THE UNIVERSITY OF MELBOURNE

Faculty of Medicine, Dentistry & Health Sciences
School of Population Health

ASSIGNMENT COVER SHEET

(For Postgraduate Coursework Students)

Students Please Note:

1. This form **MUST** be attached to all submitted written work with all sections completed. An incomplete form may result in the delayed return of your assignment or of your mark for the assignment. Please keep a copy of all assignments before submitting them for assessment.
2. It is the **STUDENT'S RESPONSIBILITY** to ensure that the assignment is handed in by the **Due Date**. Penalties will apply for assignments handed in after the due date. Please refer to the SPH Assessment and Extension policy for further details.

Student / Assignment Details

Surname: BASKOTA **Given Name(s):** RABINDRA

Student Number: 1163528

Subject Number: POPH90255_2021_SM1 **Subject Name:** Research Project in Public Health - S

Subject Coordinator: Dr Alison Barr

Title of Assignment: Evaluation of the Economic Burden of scabies in Fiji

Assignment Due Date: 11th June 2021 **Extension Due Date** *(if applicable)*:

Have you been receiving assistance from the MDHS International Student Support Program (ISSP)? ☐ Yes ☒ No
Have you been receiving assistance from the Language and Learning Skills Unit (LLSU)? ☐ Yes ☒ No
Have you received assistance with the preparation of this assignment from the LLSU or ISSP? ☐ Yes ☒ No

Student Declaration and Signature

ACADEMIC HONESTY AND PLAGIARISM:
Plagiarism is the act of representing as one's own original work the creative works of another, without appropriate acknowledgment of the author or source (e.g. published books, periodicals or internet sites), or from your own unpublished work that has been submitted for assessment elsewhere, without due acknowledgement in the text. Information regarding plagiarism can be found at: http://www.services.unimelb.edu.au/plagiarism/ .

COLLUSION:
Collusion is the presentation by a student of an assignment as his or her own which is in fact the result in whole or in part of unauthorised collaboration with another person or persons. Collusion involves the cooperation of two or more students in plagiarism or other forms of academic misconduct. Both collusion and plagiarism can occur in group work. For examples of plagiarism, collusion and academic misconduct in group work please see the University's policy on Academic Honesty and Plagiarism: https://academichonesty.unimelb.edu.au

Plagiarism and collusion constitute cheating. Disciplinary action will be taken against students who engage in plagiarism and collusion as outlined in University policy. Proven involvement in plagiarism or collusion may be recorded on my academic file in accordance with Statute 13.1.18.

Please tick to indicate that you UNDERSTAND the following statements:

I **DECLARE** that:

☒ This assignment is my own original work, except where I have appropriately cited the original source (Appropriate citation of original work will vary from discipline to discipline).
☒ This assignment has not previously been submitted for assessment in this or any other subject.

For the purposes of assessment, I **GIVE** the assessor of this assignment the permission to:

☒ Reproduce this assignment and provide a copy to another member of staff; and
☒ Take steps to authenticate the assignment, including communicating a copy of this assignment to a checking service (which may retain a copy of the assignment on its database for future plagiarism checking).

Signature: ______________ Date: 09/06/2021

The University's Privacy Policy can be viewed at: http://www.unimelb.edu.au/unisec/privacy/studentinfo.html. This website provides detailed information about the contact details, complaints procedures and other aspects of the University's privacy regime.

Evaluation of the Economic Burden of Scabies in Fiji

Name of student: Rabindra Baskota

Department: School of Population and Global Health

University: The University of Melbourne

Course: Master of Public Health

Subject name and code: Research Project in Public Health – S (POPH90255_2021_SM1)

Supervisors:

- Dr Natalie Carvalho: Senior Research Fellow, Health Economics Unit, Centre for Health Policy, School of Population and Global Health
- Patrick Abraham: Research Assistant, Health Economics Unit, Centre for Health Policy, School of Population and Global Health
- Maria Mow: Big Skin Health Intervention Fiji Trial (BigSHIFT) Project, Murdoch Children's Research Institute (MCRI)

Date of submission: 9th June 2021

Words: 6254

Acknowledgements

I wish to acknowledge my supervisors Dr Natalie Carvalho, Patrick Abraham and Maria Mow for their continuous support and guidance throughout the research project. I thank Professor Dr Andrew Steer who is the Principal Investigator of the BigSHIFT trial and Dr Li Jun Thean who developed the data collection forms and carried out the data collection. The BigSHIFT project was funded by the National Health and Medical Research Council (NHMRC) of Australia (Grant number: APP1127300).

Affirmation

The work presented in this report was undertaken to partially fulfill the requirements of the degree of Master of Public Health at The University of Melbourne. The views expressed herein are those of the authors and may not reflect the views of The University of Melbourne.

List of abbreviations

AUD	Australian Dollar
BigSHIFT	Big Skin Health Intervention Fiji Trial
CDC	Centres for Disease Control and Prevention
CHOICE	Choosing Interventions that are Cost Effective
CWMH	Colonial War memorial Hospital
FJD	Fijian Dollar
GBD	Global Burden of Disease
IACS	International Alliance for the Control of Scabies
ICU	Intensive Care Unit
IMCI	Integrated Management of Childhood Illness
NHMRC	National Health and Medical Research Council
NTD	Neglected Tropical Disease
OPD	Out Patient Department
SSTI	Skin and Soft Tissue Infection
USD	United States Dollar
WHO	World Health Organisation

Abstract

Topic: Evaluation of the economic burden of scabies in Fiji.

Background: Scabies is a common, contagious skin disease with a high prevalence in the Pacific region. It poses a significant burden on public health, healthcare resource utilisation and health budgets. There are limited studies related to costing of scabies in low- and middle-income countries. This study was conducted to evaluate the economic burden of scabies in the Northern Division of Fiji.

Methods: Data obtained from the Big Skin Health Intervention Fiji Trial (Big SHIFT) project was analysed. A cost of illness approach was applied to estimate the direct medical cost of all new cases of scabies over the trial period (July 2018 to June 2019). Micro costing was done to identify the cost items which were valued by bottom-up approach. Data were analysed separately for hospital admitted and outpatient cases. Results were presented as cost per patient as well as total cost of all scabies-related healthcare resource utilisation from the government perspective.

[58 hospitalized and 3643 outpatient cases]

Results: Data were collected from 58 hospital admitted and 3,643 outpatient cases of scabies. For the hospital admitted cases, the mean length of hospital stay was 10.41 days (95% CI 7.87-12.95), and the median length of stay was 7 days. Oral antibiotics was prescribed for 1,508 (41.39%) of outpatient cases. The average direct medical cost per patient for hospital admission was $736 (2019 USD) and that for outpatient clinic visit was $14.51. During the study period, the total cost of scabies in the Northern Division from the government perspective was $96,263.

Conclusions: The cost of scabies is high and represents a substantial economic burden for the government in the Northern Division of Fiji. These findings may be relevant to other Pacific countries where there is similar prevalence and similar cost of treatment of scabies.

Table of Contents

1 Background

1.1 Introduction

Scabies is a common, contagious skin disease, caused by the infestation of the mite sarcopties scabiei var. hominis (1). It is primarily transmitted through direct contact with the skin of affected individuals. The disease presents with generalised itching, particularly at night, which is associated with the appearance of small burrows, scabies nodules and crusting (2). The most common sites of involvement in adults are the webs of fingers, wrists, axillae, abdomen, thighs and genitalia, while in infants and young children, it also involves palms, soles and the head (2). Diagnosis is confirmed by direct visualisation of mites, eggs or faeces of mites by microscopy or dermoscopy (3). However, most physicians rely on clinical diagnosis with history of itching and typical distribution of skin lesions (3). Multiple treatment modalities are available, including creams such as benzyl benzoate, gamma benzene hexachloride, malathion and permethrin, as well as oral tablets such as ivermectin (4).

