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The cost of outpatient pneumonia in children <5 years of age in Fiji

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Abstract

OBJECTIVES Pneumonia is the most common reason for visiting an outpatient facility among children <5 years old in Fiji. The objective of this study is to describe for the first time the costs associated with an episode of outpatient pneumonia in Fiji, in terms of cost both to the government health sector and to the household.

METHODS Costs were estimated for 400 clinically diagnosed pneumonia cases from two outpatient facilities, one in the capital, Suva, and one in a peri-urban and rural area, Nausori. Household expenses relating to transport costs, treatment costs and indirect costs were determined primarily through structured interview with the caregiver. Unit costs were collected from a variety of sources. Patient-specific costs were summarised as average costs per facility.

RESULTS The overall average societal cost associated with an episode of outpatient pneumonia was $18.98, ranging from $14.33 in Nausori to $23.67 in Suva. Household expenses represent a significant proportion of the societal cost (29% in Nausori and 45% in Suva), with transport costs the most important household cost item. Health sector expenses were dominated by personnel costs at both sites. Both the average total household expenses and the average total health sector expenses were significantly greater in Suva than Nausori.

CONCLUSIONS A single episode of outpatient pneumonia represents a significant cost both to the government health sector and to affected households. Given the high incidence of this disease in Fiji, this places a considerable burden on society.

keywords pneumonia, cost and cost analysis, ambulatory care, Fiji

Introduction

Community-acquired pneumonia is a common cause of morbidity and mortality in children <5 years of age in developing countries, with significant associated costs to both governments and families. Several public health interventions may reduce the burden of outpatient pneumonia, and an estimate of the costs associated with this disease is useful, particularly for countries considering the introduction of pneumococcal conjugate vaccines.

Although the per episode cost of outpatient pneumonia is substantially less than that of hospitalised pneumonia, the higher frequency of outpatient pneumonia episodes could result in substantial overall costs. Indeed, a study of lower respiratory tract infections (LRTIs) in children <2 years of age in the United States estimated that outpatient costs were responsible for almost half of the total cost of LRTIs (McConnochie *et al.* 1988).

Few studies have investigated the cost of outpatient pneumonia in children around the world, with none from the Pacific region. In Fiji, pneumonia is the most common diagnosis among young children visiting outpatient medical facilities, accounting for over a quarter of all visits recorded in the Fiji Patient Information System (PATIS). At the Colonial War Memorial Hospital (CWMH), the largest hospital in Fiji, 88% of pneumonia cases among under 5-year-olds in 2007 were seen as outpatients (source: PATIS). This study aims to estimate the average health sector and household costs of outpatient pneumonia treatment in children <5 years old in Fiji.

Methods

This study was conducted at the paediatric outpatients departments of two government facilities on Viti Levu, the largest island in Fiji: CWMH, a tertiary referral hospital in the capital, Suva; and Nausori Health Centre (Nausori), a primary health clinic approximately half an hour from Suva, which serves a peri-urban and rural population. These facilities were selected from established sites within a broader programme of research in Fiji (Russell *et al.* 2009) to provide cost estimates from an urban and a more rural area. In Fiji, the majority of healthcare services are provided through government health facilities. All government paediatric outpatient services are provided free of charge, but in the event that medication is out-of-stock, patients are required to purchase it from elsewhere. Some private healthcare facilities also offer paediatric outpatient services. Paediatric pneumonia cases are diagnosed clinically and should, according to protocol, be based on the WHO Integrated Management of Childhood Illness (IMCI) definition of presence of cough and fast breathing. Chest X-rays are not routinely performed in suspected paediatric outpatient pneumonia cases.

Between April and July 2008, 400 children were enrolled in the study, with 200 from each site. Recruitment took place on 2–3 days on average per week, with all eligible children presenting to the study sites on those days invited to participate. Children were eligible if they (i) were <5 years of age; (ii) had a clinical diagnosis of pneumonia from the attending nurse; and (iii) were treated as an outpatient.

