

# Healthcare Utilization, Out of Pocket Expenditures and The Role of Insurance of Dengue Affected Households in Semi-Urban Setting of Sri Lanka

C.W. Kalansooriya

University of Sri Jayewardenepura

**Abstract - Dengue is a mosquito borne viral disease which is a significant threat in the health sector of tropical and sub-tropical countries. Sri Lanka has experienced a dengue outbreak in recent years reporting nearly two hundred thousand dengue cases. Yet, studies which have focused on the household level burden that arise from the disease as out of pocket expenditures, especially in a situation where the absence of proper insurance to cover the expenses, are scarce. Hence, this study attempts to estimate the out of pocket expenditures abided by dengue disease at household level while identifying the use of different healthcare services and the role of health insurance. The study is based on a sample of 236 dengue affected people selected from a semi-urban setting in Sri Lanka. The results show that while public healthcare services are common for hospitalization, the use of private medical services for minor treatments and laboratory services are popular among people irrespective of the level of income. The study also concluded that households have to bear a considerable level of out of pocket expenditures due to the prevalence of dengue and the majority is the treatment cost in which 38% has been claimed through health insurances. The extrapolations show that households' total out of pocket expenditures of dengue disease in the country is approximately 0.23% of GDP in the year 2017.**

**Keywords: Dengue, Out of pocket expenditures, healthcare, insurance.**

## I. INTRODUCTION

Dengue is a viral infection transmitted through the bite of infected *Aedes* mosquitoes. It has been identified as the most crucial tropical disease in the 21<sup>st</sup> century (Gubler, 2002) and as most rapidly spreading mosquito-borne viral disease (WHO 2014). Although dengue is a global concern, its risk highly exists in tropical and subtropical countries of America, Africa, Asia, and Oceania. According to WHO estimates, 75% of the global population exposed to dengue are in the Asia-Pacific region (WHO 2012).

Sri Lanka as a tropical country has been experiencing the adverse outcome of dengue for decades. The disease was endemic to the country from the beginning of 90's (Sirisena and Noordeen, 2014) and it spread at accelerated phases during the following decades. By 2017, Sri Lanka faced an outbreak of dengue fever, recording 237 percent increase in dengue notification compared to the previous

year. According to the official statistics a total of 186101 cases were reported with over 320 deaths during the year 2017 (LKRCS, 2018).

While dengue has resulted in considerable threats to population health, it also caused substantial costs in terms of the use of economic resources. Since it is an epidemic it consumes a lot of public funds because it is the responsibility of the government to mitigate the problem by allocating more of public funds. As a country, which provides free basic healthcare service for all people, government cost of providing healthcare automatically increases with increasing prevalence of dengue. Similarly, the individuals and their families who suffer from the disease also have to bear the cost of treatments in the absence of government provision and the other out of pocket expenditures. Meanwhile, like in many other diseases, dengue indirectly affects the day to day economic functioning of individuals who are affected and reduces their productivity. If the disease makes a fatal outcome, then the loss becomes higher in terms of forgone productivity that a person could have earned. Further, it not only affects people who are infected, but also their family members as they have to devote their productive time which can be used for an economic activity caring for the patient, frequently visiting the hospital and so on. Accordingly, the total impact made by dengue is extensive and challenging to estimate.

Among different costs associated with dengue disease the out of pocket expenditures are crucial in terms of household welfare. These out pocket expenditures may include the treatment costs, cost of laboratory tests, transportation cost, cost associated with caring for patients, etc. Due to the reason that the disease is unexpected and the treatments cannot be postponed, individuals and households have to somehow manage the disease burden. Sometimes this may cause indebtedness of households for considerable period (Harving and Ronsholt, 2007, Tozan et al, 2017 ) affecting household welfare.

In Sri Lanka while there are few studies (Senanayake et al. 2014, Thalagalla et al. 2016) which have estimated the economic cost of dengue, none of those have

concentrated on the out of pocket expenditures incurred by the households and how those households managed those expenditures. Hence, this study aims to estimate the out of pocket expenditures at household level due to the prevalence of dengue, while identifying their use of healthcare services. Similarly, the study attempts to identify the role of insurance in mitigating the adverse effect of the disease on household economy. The study would help policy makers to identify the severity of the burden of dengue disease at household level and therefore, to implement necessary policies to overcome the disease burden.