Current strategies for controlling scabies include treatment of the affected person and their close contacts with scabicide medicines, maintenance of hygiene and ivermectin-based mass drug administration (5). With appropriate treatment and control measures, the disease is cured in several weeks. However, in the absence of adequate treatment, scabies may lead to a significant public health burden. Scabies has a negative effect on quality of life because it creates itching. A study in India found that 52% of adults with scabies had some effect on quality of life, ranging from disturbances in work and sleep to difficulties in concentration and feelings of embarrassment (6). Moreover, scabies can lead to secondary bacterial skin and soft tissue infections (SSTIs) such as impetigo, cellulitis and abscess (7). These complications can lead to increased utilisation of healthcare resources, including outpatient visits, hospital stay, laboratory tests, multiple antibiotic use and surgical procedures.

1.2 Prevalence and Epidemiology

Scabies is present in all countries around the world, but it disproportionately affects tropical countries. The estimated global point prevalence of scabies reported in the 2016 Global Burden of Disease study was approximately 147 million and the annual incident case number was approximately 455 million (8). Prevalence varies across countries, regions and communities. There is a lower prevalence of scabies in European countries than in Pacific (9). A 2007 national survey in Fiji found the prevalence of scabies to be as high as 23.6% (10). An even higher rate (36.4%) was found in the Skin Health Intervention Fiji Trial (SHIFT) project conducted during the period 2012–2013 among the residents of the three islands of Fiji (11).

Multiple epidemiological factors influence the distribution of scabies in populations, including age, gender, ethnicity, economic status and living conditions. According to a 2005 systematic review by the World Health Organization (WHO) that included 18 prevalence studies in developing countries, scabies was one of the most common skin diseases in children (12). In the Fijian National Survey of 2007, the prevalence of scabies was highest (43.7%) in children aged 5–9 years (10). The elderly population is a vulnerable group for scabies outbreaks. One study in Southeast England found that in residential care homes for elderly people, 27% of residents developed scabies during outbreaks (13). In this study, an outbreak was defined as two or more cases of scabies at a single care home and the study examined residents throughout 10 outbreaks between 2014 and 2015. Scabies is equally common in male and female (14) but differences in prevalence among racial groups have been described. In the National Fijian Survey, iTaukei Fijians were affected two times more than were Indo Fijians (10). Poverty and overcrowding are established risk factors for scabies. A review by Heukelbach and Feldmeier found that scabies is more prevalent among low socioeconomic populations (15). The authors suggested that overcrowding, which is common among poorer socioeconomic communities, encourages the spread of the disease.

1.3 Burden of Scabies

Scabies poses a significant burden on public health, healthcare resource utilisation and health budgets. A cross-sectional analysis from the 2015 Global Burden of Disease study noted that scabies was responsible for 0.21% of disability-adjusted life years (16). In response to the high public health burden of the disease, scabies was recognised as a neglected tropical disease by the World Health Organisation (WHO) in 2017 (17).

Scabies-related healthcare resource utilisation is substantial in many countries. The prevalence of scabies presenting in dermatology outpatient departments (OPDs) of hospitals ranges from 5.10% in Ghana (18) to 47.60% in Pakistan (19). Even in Australia, presentation of cases of scabies in primary healthcare centres was found to be high in some Indigenous communities. Data from the East Arnhem Healthy Skin Project, conducted from 2004 to 2007 in five remote communities of Northern Australia, noted that 69% of children had presented with at least one episode of scabies to healthcare centres (20). Healthcare resource utilisation is significantly higher during outbreaks. A retrospective review of scabies outbreaks from 1984 to 2013 reported that outbreaks of scabies lead to increased dermatology consultations, acaricide prescriptions, prophylactic treatment and workforce (21). Further, if not treated in time, scabies may lead to serious complications that require hospital admissions. For example, a recent study in the Northern Division of Fiji found a population incidence of 647 hospital admissions for SSTIs per 100,000 person-years, where 58 (7.60%) of cases had scabies at the time of admission (22).

Scabies imposes significant economic loss to individuals, families and communities as a result of direct and indirect treatment costs. Direct treatment costs refer to the cost of medical care, including outpatient visits, hospitalisation, diagnostic tests, general practitioner and specialist services, medicines and rehabilitation (23). A study in the United States estimated that the average cost of treatment per case of scabies was $95 (2005 USD) (24). This evidence was generated through private insurance claims data that estimated the annual economic burden of scabies to be approximately $10.4 million. However, the actual economic burden caused by scabies is underestimated in this study because the study population was limited to outpatient cases only. A survey in a community of Mexico found that the treatment cost of skin diseases was equivalent to one week of household income (25). The survey captured all cases of skin disease, including scabies, but the actual cost of treatment of scabies was not determined in the study. Further, in an Australian study, the estimated cost per admission of paediatric scabies patients was found to be $9,584 (2013 AUD) (26).

1.4 Rationale

Despite the significant morbidity rate associated with scabies, there are few studies on the economic burden of scabies. The cost of illness studies conducted previously that have included scabies have focused either on neglected tropical diseases overall or on general skin diseases. There are no costing studies specific to scabies and scabies-related skin and soft tissue infections (SSTIs). Moreover, many of the published studies have been conducted from only the societal or third-party-payer perspective (24). Most studies have included only children, excluding the elderly cohort, which contributes significantly to the prevalence of the disease (26). Further, most studies have been conducted in high-income countries such as the United States and Australia, where the prevalence is generally low. To our knowledge, no published studies have investigated the direct economic burden of scabies since the World Health organisation (WHO) declared scabies a neglected tropical disease in 2017. Thus, our study is the first since this declaration to evaluate the economic burden of scabies in an upper-middle income country such as Fiji.

1.5 Objectives

1.5.1 Primary objective

1. To estimate the direct medical cost of scabies in the Northern Division of Fiji from the government perspective.

1.5.2 Secondary objectives

1. To understand the patient characteristics of hospital admitted and outpatient cases of scabies in the Northern Division of Fiji.
2. To determine the healthcare resource utilisation for the treatment of patients with scabies in the Northern Division of Fiji.

1.6 Research Questions

The primary research question for this study is as follows: What is the economic burden of scabies among the general population of Fiji's Northern Division from a government perspective? By addressing this question, we will evaluate the total healthcare cost to the government for treatment of scabies cases in the Northern Division of Fiji.

The study will also answer the following two secondary research questions:

- What is the average direct medical cost for treatment of a hospital admitted case of scabies in the Northern Division of Fiji?

- What is the average direct medical cost for treatment of an outpatient case of scabies in the Northern Division of Fiji?

The answers to these questions may help governments to make informed decisions about allocating limited resources in resource limited countries. These research questions are aimed at estimating the cost of scabies in Fiji and the findings may inform policy makers in prioritising scabies control activities alongside other neglected tropical diseases. We answered these research questions by analysing the baseline data obtained from the Big SHIFT project. The Big SHIFT project was a community-based before-after intervention trial of two doses of ivermectin-based mass drug administration delivered to the whole population of the Northern Division of Fiji.

2 Methods

2.1 Ethics Statement

Ethical approval for the Big SHIFT in Fiji was obtained from The Royal Children's Hospital Human Research Ethics Committee, Melbourne, Australia (reference number: 38020) and from the Fiji National Health Research Ethics Review Committee (reference number: 2018.38.NOR). Written informed consent was obtained from all study participants. Consent of a parent or legal guardian was taken if the participant was less than 18 years of age. The collected information was entered into the study database and each case was assigned a case number to maintain confidentiality. The Big SHIFT project was funded by the National Health and Medical Research Council (NHMRC) Australia.

2.2 Diagnostic Criteria

Diagnosis of scabies was made according to the criteria in the International Alliance for the Control of Scabies (IACS) guidelines (27). Skin and soft tissue infections (SSTIs) were based on the working diagnosis of the treating physicians as recorded in the admission registers, round books, and the hospital's electronic record system. SSTIs were categorised into two groups: 1) SSTIs that were potentially scabies related (abscess, impetigo, cellulitis, pyomyositis, crusted scabies, infected scabies, necrotising fasciitis with pure growth of *Staphylococcus aureus* or group A *Streptococcus*); 2) SSTIs that were unlikely scabies related (wound infections, surgical wound infections and necrotising fasciitis without pure growth of *Staphylococcus aureus* or group A *Streptococcus*) (22).