Data were collected primarily through parent/caregiver (henceforth referred to as caregiver) interview, with verification through review of clinic notes where applicable. Data were collected on demographics, symptoms, travel information, previous care (including place, transport costs and treatment costs), indirect costs and medications prescribed. Indirect costs were estimated by asking whether anyone in the household had to take time off work, for how many days and at what cost per day in lost income. The costs of out-of-stock medications that had to be purchased by the caregiver from elsewhere were approximated by the price at pharmacies in close proximity to the study sites.

Any request for return visits was also established during the interview. There are two types of return visit commonly requested for outpatient pneumonia cases in Fiji: a review visit on day three following prescription of an antibiotic; and return visits to complete a course of injectable procaine penicillin. For the former, written informed consent was obtained to review the child's medical records at a later date, to determine whether the appointment was kept and any further medications prescribed. Transport costs for such review visits were assumed to be the same as for the initial visit. For the latter, the number of completed return visits was determined from the clinic injection record book. The likely method and estimated cost of transport for such visits were ascertained at the interview, as it was established during piloting of the questionnaire that the requirement for multiple return visits was likely to result in a change of transport usage. All transport costs, treatment costs incurred by the patient and the indirect costs associated with loss of income contributed to the household expenses.

Government health sector expenses comprised medications provided by the site and personnel costs. Capital costs, such as buildings and equipment, and overhead costs such as supervision, administration, record keeping and utilities were not included in the analysis. Unit costs of drugs provided were sourced from the inventory of medical supplies from Fiji Pharmaceutical Services, the sole supplier to government facilities. The unit cost for each drug was multiplied by the quantity prescribed and added to the costs of any consumables required for its administration, such as syringes for liquid oral medications or needles and syringes for injectable medications (Table 1). The costs of all medications, including non-pneumonia medications, were included, under the assumption that pneumonia was the primary reason for the visit. Only the exact costs of prescribed medications were included; wastage and the cost of general clinic supplies were not taken into account. Salaries and benefits were obtained from the Ministry of Health salary scales. Annual costs were calculated for the average staff in the outpatients department, factoring in the proportion of each position allocated to that department. The annual personnel costs for each site were divided by the total number of visits in 2007 to estimate the per-visit personnel cost (Table 2).

Data were analysed using STATA Version 10.0 (StatCorp LP, Tx). Individual patient resource utilisation data were coupled with unit cost estimates to generate a patient-specific cost estimate for each outpatient pneumonia case. Patient-specific costs were summarised as arithmetic mean costs per site, the statistic most relevant to policy makers because of its relationship with total costs (Mihaylova *et al.* 2011). To accommodate the skewed nature of resource use data, the variance was described using 95% confidence intervals calculated from 1000 bootstrap estimates (Briggs & Gray 1998). Average costs between study sites were compared using *t*-tests, with the robustness assessed by comparison with bootstrap results (Barber & Thompson 2000). All costs were converted to 2008 US dollars (USD), using the average exchange rate from

Table 1 Example costings for IMCI-recommended treatment courses of commonly prescribed medications

	IMCI treatment guidelines			
Name of drug (concentration)	Weight of child (kg)	Dose & frequency	Consumables	Cost per recommended course*
Amoxycillin suspension (125 mg/5 ml)	4.0–9.9	5 ml × 3 times daily × 5 days	5-ml syringe	$0.13
	10.0–19.9	10 ml × 3 times daily × 5 days	10-ml syringe	$0.31
Cotrimoxazole suspension (240 mg/5 ml)	4.0–9.9	5 ml × twice daily × 5 days	5-ml syringe	$0.23
	10.0–19.9	7.5 ml × twice daily × 5 days	10-ml syringe	$0.37
Procaine penicillin injection (4 mega units)	<9.0	1/4 mega unit	3-ml syringe, 21G needle, 23G needle	$0.20
	9.0–13.9	3/8 mega unit	3-ml syringe, 21G needle, 23G needle	$0.20
	14.0–19.9	1/2 mega unit	5-ml syringe, 21G needle, 23G needle	$0.20
Paracetamol mixture (120 mg/5 ml)	4.0–13.9	5 ml × 6 hourly until symptoms resolve	5-ml syringe	$0.42 (per 100 ml)
	14.0–19.9	10 ml × 6 hourly until symptoms resolve	10-ml syringe	$0.45 (per 100 ml)
Salbutamol elixir (ventolin po) (2 mg/5 ml)	4.0–9.9	1 ml × 3 times daily × 5 days	3-ml syringe	$0.08
	10.0–13.9	2.5 ml × 3 times daily × 5 days	3-ml syringe	$0.19
	14.0–19.9	5 ml × 3 times daily × 5 days	5-ml syringe	$0.35

*The actual quantity prescribed, rather than the recommended quantity, was used in the calculation of individual treatment costs. IMCI, Integrated Management of Childhood Illness.

