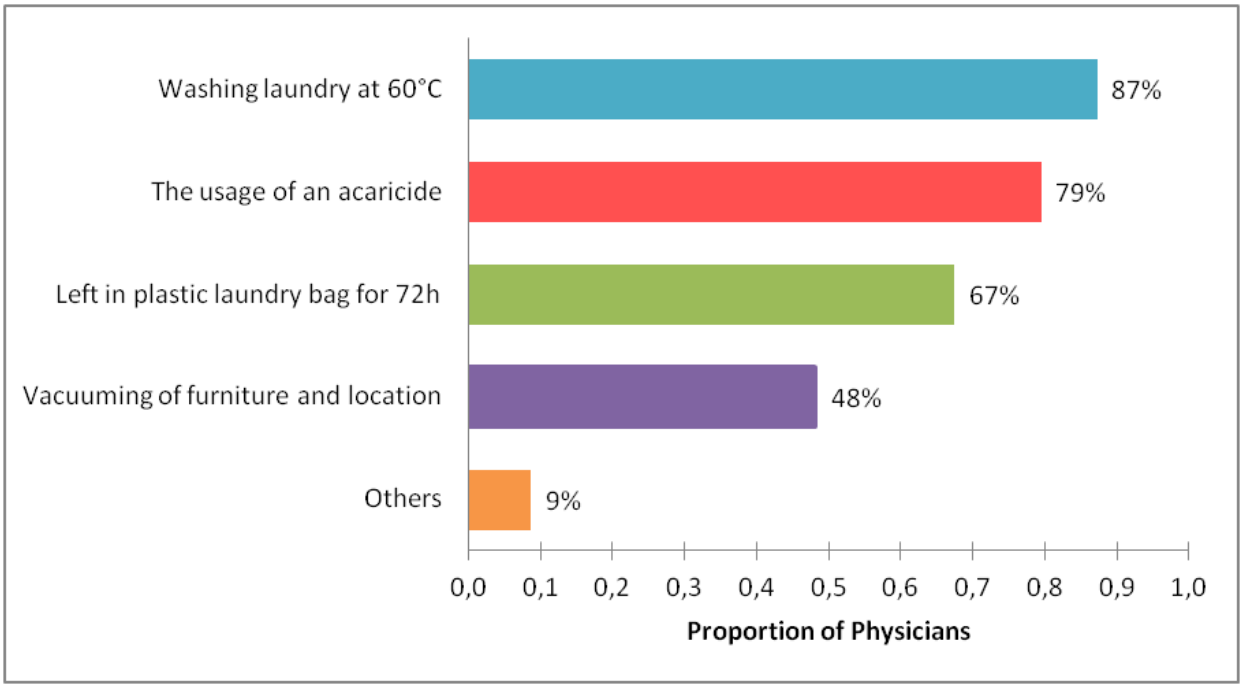


Figure 10: *Types of treatment for scabies infested environments*

9.1.7 Perception of Risk Factors

All physicians were asked questions on what they believed were the risk factors associated with contracting a scabies infestation based on proposed risk factors found in academic literature. Figure 11 shows the overall perceptions of what are risk factors for scabies by Brittany physicians. It should be noted that the risk factors with the highest proportions, promiscuity and community living, are two risk factors cited in the national report my HCSP (7).