2.3 Approach

A cost of illness approach was applied to estimate the total cost of scabies for the Northern Division of Fiji. A cost of illness approach quantifies healthcare resource utilisation and expresses cost in monetary terms (23). This approach has been adopted in several important studies conducted by the World Health Organisation (WHO) (28) and the Centres for Disease Control and Prevention (CDC) (29) to estimate the economic resources utilisation of aspects of healthcare. Cost was evaluated from the government perspective to estimate the direct medical cost of scabies. This is because most expenses pertain to treatment cost which are included as direct medical costs, and the government in Fiji is the main healthcare payer for direct medical care. Public provision of most outpatient and inpatient care cost is free in Fiji and user fee is insignificant to the government health expenditure (30).

2.4 Study Population and Data Source

A retrospective analysis was done on baseline data obtained from the Big SHIFT trial. During the trial, data on hospital admitted cases was collected by prospective surveillance of SSTI at Labasa Hospital during the period of 48-weeks (from 16th July 2018 to 30th June 2019, with a pause of two weeks from 24th December 2018 to 6th January 2019) (22). The cases of scabies and SSTIs were identified by reviewing admission registries and case notes of all newly admitted cases at the hospital. A verbal confirmation was done with the nurse in charge of each ward. The microbiology laboratory records in the hospital were reviewed for skin swabs to identify potential cases for enrolment in our study. Data of scabies patients presenting to the OPD at the subdivisional hospitals and other clinics were taken by reviewing monthly reports. Data on scabies in children was also collected from records of the Integrated Management of Childhood Illness (IMCI) clinics through maternal and childcare nurses.

2.5 Costing

The costs of all new cases of scabies were estimated with respect to their treatment in two settings; 1) Patients with scabies and SSTI admitted to Labasa Hospital, the main referral hospital in the Northern Division; 2) Patients with scabies who presented to outpatient settings. Within each setting, specific healthcare service activities were identified from the dataset. This included hospital admissions, diagnostic tests, surgical procedures, clinic visits and medicines. A micro costing method was used to identify the cost items consumed for treatment of scabies and SSTIs related to scabies. This method was employed because it is generally more accurate in identifying and valuing resources (31). For hospital admitted cases, the cost items included hospital bed-days, intensive care unit (ICU) bed-days, skin swabs, blood cultures, tissue cultures, operations and medicines. Cost items for outpatient cases included clinic visits, oral antibiotics, intramuscular antibiotics, intravenous antibiotics, permethrin cream and need for admission for treatment of scabies. Given that scabies is usually an acute disease with a relatively short duration of illness (in weeks), discounting was not applied for economic burden estimation (32).

All cost items were valued in appropriate prices at the most detailed level by using a bottom-up approach (31). Unit costs of each healthcare resource utilisation were obtained through various sources (shown in Table 1). Unit costs refer to the average cost of providing a single good or service (33). The unit costs of a hospital bed-day, ICU bed-day and cost of laboratory tests were obtained from 'Costing Study of Selected Health Facilities in Fiji' conducted by the Fiji Ministry of Health in 2012 (34). The study reports cost estimates of various healthcare services in in certain hospitals including the Colonial War Memorial Hospital (CWMH). The study participants of our study were admitted in Labasa hospital, the referral centre in Fiji's Northern Division. Since Labasa hospital is comparable to the CWM Hospital, the cost estimate of the CWM Hospital was used in our study. Unit costs of medicines were estimated by referring the third edition of 'Fiji Essential Medicines List' published in 2013 (35). The cost of an outpatient clinic visit was estimated from the 'WHO Choosing Interventions That are Cost-Effective (WHO-CHOICE) Estimates of Cost for Inpatient and Outpatient Health Services Delivery 2010' (36). Given that the patients presenting to outpatient settings were seen in the subdivisional hospitals, Integrated Management of Childhood Illness (IMCI) clinics and primary healthcare clinics, the clinic visit costs were estimated corresponding to the costs of clinic visits in secondary hospitals and health centres (no beds) that are reported in the WHO-CHOICE estimate. Since the amount of drugs used by each patient was not available in the dataset, the dose of medicines was estimated following the 4th edition of the 'Fiji Antibiotic Guidelines' published in 2019 by Fiji's Ministry of Health (37). Cost of operation were not estimated separately because it was captured in the unit cost of hospital bed-days. It was indicated that, while calculating the unit cost of inpatient services, 85% of theatre costs was included to the inpatient cost (37). For the cost of hospital bed-days and OPD visits, there was variation between the Fiji costing study and the WHO-CHOICE estimates. The cost variation was analysed using sensitivity analysis.

Table 1: Estimated Healthcare Unit Cost and Source of Cost Information

Cost component	Unit cost (2010 FJD)	Unit cost (2019 USD)	Source of cost
Hospital bed-day	84.35	57.31	Costing study of selected health facilities in Fiji, by the Fiji Ministry of Health, 2012.
Intensive Care Unit (ICU) bed-day	279.16	189.69	
Laboratory test	22.14	15.04	
OPD visit (CWMH)	59.05	40.12	
Hospital bed-day (tertiary hospital)	64.90	44.10	WHO-CHOICE estimates of cost for inpatient and outpatient health service delivery, by the WHO, 2010.
OPD visit (secondary hospital)	10.40	7.06	
OPD visit health centres (no bed)	7.10	4.82	
Medicines	Appendix 1	Appendix 1	Fiji essential medicines list, third edition, 2013.

For hospital admitted cases, the number of each cost item utilised by each patient was calculated through patient utilisation data. For outpatient cases, the number was estimated from the corresponding data of the hospital admitted cases because the exact amount of their healthcare resource utilisation information was not available in the dataset. Each unit of resource utilised by each individual patient was multiplied by unit prices (presented in Table 1 and in Appendix 1) to estimate the cost of each resource utilised by the individual patient. The cost of each resource utilised by an individual patient was added to obtain the average cost of treatment of one case of scabies. The following model developed by Smith and Waycaster (38) was used to estimate the total direct costs of scabies:

Total direct cost of illness = Total inpatient direct costs (a*b) + Total outpatient direct cost (c*d)

Where 'a' referred to the number of cases of scabies with hospital admission (obtained from the Big SHIFT dataset); 'b' referred to the direct cost associated with each case of hospital admission (mean cost for hospital bed-day + mean cost for laboratory tests + mean cost for medicines); 'c' referred to the number of cases of scabies in outpatient visits (obtained from the Big SHIFT dataset); and 'd' referred to the direct costs associated with clinic visits (mean cost of outpatient visit + mean cost of medicines).

The total economic burden of scabies was calculated by adding the total cost for hospital admitted cases and outpatient cases. The cost was adjusted for inflation using the gross domestic product implicit price deflator (39). The cost in Fijian Dollar (FJD) was converted to United States Dollar (USD) using the official exchange rate of 2019 (1 USD = 2.16 FJD) (40). All costs are presented in 2019 USD, unless otherwise stated.

2.6 Data Analysis

Demographic characteristics were analysed for age, sex and ethnicity for hospital admitted cases and outpatient cases separately. Ethnicity was classified as iTaukei, Fijian of Indian origin and other ethnicity groups. The age groups were stratified in intervals of 10 years to provide a burden estimate specific to the age group. However, for the first group, age range of 0–4 years was taken because the Integrated Management of Childhood Illness (IMCI) guidelines refer to the management of children under 5 years of age (41). Stata/IC version 16.1 (StataCorp, United States) was used for statistical analysis.

