

# Direct Medical Costs of Dengue Fever in Vietnam: A Retrospective Study in a Tertiary Hospital

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## Abstract

**Background:** In Vietnam, dengue fever is a major health concern, yet comprehensive information on its economic costs is lacking. The present study investigated treatment costs associated with dengue fever from the perspective of health care provision.

**Methods:** This retrospective study was conducted between January 2013 and December 2015 in Cu Chi General Hospital. The following dengue-related treatment costs were calculated: hospitalisation, diagnosis, specialised services, drug usage and medical supplies. Average cost per case and treatment cost across different age was calculated.

**Results:** In the study period, 1672 patients with dengue fever were hospitalised. The average age was 24.98 (SD = 14.10) years, and 47.5% were males (795 patients). Across age groups, the average cost per episode was USD 48.10 (SD = 3.22). The highest costs (USD 56.61, SD = 48.84) were incurred in the adult age group (> 15 years), and the lowest costs (USD 30.10, SD = 17.27) were incurred in the paediatric age group (< 15 years).

**Conclusion:** The direct medical costs of dengue-related hospitalisation place a severe economic burden on patients and their families. The probable economic value of dengue management in Vietnam is significant.

**Keywords:** direct cost, dengue, dengue fever, hospitalisation, Vietnam

## Introduction

Dengue is a vector-borne viral infection, commonly transmitted by the mosquitos *Aedes aegypti* and *A. albopictus* in tropical and subtropical regions (1–2). It is associated with dengue virus infection in human. Dengue-related signs, which include flu-like symptoms, a severe headache, and joint and muscle soreness, are not always clearly distinguishable from symptoms associated with other illnesses (3). If dengue is left untreated, hospitalisation and death are common (3).

According to the World Health Organisation, nearly 2.5 billion people are

susceptible to dengue, with a global incidence of 50–100 million cases per annum (4). Furthermore, the rate of infection has expanded dramatically (30 fold increase) within the last 50 years. According to one study in more than 100 countries in the WHO regions of Africa, the Americas, the Eastern Mediterranean, South-East Asia and the Western Pacific. The America, South-East Asia and Western Pacific regions, dengue was responsible for 500,000 hospitalisations and 20,000 deaths annually (4).

Endemic dengue has declined in over 100 countries and throughout a number of regions, including Africa, the U.S., Eastern Mediterranean, South East Asia and Western

Pacific (5). According to estimates, 390 million dengue infections occur annually, with 96 million clinical dengue infections (70%) reported in Asia, followed by 16% in Africa (16 million infections) and 14% in Latin America (13 million infections) and the Caribbean (6). In Columbia, 1,020,000 cases were recorded during a 32-year period from 1972 to 2010 (3). Among dengue cases reported in Colombia in 2011 and 2012, 56,998 cases required medical attention (22,799 ambulatory and 34,199 hospitalised), 1851 were severe cases and 205 were deaths (7).

In Vietnam, between 2001 to 2010, the total number of reported dengue cases in 19 provinces was 592,938 (8). In 2014, Vietnam recorded 43,000 cases in 53 provinces, with 28 deaths (9). The expansion of endemic regions has major implications for the national economy. Based on an economic analysis of data collected in 2011, dengue control in Columbia cost the country between USD 52.2 and USD 61.0 million (7). Over the decade of 2001–2010, the yearly economic burden of dengue control in Southeast Asia was USD 950 million (USD 610 million to USD 1,384 million) or about USD 1.65 per capita (USD 1.06 to USD 2.41) (10). In the U.S., the dengue illness was estimated to cost USD 2.1 billion per year on average from 2000 to 2007 (in 2010 USD), with a range of USD 1–USD 4 billion in sensitivity analyses and substantial year to year variation (4). According to the Department of Health in the Philippines, which reported an annual number of dengue cases of 117,065, the clinical diagnosis and direct medical costs associated with 842,867 dengue cases

was USD 345 million (USD 3.26 per capita), as per the currency exchange rate in 2012 (11). In Singapore, between 2000 and 2009, the average economic impact of dengue ranged from USD 0.85 billion to USD 1.15 billion (12).