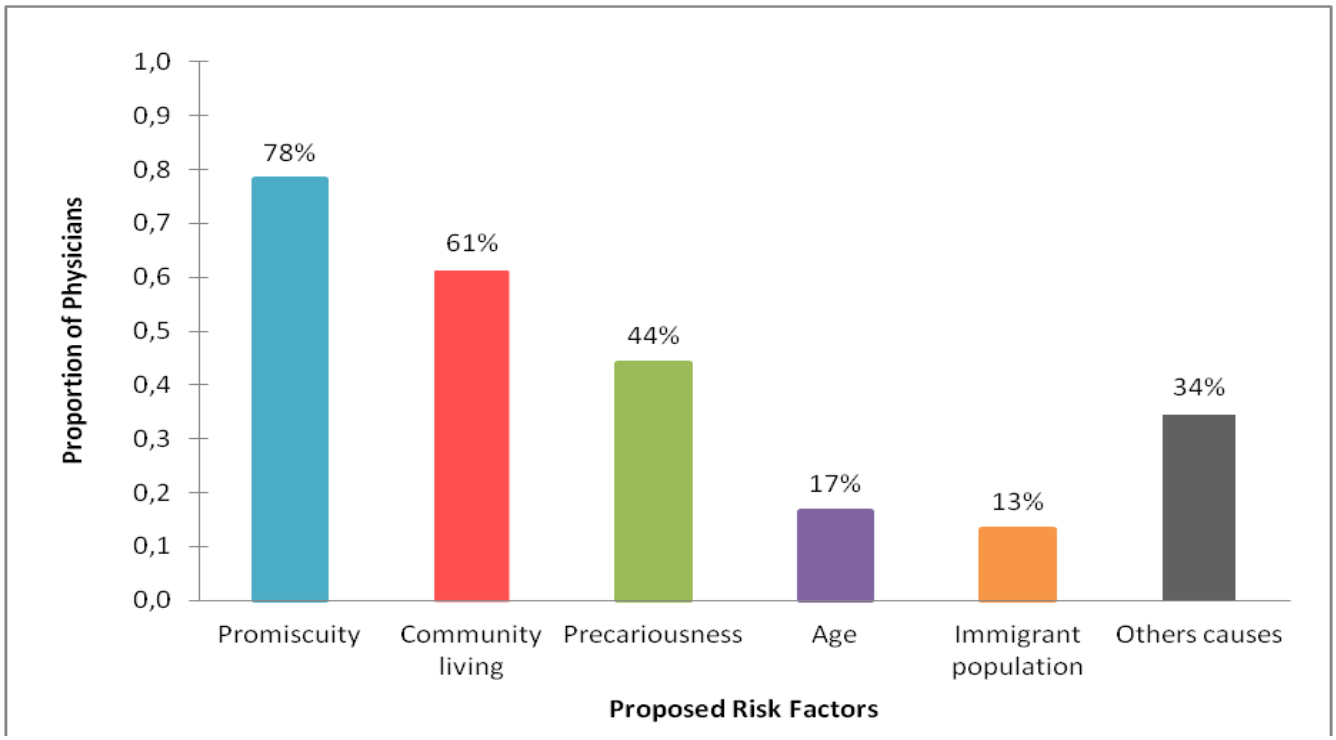


Figure 11: *Proposed Risk Factors for scabies infestation*

9.1.8 Knowledge and needs of physicians

The final questions on the survey were dedicated to finding out more about the physicians' existing knowledge; if they would like to be better informed about managing scabies outbreaks and what we could, as public health professionals, offer to better fulfill those needs.

According to the survey, 66.7% (95%CI [60.3, 72.7]) of physicians said they were not aware of the most recent national recommendations on scabies case management, published by HCSP in 2012. Moreover, 78.8% (95% CI [73.2, 83.5]) of physicians wish to be better informed on the management of scabies and 83.7% (95% CI [78.5, 87.9]) of physicians wished to receive additional information such as, informational guides they can give to their patients to help in the proper treatment of the household and living environments. Many physicians also requested annual informational meetings or to have information sent to them by mail.

9.2 Multivariate Logistic Regression Analysis

A multivariate logistic regression analysis was performed using an indicator variable to determine whether physicians' current practices based on the results of the survey complied with the most recent national recommendation for scabies case management.

9.2.1 HCSP Indicator variable

The HCSP report, *«Recommandations relatives à la conduite à tenir devant un ou plusieurs cas de gale »*, published in 2012 were in response to rising scabies epidemic in France. The Brittany region has been involved in this epidemic; therefore we found it interesting to determine how region's physicians' practices compared in relation to the HCSP recommendations and what factors could be associated with the any differences or similarities observed.

The HCSP indicator variable, *hcsp1*, was created taking into account a majority of the specific recommendations. The code was based on the responses to six different questions – Method of diagnosis, types of treatment give to cases, number of treatment rounds given to cases, prescribes treatment to contacts, types of treatments to contacts, and method prescribed for the environment.

