

RESEARCH ARTICLE

The economic burden attributable to asthmatic inpatients and outpatients in a military hospital, Vietnam: A retrospective 5-year analysis

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Abstract

Objectives: Asthma is a disease that causes significant health and economic burdens worldwide. The prevalence and incidence of asthma have been rising around the world over recent decades. The current study is to capture the direct medical costs of inpatient and outpatient asthma treatment for the period from 2013 to 2017.

Methods: This study was conducted at Military Hospital 175 in Vietnam. The study was performed from the patient and social insurance perspective, which means all types of costs were identified and measured based on patients' healthcare insurance. Cost analysis was measured using the medical records for estimating the economic burden of asthma. The study adopted descriptive statistics and bootstrap techniques to calculate asthma-related costs as well as analyze the background characteristics of asthma patients.

Results: The average outpatient and inpatient costs were US\$64.90 and US\$141.20, respectively, over the period from 2013 to 2017, for which out-of-pocket payments accounted for 10-12%. Medications, specifically asthma controller drugs, were the key driver leading to the substantial burden of direct medical costs for treating asthma. The cost burden was also significantly higher for adult patients compared to children.

Conclusions: Asthma continues to be a concerning problem in Vietnam. The economic impact of either preventive or promotive health interventions that can reduce the prevalence of asthma can be predicted from the statistics found in this research. Moreover, this data will help policymakers plan and allocate national expenditures for asthma treatment in a more rational way.

Keywords: Asthma; cost of illness; direct medical cost; military hospital; out-of-pocket payment; Vietnam. (JPMA 69: S-41 (Suppl. 2); 2019)

Introduction

Asthma, a chronic respiratory disease, is one of the major noncommunicable diseases; it is characterized by chronic inflammation of the airways and associated with variable expiratory airflow obstruction resulting in manifestations of wheezing, chest tightness, dyspnoea, and coughing.¹ Recurrent symptoms are triggered by environmental and genetic factors such as exercise, allergens, viral infections, air pollution, or chemicals.¹

According to the latest World Health Organization data, there are about 235 million people currently suffering from asthma worldwide.² Additionally, WHO (2017) estimated that asthma caused over 380,000 deaths in 2015, with most of these deaths occurring in older adults.² Regarding the prevalence of clinical asthma in adults, there is not a great difference between regions, with the Western Pacific region responsible for the highest

prevalence (6.2%); the top five countries with the highest prevalence are Australia (21.5%), Sweden (20.2%), the U.K. (18.2%), the Netherlands (15.3%), and Brazil (13.0%).³ Furthermore, the Global Initiative for Asthma (2018) reported that the prevalence of asthma in both children and adults has been increasing,⁴ and the study by Masoli (2004)⁵ predicted that there may be an additional 100 million more asthmatics by 2025 if the current trends continue. Asthma is a major chronic respiratory disease in Asia. Although the prevalence of adult asthma is generally lower in Asia compared to Europe, the increasing trends may lead to a greater disease burden in the near future.⁶

Because asthma is a chronic and under-treated disease, it also creates a substantial lifelong economic burden for individuals and families.² As per WHO, in 2004, the world's aggregate asthma costs most likely surpassed those of tuberculosis and HIV/AIDS combined. In the period from 2000-2001, the health expense of asthma in Australia was around AU\$693 million, which represented 1.4% of the overall health expenditure for Australians for that period.⁷ A report evaluated that the total expense of asthma in the United States was US\$56 billion (in 2009 US dollars) in 2007, or US\$3,259 per individual per year.⁸ A European investigation calculated the aggregate cost of asthma in

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2011 to be €19.3 billion (in 2011 Euros) among Europeans aged from 15 to 64 years.⁹ In another report in the Asia-Pacific area, asthma's direct and indirect costs per patient per year varied from US\$184 in Vietnam to US\$1,189 in Hong Kong (in 2000 US dollars).¹⁰

Vietnam is a country in Asia with an estimated prevalence of clinical asthma of 1% in 2012.³ Some studies have been conducted to estimate asthma-related costs in Vietnam; however, these studies did not consider whether the cost of asthma caused an economic burden. It is essential for policymakers to understand the precise estimate of the economic cost of asthma treatment when setting priorities for the balanced allocation of scarce resources. Hence, the current study, which measures the economic burden of direct medical costs in treating asthma, was conducted to fill this research gap.