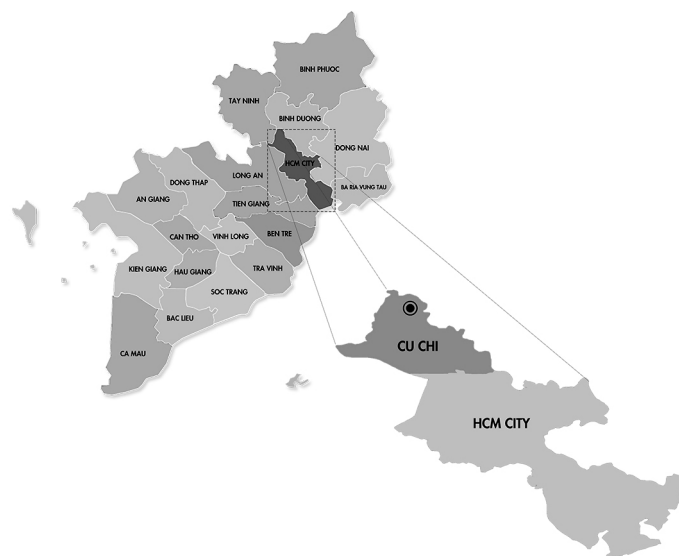
Nationwide, data are lacking on dengue-related treatment costs in Vietnam. Information on the economic burden of dengue in Vietnam would aid the distribution of resources for dengue control. The present retrospective study was undertaken to identify treatment-related costs of dengue episodes in Vietnam from 2013 to 2015.

## Methods

A retrospective cost-of-illness analysis of the data records of Cu Chi General Hospital was used to compute direct medical costs to the state. Information was also obtained on the probable expenses of each dengue episode in a population-based sample by correlating the patient's records with the hospital's billing data.

### Study site

Cu Chi General Hospital is located in Cu Chi District, Ho Chi Minh City, Southern Vietnam. It is a single tertiary care, level II hospital, with a capacity of over 1000 beds and adequate modern equipment required to treat and research infectious diseases. The hospital serves the people of Cu Chi district and those of other provinces, including Tay Ninh, Long An and Binh Duong.



**Figure 1.** Map of Ho Chi Minh City, Vietnam, showing Cu Chi district in dark grey

### Study population

Patients ( $N = 1672$ ) with a primary discharge diagnosis of dengue according to International Classification of Diseases Codes-10 (A90: dengue fever; A91: dengue haemorrhagic fever) were identified from January 2013 to December 2015 (2–13). Patients with dengue who were discharged for other reasons (patients who discharged themselves, were transferred to another hospital or were discharged for non-specified reasons) were excluded.

### Data collection

The numbers of dengue patients who underwent diagnostic tests and treatment at Cu Chi General Hospital from January 2013 to December 2015 were recorded, and the direct medical costs associated with health care provision (diagnostic tests and treatment) per patient were calculated. Data were also obtained on the demographic characteristics of the patient, resource utilisation, cost per component per case (hospitalisation, diagnostic tests, specialised services, drug usage and medical supplies) and total cost of the illness.

### Data analysis

Data on the demographic characteristics of the patient, resource utilisation, cost per component and total cost of the illness were summarised using descriptive statistics. A subgroup analysis of the dengue-related costs of different age groups (children: younger than 15 years; adults: older than 15 years) was performed based on a previous study in Vietnam (14).

The direct medical costs associated with health care provision (diagnostic tests and treatment) per patient were analysed. The electronic database of Cu Chi General Hospital was searched to obtain data on overall medical costs. These included the cost of hospitalisation, diagnostic tests, specialised services, drug usage and medical supplies. Direct diagnostic-related costs were calculated based on the number of services utilised, together with the specific unit cost of each service (direct cost = the number of services  $\times$  cost per service).

In determining the costs per case from 2013 to 2015, we report our results in 2015 was converted to USD using the currency exchange rate in 2015 (1 USD = VND 21,698) (15). The data on the costs per case were extracted from the electronic database of Cu Chi General Hospital.

### Statistical analysis

Descriptive statistical methods were used. The total number, number of missing values, minimum, median, maximum, mean and standard deviation (SD) are presented. All calculations were executed using Microsoft Excel 2013.