- ***Method of diagnosis****:* According the HCSP, all listed diagnosis methods are acceptable. Only responses listed at 'Other' where not included.
- ***Types of treatment for cases:*** All treatment options listed in the survey where included, those who listed any treatment outside of Stromectol®, Ascabiol®/Spregal® or the two types of treatments together were excluded.
- ***Number of rounds given to cases:*** The recommendations specify that two rounds are necessary to effectively eliminate scabies. All other responses were excluded.
- ***Prescribes treatment to contacts:*** The treatment of only close contacts was included. Additional extended treatment is not necessary.
- ***Types of treatments for contacts:*** The same inclusion measures as treatments for cases.

- ***Method prescribed for the environment:*** Ideally, all methods should be prescribed to ensure an effective elimination of the scabies mites, but the minimal procedure is either 'Washing laundry at 60°C' **or** 'Treating laundry with an acaricide', plus 'Leaving clothes in a bag for 72 hours' **and** 'Vacuuming the entire living space and furniture'.

After compiling the '*hcsp1*' variable, only 17% (n=65, 95%CI [12.8, 22.3]) of the physicians surveyed complied with the current HCSP recommendations.

9.2.2 Logistic Regression

Figure 12 shows the results of the logistic regression analysis. Relevant variables included in the model were the type of physician (*type_num),* rural or urban zone (*zone2*), department (*region*), work experience (*class_install*) broken into three categories – less than 10 years, 10-30 years, more than 30 years – gender (*genre*), and whether the physician has diagnosed a case of scabies in the last seven months (*gale_yn*). The final model was significant with p=0.0172.

Dummy variables were created for the categorical, non-dichotomous variables – *class_install, type_num,* and *region.* Both general practitioners (*type_num2*) (OR=0.049, 95%CI [0.01, 0.22]) and pediatricians (*type_num3*) (OR=0.056, 95%CI [0.01, 0.32])) showed a significant inverse association to reference group, dermatologists. The work experience variables were not significantly associated when compared to the reference group of the inexperienced workers, (OR=1.53, 95%CI [0.60, 3.88]) and (OR=1.37, 95%CI [0.46, 4.11]), but it does show a positive trend of association.

```
. svy: logistic hcsp1 zone2 genre gale_yn i.class_install i.type_num i.region
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =       288
Number of PSUs     =       288                  Population size    =      1269
                                                Design df          =       279
                                                F(  10,     270)   =      2.22
                                                Prob > F           =    0.0172
```

hcsp1	Odds Ratio	Linearized Std. Err.	t	P>|t|	[95% Conf.	Interval]
zone2	1.020335	.358055	0.06	0.954	.5113737	2.035856
genre	1.04602	.472669	0.10	0.921	.4297629	2.545959
gale_yn	1.210327	.622951	0.37	0.711	.4394235	3.333665
class_inst~l						
1	1.525567	.7230695	0.89	0.374	.6001111	3.878208
2	1.372935	.7651945	0.57	0.570	.4583239	4.112703
type_num						
2	.0486236	.0370983	−3.96	0.000	.0108288	.2183314
3	.0563149	.0493437	−3.28	0.001	.0100356	.3160121
region						
29	.9317628	.4616099	−0.14	0.887	.351374	2.47082
35	.8312678	.4438496	−0.35	0.730	.2905814	2.378012
56	.7399269	.3820256	−0.58	0.560	.2677918	2.044469

Figure 12: *Stata output – Logistic Regression Analysis I*

10 Discussion

This study is novel not only for focused on a very relevant and timely issue, which is understudied in France, and produced results that could lead to immediate action, but because a group of students developed, executed and produced result in three weeks. The IDEA program allows for professionals working in public health the ability to receive formal training in epidemiology that will only benefit and diversity the field. The most notably factor of the program is that it allows for a new topic to be investigated every year, producing tangible results.

The results of the survey show that the incidence rate of scabies is 12 200 cases per 7 months, much higher than the incidence rate recently estimated by ARS in 2011, at approximately 10 000 cases per year. This is evidence of a continued scabies epidemic in the Brittany region.

There are many things can be taken away from this survey about vast differences in case management. A lack of uniformity in the treatment of scabies cases between physician types is troubling. Outside of dermatologists, who were the most compliant with HCSP recommendations, in part because their specialization requires a certain level of expertise in skin infections, general practitioners and pediatrician were not aware of currently endorsed treatment practices.