Table 2 Outpatient department output

Output	CWMH	Nausori
Equivalent number of full-time (EFT) staff*	14	5.6
Total annual personnel costs (salary + benefits)	$156 595	$62 454
Total number of visits (2007)	12 841	6504
Per-visit personnel costs	$12.19	$9.60

*Includes medical personnel, pharmacists and administrative staff. CWMH, Colonial War Memorial Hospital.

1 January to 15 July 2008 of USD 0.66686 to the Fiji dollar (Oanda).

This study was approved by the Fiji National Research Ethics Review Committee and the London School of Hygiene and Tropical Medicine Ethics Committee.

Results

Patient characteristics

Ten children did not fit the IMCI criteria for pneumonia despite a clinical diagnosis from the attending nurse and were therefore excluded from the analysis. Of the 390 children included, the majority were <2 years of age (n = 257, 66%; Table 3). Sixty-two patients (16%) presented with at least one comorbidity, with diarrhoea being the most common (n = 22, 6%). Twenty-six patients (7%) showed signs of being underweight (Z score <2 SD), 20 (77%) of whom were from Nausori. The age and sex distribution of the children was similar between sites ($\chi^2 = 1.75$, $P = 0.782$ and $\chi^2 = 0.08$, $P = 0.771$, respectively). The majority of the non-indigenous and non-Indo-Fijian ('other' ethnicity) children were from CWMH (25/29, 86%). Children from CWMH also had a longer median duration of illness at presentation than those from Nausori [3 (IQR 2–4) *vs.* 2 (IQR 2–3) days; $P < 0.001$].

Treatment procedures

Forty-two patients (11%) had sought care prior to presenting to the study sites, the majority of whom were from CWMH (n = 35, 83%). Thirty-one (74%) had been to a primary government facility and 12 to a private facility (with one patient having been to both). Six had also visited a pharmacy. Of all patients, only three were not prescribed any medication, all of whom had sought previous care. Of the 387 children prescribed medication, all but one were prescribed an antibiotic. Oral amoxycillin was the most commonly prescribed antibiotic (n = 322, 83%), with 7% of patients prescribed each of oral

Table 3 Pneumonia patient characteristics

Characteristics	Frequency (%) unless specified
Site	
CWMH	194 (50)
Nausori	196 (50)
Age (months)	
0–11	122 (31)
12–23	135 (35)
24–35	66 (17)
36–47	43 (11)
48–59	24 (6)
Sex	
Male	226 (58)
Female	164 (42)
Ethnicity	
Indigenous Fijian	244 (63)
Indo-Fijian	117 (30)
Other	29 (7)
Comorbidities (% of total patients)	
Diarrhoea	22 (6)
Vomiting	15 (4)
Skin conditions	10 (3)
Other	21 (5)
Weight-for-age (*Z* score)	
<−3 SD	9 (2)
−3 SD to −2 SD	17 (5)
≥−2 SD	364 (93)
Duration of illness (days), median (range)	3 (1–21)

CWMH, Colonial War Memorial Hospital.

erythromycin and intramuscular procaine penicillin (n = 28 and n = 27, respectively), and the remaining 3% prescribed either cotrimoxazole (n = 8) or flucloxacillin (n = 2). The other commonly prescribed medications were paracetamol (n = 220, 56% of all patients), ventolin nebulizer (n = 91, 23%) and ventolin po (n = 49, 13%). Of the 27 patients prescribed a course of procaine penicillin injections, all but one (96%) returned for additional injections, with the number of additional injections ranging from 1 to 5. A further 183 patients were asked to return for review, of whom only 77 (42%) kept their appointment.