### Ethics in research

The research protocol was approved by the biomedical research ethics Council of the Faculty of Pharmacy, University of Medicine and Pharmacy, Ho Chi Minh City Vietnam. As this study utilised medical record data, with neither patient contact nor collection of personal data, Cu Chi General Hospital waived the need for written informed consent from the participants.

## Results

The average age range of the patients in 2013, 2014 and 2015 was 24.98 years (SD = 14.10). In the study period, there was a higher proportion of patients in the older age group ( $> 15$  years,  $n = 1,135$ , 67.88%) than in the younger age group ( $< 15$  years). The numbers of male and female cases did not fluctuate noticeably within the three years, with peaks of 795 and 877 in males and females, respectively. Regarding the diagnosis, in the study group ( $N = 1672$ ) the majority of patients were classified as ICD-A91 ( $n = 1650$ , 98.68%).

In 2013, the mean age was 24.83 years, and adult patients accounted for two-thirds ( $n = 263$ ) of the total number of patients ( $n = 383$ ) who underwent tests for dengue. The numbers of males ( $n = 190$ ) and females ( $n = 193$ ) was similar. The mean (SD) number of treatment days in 2013 was 4.57 (SD = 1.87) but ranged from 1–12 days. With regard to the classification, A91 accounted for the majority of cases (383/369, 96.34%).

In 2014 and 2015, there was little change in the proportion of males and females: 47.63% males and 52.37% females (231 males and 254 females) in 2014 and 46.52% males and 53.48% females (374 males and 430 females) in 2015.

As can be seen in Table 1, the number of patients who underwent diagnostic tests for dengue in the three years differed, with 804 patients undergoing tests in 2015 (accounting for nearly half of the total number of patients ( $N = 1672$ ), 383 and 485 patients undergoing tests in 2013 and 2014, respectively (accounting

for a quarter of the total number of patients ( $N = 1672$ ).

The average treatment time was five days. In some cases, the treatment time was one day,

but it was up to 11 days (2014), 12 days (2013) and 17 days (2015). Patients classified as ICD-10 A90 accounted for only a small proportion of cases (< 5%) each year.

**Table 1.** Overview of demographics of the patients from 2013 to 2015, Cu Chi General Hospital ( $N = 1672$ )

		2013 ( $n = 383$ )	2014 ( $n = 485$ )	2015 ( $n = 804$ )	2013 – 2015 ( $n = 1672$ )
		$n$ (%)	$n$ (%)	$n$ (%)	$n$ (%)
<b>Age (years)</b>	Mean (SD)	24.83 (14.64)	26.09 (13.67)	23.39 (14.08)	24.98 (14.10)
	≤ 15	120 (31.33)	133 (27.42)	303 (37.69)	537 (32.12)
	> 15	263 (68.77)	352 (72.53)	501 (62.31)	1135 (67.88)
<b>Gender</b>	Male	190 (49.61)	231 (47.63)	374 (46.52)	795 (47.55)
	Female	193 (50.39)	254 (52.37)	430 (53.48)	877 (52.45)
<b>Length of hospital stay (day)</b>	Mean (SD)	4.57 (1.87)	4.77 (1.95)	5.09 (2.02)	4.88 (1.98)
	Median	4.00	5.00	5.00	5.00
	Range	1.00 – 12.00	1.00 – 11.00	1.00 – 17.00	1.00 – 17.00
<b>ICD-10™</b>	A90	14 (3.66)	7 (1.44)	1 (0.12)	22 (1.32)
	A91	369 (96.34)	478 (98.56)	803 (99.88)	1650 (98.68)