There was also insufficient treatment coverage of contacts, due to only receiving one round of medication when two rounds are recommended, although younger physicians did appear to be more aware of this when prescribing treatment to contacts.

11 Limitations

Due to such a small time period to conduct a full study from beginning to end, some limitations were to be expected. Firstly, the time constraint limited the depth of the study. Only two days for data collection limited the amount of physicians we could contact and an additional two days for data analysis confined the majority of the results to descriptive statistics.

The majority of data collection was conducted on a Monday and many physicians had full schedules and therefore could not participate, this greatly limited our response rate. Furthermore, two students, who were each assigned 40 physicians to contact, dropped out of the program and further limited the amount of response we could obtain.

There were also various technical problems with the online platform, Voozanoo. This caused further issues during data entry, leading to much error in the database. Additionally, during the data analysis workshops, large numbers of students participated in producing the results which made the compilation of databases, Stata files, and finally the results a very complex process.

In terms of bias, respondents and non-respondents differed in urban and rural zone, as well as specialization, limiting the representativeness of the findings. Finally, the estimation of the total number of scabies cases was not based on exact numbers, but on average numbers observed by the physicians.

12 Conclusion

In conclusion, scabies is a real and important problem in the Brittany region of France. This study will be important in informing the private practice physicians on the state of the situation in their area and the issues that still need to be resolved. An important thing to take away from this study is that physicians are beginning to recognized scabies a real issue and are willing to take action to drive down the current epidemic.

Important further steps will be to look into the surveillance of medications as a possible indicator for predicting the next scabies epidemic. Finally, providing physicians with information on proper methods of scabies case management.

13 References

1. WHO. WHO | Water-related Diseases. *World Health Organization: Water-borne diseases*. 2013;

2. CDC - Centers for Disease Control and. CDC - Scabies - General Information - Frequently Asked Questions (FAQs). 2010;(http://www.cdc.gov/parasites/scabies/gen_info/faqs.html). (Accessed February 28, 2013)

3. Buxton PA. Parasitology of Scabies. *Br Med J*. 1941;2(4211):397.

4. Orion E, Matz H, Wolf R. Ectoparasitic sexually transmitted diseases: scabies and pediculosis. *Clinics in dermatology*. 2004;22(6):513–9.

5. Bitar D, Castor C, Che D, et al. La gale est-elle en augmentation en France ? État des lieux à partir de diverses enquêtes régionales et nationales 2008-2010. Saint-Maurice: 2011.

6. Demillac R, Huguenet D. Épidémie de gale sur le secteur de Tinténiac,Ille-et-Vilaine (France). *Bulletin de veille sanitaire*. 2012;6(Cire Ouest):19–20.

7. HCSP - Haut Conseil de santé publique. Recommandations relatives à la conduite à tenir devant un ou plusieurs cas de gale. Paris: 2012.

8. Poujol I, Thiolet J, Bernet C, et al. Signalements externes des infections nosocomiales, France, 2007-2009. *BEH - Bulletin épidémiologique hebdomadaire*. 2010;(38-39):393–397.

9. Bitar D, Thiolet J, Haeghebaert S, et al. La gale en France entre 1999 et 2010 : augmentation de l'incidence et implications en santé publique. *Annales de Dermatologie et de Vénéréologie [Ann Dermatol Venereol]*. 2012;139(6-7):428–34.

10. Downs AM, Harvey I, Kennedy CT. The epidemiology of head lice and scabies in the UK. *Epidemiology and infection*. 1999;122(3):471–7.

11. Pannell RS, Fleming DM, Cross KW. The incidence of molluscum contagiosum, scabies and lichen planus. *Epidemiology and infection*. 2005;133(6):985–91.

12. Lapeere H, Naeyaert J-M, De Weert J, et al. Incidence of scabies in Belgium. *Epidemiology and infection*. 2008;136(3):395–8.

13. Owusu-Edusei K, Chesson HW, Gift TL. The economic burden of pediculosis pubis and scabies infections treated on an outpatient basis in the United States: evidence from private insurance claims data, 2001-2005. *Sexually transmitted diseases*. 2009;36(5):297–9.

14. Lukasiewicz E, Martel J, Roujeau J-C, et al. La dermatologie libérale en France métropolitaine en 2000. *Annales de dermatologie et de vénéréologie*. 129(11):1261–1265.