Patients and Methods

A retrospective cost-of-illness study was conducted using an electronic medical records database to judge the economic healthcare effect of asthma in Military Hospital 175 (MH175) in Ho Chi Minh (HCM) City during a 5-year period from January 2013 to December 2017. Because of the infeasibility of gaining individual consent, patient records were anonymized before analysis.

HCM City is the biggest city in Vietnam and is located in the southeastern region of the country. It is located from 10°10' to 10°38' North and 106°2' to 106°54' East.¹¹ It is 1760 km south of Hanoi and is at the crossroads of international maritime routes. HCM City contains 8.34% of the population of Vietnam and 20.2% of its GDP. Therefore, although the city takes up just 0.6% of the country's land area, it is the economic center of Vietnam and accounts for a large proportion of the Vietnamese economy.

MH175, operated by the Ministry of Defense, is a formal and prestigious military medical institution in southern Vietnam. Over the past years, MH175 has been visited by delegations of officials and experts from around the world in order to expand relations in the healthcare sector. MH175 has also been prepared as a level-two field hospital to take part in the United Nations peacekeeping mission.¹² In the next 5 years, MH175 is expected to become a 1500-bed complex that meets the national standards of a special-ranked hospital.¹³

After receiving ethical approval from MH175, the data on patient characteristics and costs were obtained from the hospital's electronic database. The computerized information, which was anonymized, consisted of an alphanumeric code, patients' basic attributes, and cost

component information. Demographic measures were reported for all subjects, including age at index date, gender, location, visit type (outpatient or inpatient), length of stay (for inpatient visit), and status of social insurance funds' expenses. Cost component information included the cost of each service and the number of medical services used for medical treatment (e.g., diagnosis, image diagnostic, pharmaceuticals, laboratory tests, hospital bed, and other service utilizations).

Inclusion and Exclusion Criteria: Inclusion criteria were all cases which were identified by searching the database records for codes J45 and J46 of the International Classification of Diseases, 10th Revision (ICD-10) during the period of January 1, 2013 to December 31, 2017.¹⁴ Files with incomplete or missing information were excluded. Those included patients with inadequate or faulty information in the hospital database, patients whose diagnosis changed during treatment, patients who moved to another hospital during treatment, and patients who did not comply with the hospital's treatment protocol.

Estimating Cost: Direct medical costs were defined as the amounts expended on asthma management within the official healthcare system. That was understood as the sum of all the direct payments for diagnosis, image diagnostic, pharmaceuticals, laboratory tests, hospital bed, and other service utilizations for one patient, for both out-of-pocket payments and insurance payments. A reference unit cost of medical services was used to estimate medical services costs. Costs before 2018 were extrapolated for inflation to the 2018 value using the Consumer Price Index. All costs are presented in US\$ calculated using the exchange rate for August 2018 according to the State Bank of Vietnam (2018) exchange rate of US\$1 = 22,671 Viet Nam Dong.

Statistical Analysis: Descriptive statistics are used to summarize the results. The categorical variables are given as the number of observations and percentage. The arithmetic mean with 95% confidence intervals (95%CI) was calculated by using bootstrapping procedures with 1000 replications to explain the continuous variables relating to costs. Pearson's chi-square test or T-test and one-way analysis of variance (ANOVA) were used to compare categorical data or continuous data, respectively. All tests were two-sided and a P-value of < 0.05 was considered statistically significant. Statistical analyses were executed using Excel 2013 for Windows® (Microsoft,) and SPSS® version 20.0 (IBM, Chicago, IL, USA) in this study.