**Table 2.** Direct medical costs of dengue from 2013 to 2015 in Cu Chi General Hospital (2015: USD 1 = VND 21,698)

		2013 ( $n = 383$ )	2014 ( $n = 485$ )	2015 ( $n = 804$ )	2013–2015 ( $n = 1672$ )
		USD (%)	USD (%)	USD (%)	USD (%)
Cost of hospitalisation bed-day		3,787.94 (17.9)	5,519.69 (25.6)	10,459.83 (27.8)	19,767.46 (24.6)
Cost of diagnostic test		6,256.13 (29.5)	8,470.98 (39.4)	16,410.30 (43.5)	31,137.41 (38.7)
Cost of specialised services		1,336.33 (6.3)	1,709.99 (7.9)	3,293.26 (8.7)	6,339.58 (7.9)
Cost of medication		9,350.57 (44.1)	5,504.14 (25.6)	6,845.58 (18.2)	21,700.30 (27)
Cost of medical supplies		472.96 (2.2)	323.53 (1.5)	677.77 (1.8)	1,473.94 (1.8)
<b>Total cost</b>		<b>21,203.92 (100)</b>	<b>21,528.34 (100)</b>	<b>37,686.74 (100)</b>	<b>80,419.01 (100)</b>

Considering specific health-related costs, annual changes in value compared to the overall structure and health care costs were clearly visible. First, regarding inpatient costs, this increased over the years from more than USD 3700 in 2013 to more than USD 5500 in 2014 and exceeded USD 10,000 in 2015. If the comparison is based on the ratio of the costs of yearly hospitalisation, bed days will likely to occupy a higher rate. In 2013, the cost per hospital bed-day accounted for 17.9% of direct medical costs, and it accounted for 27.8% of

direct medical costs in 2015. Although drug-related costs fluctuated, they decreased annually, accounting for 44.1% of direct medical costs in 2013 and 25.6% and 18.2% of direct medical costs in 2014 and 2015, respectively.

The total cost for health care changed during 2013–2015. During 2013–2014, the total treatment costs did not increase significantly (from USD 21,203.92 to USD 21,528.34, respectively). However, in 2014–2015, there was a sharp rise in treatment costs, increasing

from just over USD 21,528.34 in 2014 to USD 37,686.74 in 2015.

As shown in Table 3, the mean (SD = value) total cost was highest in 2013 (USD 55.36, SD = 44.00). In the study period, the lowest costs in 2013, 2014 and 2015 were for medical supplies: USD 1.30 (SD = 1.16), USD 1.05 (SD = 2.60) and USD 2.01 (SD = 2.89), respectively. The highest drug-related costs were in 2013, with a total value of USD 24.48 (SD = 32.28). These decreased to USD 11.42 (SD = 23.71) in 2014. Regarding hospitalisation and diagnostic costs, these increased steadily every year from 2013–2015. During this period, the specialised services costs were highest in 2015 (USD 5.28, SD = 9.87). With regard to medical supply costs, these were highest in 2015 (USD 2.01, SD = 2.89) and

declined to USD 1.30 (SD = 1.16) and USD 1.05 (SD = 2.60) in 2013 and 2014, respectively.

*Economic burden of dengue fever*

From 2013–2015, the total cost of treatment increased gradually, with total costs of USD 21,203.92, USD 21,528.34 and USD 37,686.74 in 2013, 2014 and 2015, respectively. However, patient-related costs (hospitalisation, diagnostic tests, specialised services, drug usage and medical supplies) were higher in 2013 than in 2014 (USD 4,921.75 and USD 4,547.54, respectively). Patients incurred the highest costs in n 2015 (USD 7,032.70), despite the percentage of patients cost decreasing slightly between 2013 and 2015: 23.2% in 2013, 21.1% in 2014 and 18.7% in 2015.