## II. LITERATURE REVIEW

Dengue Fever (DF) and Dengue haemorrhagic Fever (DHF) has been identified as the most crucial tropical diseases in the 21<sup>st</sup> century (Gubler, 2002). DF and DHF imposes a significant burden to the society and for the government in many countries (Rigau-Perez, 2006; Castañeda-Orjuela et al., 2012; Luz et al., 2009; Harving & Ronsholt, 2007; Clark et al., 2005). However, the disease has not yet received the attention of the policy makers received for malaria (Gulber, 2012). Many studies show that the dengue burden is on the same order of magnitudes as leishmaniosis, leprosy, hepatitis B & C, syphilis and malaria (Luz et al,2009, Anderson et al 2007, Shepard et al. 2014).

Since Dengue is a tropical disease most of the cost of illness studies are focused on tropical and sub-tropical countries in America and Asia. For example, many studies can be found in Colombia (Beaute and Vong, 2010, Castañeda-Orjuela et al, 2012, Orjuela et al. (2011)) Thailand (Tozan et al, 2017, Clark et al., 2005), Brazil (Luz et al, 2009), Vietnam (Harving and Ronsholt, 2007), India (Shepard et al., 2014) and Singapore (Carrasco et al., 2011). Further, most of those studies identify dengue as an urban problem since dengue patients are higher in urban area than rural areas (Suaya et al, 2009) and so as the cost of the disease (Luz et al, 2009). However, evidence exist for the increasing tendency of spread of the disease towards rural area as well (Shepard et al., 2014).

The cost associated with dengue disease has many faces such as direct medical cost, direct non-medical cost, indirect cost and vector control cost. Some studies found that indirect costs are the most crucial type of cost while some argue direct costs are higher (Harving and Ronsholt, 2007, (Halasa et al.,2012, Lee et al., 2017). Meanwhile, the importance of vector control costs is also emphasized in some studies. For example in Colombia the vector control costs have been identified to have a greater share than; 69%-72% than of healthcare costs (Castañeda-Orjuela et al, 2012).

Hospitalization cost is the main portion of the direct medical cost of dengue. Burden of the disease is higher for hospitalized patients than for ambulatory patients (Anderson et al, 2007, Shepard et al., 2014) due to the higher direct cost incurred by hospitalized patients. However, ambulatory patients are higher than the hospitalized patients for the case of dengue (Suaya et al, 2009). The duration and the timing of the dengue hospitalization is also different. While there are multiple hospitalizations, majority are hospitalized during their first visit (Tozan et al, 2017). Overall, the mean duration of illness of hospitalized dengue cases are greater than non-hospitalized dengue cases (Anderson et al, 2007).

Most of the hospitalized patients are pediatrics in the case of dengue. (Suaya et al, 2009) Therefore, hospitalization cost is higher for the case when children get the disease. Further, the nights spent in hospital is higher for pediatrics than for adults while the mean duration of illness is higher for adult patients than for pediatric patients (Tozan et al, 2017). The severity of the disease also affects the direct hospital cost. When the severity of the disease and the intensity of the treatment increase, the cost of treatment was found to be increased (Harving and Ronsholt, 2007) and the cost of severe dengue case is nearly three times higher than of a cost of a minor dengue case in Colombia (Castañeda-Orjuela et al (2012). Type of the hospital also determines the cost of hospitalization for dengue disease. Most patients seek care from the public sector rather than the private sector (Tozan et al (2017). This is due to the fact that average cost per bed-days and average cost of ambulatory services if treated in private sector were found to be higher than of public sector (Shepard et al, 2014).

Indirect cost is also an important part of the cost of dengue illness. A study (Halasa et al.,2012) shows that 50% of the total cost of dengue was because of productivity losses that affect households and employers as well as the government. Another study (Clark et al., 2005) found that the approximate net monthly household income loss is 37% for unpaid leave due to dengue. The number of days affected by dengue for both patients and household members have averaged 30.5 days per case, of which 24.6% (7.2 days) were because of absenteeism from school and work (Halasa et al.,2012).