Cost estimates, including the utilisation of health services, are subject to uncertainty (42). Our study was based on various assumptions and sources, with some resulting in a high level of uncertainty in the estimated cost of scabies. A one-way sensitivity analysis approach recommended by Briggs and Gray (43) was conducted to test the robustness of the economic evaluation and to examine how sensitive the estimates are to fluctuations in cost and health resource utilisation. The sensitivity analysis was conducted taking $\pm$20% variation around the cost of medicines, laboratory tests, ICU bed-days and clinic visits. Similarly, 95% Confidence Interval (CI) was used for uncertainty around length of stay. WHO-CHOICE Estimates were used to examine variation in hospital bed-day cost. The results of the sensitivity analysis were reported on a tornado chart. Uncertainty in a parameter may also be represented by costing values from clinical studies evidence, utility surveys and cost data sets leading to cost variation (42). Scenario analysis was done to report the alternative outcomes. A worst scenario was projected taking all of the high cost estimates and a best scenario was projected taking all of the low cost estimates.

3 Results

Of the 1,31,914 population of Northern Division of Fiji (44), a total of 3,701 patients presented to health facilities with scabies and scabies-related SSTIs during the study period. Among these, 58 (1.23%) were hospital admitted cases and 3,643 (98.76%) were OPD examined cases. Of the 58 hospital admitted cases, two had scabies along with other SSTIs, but their SSTIs were not related to scabies. So, the cost of management of SSTIs of these two cases were excluded from the costing analysis and were treated as outpatient cases for cost estimation. Of the 3,643 patients examined in outpatient settings, three required hospital admission. The cost of hospitalisation of these three cases was included in our cost analysis as hospital admitted cases. Thus, for the purpose of costing, 59 patients were taken as hospital admitted cases and

3642 cases were taken as outpatient cases. Out of the total 3,643 cases in the outpatient setting, 23 data were missing for sex and 22 for age.

3.1 Patient Characteristics

3.1.1 Hospital admitted cases

Of the 58 hospital admitted cases, 31 (53.45%) were male and 27 (46.55%) were female. Most patients (86.21%) belonged to iTaukei ethnicity, compared to 56.82% from the census population of the Northern Division. Similarly, more than half (53.45%) of the cases were aged between 0–4 years, compared to 11.05% of the census population. At the time of patient admission, the minimum age was 1 month and the maximum age was 70 years. The mean age was 18.42 years (95% CI 12.40–24.43) and the median age was 4 years. The patient characteristics of the hospital admitted cases are listed in Table 2.

Table 2: Hospital Admissions- By Gender, Ethnicity and Age Group

Demographic characteristics (N = 58)		Sample frequency	Sample percent	Census percent (2017)*
Gender	Male	31	53.45	51.20
	Female	27	46.55	48.80
Ethnicity	iTaukei	50	86.21	56.82
	Fijian of Indian origin	7	12.07	37.47
	Other	1	1.72	5.70
Age group	0–4 years	31	53.45	11.05
	5–14 years	5	8.62	20.80
	15–24 years	2	3.45	15.10
	25–34 years	5	8.62	13.80
	35–44 years	4	6.90	13.10
	45–54 years	5	8.62	11.60
	55–64 years	4	6.90	8.40
	≥65 years	2	3.45	6.15

*Fiji Islands Bureau of Statistics, 2017.

3.1.2 Outpatient cases

During the study period, there were 3,643 patients with scabies presenting as outpatient cases. Among these, 1,914 (52.87%) were males and 1,706 (47.13%) were females. Most of them (86.47%) belonged to iTaukei ethnicity, as compared to 56.82% from the census population. People of the age group 0-4 years had the highest presentation (49.32%) as compared to the census population (11.05%). The mean age was 8.36 years (95% CI 7.92–8.79), and the median age was 5 years. The minimum age was 1 month, and maximum age was 95 years. A total of 1,723 (47.30%) patients presented from urban areas and 1,920 (52.70%) presented from rural areas. The patient characteristics of outpatient cases is presented in Table 3.

Table 3: Outpatient Cases of Scabies in Northern Division of Fiji—By Gender, Ethnicity, Age Group and Area of Residence

Demographic characteristics (N = 3,643)		Sample frequency	Sample percent	Census percent (2017)
Gender	Male	1,914	52.87	51.20
	Female	1,706	47.13	48.80
Ethnicity	iTaukei	3,080	86.47	56.82
	Fijian of Indian origin	286	8.03	37.47
	Other	196	5.50	5.70
Age group	0–4 years	1,786	49.32	11.05
	5–14 years	1,418	39.16	20.80
	15–24 years	157	4.34	15.10
	25–34 years	64	1.77	13.80
	35–44 years	46	1.27	13.10
	45–54 years	42	1.16	11.60
	55–64 years	50	1.38	8.40
	≥65 years	58	1.60	6.15
Area of residence	Urban	1,723	47.30	29.80
	Rural	1,920	52.70	70.20

3.2 Healthcare Resource Utilisation

3.2.1 Hospital admitted cases

The mean length of hospital stay for patients with scabies was 10.41 days (95% CI 7.87–12.95) and the median was 7 days. Length of stay referred to the duration of a single episode of hospital admission (calculated by subtracting the day of admission from the day of discharge). The length of stay was associated with the use of intravenous antibiotics. Those with SSTIs who required longer duration of intravenous antibiotics were required to stay longer. The minimum number of days in hospital was 2 days and the maximum was 51 days (SD = 9.64 days). Most of the patients (62.06%) had a length of stay of fewer than 10 days. Very few patients (6.89%) had a length of hospital stay for more than 20 days. The frequency of patients and their hospital bed-days are presented in Figure 1.

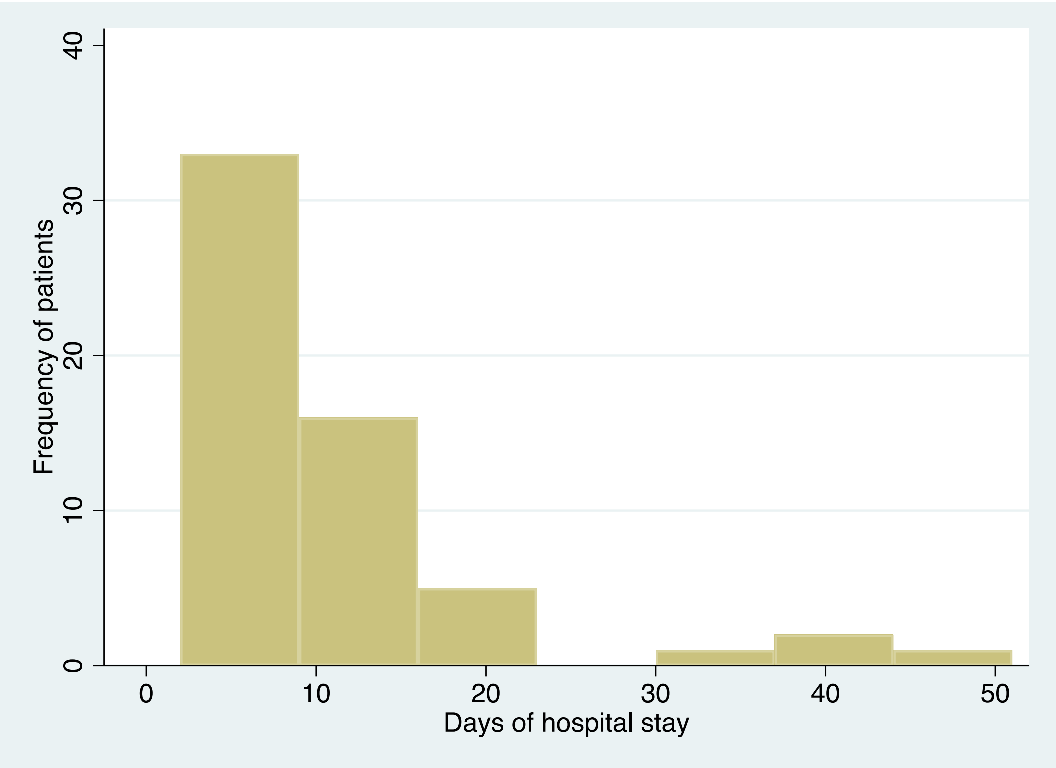


Figure 1: Histogram—Frequency of Patients and Days of Hospital Stay

Eleven patients were admitted to the ICU for potentially scabies-related SSTIs. The mean days of their stay in ICU was 3.54 days (95% CI 1.94–5.14) and the median was 2 days. The length of stay in ICU ranged from 1 day to 8 days. From the 58 admissions, five patients required ventilation.