15. Lambert A, Delaporte E, Lok C, et al. Activité de consultation de trois services de dermatologie hospitalo-universitaires français. *Annales de Dermatologie et de Vénéréologie*. 2006;133(8-9):657–662.

16. Ansart S, Perez L, Jaureguiberry S, et al. Spectrum of dermatoses in 165 travelers returning from the tropics with skin diseases. *The American journal of tropical medicine and hygiene*. 2007;76(1):184–6.

17. InVS. Épidémie de gale communautaire Guide d'investigation et d'aide à la gestion. 2008.

18. Burns DA. An outbreak of scabies in a residential home. *The British journal of dermatology*. 1987;117(3):359–61.

19. Andersen BM, Haugen H, Rasch M, et al. Outbreak of scabies in Norwegian nursing homes and home care patients: control and prevention. *The Journal of hospital infection*. 2000;45(2):160–4.

20. Moberg SA, Löwhagen GB, Hersle KS. An epidemic of scabies with unusual features and treatment resistance in a nursing home. *Journal of the American Academy of Dermatology*. 1984;11(2 Pt 1):242–4.

21. Holness DL. Scabies in Chronic Health Care Institutions. *Archives of Dermatology*. 1992;128(9):1257.

22. Obasanjo OO, Wu P, Conlon M, et al. An outbreak of scabies in a teaching hospital: lessons learned. *Infection control and hospital epidemiology : the official journal of the Society of Hospital Epidemiologists of America*. 2001;22(1):13–8.

23. Larrosa A, Cortés-Blanco M, Martínez S, et al. Nosocomial outbreak of scabies in a hospital in Spain. *Euro surveillance : bulletin Européen sur les maladies transmissibles = European communicable disease bulletin*. 2003;8(10):199–203.

24. Clark J, Friesen DL, Williams WA. Management of an outbreak of Norwegian scabies. *American Journal of Infection Control*. 1992;20(4):217–220.

25. Buxton PA. Parasitology of Scabies. *British medical journal*. 1941;2(4211):397–401.

26. Chosidow O. Clinical practices. Scabies. *The New England journal of medicine*. 2006;354(16):1718–27.

27. Mimouni D, Ankol OE, Davidovitch N, et al. Seasonality trends of scabies in a young adult population: a 20-year follow-up. *The British journal of dermatology*. 2003;149(1):157–9.

28. Mellanby K. Transmission of Scabies. *British medical journal*. 1941;2(4211):405–6.

29. Currie BJ, McCarthy JS. Permethrin and ivermectin for scabies. *The New England journal of medicine*. 2010;362(8):717–25.

30. Arlian LG, Estes SA, Vyszenski-Moher DL. Prevalence of Sarcoptes scabiei in the homes and nursing homes of scabietic patients. *Journal of the American Academy of Dermatology*. 1988;19(5 Pt 1):806–11.

31. Chosidow O. Scabies and pediculosis. *The Lancet*. 2000;355(9206):818.

32. Hay RJ. Scabies and pyodermas--diagnosis and treatment. *Dermatologic therapy*. 2009;22(6):466–74.

33. Mounsey KE, McCarthy JS, Walton SF. Scratching the itch: new tools to advance understanding of scabies. *Trends in parasitology*. 2013;29(1):35–42.

34. Orion E, Marcos B, Davidovici B, et al. Itch and scratch: scabies and pediculosis. *Clinics in dermatology*. 2006;24(3):168–75.

35. Albrecht J, Bigby M. Testing a test: critical appraisal of tests for diagnosing scabies. *Archives of dermatology*. 2011;147(4):494–7.

36. Botterel F, Foulet F. Diagnostic et traitement de la gale en 2010 : quoi de neuf ? *Journal des Anti-infectieux*. 2011;13(2):109–116.

37. Fukuyama S, Nishimura T, Yotsumoto H, et al. Diagnostic usefulness of a nested polymerase chain reaction assay for detecting Sarcoptes scabiei DNA in skin scrapings from clinically suspected scabies. *The British journal of dermatology*. 2010;163(4):892–4.

38. Hengge UR, Currie BJ, Jäger G, et al. Scabies: a ubiquitous neglected skin disease. *The Lancet infectious diseases*. 2006;6(12):769–79.