Either direct or indirect, the cost borne by the households is very significant in both ways. Both direct and indirect costs caused approximately 81.5% net monthly household income loss (Clark et al., 2005). As proven in many studies, the highest share (65% to 80%) of the economic cost and disease burden of dengue was borne by the patients and households (Beaute and Vong, 2010, Shepard et al., 2014, Halasa et al., 2012). Unexpected disease burden significantly affect households

normal spending. Sometimes the average cost of disease exceeds the average monthly salary (Harving and Ronsholt, 2007). Therefore, households have utilized additional financial resources such as savings and borrowing from other households for the period suffering from the disease (Tozan et al, 2017). However, it was found that the percentage of the economic burden to be decreased when moving towards the higher income groups. Further the early treatments, higher education and better knowledge of dengue are associated with the reduction of the probability of developing more severe illness. Moreover, having an insurance condenses the burden made by the direct medical cost of illness to households (Lee et al., 2017).

The first attempt to assess the cost of illness of dengue disease in Sri Lanka was made by Senanayake et al. (2014) by estimating the economic cost of hospitalized non-fatal pediatric dengue patients. The results show that the average hospital stay of DHF and DF patients was 4.8 and 3.8 days respectively. The average cost to hospital per case of DHF and DF was LKR 24,856 (USD 191) and LKR 10,348 (USD 80) respectively. Direct and indirect medical and non-medical costs incurred by households were LKR 4,758 (USD 36.6) for DHF and LKR 3,965 (USD 30.5) for DF. Further it reveals that the government incurred 84% and 72% of the total costs of DHF and DF respectively. However, there the study sample was limited to the pediatric patients hospitalized in government hospitals and these percentages would change with the consideration of patients treated in private hospitals. Another study which was again concentrated on public sector hospitalization, done by Thalagalla et al. (2016) estimated the public sector costs of dengue control activities and the direct costs of hospitalizations. The study found that the average costs per hospitalization is ranged between US\$216–609 for pediatric cases and between US\$196–866 for adult cases according to disease severity and treatment setting.

### III. DATA

The study was based on primary data gathered from the Western province where the dengue outbreak was severe during the study period. Within the Western province, Colombo district was the most affected area as there were 34274 dengue cases reported in 2017. The study concentrated on Maharagama division, a semi-urban area with high density of reported dengue cases, in Colombo district. The unit of investigation of the study was the individuals who had been recorded as a dengue affected patient during the last six months period from the survey date. Since the survey was undertaken in January 2017, the period of investigation was considered as July to December in 2017. The sample was selected based on the Public Health inspector's (PHI) records of the

Maharagama divisional health office. Based on the list of dengue affected households, information were gathered from 228 households which were reachable at the time of the survey and information was obtained from about 236 individuals. A questionnaire was used to collect data and questions were asked from either household head or spouse of the households.

## IV. RESULTS

### 4.1 Characteristics of the sample

According to the table 4.1 which gives the general characteristics of the sample, majority of the dengue affected individuals were females. More than 60% were below 30 years of age and majority of them were students (35%) while a considerable percentage was employed (28%). Most of the household heads in dengue affected households were educated up to G.C.E. Advanced Level and their average monthly income was between LKR 40000-60000.

TABLE 4.1: GENERAL CHARACTERISTICS OF THE SAMPLE

Incident rate		% of the total sample
By Gender	Male	46%
	Female	54%
By Age	Below 10 years	17%
	11 – 20 years	25%
	21 to 30 years	24%
	31 to 40 years	7%
	41 to 50 years	9%
	51 to 60 years	8%
	Over 60 years	9%
By employment	Employed	28%
	Self employed	10%
	Retired	7%
	Household work	17%
	Student	36%
	Unemployed	2%
By education level of the household head	Up to primary	8%
	Passed GCE O/L	23%
	Passed GCE A/L	51%
	Graduated	18%
By household income	Below 20000	13%
	20000 – 40000	22%
	40000 – 60000	31%
	60000- 80000	17%
	80000 – 100000	11%
	Over 100000	6%

Source: author calculation based on sample data

4.2 Healthcare Utilization

The characteristics of the healthcare utilization of the sample is given in table 4.2. Almost all the patients had been treated before they have been identified as a dengue patient either by a family doctor in a government hospital or in a private hospital. Majority of them were diagnosed with the expense of their own as only 38% of patients have used government health service to diagnose.