All admitted cases required antibiotics. Fifty-six (95.55%) of these required intravenous antibiotics and two (4.45%) were managed with oral antibiotics. Four (6.89%) patients were managed with single antibiotics while 24 (41.37 %) required three different antibiotics and two (3.44%) required six different antibiotics. Oral antibiotics were prescribed for a mean duration of 7.5 days. Flucloxacillin was the most frequently prescribed oral antibiotic. Similarly, intravenous antibiotics were prescribed for a mean duration of 6.46 days. Cloxacillin was the most frequently prescribed intravenous antibiotic. Twelve (20.69%) patients required surgery. Common surgeries include incision and drainage, dressing and debridement. Laboratory test was conducted for 53 (91.37%) patients which included skin swab and blood culture. None of these patients underwent tissue culture. The frequency of healthcare resource utilisation by hospital admitted cases and the unit cost of each healthcare resource are presented in Table 4.

Table 4: Healthcare Resource Utilisation by Hospital Admitted Patients

Healthcare resource utilisation (N = 58)	Number of patients	Percent (%)	Average number of units utilised per patient
Hospital bed-day	58	100	9.78
ICU stay	11	18.97	0.66
Ventilators	5	8.62	0.41
Surgery	12	20.69	NA
Lab test	53	91.37	0.94
Intravenous antibiotics	56	95.55	Appendix 2
Oral antibiotics	2	4.45	

3.2.2 Outpatient cases

Permethrin was prescribed for 2,972 (81.58%) patients for their treatment of scabies at the time of presentation. Oral antibiotics were prescribed for 1,508 (41.39%) patients. Intramuscular antibiotics were prescribed for 975 (26.76%) patients and five (0.14%) patients required intravenous antibiotics. The frequency of healthcare resource utilisation by outpatient cases and the unit cost of each healthcare resource is presented in Table 5.

Table 5: Healthcare Resource Utilisation by Outpatient Cases of Scabies

Healthcare resource use (N = 3,643)	Frequency	Percent	Average units utilised per patient
Clinic visits	3,643	100	1
Permethrin	2,972	81.58	0.81
Oral antibiotics	1,508	41.39	Appendix 2
Intramuscular antibiotics	975	26.76	
Intravenous antibiotics	5	0.14	
Hospital admission	3	0.08	NA
Referred out	22	0.60	NA

3.3 Cost

3.3.1 Hospital admitted cases

The average cost per hospital admitted case of scabies was $736 (2019 USD). The total bed-day cost for all hospital admissions was $33,076, and that for ICU bed-days was $7,393. The total cost for diagnostic tests was $840 and the total cost for medications was $2,108. The total direct medical costs of all hospital admitted cases of scabies was $43,417. The majority of the direct medical costs was for the hospital bed-days.

3.3.2 Outpatient cases

The average cost per outpatient case of scabies was $14.51 (2019 USD). The total cost of all outpatient cases was $52,846. The total cost for medicines was $31,565 which accounted for 60% of the total outpatient costs. The age group that accounted for most of the costs of medicines was 0-4 years, accounting for 53.51% of the total cost of medicines. Cost of medicines per age group for outpatient cases of scabies is presented in Table 6.

Table 6: Total Cost of Medicine per Age Group for Outpatient Scabies Cases

Age group	Cost (2019 USD)	Percent
0–4 years	16,870	53.51
5–14 years	8,935	28.34
15–24 years	344	1.09
25–34 years	2,153	6.82
35–44 years	1,057	3.35
45–54 years	578	1.83
55-64 years	635	2.01
≥65 years	993	3.14
Total	31,565	100

The overall direct medical cost of scabies in the Northern Division of Fiji from the government perspective was $96,263 (2019 USD), which is equivalent to $207,929 (2019 FJD). The average cost per patient for each component of treatment is presented in Table 7.

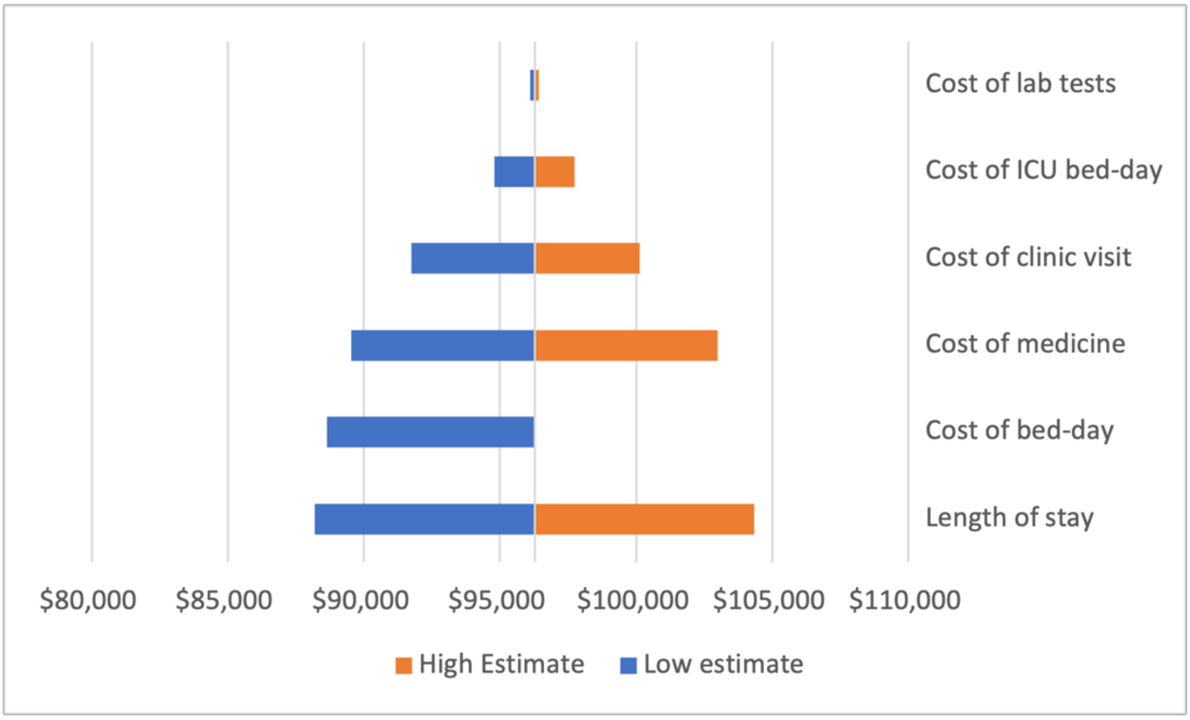
Table 7. Cost Breakdown by Healthcare Resource Utilisation

Healthcare resource	Average cost per patient (2019 USD)	Total patients	Total cost (2019 USD)	Percent
Outpatient setting				
Clinic visit	5.84	3,642	21,281	40.26
Medicines	8.66	3,642	31,565	59.74
Total	14.51	3,642	52,846	100
Hospitalised setting				
Hospital bed-day	560.60	59	33,076	76.18
ICU stay	125.30	59	7,393	17.02
Lab tests	14.23	59	840	1.95
Cost of medicines	35.73	59	2,108	4.85
Total	736	59	43,417	100
Grand total		3,701	96,263	100

3.4 Sensitivity Analysis

One-way sensitivity analysis was applied on the total costs taking $\pm$20% variation around the cost of medicines, laboratory tests, ICU stay and clinic visits. A 95% CI was used for sensitivity analysis of length of stay and WHO-CHOICE estimates was used for sensitivity analysis for hospital bed-day. This range allowed sufficient variation in cost figures with respect to the overall values obtained in the base-case analysis, as presented in the tornado plot of Figure 2. While the base value was $96,263 the total direct medical cost in worst case scenario was $1,08,514 while that in the best case scenario was $75,298. The length of stay was the major determinant in cost for hospital admitted cases as seen in the tornado graph.