39. Buffet M, Dupin N. Current treatments for scabies. *Fundamental and Clinical Pharmacology*. 2003;17(2):217–225.

40. Strong M, Johnstone P. Interventions for treating scabies. *Cochrane database of systematic reviews (Online)*. 2007;(3):CD000320.

41. Meinking TL, Taplin D, Herminda JL, et al. The Treatment of Scabies with Ivermectin. *N Eng J Med*. 1995;(333):26–30.

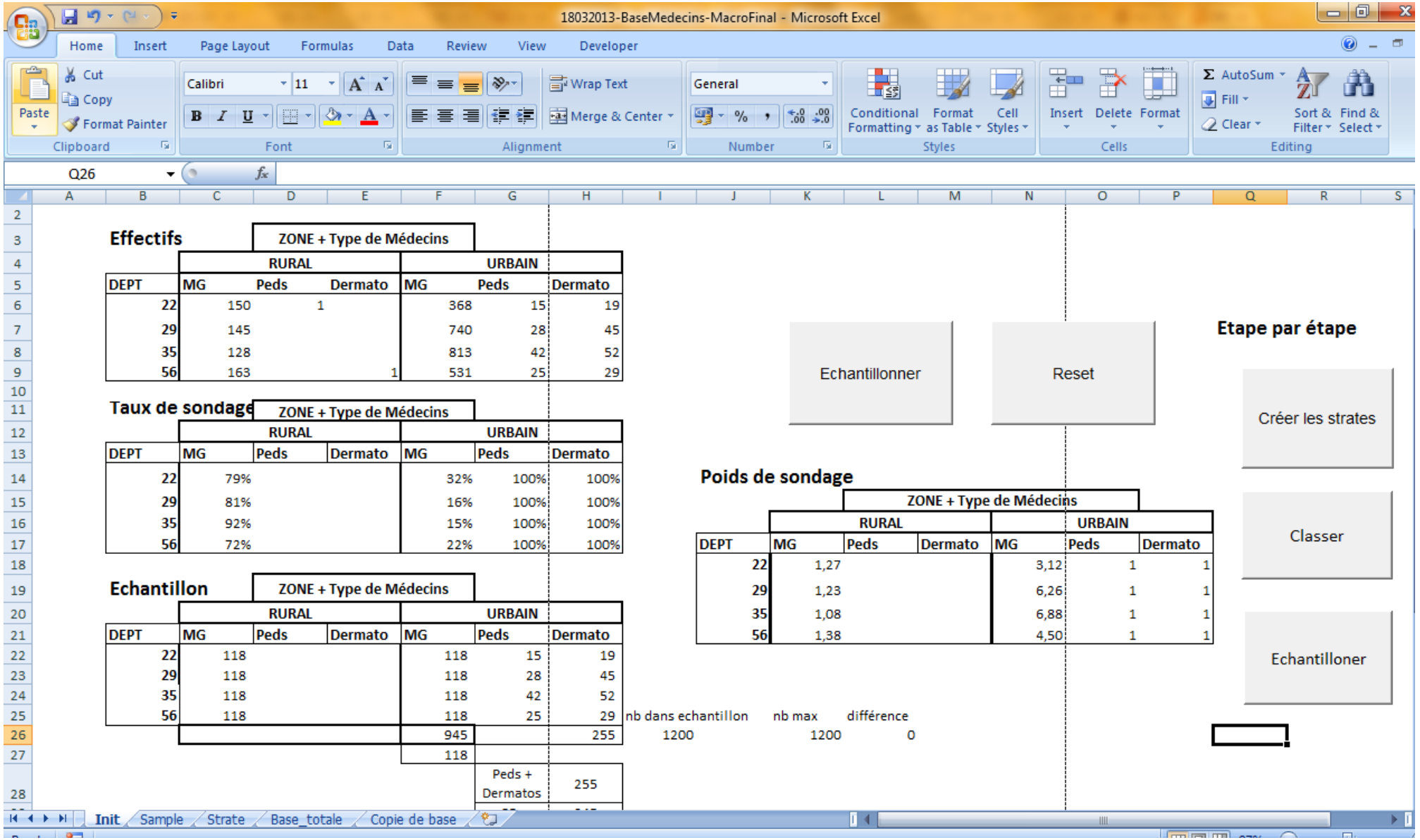
42. Ko CJ, Elston DM. Pediculosis. *Journal of the American Academy of Dermatology*. 2004;50(1):1–12.