Ethical Approval: The ethical review committee of

Military Hospital 175 approved the study protocol. Data were obtained and analyzed without any patient contact and identification. Thus, written informed consent from the patients was waived.

Results

All 1,796 patients of the outpatient department (OPD) and 820 episodes hospitalized at the inpatient department (IPD) at MH175 were included in this study. Statistics on gender, location, healthcare insurance, and length of stay (for IPD only) of participants are presented in Tables-1 and 2 for OPD and IPD, respectively. The mean age of OPD patients varied between study years, ranging from 52.7 ± 19.3 to 57.1 ± 20.5 years; these figures were higher in the IPD (54.1 ± 23.8 to 67.2 ± 21.8 years). Additionally, adults accounted for the majority of patients in both departments. The proportion of males to females in the OPD was around 1:1, but in the IPD, the number of males was higher than that of

females for all years. Regarding healthcare insurance status, the majority of patients received reimbursement with a share of 80%. The mean length of stay for IPD patients varied from 10 to 14 days in the period from 2013-2017 (Table 1, Table 2).

Table-3 indicates the direct medical cost components for

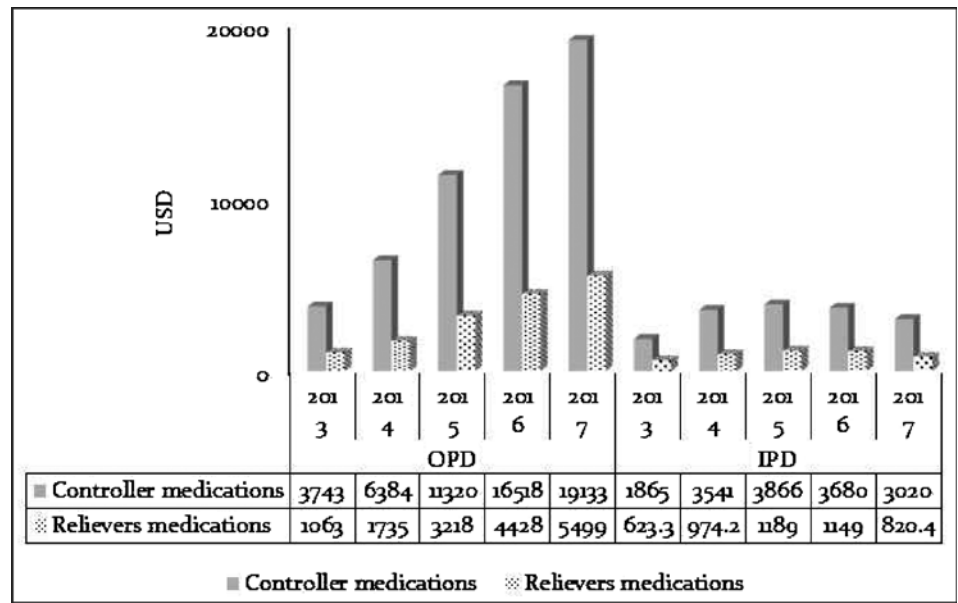


Figure-1: Expenditure on two medication groups in treating asthma from 2013 to 2017 (USD 2018).

Table-1: Background characteristics of asthmatics in the period 2013-2017 at the OPD [n (%)].