Figure 2: Tornado Diagram: One Way Sensitivity Analysis Around Total Cost Estimate



4 Discussions

Our study presents the patient characteristics, healthcare resource utilisation and the economic burden of scabies and scabies-related SSTIs in the Northern Division of Fiji for both hospital admitted and outpatient cases.

Both men and women are equally susceptible to scabies. Our study found a similar proportion of males and females in both hospital admitted and outpatient scabies cases. This proportion is in line with the results of studies from other tropical and subtropical countries (45). Majority of the scabies patients were of iTaukei ethnicity. Consistent with our findings, previous studies in Fiji have documented that scabies is more common in the iTaukei Fijian population (46-47). Social and behavioural factors may explain the higher prevalence of scabies in this population. For example, the iTaukei population has more children per family and tends to live in houses with a high density of occupants (48). In our study, scabies was more common among children of age group 0–4 years. However, a cross-sectional study by Nair et al.'s (6) demonstrated that the age group most affected by scabies was 21–40 years The study was conducted in a tertiary hospital with a smaller sample size in a state of India. In our study, 52.70% of the outpatient cases of scabies were in rural areas. This result is comparable to that of Nair et al., who found 60.78% of patients from rural areas (6). A possible explanation for the higher frequency of scabies cases in rural areas is that shortage of water is associated with poor personal hygiene and poor hygiene leads to an increased risk of transmission of scabies (49).

Scabies is usually cured if treatment is taken properly. Permethrin is the recommended medicine prescribed for treatment of uncomplicated scabies. However, severe scabies, crusted scabies, scabies with secondary bacterial infections and other complications warrant admission to hospital. In our study period, 58 cases admitted to hospital for SSTIs had scabies. In an Australian study where most of the patients were from the Indigenous population and from economically disadvantaged remote communities, 237 patients were admitted with a diagnosis of scabies between 2006 and 2016 at the Royal Darwin Hospital (50). We observed that patients in our study required a mean length of stay of 10.41days. In the Australian study by Whitehall et al. (26), the mean duration of hospital stay for children with scabies was 4.5 days. One possible explanation for the longer duration of hospital stay in our study is the associated SSTIs, supported by the findings that all hospital admitted cases required antibiotics. In addition, resource use may differ substantially between countries such as Fiji and Australia depending on the healthcare policy, funding, access to healthcare services and cultural practices.

The high economic burden of neglected tropical diseases has been documented in various studies. Prior reviews have consistently documented the burden of scabies in children, and only a limited number of studies have described the burden in the elderly. Our study extends previous cost-estimate studies by providing an estimation of the cost and healthcare resource utilisation associated with scabies cases for all age groups. Our study found that the average cost per patient with scabies for hospital admitted cases was $736. In an Australian study, the estimated annual cost for treatment of one case of paediatric scabies and pyoderma in a hospitalised setting was $10,499 (2019 USD) (51). There are three possible explanations for this huge gap: 1) the Australian study included cases of pyoderma, which increased the cost estimates; 2) the Australian study included direct non-healthcare costs such as the cost of transport; 3) healthcare services in Australia are expensive compared with Fiji, as reflected by the WHO-CHOICE Estimates demonstrating that the cost of a hospital bed-day in Australia is almost ten times higher than in Fiji.

In our study, the average cost of treatment of a case of scabies in an outpatient setting was $14.51. In contrast, the average cost of treating a case of scabies in outpatient care in the United States was $216 (2019 USD) (24) where the cost estimate was based on claims for a privately insured population. We derived direct costs using a bottom-up approach, applying a government perspective, whereas the United States study applied the third-party-payer perspective to estimate the cost. Our study also revealed that the cost of treating scabies is mainly driven by the use of medicines, which is supported by the finding that antibiotics were prescribed for all cases of hospital admitted cases that presented with secondary bacterial infections, complications and scabies related SSTIs. It is plausible that delayed detection and normalisation of skin infections contribute to complications of scabies in endemic countries. In endemic countries, patients may not seek treatment of scabies unless it creates a significant disturbance to their quality of life (52).

As per the National Health Accounts from the Ministry of Health of Fiji, the average per capita health spending was $375.60 (FJD) (180 USD) in 2015 (53). An average per capita spending for outpatient cases was $51 where 41.90% of curative expenditure was for inpatient cases and 58.1% of curative expenditure was for outpatient cases (53). When the transport cost and indirect costs were excluded, the average cost of one episode of scabies in our study was $736 (2019 USD) for hospital admitted cases and $14.51 (2019 USD) for outpatient cases. This data reflects that accounting for the total annual per capita inpatient cost, the cost for hospital admission for scabies and its complications is relatively higher.

We compared the cost of treatment of scabies with the cost of treatment of pneumonia in the similar setting in Fiji. Pneumonia also has a high health burden in Fiji (annual incidence 26.5 per 1,00,000 population) (54). The cost of medicines is higher for scabies. While the cost of medicines for outpatient scabies in our study was $8.66 (2019 USD) the cost of medicines for treatment of outpatient pneumonia ranged from $0.20 (2019 USD) to $7.46 (2019 USD) (55). The average cost per episode of outpatient pneumonia in their study was $18.98 including the societal cost. This cost is comparable to the cost of outpatient scabies from our study where we have not included the societal cost.

Our direct cost estimate not only addresses the cost of scabies to the Fijian government but also highlights the major contributing factor of the direct cost of scabies. This study demonstrates that the cost of medicine, hospital bed-day and length of stay creates the major financial burden for scabies in Fiji. Moreover, this study also demonstrates that strategies for early detection and treatment of scabies and related SSTIs in the age group 0-4 years could reduce the economic burden to the government because children of this age group are the major contributors for increased healthcare utilisation and healthcare costs. The cost of hospital bed-days, operations, ICU stays, medicines and laboratory tests varies between countries and between levels of healthcare services. Our sensitivity analysis revealed that a high level of sensitivity was associated with cost of medicines and length of stay while the cost of laboratory analyses had minimal sensitivity around the baseline cost.

A strength of this study is that it analyses the data obtained from a trial that was conducted among the entire population of the Northern Division of Fiji, including the children and the elderly. In addition, we used the micro costing method to identify cost items and a bottom-up approach to value the cost, which are more accurate in cost estimation.

However, there were several limitations to our study. The approach used for calculating direct costs might understate the true economic burden given that the dataset lacked cases of scabies that were not recognised by clinicians or the cases that were recognised and treated but not included in patient records. Additionally, many people choose traditional medical remedies for scabies in Fiji (56). It is also possible that because scabies is generally normalised by clinicians in endemic settings, the reliance on hospitals and clinics for diagnosis and treatment may lead to under-reporting of cases. Furthermore, indirect costs, cost of management of recurrent cases and cost of institutional outbreaks were not analysed in this study. Alternative approaches such as a societal perspective would be more informative; however, we choose to employ the government perspective because the data was not collected during the study on indirect costs and non-medical costs including the cost of transport. The selection criteria applied in this study included cases of SSTIs related to scabies. The risk with this selection criteria on cost estimation is that the estimated total cost of scabies may overlap with the economic burden of other diseases because a single patient may present with multiple illnesses. There were missing data in outpatient cases, but the number was insignificant in consideration of our large sample size. The doses of medicine were not reported in the dataset; thus we estimated the dose based on ‘Fiji Antibiotic Guidelines’. It is likely that depending on clinicians, the doses of medicine would vary between clinical practice and recommendations from the guidelines. Thus, the estimated doses may not exactly correspond to the actual dose of medicines prescribed to the patients in this study.