The hospitalization rate for the sample was high (93%) as 220 out of 236 were hospitalized. However, in the case of hospitalization, government hospitals share was high as 65% of patients were hospitalized in government hospitals and only 14% in private hospitals. Further, 21% had used semi-government hospitals where hospital chargers are relatively low compared to private hospitals. Although there was no significant relationship between the monthly income of households and the choice of health service to diagnose the disease, the relationship between the type of hospitalization and income level is statistically significant. As shown in figure 4.1, higher percentage of private hospitalization is recorded for higher income categories compared to the lower income households. For the highest income group private hospitalization rate was 50% while 42% utilized semi-government hospitalization. There was no private hospitalization for the lowest income groups, while there is no government hospitalization for the highest income group. Further, the selection of semi-government hospital is also higher for high income households, however, the selection between private or semi-government hospitals are income neutral.

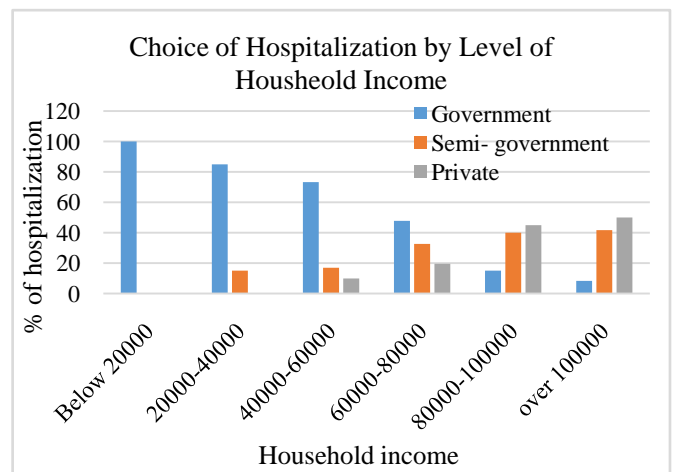
TABLE 4.2: HEALTHCARE UTILIZATION

Use of healthcare		% of patients
Disease identification	By a family doctor	32%
	Government hospital	38%
	Private hospital	30%
Hospitalization	Government hospital	65% Out of total hospitalization
	Semi government	
	Private hospital	
Duration of	Mean	5.4 Days
	1-3 days	32%
	4- 6 days	40%
	7 -10 days	21%
	More than 10 days	7%
Health	Fully covered health	13%
	Partially covered	23%
	No health insurance	64%

Source: Own calculation based on sample data

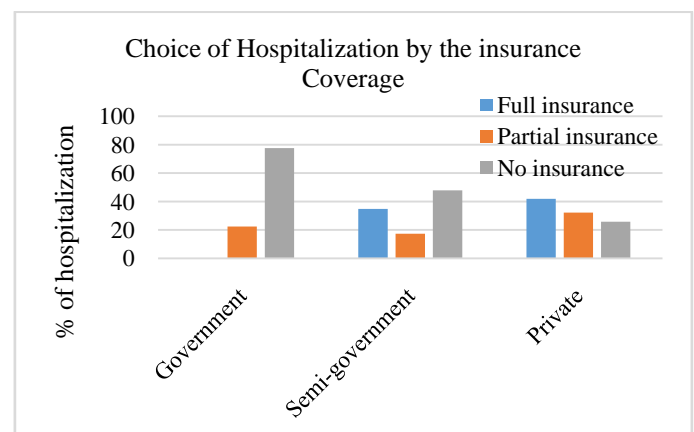
The type of healthcare utilization has been affected by the fact that patients had a health insurance or not. Majority (64%) of the individuals in the sample had not been covered by any kind of healthcare insurance while only 13% of individual were covered by a full healthcare insurance, which covers the total healthcare cost including hospitalization, and 23% by a partial insurance, which covers selected healthcare cost; where hospitalization cost was mostly not included. As shown in figure 4.2, 41% of the patients who have chosen private hospitals for their hospitalization were covered by a health insurance, while there none of the patients who treated on government hospital with a full insurance. Majority of the patients who had were covered by a full insurance were treated in private hospitals.