Outpatient Department	2013	2014	2015	2016	2017	p-value*
No. of patients	184	251	326	590	656	
Age						
Mean (SD)	57.1 (20.5)	56.9 (18.3)	56.0 (20.0)	52.7 (19.3)	53.4 (18.4)	
Median (Q1-Q3)	60.0 (44.0-71.3)	59.0 (47.0-70.0)	61.0 (42.3-69.0)	56.0 (38.0-67.0)	56.0 (40.8-66.0)	
Range (Min-Max)	11-93	11-95	9-97	6-97	3-97	
Age group						
Pediatric (≤ 16)	12 (6.5)	7 (2.8)	17 (5.2)	21 (3.6)	23 (3.5)	0.2
Adult (>16)	172 (93.5)	244 (97.2)	309 (94.8)	569 (96.4)	633 (96.5)	
Gender						
Male	91 (49.5)	135 (53.8)	170 (52.1)	341 (57.8)	353 (53.8)	0.254
Female	93 (50.5)	116 (46.2)	156 (47.9)	249 (42.2)	303 (46.2)	
Location						
HCMC	172 (93.5)	219 (87.3)	299 (91.7)	512 (86.8)	573 (87.3)	0.03
Others	12 (6.5)	32 (12.7)	27 (8.3)	78 (13.2)	83 (12.7)	
Healthcare insurance						
0 ^(a)	-	-	-	40 (6.8)	34 (5.2)	<0.001
30	10 (5.4)	25 (10.0)	-	-	-	
80	88 (47.8)	112 (44.6)	149 (45.7)	336 (56.9)	360 (54.9)	
95	45 (24.5)	62 (24.7)	78 (23.9)	53 (9.0)	53 (8.1)	
100 ^(b)	41 (22.3)	52 (20.7)	99 (30.4)	161 (27.3)	209 (31.9)	

Note: ^(a)Out-of-pocket; ^(b)No payment; *Calculated by Chi-square test
SD: Standard Deviation; Q1: the first quartile; Q3: the third quartile.

Table-2: Background characteristics of asthmatics in the period 2013-2017 at the IPD [n (%)].

Inpatient Department	2013	2014	2015	2016	2017	p-value*
No. of episodes	73	142	164	225	216	
Age						
Mean (SD)	67.2 (21.8)	64.4 (19.1)	57.2 (22.4)	58.5 (21.0)	54.1 (23.8)	
Median (Q1-Q3)	73.0 (64.0-82.0)	70.0 (55.0-77.5)	61.0 (47.8-73.0)	63.0 (51.0-72.0)	60.0 (37.0-72.0)	
Range (Min-Max)	6-94	5-100	5-97	4-91	2-97	
Age group						
Pediatric (≤ 16)	5 (6.8)	3 (2.1)	16 (9.8)	11 (4.9)	20 (9.3)	0.031
Adult (>16)	68 (93.2)	139 (97.9)	148 (90.2)	214 (95.1)	196 (90.7)	
Gender						
Male	54 (74.0)	96 (67.6)	110 (67.1)	146 (64.9)	130 (60.2)	0.240
Female	19 (26.0)	46 (32.4)	54 (32.9)	79 (35.1)	86 (39.8)	
Location						
HCMC	63 (86.3)	113 (79.6)	133 (81.1)	167 (74.2)	177 (81.9)	0.136
Others	10 (13.7)	29 (20.4)	31 (18.9)	58 (25.8)	39 (18.1)	
Healthcare insurance						
0 ^(a)	-	1 (0.7)	14 (8.5)	23 (10.2)	21 (9.7)	<0.001
30	5 (6.8)	6 (4.2)	5 (3.0)	10 (4.4)	8 (3.7)	
80	34 (46.6)	71 (50.0)	69 (42.1)	88 (39.1)	93 (43.1)	
95	12 (16.4)	14 (9.9)	9 (5.5)	16 (7.1)	6 (2.8)	
100 ^(b)	22 (30.1)	50 (35.2)	67 (40.9)	88 (39.1)	88 (40.7)	
Length of stay						
≤ 5	4 (5.5)	18 (12.7)	21 (12.8)	44 (19.6)	61 (28.2)	<0.001
5-10	19 (26.0)	26 (18.3)	34 (20.7)	70 (31.1)	78 (36.1)	
>10	50 (68.5)	98 (69.0)	109 (66.5)	111 (49.3)	77 (35.6)	
Mean (SD)	14.2 (5.8)	13.8 (7.4)	12.5 (6.1)	10.6 (7.8)	8.9 (6.5)	

Note: ^(a)Out-of-pocket; ^(b)No payment; *Calculated by Chi-square test
SD: Standard Deviation; Q1: the first quartile; Q3: the third quartile.