Costs of personnel, drugs and medical supplies

Personnel costs dominated the government health sector expenses, accounting for over 90% at each site (Table 4). The per-visit personnel costs were $12.20 at CWMH and $9.60 at Nausori. The cost of medication provided to an individual patient ranged from $0.17 (for 100 ml amoxycillin) to $6.45 (for 100 ml amoxycillin, 50 ml ventolin po and Silverzine cream for burns). The most common treatment was 100 ml amoxycillin at $0.17 and 100 ml paracetamol at $0.42, totalling $0.59. The same dose sizes of these medications were priced at $1.90 and $4.61, respectively, at pharmacies in close proximity to the study sites.

Treatment costs contributing to household expenses comprise costs associated with the main visit and with previous care. A small number of patients have such expenses; thus, although the average cost is low ($1.15 across both sites), these represent a significant cost for those involved. For previous care, the average cost among the six patients with pharmacy costs was $14.12 (range $8.00–$25.34) and among the 12 patients with private facility costs was $19.85 (range $2.47–$116.70). Medication out-of-stock at the study site that had to be purchased from elsewhere was prescribed to 40 patients at an average estimated cost of $3.12 (range $1.30–$7.59). At CWMH, treatment costs borne by the patient were dominated by the cost of previous care, and only six patients were prescribed medication that they had to purchase from elsewhere. In contrast, 34 patients from Nausori (17%) were required to purchase medication, accounting for the majority of the household treatment costs at this site.

Transport and indirect household costs

At both sites, transport expenses were the most important household cost item, accounting for almost three quarters of the total household costs. Transport associated with the main visit in the study accounted for the largest portion of the transport expenses, but the cost associated with additional visits was also substantial. Among the 103 patients who made return visits, the average total transport cost for those visits was $5.67 (range $0–$26.67); among the 42 who had sought previous care, it was $3.92 (range $0–$14.67). Most children were accompanied by their mother (n = 341, 87%), with the remainder accompanied by either their father (n = 27, 7%) or another relative (n = 22, 6%). Few people reported anyone in the household having to take time off work as a result of the child's illness (n = 42, 11%), only four of whom were from Nausori. For half of those who reported taking time off work (n = 21), this was associated with lost income, ranging from $5 to $30 in total.

Societal cost

The societal cost for an episode of outpatient pneumonia ranged from $9.78 to $174.32 (Figure 1). The second highest cost was $80.13; the outlier of $174.32 was for a patient who paid $142 for private treatment and pharmacy costs prior to presenting to CWMH. The average societal cost was significantly different between sites, at $23.67 for children seen at CWMH and $14.33 for children seen at Nausori (P < 0.001; Table 4). A considerable proportion

Table 4 Average cost of outpatient pneumonia, by study site

	Mean cost (95% CI), 2008 USD		
	CWMH (n = 194)	Nausori (n = 196)	P-value (t-test)
Health sector expenses			
Drugs and consumables			
Main visit	0.80 (0.72–0.89)	0.46 (0.39–0.54)	
Previous care	0.05 (0.02–0.07)	0.01 (0.00–0.03)	
Return visits	0.09 (0.05–0.13)	0.04 (0.01–0.07)	
Subtotal	0.93 (0.84–1.04)	0.51 (0.43–0.60)	<0.001
Personnel costs	12.20	9.60	
Total health sector expenses	13.13 (13.04–13.22)	10.12 (10.04–10.20)	<0.001
Household expenses			
Transport costs			
Main visit	4.96 (4.47–5.51)	2.09 (1.84–2.38)	
Previous care	0.71 (0.45–1.04)	0.13 (0.03–0.27)	
Return visits	2.18 (1.59–2.80)	0.82 (0.43–1.29)	
Subtotal	7.86 (6.95–9.00)	3.04 (2.53–3.71)	<0.001
Drugs, consumables and private facility user fees			
Main visit	0.08 (0.02–0.15)	0.56 (0.35–0.80)	
Previous care	1.45 (0.33–3.47)	0.21 (0–0.47)	
Subtotal	1.53 (0.41–3.22)	0.77 (0.48–1.08)	0.340
Indirect costs	1.15 (0.63–1.83)	0.40 (0.04–0.92)	0.042
Total household expenses	10.54 (8.48–13.01)	4.22 (3.44–5.06)	<0.001
Total societal cost	23.67 (21.66–26.18)	14.33 (13.58–15.20)	<0.001