43. Pirard P, Franke F, Thillier C. Caractérisation des risques radon dans les régions : faire s'approprier par les acteurs un problème de santé publique méconnu. *Bulletin épidémiologique hebdomadaire (BEH)*. 2007;(18-19):158–163.

14 Appendix

Appendix I: Map of Brittany region, including departments. Source: Wikipedia – Région Bretagne. http://fr.wikipedia.org/wiki/R%C3%A9gion_Bretagne

Appendix II: Macro-enabled Excel tables used for sampling calculations



Plan d'analyse

1) Contrôle de qualité des données.
Représentativité de l'échantillon (âge, sexe, profession, lieu d'exercice rural/urbain) ;
Taux de réponse.
Analyse des caractéristiques des non-répondants (motif, profession, âge, sexe, lieu d'exercice rural/urbain).

2) Epidémiologie descriptive
Description des caractéristiques individuelles.

Construction des indicateurs composites et des indicateurs simple à partir des variables identifiés précédemment.
Ordonner ces variables en fonction des catégories :

- Caractéristiques individuelles et de la maladie
- Perception et Connaissance
- Pratiques de diagnostic
- Pratiques de traitement

3) Epidémiologie analytique
Croisement de toutes les caractéristiques individuelles, en particulier les variables « spécialités médicales », « niveau d'urbanisation », « département », avec toutes les variables « connaissance », « perception », « pratiques ».

Potentiellement, on peut aussi croiser :

- l'indicateur de connaissance avec l'indicateur de perception et les indicateurs de pratiques
- l'indicateur de perception avec les indicateurs de pratiques

Appendix IV: Survey questionnaire

ID Enquêteur _____
ID Médecin _____

Bonjour je souhaiterais parler au Docteur_____ ,

Texte d'introduction secrétaire :

Bonjour (madame, monsieur), je m'appelle (ou je suis le Dr) ____, je suis épidémiologiste. Le Docteur ____ a été informé par l'Institut de Veille Sanitaire et l'URPS la semaine dernière, qu'une enquête de santé publique est menée par l'Agence Régionale de Santé de Bretagne. L'entretien durera moins de 10 minutes.
Pourriez-vous me le passer ?
Pourrais-je avoir un rendez-vous téléphonique avant mercredi soir (ou sa ligne directe) ?

Texte d'introduction médecin :

Bonjour (Docteur) ____, je suis _____, épidémiologiste, vous avez été informé par l'Institut de Veille Sanitaire et l'URPS la semaine dernière, qu'une enquête de santé publique est menée par l'Agence Régionale de Santé de Bretagne. L'entretien durera moins de 10 minutes.
Si vous êtes d'accord, pouvons-nous commencer ?

(Si non) Pourrions-nous prendre un rendez-vous téléphonique.

(Si non) *(Refus /_/)*

(Indisponible /_/)

(Ne pas demander !)
Homme ☐
Femme ☐
Ne sait pas ☐

QUESTIONNAIRE

L'enquête porte sur la prise en charge de la gale. *(Refus après annonce ? /_/)*

1. **Avez-vous diagnostiqué des cas de gale depuis la rentrée scolaire de septembre 2012 ?**
   /_/Oui /_/Non

Si oui,
Approximativement combien ? /_/_/ (*on prend l'estimation haute)*
Parmi eux, combien étaient des gales hyperkératosiques (*profuses, norvégiennes*)? /_/_/

Je vais vous poser plusieurs questions auxquelles il suffit de répondre par oui ou par non. *(Le conditionnel devra être utilisé en cas de non diagnostic de cas de gale)*

2. **Dans votre pratique habituelle, votre diagnostic d'un cas de gale repose (*rait*) sur :**
   a. Des critères cliniques /_/Oui /_/Non
   b. Un examen dermatoscopique *(une loupe)* /_/Oui /_/Non
   c. Un recours aux prélèvements parasitologiques /_/Oui /_/Non
   d. Un recours aux spécialistes /_/Oui /_/Non

Si autres précisez :