Table-3: Distribution of direct medical cost of asthma treatment from 2013 to 2017 (USD 2018).

OPD	2013	2014	2015	2016	2017
Diagnosis	212.8	684.2	1,153.5	1,737.1	3,917.7
Laboratory Tests	84.8	300.6	438.3	2,208.3	3,408.3
Imaging Methods	116.5	215.3	336.9	850.1	1,171
Medications	6,432.4	13,093	20,706	27,005	31,892.1
Others	14.2	35.8	16.7	211.1	432.8
Total	6,860.924	14,328.92	22,651.38	32,011.52	40,821.92
Total per patient (95%CI)	37.3 (30.2-45.9)	57.1 (48.4-67.5)	69.5 (57.7-82.3)	54.3 (48.2-60.6)	62.2 (56.7-68.0)
IPD	2013	2014	2015	2016	2017
Hospitalization	200.5	910.3	1,013.2	1,423.7	2,925.8
Laboratory Tests	104.8	624.9	771.9	1,343.1	1,284.7
Imaging Methods	73.2	145.2	195.2	264.4	313.4
Medications	10,328.2	15,471.4	22,704.5	27,492.6	22,409.2
Others	301.7	1,093.0	978.3	1,736.4	1,667.9
Total	11,008.4	18,244.8	25,663.2	32,260.3	28,601.0
Total per patient (95%CI)	150.8 (126.5-162.8)	128.5 (100.3-143.2)	156.5 (132.4-171.9)	143.4 (101.4-210.9)	132.4 (110.6-149.5)

Table-4: Mean asthma-related direct medical cost per patient in the period 5-year from different perspective [Mean (95%CI); USD 2018].

	Cost categories	N	Total mean cost per patient	Social insurance funds' expense	OOP payments per patient	% OOP payments
OPD	Diagnosis	1,796	4.3 (3.9-4.7)	3.8 (3.5-4.2)	0.5 (0.4-0.5)	11.6
	Laboratory Test	405	15.9 (14.6-17.2)	13.3 (12.1-14.5)	2.6 (2.2-3.1)	16.4
	Imaging Methods	599	4.5 (4.2-4.9)	3.7 (3.5-4.0)	0.8 (0.6-1.0)	17.8
	Medications	1,698	58.3(53.2-64.4)	52.7 (47.7-58.6)	5.6 (5.1-6.2)	9.6
	Others	68	10.5 (7.8-13.6)	9.0 (6.7-11.8)	1.5 (0.9-2.1)	14.4
	Total	1,796	64.9 (59.3-71.4)	58.2 (52.7-64.5)	6.7 (6.2-7.3)	10.3
IPD	Hospitalization	820	7.9 (7.2-8.8)	6.3 (6.0-6.8)	1.6 (1.2-2.1)	20.3
	Laboratory Tests	401	10.3 (9.2-10.8)	8.5 (8.0-8.7)	1.8 (1.2-2.0)	17.5
	Imaging Methods	209	4.7 (4.3-5.1)	4.2 (3.9-4.7)	0.5 (0.4-0.6)	10.6
	Medications	820	121.4 (107.8-139.3)	99.1 (90.7-108.0)	22.3 (13.2-38.7)	18.4
	Others	589	9.8 (8.7-10.6)	7.6 (7.1-8.0)	2.2 (1.7-2.5)	22.4
	Total	820	141.2 (138.7-146.4)	123.1 (121.9-126.7)	18.1 (16.4-19.3)	12.8

Note: Others: Consumable Material, Medical Supplement, Infusion, ...

OOP: out-of-pocket.

Table-5: Association between direct medical cost and other variables in the OPD (USD 2018).