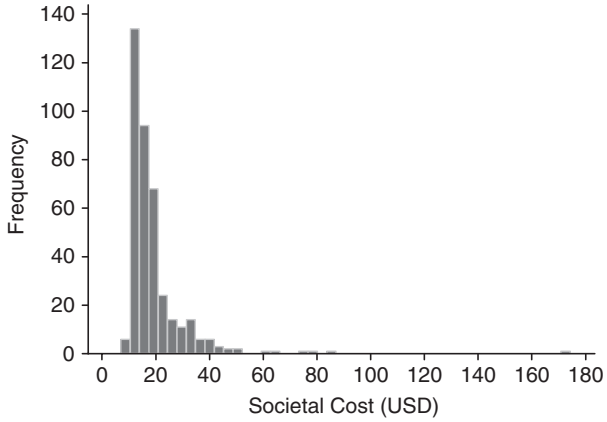

Figure 1 Distribution of per patient societal cost.

of the cost is borne by the patients, with household expenses representing 45% and 29% of the societal cost at CWMH and Nausori, respectively. The average household expense differed significantly between the study sites, with the average cost for patients from CWMH almost two and a half times that for patients from Nausori ($10.62 *vs.* $4.32; $P < 0.001$). This is largely explained by differences in average transport expenses ($7.94 *vs.* $3.15; $P < 0.001$), although there was also a significant difference in indirect costs between sites. The pattern of transport usage differed between sites. Over half of the patients attending CWMH travelled by taxi (n = 180, 56%) compared with only 14% (n = 27) of those from Nausori, the majority of whom travelled by bus (n = 139, 71%). The median travel time was 20 min at both sites. Comparison of average costs between sites based on bootstrap values and t-tests produced very similar results, therefore t-test results are presented for all comparisons.

Discussion

This study revealed differences between the study sites, in terms of both patient characteristics and costs associated with an episode of outpatient pneumonia. The difference in ethnic composition of patients presenting to CWMH and Nausori reflects population differences in these areas; a greater proportion of the general population in the Suva area are both non-indigenous and non-Indo-Fijian ('other' ethnicity) compared with the Nausori area (National Census 2007). There were no differences between ethnic groups in average costs or in the proportion of patients who sought previous treatment. However, a greater proportion of patients presenting to CWMH had sought previous treatment, which is likely to reflect both the greater availability of alternative treatment centres in Suva and the fact that CWMH is a referral centre. Patients at CWMH also presented with a longer median duration of

illness prior to presentation (median duration 3 *vs.* 2 days for Nausori). This difference is not explained by previous treatment seeking and may reflect the large squatter population in Suva who have delayed health-seeking behaviour (L. Tikoduadua, personal communication).

Differences in costs between sites were seen in both the average household expense and the average health sector expense. The difference in household expenses is largely because of differences in transport expenses. This can be explained by the difference in transport usage between the study sites and also by the fact that more patients from CWMH were asked to return for review, a greater proportion of whom kept their appointment, compared with patients from Nausori. Fifty-eight per cent of patients from CWMH were asked to return for review, of whom 58% kept their appointment, compared with 49% from Nausori, of whom 39% kept their appointment. Health sector expenses were also higher at CWMH compared with Nausori, particularly medication and consumable costs that were 78% higher ($P < 0.001$). These costs will be partially influenced by the greater number of patients from CWMH with review visits, but prescription practices also differed between sites. Non-pneumonia medications were more likely to be prescribed at CWMH, which may be explained by the higher proportion of patients presenting with comorbidities (22% *vs.* 10%, $P = 0.002$).