FIGURE 4.1: HOSPITALIZATION BY LEVEL OF INCOME



Source: Author calculation based on sample data

FIGURE 4.2: HOSPITALIZATION BY INSURANCE COVERAGE



Source: Own calculation based on sample data

Further, only 34% of the patients who were treated in semi government hospitals had been covered by a full health insurance and 17% from a partial insurance. That means 48% patients were treated in semi-government hospitals without any insurance and total hospitalization cost was borne by themselves. Similarly, there were 16% of patients who were treated in private hospitals not covered by any kind of health insurance.

There was no significant difference between the hospitalized period between private and government hospitals. The average number of days hospitalized was 5.4 days while the maximum duration is 29 days. Majority of patients were treated within 4-6 days in hospitals.

#### 4.3 Cost calculations

The study calculated the out of pocket expenditures which had been borne by the households when they experienced a dengue patient within the household. The cost calculations has been done under two headings; direct medical cost and direct non- medical cost. Under direct medical cost, the cost of out-patient treatment, in-patient treatment, prescribed medicine cost and the cost of laboratory tests were calculated while non-medical cost covers the caring cost, transportation cost, food and other costs borne by households with the disease.

Table 4.3 summarizes the average costs of different cost categories in the sample. Almost all the patients had been treated before they have been identified as a dengue

patient. Since some of those treated in government hospitals and not generated a cost, only 78% of patients incurred with pre-diagnosed medical expenses. The average cost for private hospitalization per patient was LKR 112500 while it was LKR 27020 for semi-government hospitals. There was no hospitalization cost for people who were hospitalized in government hospitals, however, they might have been engaged with some of the laboratory costs as there were 85% of patients incurred with laboratory chargers. The cost for prescribed medicine was quite low as it was LKR 355 on average. However, it was difficult to identify clearly the out of pocket expenditures on medicines for the patients who were hospitalized in private and semi-government hospitals because of the uncertainty of those medicine costs had already been included in their total hospital bills. Therefore, the medicine cost was ignored for the patients who were treated as in-patient in private or semi-government hospitals and assumed those costs had already been included in their total hospital charges.

TABLE 4.3: HOUSEHOLD OUT OF POCKET EXPENSES

	Average cost per patient (LKR)	Minimum (LKR)	Maximum (LKR)	Total expenses (LKR)	% of patients incurred with	(Total expense - Insurance claims)	% of total expenses
<i>Direct medical cost</i>							
Pre diagnosed medical cost	2750	350	6500	506220	78%	303732	6.91
Cost of laboratory tests	2110	200	15280	423266	85%	262425	5.98
Cost for prescribed medicines	355	100	2500	33512	40%	21113	0.48
<i>Hospital charges</i>							
For private hospitals	112500	25000	250000	3717000	14%	2193030	49.89
For semi-government hospitals	27020	6000	100000	1339111	21%	950769	21.63
<i>Direct non-medical cost</i>							
Caring cost	2738	600	18000	168004	26%	168004	3.82
Transportation cost	1734	250	6000	388763	95%	388763	8.84
Food and beverages	482	250	1940	77351	68%	77351	1.76
Other costs	560	200	3500	30397	23%	30397	0.69
<b>Total cost</b>				<b>6683624</b>		<b>4395583</b>	

Source: Own calculation based on sample data

Caring cost was the highest cost included in non-medical cost. 26% off households had taken the service of a care-giver, especially when the patient is older. It was not counted if the caring had been done by a family member and only the paid caring service was considered. The average caring cost per patient was calculated as LKR 2736 while the maximum recorded as LKR 18000. Almost all the patients incurred transport costs and the average transport cost per patient was LKR 1734. While 68% of the patients spent money for extra food and beverages, 23% of the households had spent money for

traditional medicines and spiritual activities to overcome the disease and for activities related to vector controls.

It is important to identify whether the healthcare expenditure is covered by an insurance so that the medication cost would not add to the individuals out of pocket expenses. As shown above 13% of patients were covered with a full insurance and 23% with a partial insurance. Generally, most of the partial insurance schemes do not provide the facility to claim in-patient treatments, therefore, this study assumed that the cost of hospitalization covered by an insurance only for the

households with full insurance coverage. However, it is assumed that the cost for other medical services had been claimed by the households with partial insurance cover as well.