Parameters	2013		2014		2015		2016		2017	
	Mean (95%CI)	P-value	Mean (95%CI)	P-value	Mean (95%CI)	P-value	Mean (95%CI)	P-value	Mean (95%CI)	P-value
Age										
Children	13.7 (8.0-20.7)	0.005	8.9 (4.2-14.4)	<0.001	8.4 (5.9-11.2)	<0.001	11.6 (8.0-15.3)	<0.001	13.9 (9.7-18.5)	<0.001
Adult	38.9 (31.1-48.3)		58.5 (49.7-68.4)		72.8 (60.2-86.8)		55.8 (50.0-62.2)		64.0 (58.3-70.2)	
Gender										
Male	46.1 (32.2-62.9)	0.079	62.1 (48.6-77.5)	0.256	74.0 (56.4-94.1)	0.498	54.0 (45.1-64.3)	0.939	64.2 (56.5-72.6)	0.464
Female	28.7 (24.4-33.3)		51.2 (40.9-63.1)		64.5 (50.1-81.4)		54.6 (47.4-61.9)		59.9 (52.8-67.9)	
Location										
HCMC	38.0 (30.3-47.1)	0.197	58.1 (48.6-69.1)	0.493	72.2 (59.0-86.7)	0.022	57.3 (50.4-65.1)	<0.001	64.7 (58.5-71.4)	0.001
Other	26.5 (13.1-41.3)		50.0 (32.8-70.2)		39.9 (24.9-59.4)		34.0 (28.4-40.3)		45.2 (37.8-53.2)	

Table-6: Association between direct medical cost and other variables in the IPD (USD 2018).

Parameters	2013		2014		2015		2016		2017	
	Mean (95%CI)	P-value	Mean (95%CI)	P-value	Mean (95%CI)	P-value	Mean (95%CI)	P-value	Mean (95%CI)	P-value
Age										
Children	15.8 (13.4-17.2)	<0.001	14.2 (10.3-17.6)	<0.001	18.9 (13.5-25.7)	<0.001	17.5 (12.3-22.1)	<0.001	21.2 (15.2-25.6)	<0.001
Adult	158.2 (121.3-155.9)		130.6 (123.7-155.4)		169.8 (110.6-204.8)		149.7 (108.5-210.5)		141.3 (117.3-180.8)	
Gender										
Male	165.9 (120.8-182.7)	0.129	142.8 (125.8-167.2)	0.376	164.8 (135.7-187.2)	0.754	159.1 (102.0-244.6)	0.446	162.4 (154.3-173.0)	0.095
Female	106.2 (73.6-134.9)		97.2 (90.4-114.5)		138.8 (108.5-186.0)		114.0 (92.4-137.1)		86.1 (72.4-103.1)	
Location										
HCMC	151.1 (134.3-172.1)	0.821	134.5 (126.3-148.1)	0.734	153.7 (129.1-167.3)	0.871	147.1 (96.4-222.1)	0.75	180.1 (132.3-207.6)	0.924
Other	144.2 (103.6-184.0)		105.1 (97.0-118.2)		168.1 (146.4-183.5)		132.1 (102.6-166.9)		192.4 (143.2-221.8)	
Length of stay										
≤5	58.4 (54.1-62.4)	0.164	51.2 (48.8-59.3)	0.073	69.1 (60.3-79.3)	0.095	74.0 (28.8-135.7)	0.152	81.3 (71.9-97.2)	0.143
5-10	71.3 (62.1-81.0)		72.5 (69.2-78.1)		82.4 (63.9-95.4)		92.8 (71.7-117.8)		93.1 (80.3-114.9)	
>10	187.6 (154.2-201.1)		157.2 (143.8-172.1)		195.3 (167.3-214.9)		202.5 (132.1-317.7)		186.6 (171.3-211.8)	