**Table 3.** Mean (SD) cost per dengue case in USD from 2013–2015 (2015: 1 USD = VND 21,698)

		Hospitalisation bed-day	Diagnostic test	Specialised services	Medication	Medical supplies	Total
	≤ 15	9.02 (7.84)	11.40 (8.49)	1.79 (1.28)	5.76 (7.73)	0.98 (1.29)	26.32 (19.98)
2013	> 15	10.29 (7.08)	19.82 (10.03)	5.31 (9.86)	33.05 (35.48)	1.43 (1.08)	68.61 (45.60)
	Total	9.89 (7.34)	17.43 (10.33)	4.51 (8.81)	24.48 (32.28)	1.30 (1.16)	55.36 (44.00)
	≤ 15	11.45 (5.26)	14.11 (10.80)	2.93 (2.20)	4.35 (4.85)	2.29 (5.66)	29.85 (18.31)
2014	> 15	11.35 (6.71)	20.06 (10.75)	5.15 (6.22)	14.11 (27.23)	0.81 (1.27)	49.88 (42.09)
	Total	11.38 (6.34)	18.62 (11.05)	4.72 (5.75)	11.42 (23.71)	1.05 (2.60)	44.39 (38.16)
	≤ 15	13.18 (4.93)	15.73 (9.04)	2.82 (2.11)	2.65 (4.81)	1.88 (4.27)	31.75 (15.47)
2015	> 15	12.98 (6.17)	24.38 (13.85)	6.23 (11.42)	12.20 (35.82)	2.04 (2.56)	56.02 (54.14)
	Total	13.06 (5.73)	21.34 (13.04)	5.28 (9.87)	8.59 (28.78)	2.01 (2.89)	46.87 (45.31)
	≤ 15	11.88 (6.04)	14.39 (9.47)	2.63 (2.05)	3.71 (5.41)	1.54 (3.70)	30.10 (17.27)
2013–2015	> 15	11.83 (6.62)	21.87 (12.29)	5.65 (9.70)	17.51 (34.11)	1.44 (1.85)	56.61 (48.84)
	Total	11.84 (6.44)	19.67 (12.02)	4.95 (8.64)	13.06 (28.98)	1.46 (2.34)	48.10 (43.22)

## Discussion

The current study was designed to estimate the direct treatment costs of dengue in Cu Chi General Hospital from 2013 to 2015. The average hospitalisation stay was five days. In studies conducted in the Philippines, France and Can Tho City, Vietnam, the average length was four days (11), three days (4) and six days (16). The total cost was USD 80,419.01 over the three-year study period. The mean (SD = value) cost of dengue inpatient treatment was USD 48.10 per case (SD = 43.22), which was lower than the reported cost in the Philippines (USD 431.36) from 2008 to 2012 (11). The cost of dengue treatment in other countries (in North America, Central America, Mexico, Brazil and South American countries) during 2000–2007 was much higher than that in Vietnam. The average treatment cost for dengue fever in North America (including the U.S. and Canada) was USD 3154 (USD 1684–4138), USD 307 (USD 210–398) in Central America and Mexico, USD 410 (USD 164–577) in Brazil and USD 382 (USD 236–508) in South American countries (17). Studies of French territories of the Americas showed that the average treatment cost in 2007–2011 was 2758 Euros (SD = 9.605) (4). These differences can be explained by economic conditions and innovations in infrastructure and health services.

According to the results of this study, the average cost of a hospital bed was USD 11.84 (SD = 6.44), which was lower than that in the Philippines (USD 102.46) (11). The total inpatient cost was USD 48.10 (SD = 43.22), which included the costs of bed days (USD 11.84, SD = 6.44), diagnostic tests (USD 19.67, SD = 12.02), specialised services (USD 4.95, SD = 8.64), drug usage (USD 13.06, SD = 28.98) and medical supplies (USD 1.46, SD = 2.34). Diagnostic tests accounted for the highest proportion of direct medical costs (38%), followed by drug- (27%) and hospitalisation-related costs (24%). Focusing on the reducing the aforementioned costs could decrease the economic burden of treating dengue patients.

Current estimates of dengue-related medical costs in several areas of Vietnam are uncertain due to a lack of data on the total number of dengue episodes. Uncertainty also surrounds the role of various factors, such as geography, time and age groups, in dengue-related costs. Thus, data on specific areas cannot be extrapolated to all dengue-transmitted regions in Vietnam.

## Conclusions

Costing evaluations provide critical data for economic evaluations. The results of this study, which examined the direct costs of dengue fever in Cu Chi General Hospital, emphasise the high economic burden of this disease. The findings of the present study can be used to estimate the cost of dengue cases and outbreaks in Southern Vietnam, from the perspectives of both the health insurance payers and society. We hope our study might be useful for policy makers in setting goals and priorities about the treatment and prevention of this disease.

## Authors' Contributions

Conception and design: VQT  
 Analysis and interpretation of the data: VQT, VTTN  
 Drafting of the article: VTTN  
 Critical revision of the article for important intellectual content: VQT, VTTN  
 Final approval of the article: VQT, PNNT  
 Provision of study materials or patients: PNNT  
 Collection and assembly of data: VTTN, PNNT

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