3. **Devant un cas de gale, en général prescrivez (*prescririez*)–vous :**
   (lire toutes les propositions)

Stromectol (*Ivermectine*) seul : /_/Oui /_/Non
Ascabiol (*benzoate de benzyl*) ou Spregal (*Esdépalléthrine*) seul : /_/Oui /_/Non

Les deux simultanément: /_/Oui /_/Non
Un autre traitement (précisez) /_/Oui /_/Non

4. **Prescrivez (prescririez)-vous systématiquement une cure ou deux cures :**
   - *une cure* ☐
   - *deux cures* ☐
   - *selon les cas* ☐

5. **Avez-vous eu l'occasion de prescrire Stromectol (*Ivermectine*) pour d'autres pathologies que la gale ?** /_/Oui /_/Non

Si oui, lesquelles ?

6. **Proposez (proposeriez)-vous systématiquement une consultation de contrôle ?** /_/Oui /_/Non

7. **Prescrivez-vous toujours des mesures pour le linge, la literie et l'environnement ?**
   /_/Oui /_/Non

Si non passez à la question 9

8. **Lesquelles parmi les mesures suivantes?**
   - lavage du linge à 60°C /_/Oui /_/Non
   - mise en sac plastique du linge pendant 72h /_/Oui /_/Non
   - utilisation d'un acaricide /_/Oui /_/Non
   - aspiration des locaux et du mobilier /_/Oui /_/Non
   - autres ? précisez …….. /_/Oui /_/Non

9. **Prescrivez (prescririez)-vous un arrêt de travail ou une éviction scolaire ?**
   /_/Oui /_/Non
10. **Prescrivez-vous systématiquement un traitement aux personnes de l'entourage du patient ?** :
    /_/Oui /_/Non

Si non passez à question 12
Si oui, traitez-vous les personnes :
- proches ☐
- fréquentant la même collectivité (lieu de travail, école) ☐
- ou autres ? précisez …….. ☐

Leur prescrivez (prescririez)–vous :
(lire toutes les propositions)
- Stromectol (*Ivermectine*) seul: /_/Oui /_/Non
- Ascabiol (*benzoate de benzyl*) ou Spregal (*Esdépalléthrine*) seul : /_/Oui /_/Non
- Les deux simultanément /_/Oui /_/Non
- Ou un autre traitement (précisez) /_/Oui /_/Non

11. **Prescrivez (prescririez)-vous systématiquement une cure ou deux cures :**
    - *une cure* ☐
    - *deux cures* ☐
    - *selon les cas* ☐

12. **Pensez-vous que la gale soit une maladie :**
- de la vie en collectivité /_/Oui /_/Non
- de l'âge /_/Oui /_/Non
- des populations immigrées /_/Oui /_/Non

- de la précarité /_/Oui /_/Non
- de la promiscuité /_/Oui /_/Non

13. **Pensez-vous qu'il y ait d'autres facteurs favorisant l'apparition de la gale ?**
/_/Oui /_/Non

- (Si oui,) lesquels ?

Pour terminer,

14. **Avez-vous eu connaissance de recommandations nationales de prise en charge des cas de gale ?**
/_/Oui /_/Non

15. **Souhaiteriez-vous être mieux informé sur la prise en charge de la gale ?**
/_/Oui /_/Non

(Si oui) sous quelle forme ? (courrier, réunion d'information,…)

16. **Souhaitez-vous disposer de fiches à destination des patients pour le traitement de l'environnement des cas de gale ?**
/_/Oui /_/Non

17. **Quelle est l'année de votre première installation** : (*année)* |_|_|_|_| *ou (durée)* |_|_|

18. **Etes-vous un médecin à exercice particulier (MEP : homéopathie, …) ?** /_/Oui /_/Non

(*Si oui)* **quelle compétence :**

19. **Par ailleurs, exercez-vous comme médecin coordonnateur au sein d'une collectivité ?**
/_/Oui /_/Non

(Si oui) **dans quel type d'établissement ?** *(EHPAD, PMI, Prison, étab. scolaire, autre)*

Je vous remercie d'avoir répondu à ce questionnaire. Vos réponses sont anonymes. Un retour d'information sera transmis à l'ensemble des médecins de la région très prochainement.
Bonne journé

Appendix V: Flowchart describing the telephone survey protocol