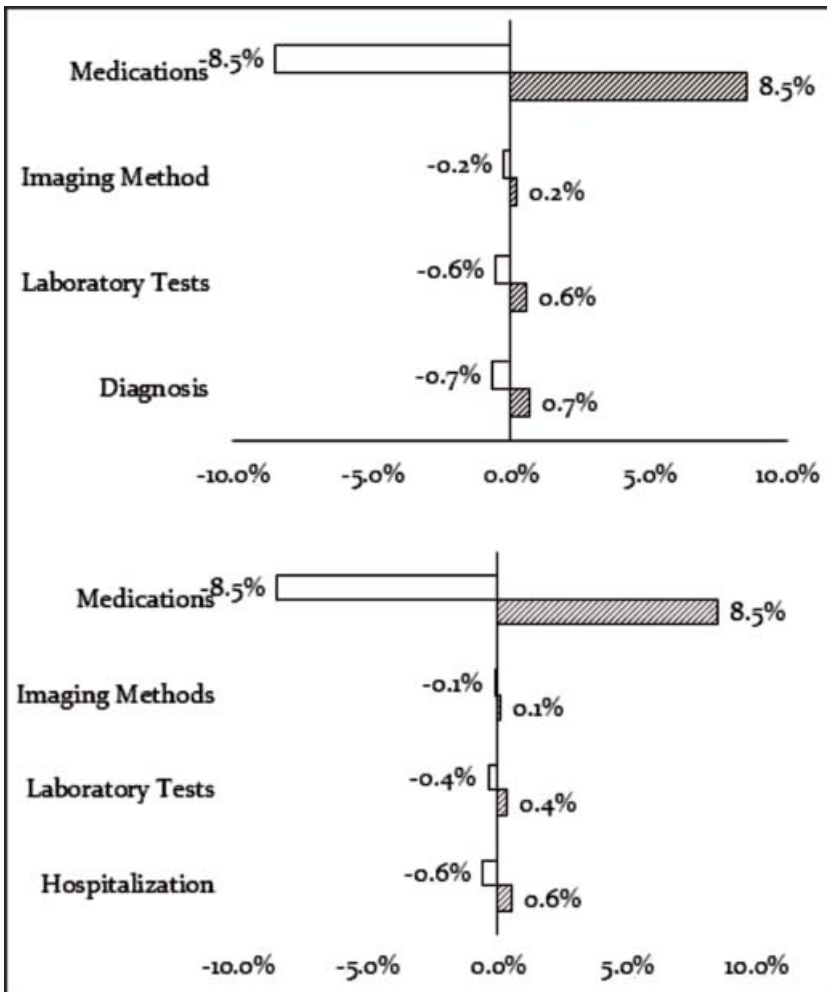


Figure-2: Sensitivity analysis for varying cost of direct medical cost components in the period 5-year [OPD (top) and IPD (bottom)].

asthma patients for the period from 2013 to 2017. Overall, over 80% of the total direct medical costs were medication expenditures. The mean total direct medical annual cost per patient increased notably from US\$37.30 in 2013 to US\$62.20 in 2017 in the OPD, while that figure in the IPD experienced a downward trend from US\$150.80 in 2013 to US\$132.40 in 2017 (Table-3).

The average asthma-related medical cost per patient during the 5-year period is depicted in Table-4 from both a patient and healthcare insurance perspective. In both departments, the out-of-pocket payments from patients accounted for a smaller percentage compared to the payments from social insurance (Table-4).

Tables-5 and 6 show the mean direct medical cost based on demographic characteristics in both departments, including age group, gender, location, and length of stay (for IPD) from 2013 to 2017. The mean expenditure on

direct medical costs for asthma for children was remarkably lower than for adult patients (Table 5, Table 6).

Figure-1 illustrates the expenditures on two types of asthma-related medications over the 5-year period. The two main types of asthma medications are controller and reliever medications. The chart provided shows that the expenses for controller medications were always higher than for reliever medications during this period (Figure-1).

Figure-2 demonstrates the sensitivity analysis for varying costs of direct medical cost components. Medication expenditures changed drastically within the margin of 8.5% on the total direct medical cost when accelerating or decelerating the portion of 10% this cost (Figure-2).