5 Conclusions

We report the economic burden of scabies in the Northern Division of Fiji. Our study highlights that scabies imposes a substantial economic loss to the government in relation to costs and healthcare resource utilisation. The true cost of scabies is likely to be much higher than what was calculated in this study because under-recognition of scabies is a common problem in highly endemic and resource-limited countries such as Fiji. It is likely that there is a similar burden of scabies in other tropical and subtropical countries. There are many factors that contribute to the high burden, but our findings confirm the need for advocacy to develop effective strategies to reduce the cases of scabies in endemic countries. Increased spending on scabies prevention and control might reduce the direct and indirect cost of treating scabies. The share of direct medical costs may vary widely across countries and health policy settings, but these data may support future investment in cost-effective strategies to control scabies. Our study contributes to the literature about the direct medical costs of scabies in a setting of high disease prevalence in Fiji. Our findings may be relevant to the Pacific, where the burden of scabies and the costs of treatment are likely to be similar to that of Fiji. Moreover, our findings can be used in the next step for this project, which is to evaluate the cost effectiveness of mass drug administration for scabies in Fiji. Further research is needed to explicitly model the net economic burden of scabies.

References

1. Engelman D, Cantey PT, Marks M, Solomon AW, Chang AY, Chosidow O, et al. The public health control of scabies: priorities for research and action. The Lancet. 2019 Jul 6;394(10192):81–92.

2. Chandler DJ, Fuller LC. A Review of Scabies: An Infestation More than Skin Deep. Dermatology. 2019;235(2):79–90.

3. Engelman D, Yoshizumi J, Hay RJ, Osti M, Micali G, Norton S, et al. The 2020 International Alliance for the Control of Scabies Consensus Criteria for the Diagnosis of Scabies. Br J Dermatol. 2020;183(5):808–20.

4. Salavastru CM, Chosidow O, Boffa MJ, Janier M, Tiplica GS. European guideline for the management of scabies. J Eur Acad Dermatol Venereol. 2017;31(8):1248–53.

5. Romani L, Whitfeld MJ, Koroivueta J, Kama M, Wand H, Tikoduadua L, et al. Mass Drug Administration for Scabies Control in a Population with Endemic Disease. N Engl J Med. 2015 Dec 10;373(24):2305–13.

6. Nair PA, Vora RV, Jivani NB, Gandhi SS. A Study of Clinical Profile and Quality of Life in Patients with Scabies at a Rural Tertiary Care Centre. J Clin Diagn Res JCDR. 2016 Oct;10(10):WC01–5.

7. Engelman D, Kiang K, Chosidow O, McCarthy J, Fuller C, Lammie P, et al. Toward the Global Control of Human Scabies: Introducing the International Alliance for the Control of Scabies. PLoS Negl Trop Dis. 2013 Aug 8;7(8):e2167.

8. Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet. 2017 Sep 16;390(10100):1211–59.

9. Romani L, Steer AC, Whitfeld MJ, Kaldor JM. Prevalence of scabies and impetigo worldwide: a systematic review. Lancet Infect Dis. 2015 Aug 1;15(8):960–7.

10. Romani L, Koroivueta J, Steer AC, Kama M, Kaldor JM, Wand H, et al. Scabies and Impetigo Prevalence and Risk Factors in Fiji: A National Survey. PLoS Negl Trop Dis. 2015 Mar 4;9(3):e0003452.

11. Romani L, Whitfeld MJ, Koroivueta J, Kama M, Wand H, Tikoduadua L, et al. The Epidemiology of Scabies and Impetigo in Relation to Demographic and Residential Characteristics: Baseline Findings from the Skin Health Intervention Fiji Trial. Am J Trop Med Hyg. 2017 Jul 17;97(3):845–50.

12. World Health Organization. Epidemiology and management of common skin diseases in children in developing countries. 2005 [cited 2021 May 12]; Available from: https://apps.who.int/iris/handle/10665/69229.

13. Cassell JA, Middleton J, Nalabanda A, Lanza S, Head MG, Bostock J, et al. Scabies outbreaks in ten care homes for elderly people: a prospective study of clinical features, epidemiology, and treatment outcomes. Lancet Infect Dis. 2018 Aug 1;18(8):894–902.

14. Hicks MI, Elston DM. Scabies. Dermatol Ther. 2009;22(4):279–92.

15. Heukelbach J, Feldmeier H. Scabies. The Lancet. 2006 May 27;367(9524):1767–74.

16. Karimkhani C, Colombara DV, Drucker AM, Norton SA, Hay R, Engelman D, et al. The global burden of scabies: a cross-sectional analysis from the Global Burden of Disease Study 2015. Lancet Infect Dis. 2017 Dec 1;17(12):1247–54.

17. World Health Organization. Report of the tenth meeting of the WHO strategic and technical advisory group for neglected tropical diseases. 2017. Neglected Trop Dis Sch. 2017.

18. Rosenbaum BE, Klein R, Hagan PG, Seadey M-Y, Quarcoo NL, Hoffmann R, et al. Dermatology in Ghana: a retrospective review of skin disease at the Korle Bu Teaching Hospital Dermatology Clinic. Pan Afr Med J [Internet]. 2017 Mar 3 [cited 2021 Mar 26];26. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5429409.

19. Zeba N, Shaikh M, Khalida N, Memon ProfK, Khan H. Scabies in Relation to Hygiene and Other Factors in Patients Visiting Liaquat University Hospital, Sindh, Pakistan. 2014 Aug 3.

20. Lydeamore MJ, Campbell PT, Cuningham W, Andrews RM, Kearns T, Clucas D, et al. Calculation of the age of the first infection for skin sores and scabies in five remote communities in northern Australia. Epidemiol Infect. 2018 Jul;146(9):1194–201.

21. Mounsey KE, Murray HC, King M, Oprescu F. Retrospective analysis of institutional scabies outbreaks from 1984 to 2013: lessons learned and moving forward. Epidemiol Infect. 2016 Aug;144(11):2462–71.

22. Thean LJ, Jenney A, Engelman D, Romani L, Wand H, Mudaliar J, et al. Hospital admissions for skin and soft tissue infections in a population with endemic scabies: A prospective study in Fiji, 2018–2019. PLoS Negl Trop Dis. 2020 Dec 9;14(12):e0008887.

23. Jo C. Cost-of-illness studies: concepts, scopes, and methods. Clin Mol Hepatol. 2014 Dec;20(4):327–37.

24. Owusu-Edusei KJ, 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. Sex Transm Dis. 2009 May;36(5):297–9.

25. Hay RJ, Castanon RE, Hernandez HA, Lopez GC, Fuentes LFL, Solis SP, et al. Wastage of family income on skin disease in Mexico. BMJ. 1994 Oct 1;309(6958):848.

26. Whitehall J, Kuzulugil D, Sheldrick K, Wood A. Burden of paediatric pyoderma and scabies in North West Queensland. J Paediatr Child Health. 2013;49(2):141–3.

27. Engelman D, Fuller LC, Steer AC, Panel for the IA for the C of SD. Consensus criteria for the diagnosis of scabies: A Delphi study of international experts. PLoS Negl Trop Dis. 2018 May 24;12(5):e0006549.

28. World Health Organisation. Manual for estimation of the economic burden of seasonal influenza [Internet]. [cited 2021 Apr 4].

29. Clabaugh G, Ward MM. Cost-of-Illness Studies in the United States: A Systematic Review of Methodologies Used for Direct Cost. Value Health. 2008 Jan 1;11(1):13–21.

30. Roberts G, Tulloch J, World Health Organization, Regional Office for the Western Pacific, Asia Pacific Observatory on Health Systems and Policies. The Fiji Islands health system review [Internet]. Manila: Asia Pacific Observatory on Health Systems and Policies; 2011 [cited 2021 Jun 7]. Available from: http://books.google.com /books?id=w28paCzPpXQC.

31. Hendriks ME, Kundu P, Boers AC, Bolarinwa OA, te Pas MJ, Akande TM, et al. Step-by-step guideline for disease-specific costing studies in low- and middle-income countries: a mixed methodology. Glob Health Action [Internet]. 2014 Mar 28 [cited 2021 Apr 8];7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3970035.

32. Chaiyakunapruk N, Kotirum S, Newall AT, Lambach P, Hutubessy RCW. Rationale and opportunities in estimating the economic burden of seasonal influenza across countries using a standardized WHO tool and manual. Influenza Other Respir Viruses. 2018 Jan 1;12(1):13–21.