Accordingly, the net expenditures of each patient for each category was calculated by considering the percentage of insurance cover for each category. As shown in table 4.4, 41% of private hospitalizations, 29% of the semi-government hospitalizations, 40% of the pre-diagnosed medications, 38% of laboratory costs and 37% of medicine costs have been claimed from insurance. Therefore, the total cost claimed by health insurance was estimated to be LKR 2,288,040(USD 13075) and it is counted as 38% of the total direct expenditures of dengue affected households.

The total out of pocket expenditures of each cost categories were calculated by multiplying the average cost per patients by the respective patient's percentage in each cost category. Accordingly, the total out of pocket expenditures of households for dengue disease was estimated to be 4,395,583 LKR (25118 USD) after their insurance claims were deducted. The highest contribution, which was 72%, to the total cost has been made by the hospitalization and private hospitalization accounted for a larger percentage of it. The highest non-medical spending was for transport followed by caring cost.

Further, the study attempted to identify whether households could manage the out of pocket expenditure within their normal income.

TABLE 4.4 COSTS CLAIMED BY INSURANCE

	Total expenses	% of patients covered by full insurance	% of patients covered by full/partial	Total cost claimed by insurance
Pre diagnosed medical cost	506220		40%	202488
Cost of laboratory tests	423266		38%	160841
Cost for prescribed	33512		37%	12399
Hospital charges				
Private hospitals	371700	41%		1523970
Semi-government	133911	29%		388342
Total				2288041

Source: Own calculation based on sample data

The data showed that only 24% of household could manage the expenditure within their income while 47% households had to spend their savings to cover the disease

cost. However, 29% households had relied on debt for financing the extra expenditure borne by the dengue disease.

## V. DISCUSSION

The study provides empirical evidence for the household's out of pocket expenditures generated by dengue disease in a semi-urban setting in Sri Lanka. As results show, higher dengue percentage was recorded for aged between 11-30 years complying with the general dengue prevalence pattern in Sri Lanka (Ali et al., 2018). It is obvious that the prevalence rates are high for students and employed people compared to household workers as they get exposed to the outside environment at a greater extent. A higher prevalence rate for student means that the parents of those patients have to sacrifice their working time to look after their diseased children. Similar time loss applies for the employed or self-employed people when they get caught to the disease as it directly affects their economic activities. Although this study did not calculate the indirect cost, the socio-demographic characteristics imply the existence of considerable indirect cost in terms of loss of productive time.

Almost all the patients had undergone pre-treatments before they have been identified as dengue patients. Majority of those households selected private medical service for their pre-treatments implying that irrespective of lower income level people choose private medical services for their minor treatments. This can be seen in obtaining laboratories services as well; although the patients who were treated in government hospitals are supposed to be free from laboratory expenses, the data reflect that they have done their laboratory tests through private channels. This will question the availability, quality and the convenience of government health service for the basic healthcare.

However, in the case of hospitalization the situation is different and majority had chosen government hospitals for their treatments. The hospitalization pattern clearly links with the household income level since low income individuals choose government hospitals for their treatments while richer people choose either private or semi government hospitals. However, most of the households could not bear the chargers of private hospitals and the selection of private hospitals was largely dependent on the availability of insurance coverage for the treatment cost. It is important to notice the role of semi-government hospitals, where patients can obtain the service relatively at low costs compared to the private hospitals. Regardless of having an insurance, people tend to choose semi-government hospitals for their in-patient treatments except the households at lowest income category. Further, it shows an indifference between the choice of private and semi-government hospitals even for

higher income levels. This gives a signal to healthcare providers for improving healthcare facilities through semi-government provision as a remedy for the pressure on government healthcare services.

The hospitalization rate was high for this sample although it is evident that the majority of patients have undergone their treatment as ambulatory (Bhatt et al. 2013). The higher hospitalization rate in this sample was probably due to the way the sample was selected as it was based on the PHI records which are used to produce national statistics of dengue prevalence in the country. However, since this study was not designed to calculate the indirect cost, the validation of finding would not be a problem since the ambulatory patients mostly incurred indirect cost than the direct cost (Suaya et al, 2009, Anderson et al, 2007).