Discussion

This pilot study provides preliminary empirical evidence on the economic burden of asthma in Vietnam. The current study found that the direct medical cost of illness per asthmatic patient was US\$141.20 for inpatients and US\$64.90 for outpatients. The mean cost for inpatients was slightly higher than the cost reported by Chuesakoolvanich (2007) for Thailand (US\$134.50).¹⁵ However, regarding outpatient costs, Celik et al. (2004) found that the average treatment cost for outpatients in Turkey reached US\$1,465.70,¹⁶ which was much higher than the findings in this study (US\$64.90). The results showed a significant difference in comparison with studies from other countries; nevertheless, this comparison may not be reliable due to the fact that unit costs, study periods, exchange rates, and annual inflation can vary between countries.

It was also found that the average length of the asthma episode ranged from 9 to 14 days, which was higher than the figures reported in regional hospitals in Thai Lan (3.2 days) and in Taiwan (6.4 days). Furthermore, as expected, findings from this study also revealed that a higher length of stay corresponded with higher direct medical costs. This result was consistent with the conclusion of another study undertaken by Stanford et al. (1999)¹⁷ in the United States. This issue may be attributed to the severity of the disease and other infections encountered in the hospital.

Another finding worthy of note is that the average treatment cost for outpatients was lower than for inpatients, which was supported by a literature review on the economic burden of asthma, which proposed that the higher costs for inpatients could be caused by several factors, including an older patient population, intensive care unit admission, or prolonged length of stay.¹⁸ However, our finding was inconsistent with the results by Alzaabi et al. (2014), who found that outpatient care was responsible for approximately 80% of direct costs.¹⁹

The present study found that the treatment cost of asthma is primarily due to medications, which were responsible for over 80% of direct medical costs. Chuesakoolvanich (2007)¹⁵ and Çelik et al. (2004)¹⁶ also came to the same conclusion in their studies. Similar findings have been observed in the literature; to be more precise, medications accounted for 38-89% of the total cost in the study by Bahadori et al. (2009).¹⁸ Moreover, analyzing the medications used by asthmatics showed that the controller medicine group cost up to threefold that of reliever medications, which was consistent with the study by Boonpiyathad (2016),²⁰ who found that quick-relief medications and control medications accounted for 11.91% and 36.85% of the total medical costs, respectively. Another retrospective study in Abu Dhabi also reported that controller medication was 10 times more costly than rescue medication.¹⁹ Additionally, controller therapy was associated with an 80% increase in direct medical asthma costs according to a study in Switzerland.²¹

Furthermore, the average direct medical costs attributable to asthma were notably higher in adult patients compared with pediatric patients. This was supported by the results of a review on the financial burden of asthma, which found remarkably higher costs for older age groups.¹⁸

This study provides a snapshot of the costs of treating asthma in Vietnam, and this estimate is conservative for several reasons. First, the population studied does not represent the entire population of Vietnamese asthmatics, but rather the population of asthmatics treated at a military hospital. Second, because the data were retrieved from patients' medical records, only direct medical costs were measured. Hence, neither non-medical costs nor indirect costs of asthma were analyzed, and therefore, this study cannot report the full societal burden of asthma. In addition, the hospital database used in this study did not contain information on either clinical characteristics or comorbidities of the study population, such as level of severity of asthma control, which have been demonstrated elsewhere to be

important determinants of costs.

Conclusion

This study highlights the substantial economic burden on society posed by total direct medical costs of asthma. In particular, medication expenditures comprised the bulk of these analyzed costs. Based on this accurate and vital information, policymakers should take note and implement the necessary steps to both better manage morbidity and reduce the impact of asthma treatment on the country's economy. These findings suggest the need for enhancing, updating, and cultivating asthma control programs as well as physicians' training. Furthermore, patients' self-management should be encouraged and a policy should be created to reduce medication costs.

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