33. Conteh L, Walker D. Cost and unit cost calculations using step-down accounting. Health Policy Plan. 2004 Mar 1;19(2):127–35.

34. Costing Study of Selected Health Facilities in Fiji [Internet]. [cited 2021 Apr 4]. Available from: http://www.health.gov.fj/wp-content/uploads/2018/03/Costing-Study-of-Selected-Health-Facilities-in-Fiji.

35. Essential Medicine List [Internet]. [cited 2021 Apr 4]. Available from: http://www. health.gov.fj/PDFs/Essential%20Medicine%20List.

36. World Health Organisation. WHO-CHOICE estimates of cost for inpatient and outpatient health service delivery. 2010. [Internet]. [cited 2021 May 13].

37. Ministry of Health and Medical Services, Government of Fiji. Fiji Antibiotic Guidelines. 4th edition. 2019. [Internet]. [cited 2021 May 8].

38. Smith AF, Waycaster C. Estimate of the direct and indirect annual cost of bacterial conjunctivitis in the United States. BMC Ophthalmol. 2009 Nov 25;9(1):13.

39. Turner HC, Lauer JA, Tran BX, Teerawattananon Y, Jit M. Adjusting for Inflation and Currency Changes Within Health Economic Studies. Value Health. 2019 Sep 1;22(9):1026–32.

40. Official exchange rate (LCU per US$, period average) - Fiji | Data [Internet]. [cited 2021 May 13]. Available from: https://data.worldbank.org/indicator/PA.NUS .FCRF? locations=FJ.

41. Steer A. Validation of an Integrated Management of Childhood Illness algorithm for managing common skin conditions in Fiji. Bull World Health Organ. 2009 Mar 1;87(3):173–9.

42. Briggs AH, Weinstein MC, Fenwick EAL, Karnon J, Sculpher MJ, Paltiel AD. Model Parameter Estimation and Uncertainty: A Report of the ISPOR-SMDM Modeling Good Research Practices Task Force-6. Value Health. 2012 Sep 1;15(6):835–42.

43. Lazzaro C, Lopiano L, Cocito D. Subcutaneous vs intravenous administration of immunoglobulin in chronic inflammatory demyelinating polyneuropathy: an Italian cost-minimization analysis. Neurol Sci. 2014 Jul 1;35(7):1023–34.

44. Fiji Islands Bureau of Statistics. 2017. Population and Housing Census Release. Fiji Bureau of Statistics [Internet]. [cited 2021 Apr 12]. Available from: https://www.statsfiji.gov.fj/.

45. Amro A, Hamarsheh O. Epidemiology of scabies in the West Bank, Palestinian Territories (Occupied). Int J Infect Dis. 2012 Feb 1;16(2):e117–20.

46. Steer AC, Jenney AWJ, Kado J, Batzloff MR, Vincente SL, Waqatakirewa L, et al. High Burden of Impetigo and Scabies in a Tropical Country. PLoS Negl Trop Dis. 2009 Jun 23;3(6):e467.

47. Haar K, Romani L, Filimone R, Kishore K, Tuicakau M, Koroivueta J, et al. Scabies community prevalence and mass drug administration in two Fijian villages. Int J Dermatol. 2014;53(6):739–45.

48. Williams VR. Indigenous Peoples: An Encyclopedia of Culture, History, and Threats to Survival [4 volumes]. ABC-CLIO; 2020. 1338 p.

49. Scheinfeld N. Controlling Scabies in Institutional Settings. Am J Clin Dermatol. 2004 Feb 1;5(1):31–7.

50. Lynar S, Currie BJ, Baird R. Scabies and mortality. Lancet Infect Dis. 2017 Dec;17(12):1234.

51. Thomas J, Carson CF, Peterson GM, Walton SF, Hammer KA, Naunton M, et al. Therapeutic potential of tea tree oil for scabies. Am J Trop Med Hyg. 2016;94(2):258–66.

52. Worth C, Heukelbach J, Fengler G, Walter B, Liesenfeld O, Feldmeier H. Impaired quality of life in adults and children with scabies from an impoverished community in Brazil. Int J Dermatol. 2012;51(3):275–82.

53. Fiji Ministry of Health and Medical Services, Fiji Health Accounts 2011-2015, Fiji, 2017. [Internet]. [cited 2021 May 29]. Available from: http://www.health.gov.fj/wp-content/uploads/2018/03/Fiji-NHA-Report-2011-2015.

54. Russell FM, Carapetis JR, Tikoduadua L, Paeds D, Chandra R, Seduadua A, et al. Invasive Pneumococcal Disease in Fiji: Clinical Syndromes, Epidemiology, and the Potential Impact of Pneumococcal Conjugate Vaccine. Pediatr Infect Dis J. 2010 Sep;29(9):870–2.

55. Temple B, Griffiths UK, Mulholland EK, Ratu FT, Tikoduadua L, Russell FM. The cost of outpatient pneumonia in children <5 years of age in Fiji. Trop Med Int Health. 2012;17(2):197–203.

56. Mitchell E, Bell S, Thean LJ, Sahukhan A, Kama M, Koroivueti A, et al. Community perspectives on scabies, impetigo and mass drug administration in Fiji: A qualitative study. PLoS Negl Trop Dis. 2020 Dec 4;14(12):e0008825.

Appendix 1: Unit Cost of Medicines

Medicine	Unit cost (2012 FJD)	Unit cost (2019 USD)
Permethrin cream	1.51	0.905
Metronidazole Tab 400 mg	0.01	0.006
Metronidazole Supp 500 mg	2.33	1.397
Flucloxacillin Cap 500 mg	0.17	0.101
Flucloxacillin Susp 125 mg/5 ml (100 ml)	6.94	4.162
Septrim Tab 480 mg	0.02	0.011
Septrim Susp 240 mg/5 ml	0.65	0.389
Erythromycin Tab 250 mg	0.17	0.101
Erythromycin Susp 125 mg/5 ml (100 ml)	1.87	1.121
Amoxycillin Cap 250 mg	0.03	0.017
Amoxycillin Cap 250 mg	0.05	0.029
Amoxycillin Susp 125 mg/5 ml (100 ml)	0.78	0.467
Doxycycline Cap 100 mg	0.03	0.017
Ciprofloxacin Tab 500 mg	0.09	0.053
Inj Ciprofloxacillin 100 mg	6.3	3.778
Inj Cloxacillin 500 mg	0.76	0.455
Inj Penicillin 1 Unit	0.53	0.317
Inj Ceftriaxone 1,000 mg	2.47	1.481
Inj Gentamicin 80 mg	0.12	0.071
Inj Metronidazole 500 mg	1.8	1.079
Inj Vancomycin 500 mg	9.16	5.49

Source: Fiji Essential Medicines List, third edition, 2013.

Appendix 2. Unit of Medicines Consumed per Patient

Medicine	Unit consumed per patient
Metronidazole Tab 400 mg	3.91
Metronidazole Supp 500 mg	1.33
Flucloxacillin Cap 500 mg	11.14
Flucloxacillin Susp 125 mg/5 ml (100 ml)	1.07
Septrim Tab 480 mg	2.42
Septrim Susp 240 mg/5 ml	0.03
Erythromycin Tab 250 mg	0.64
Erythromycin Susp 125 mg/5 ml (100 ml)	0.05
Amoxycillin Cap 500 mg	0.16
Amoxycillin Susp 125 mg/5 ml (100 ml)	0.03
Doxycycline Cap 100 mg	0.92
Ciprofloxacin Tab 500 mg	5.42
Ciprofloxacin Susp	0.07
Inj Ciprofloxacillin 100 mg	0.20
Inj Cloxacillin 500 mg	12.68
Inj Penicillin 1 Unit	7.12
Inj Ceftriaxone 1,000 mg	2.35
Inj Gentamicin 80 mg	1.82
Inj Metronidazole 500 mg	0.09
Inj Vancomycin 500 mg	2.62