For pneumonia treatment in Fiji, amoxycillin is the first-line antibiotic of choice. In the absence of available amoxycillin, patients from CWMH were all provided alternative antibiotics from the site, whereas those from Nausori were typically required to purchase this drug from elsewhere. The cost of medication was transferred to 31 patients from Nausori, with alternative antibiotics prescribed to only 15 patients. In contrast, no patients from CWMH were asked to purchase amoxycillin, with alternative antibiotics prescribed to 49 patients. Thus, in the more rural area, where the average household income is lower, the average cost to households for medications prescribed was seven times higher ($0.56 *vs.* $0.08) and constituted 13% of the total household expenses at this site.

According to IMCI treatment guidelines in Fiji, the recommended course of amoxycillin totals 75 ml for children weighing 4.0–9.9 kg and 150 ml for children weighing 10.0–19.9 kg (Table 1). However, the majority of patients prescribed amoxycillin were given 100 ml ($n = 278$, 86%). Among 197 children weighing over 10 kg that were prescribed amoxycillin, 155 (79%) were given less than required to complete the recommended course (Table 5). These data suggest a significant occurrence of under-prescribing, which may have implications both for treatment success rates and for the development of antibiotic resistance in Fiji.

Table 5 Quantity of amoxycillin prescribed, by weight of child

Volume prescribed (ml)	Frequency (%)	
	Weight <10 kg	Weight ≥10 kg
75	1 (1)	0 (0)
100	123 (98)	155 (79)
150	1 (1)	8 (4)
200	0 (0)	34 (17)

CWMH, Colonial War Memorial Hospital; USD, US dollars.

A total of 99 patients (25%) were prescribed ventolin po and/or ventolin nebulizer. Although 98 of these patients were also prescribed an antibiotic, this may suggest a diagnosis of asthma rather than pneumonia. The majority of these patients were from CWMH ($n = 85$, 86%), and excluding them from the analysis results in a statistically significant $0.15 drop in average medication and consumable costs (from $0.93 to $0.77, $P = 0.034$) and a subsequent significant drop in the average total health sector expenses at CWMH. However, exclusion of these patients does not significantly alter the average societal cost of an episode of outpatient pneumonia.

The indirect costs captured in this study are relatively low, representing only 11% and 9% of the total household expenses for patients from CWMH and Nausori, respectively. However, this information was collected in relation to time off work, so costs associated with lost subsistence work, or with time lost from household work or leisure, have not been captured. The majority of children were accompanied by their mother ($n = 341$, 87%), and less than a quarter of women aged 15 years and over in Fiji are classified as having money income (FIBOS 2008). These values are therefore likely to underestimate the true indirect costs associated with an episode of outpatient pneumonia in a child <5 years of age in Fiji. A study from southern Israel, which measured direct and indirect costs for a 1-month period following diagnosis of pneumonia in children <3 years old in a primary health clinic, estimated that 89% of the total cost to the household was related to indirect costs, as estimated by the caregiver (Shoham *et al.* 2005). In that study, an episode of outpatient pneumonia was associated with an average of 1.7 lost work days (SD 1.9), a median of seven non-routine days and a significant reduction in quality of life indicators. The health service expenses captured in our study will also be an underestimate, as the costs associated with the buildings and utilities were not included. In a study from Zambia where these resources were included, capital costs contributed 7% of total costs (Chola & Robberstad 2009).

The overall average societal cost associated with an episode of outpatient pneumonia in our study was $18.98

(95%CI $17.79–$20.38). Other studies have estimated the average cost per episode of outpatient pneumonia to be $16.35 and $24.55 in Pakistan (Hussain *et al.* 2006, 2008) and $51.26 in Zambia (Chola & Robberstad 2009), when converted into 2008 USD (US Inflation Calculator). None of these studies included an estimation of the indirect costs. The cost of outpatient pneumonia will inevitably vary greatly between countries, both because of study methodologies and also because of real differences in the cost of medical care, transport costs and average incomes. Hence, the absolute costs need to be understood within the economic context of individual countries.