Hospitalization cost was the highest share of the out of pocket expenses of dengue disease specially the cost of private hospitalization. However, households who had a fully covered insurance could reduce this burden of direct medical cost by nearly 85% although the percentage of households with fully covered insurance is smaller and the majority of households had to bear the cost by their own. Therefore, the study suggests that having an insurance with full coverage would help households to reduce the direct cost of dengue disease by more than three fourth of the total cost.

Transport cost and caring cost are considerable fractions of non-medical cost which households had to bear totally as out of pocket expenditures. However, the cost of caring would have been underestimated due to the fact that the study considered only paid caring service. However, caring was applied for many patients especially for the children and therefore, unpaid caring would be high in terms of the loss of productivity of the people who are engaged in caring. Further, it was identified that few households would believe in the traditional and spiritual activities when they get dengue disease.

Based on the data of the sample it is possible to estimate the total out of pocket expenditures for all dengue patients reported in the country during the year. As per the extrapolations of the cost calculations, the total household out pocket expenditures of dengue in the absence of any kind of healthcare insurance is estimated to be LKR 3.5 billion (20 million USD) and it accounts 0.23% of the GDP of the year 2017. However, the actual expenditures would be higher than this as unreported dengue cases are much higher than the reported cases.

## VI. CONCLUSION

This study provides empirical evidence on households' use of healthcare services and their out of pocket expenditures abided by dengue disease in semi-

urban setting of Sri Lanka. It is evident that although public healthcare services are common for hospitalization, there is a tendency for the use of private medical services for minor treatments and laboratory services. It can also be concluded that households have to bear considerable out of pocket expenditures abided by dengue disease and majority of those expenses are medication costs which can be largely financed by a healthcare insurance.

## REFERENCES

- [1] Ali S., Khan A.W., Taylor-Robinson A.W., Adnan M., Malik S. & Gul S. (2018) The unprecedented magnitude of the 2017 dengue outbreak in Sri Lanka provides lessons for future mosquito-borne infection control and prevention. *Infection, Disease & Health* (2018) 23, 114-120
- [2] Anderson, K., Chunsuttiwat, S., Nisalak, A., Mammen, M., Libraty, D., Rothman, A., Green, S., Vaughn, D., Ennis, F and Endy, T. (2007). Burden of symptomatic dengue infection in children at primary school in Thailand: a prospective study. 369 (9571), pp. 1452-1459.
- [3] Beauté, J. and Vong, S. (2010). Cost and disease burden of Dengue in Cambodia. *BMC Public Health*, 10(521), pp.1471-2458.
- [4] Bhatt, S., P. W. Gething, O. J. Brady, J. P. Messina, A. W. Farlow, C. L. Moyes, J. M. Drake, et al. 2013. "The global distribution and burden of dengue." *Nature* 496 (7446): 504-507. doi:10.1038/nature12060. <http://dx.doi.org/10.1038/nature12060>
- [5] Carrasco, L. R., Lee, L. K., Lee, V. J., Ooi, E. E., Shepard, D. S., Thein, T. L., Gan, V., Cook, A. R., Lye, D., Ching, L. & Leo, Y. S. (2011). Economic Impact of Dengue Illness and the Cost-Effectiveness of Future Vaccination Programs in Singapore, *PLoS Negl Trop Dis* 5(12):
- [6] Castañeda-Orjuela, C., Díaz, H., Alvis-Guzman, N., Olarte, A., Rodriguez, H., Camargo, G. and De la Hoz-Restrepo, F. (2012). Burden of Disease and Economic Impact of Dengue and Severe Dengue in Colombia, 2011. *Value in Health Regional Issues*, 1(2), pp.123-128.
- [7] Clark, D., Mammen, M., Nisalak, A., Puthimethee, V and Endy, T. (2005). Economic Impact of Dengue fever/ Dengue hemorrhagic fever in Thailand at the Family level and Population levels. *The American society of Tropical Medicine and Hygiene*, 72(6), pp.786-791.
- [8] Gubler, D, J. (2002). Epidemic dengue/dengue hemorrhagic fever as a public health, social and economic problem in the 21<sup>st</sup> century. *Trends in Microbiology*, 10(2), pp. 100-103.
- [9] Gubler, D, J. (2012). The Economic Burden of Dengue. *The American Society of Tropical Medicine and Hygiene*, 86(5), pp.743-744
- [10] Halasa Y.A., Shepard D.S. & Zeng W. (2012). Economic cost of dengue in Puerto Rico. *American Journal of Tropical Medicine and Hygiene*, 86(5):745-752.
- [11] Harving, M., Ronsholt, F. (2007). The conomic impact of dengue hemorrhagic fever on family level in Southern Vietnam. *Danish Medical Bulletin*, 54 (2), pp. 170-172.

- [12] Lee, J. S., Mogasale, V., Lim, J. K., Carabali, M., Lee, K. S., Sirivichayakul, C., Dang, D. A., Palencia-Florez, D. C., Nguyen, T. H., Riewpaiboon, A., Chanthavanich, P., Villar, L., Maskery, B. A and Farlow, A. (2017). A multi country study of the economic burden of dengue fever: Vietnam, Thailand and Colombia. *PLOS Neglected Tropical Diseases*, 11(10), e0006037. <https://doi.org/10.1371/journal.pntd0006037>.
- [13] Luz, P., Grinsztejn, B. and Galvani, A. (2009). Disability adjusted life years lost to dengue in Brazil. *Tropical Medicine & International Health*, 14(2), pp.237-246. Available at: <https://doi:10.1111/j.1365-3156.2008.02203.x>
- [14] Rigau-Pérez, J. (2006). Severe dengue: the need for new case definitions. *The Lancet Infectious Diseases*, 6(5), pp.297-302.
- [15] Senanayake, M., Jayasinghe, S., Wijesundera, D. and Manamperi, M. (2014). Economic cost of hospitalized non-fatal paediatric dengue at the Lady Ridgeway Hospital for Children in Sri Lanka. *Sri Lanka Journal of Child Health*, 43(4), pp.205-207.
- [16] Shepard, D., Chellaswamy, V., Adhish, S., Gaba, M., Nandan, D., Halasa, Y., Arora, N., Karthiga, K. and Tyagi, B. (2014). Economic and Disease Burden of Dengue Illness in India. *The American Journal of Tropical Medicine and Hygiene*, 91(6), pp.1235-1242.
- [17] Sirisena, P.D.N.N and Noordeen, F. (2014) Evolution of dengue in Sri Lanka- Changes in the virus, vector and climate, *International journal of infectious disease* 19 (2014) 6-12
- [18] LKRCS. (2018) Dengue DREF final report. International Federation of Red Cross and Red Crescent Societies.
- [19] Suaya, J., Shepard, D., Siqueira, J., Martekki, C., Lum, L., Tan, L., Kongsin, S., Jiamton, S., Garrido, F., Montoya, R., Armien, B., Huy, R., Castillo, L., Caram, M., Sah, B., Sughayyar, R., Tyo, K and Halstead S. (2009). Cost of Dengue cases in eight countries in the Americas and Asia: A prospective study. *The American Society of Tropical Medicine and Hygiene*, 80(5), pp. 846-855.
- [20] Thalagala, N., Tissera, H., Paliwadana, P., Amarasinghe, A., Ambagahawita, A. & Wilder-Smith A, et al. (2016). Costs of Dengue Control Activities and Hospitalizations in the Public Health Sector during an Epidemic Year in Urban Sri Lanka. *PLoS Negl Trop Dis* 10(2)
- [21] Tozan, Y., Ratanawong, P., Sewe, M., Wilder-Smith, A. and Kittayapong, P. (2017). Household costs of hospitalized dengue illness in semi-rural Thailand. *PLOS Neglected Tropical Diseases*, 11(9):e0005961. <https://doi.org/10.1371/journal.pntd.0005961>
- [22] World Health organization. (2012) Global Strategy for Dengue Prevention and Control, 2012–2020. WHO Press.
- [23] World Health Organization. (2014). A global brief on vector-borne diseases. WHO/DCO/WHD/2014.1.