According to the Fiji National Health Accounts from the Ministry of Health, the average health expenditure per capita totalled $74 in 2008, with an average per capita spending on outpatient treatment (curative care and medical goods) of $51 (Fiji Health Accounts 2007–2008). Excluding transport costs and indirect costs, the average cost of one episode of outpatient pneumonia in this study is $12.76, thus accounting for a quarter of the total annual per capita outpatient costs, which must be considered to be relatively high. GDP per capital of Fiji was $4074 in 2008 and the basic needs poverty line (BNPL) was approximately $29.18 per adult equivalent per week (Narsey *et al.* 2010). The Household Income and Expenditure Survey 2008–09 estimated that a total of 26% of households, consisting of 31% of the population, were below the BNPL. The average household expense relating to a single episode of child outpatient pneumonia of $10.54 at CWMH and $4.22 at Nausori therefore represents a considerable burden to households.

This study is limited by the fact that it was conducted in only two health facilities. CWMH, as a tertiary referral hospital, may attract more severe cases to the outpatients department compared with other outpatient facilities. As such, it may not be representative of other urban areas in Fiji. Similarly Nausori, despite its rural setting, may not be representative of other rural areas because of its relative proximity to the capital. It is not possible to determine how the average cost of an episode of outpatient pneumonia may differ in other parts of the country. However, the observed difference in cost between an urban and more rural setting is likely to be real, given the different staffing, treatment practices and transport usage in these areas, and the burden to households caused by an episode of outpatient pneumonia is considerable in both settings. Given the frequency of outpatient pneumonia cases in Fiji, these costs should be included in any cost-effectiveness analyses for pneumonia intervention strategies.

References

Barber JA & Thompson SG (2000) Analysis of cost data in randomized trials: an application of the non-parametric bootstrap. *Statistics in Medicine* **19**, 3219–3236.

Briggs A & Gray A (1998) The distribution of health care costs and their statistical analysis for economic evaluation. *Journal of Health Services Research & Policy* **3**, 233–245.

Chola L & Robberstad B (2009) Estimating average inpatient and outpatient costs and childhood pneumonia and diarrhoea treatment costs in an urban health centre in Zambia. *Cost Effectiveness and Resource Allocation* **7**, 16.

CoinNews Media Group LLC (n.d.) US Inflation Calculator. http://www.usinflationcalculator.com. accessed 18 March 2011.

FIBOS (2008) *2007 Census of Population and Housing*. Fiji Islands Bureau of Statistics, Suva.

Fiji Ministry of Health (n.d.) *Fiji Health Accounts 2007–2008*. Fiji Ministry of Health, Suva.

Hussain H, Waters H, Omer SB *et al.* (2006) The cost of treatment for child pneumonias and meningitis in the Northern Areas of Pakistan. *The International Journal of Health Planning and Management* **21**, 229–238.

Hussain H, Waters H, Khan AJ, Omer SB & Halsey NA (2008) Economic analysis of childhood pneumonia in Northern Pakistan. *Health Policy Plan* **23**, 438–442.

McConnochie KM, Hall CB & Barker WH (1988) Lower respiratory tract illness in the first two years of life: epidemiologic patterns and costs in a suburban pediatric practice. *American Journal of Public Health* **78**, 34–39.

Mihaylova B, Briggs A, O'Hagan A & Thompson SG (2011) Review of statistical methods for analysing healthcare resources and costs. *Health Economics* **20**, 897–916.

Narsey W, Raikoti T & Waqavonovono E (2010) *Preliminary Report: Poverty and Household Incomes in Fiji in 2008-09 (based on the 2008–09 Household Income and Expenditure Survey)*. Fiji Islands Bureau of Statistics, Suva.

OANDA Historical Exchange Rates. http://www.oanda.com/currency/historical-rates? date_fmt=us&date=07/15/08&date1=01/01/08&exch=FJD&expr=USD&format=HTML&margin_fixed=0. accessed 6 December 2010.

Russell FM, Balloch A, Tang ML *et al.* (2009) Immunogenicity following one, two, or three doses of the 7-valent pneumococcal conjugate vaccine. *Vaccine* **27**, 5685–5691.

Shoham Y, Dagan R, Givon-Lavi N *et al.* (2005) Community-acquired pneumonia in children: quantifying the burden on patients and their families including decrease in quality of life. *Pediatrics* **115**, 1213–1219.

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