Original Article

DOI: 10.7860/JCDR/2018/35731.11704

Medical Expenditures of Community-Acquired Pneumonia Hospitalization: A Two-Year Retrospective Study from a Hospital Electronic Database in Vietnam

Public Health Section

TRUNG QUANG VO[1], HIEN THU BUI[2], THUY PHAN CHUNG TRAN[3], TRAM THI HUYEN NGUYEN[4], THUY VAN HA[5], HA THI SONG NGUYEN[6]

ABSTRACT

Introduction: Community-Acquired Pneumonia (CAP) causes respiratory diseases that lead to numerous deaths and an increased burden on the healthcare system. In 2014, the Ministry of Health of Vietnam reported that 4000 children under the age of 5 die because of CAP every year.

Aim: The aim of this study was to estimate the direct medical costs per case for CAP treatment from the hospital perspective and to evaluate the use of antibiotics at a public hospital in Ho Chi Minh City.

Materials and Methods: A retrospective study was conducted between January 2015 and December 2016 at Trung-Vuong Hospital. Pneumonia episodes, identified by ICD-10 (J10–J18) and assigned to medical encounters, were validated through the hospital electronic database (n=1,854). Treatment costs consisted of costs of hospital beds, diagnostics, operations, laboratory tests, pharmaceuticals, medical supplies and other services, which was calculated and .presented by using descriptive statistics methods.

Results: The average cost per case (mean/SD) of all age groups was $795.1/$86.2; the highest cost was incurred by the group aged over 85 years, at $1253.7/$90.3. The average cost to treat CAP in male patients was $810.2/$85.5, which was higher than the treatment cost for females, at $778.6/$86.7, but the difference was not significant (P=0.450). The total burden of CAP in the period 2015–2016 was $1,474,052.9. The total costs of pharmaceuticals represented the largest proportion of the total costs (65.9%), at $971,646, and the cost of antibiotics was $380.5/$111.8 per episode. According to the sensitivity analysis, if the costs of the hospital beds were reduced by 20%, the total treatment cost for CAP would fall by 1.6%.

Conclusion: The study contributed evidence of the high treatment costs of CAP in the Vietnamese context. Given the significance of the disease burden, the potential benefit of vaccination in adults is substantial.

Keywords: CAP, Community-acquired pneumonia, Direct cost, Economic analysis, Vietnam

INTRODUCTION

CAP is a common infectious disease which causes important morbidity worldwide [1]. *Streptococcus pneumonia* is the major bacterial cause of adult CAP requiring hospital admission throughout the world [2]. Two main vaccinations offer protection against pneumococcal disease, including a 7-Valent Conjugate Vaccine (PCV-7) for children and a 23-Valent Polysaccharide Vaccine (PPV-23), which is recommended especially for adults older than age 65 and for specific at-risk groups [3].

The 1.9 million deaths of adults aged ≥ 15 years per year make lower respiratory tract infections one of the most common causes of death [2]. The second major cause of death from infectious disease in 1999 in Lazio, Italy, was pneumonia because of acquired immune-deficiency syndrome [4]. In the United States (USA), CAP affects a large proportion of seniors every year, resulting in 600,000 hospitalizations and 59,000 deaths [5]. In 2014, the Ministry of Health of Vietnam reported that 4,000 children under the age of five die from CAP every year [6].

CAP causes a high number of hospitalisations, but it also imposes a huge economic burden. For instance, according to File TM et al., CAP caused an economic burden of about 17 billion US Dollars ($) annually in America [3]. In 2011, a retrospectively analysed study by Ambrose Li for the three-year period from 2006–2009 showed that pneumonia cost 20 million Australian Dollars (A$) per year in Australia [7]. The annual cost incurred by CAP in New Zealand was 63 million New Zealand Dollars (NZ$), with 30 million NZ$ from direct costs, according to Scott G et al., [8]. In Turkey, a study by Doruk S et al., [9]. In 2009 estimated the average direct cost of 114 cases at about 1630.77 Euro, with an average age of 70.9 years. The Chinese Ministry of Health mentioned average hospitalisation costs of CAP at $575.3 in 2005 [10]. In addition, Tumanan-Mendoza BA et al., reported an economic burden imposed by pneumonia of 8.48 billion Philippine Pesos (PHP) for moderate risk CAP and 643.76 million PHP for high risk CAP in 2012 [11]. Various studies have been conducted to evaluate the burden of pneumonia in different countries, such as in New Zealand [8], Turkey [9], China [10] and the Philippines [11], but information on the CAP economic burden in Vietnam is limited. In Vietnam, a study conducted in KhanhHoa General Hospital (in 2010) reported the treatment cost for suspected pneumonia was $31 [12] and a study conducted in Hanoi (in 2014) provided the average total pneumonia treatment cost from a societal perspective were $318 [13]. Understanding the health and economic consequences of disease is important for policy makers, clinicians and patients in helping to control against pneumonia outbreaks. In recognition of the important effects of CAP on human health and the lack of information on the cost of treatment of the disease, this study was conducted in a hospital in Ho Chi Minh City.

The overall goal of this study was to provide researchers and policy-makers with a better understanding of the medical expenditures and morbidity due to pneumonia at Trung-Vuong Hospital over a period of two fiscal years, from 2015–2016.

MATERIALS AND METHODS

Study Design and Study Site

A retrospective database analysis was conducted using an electronic medical records database to determine the treatment costs of CAP hospitalisation cases from the healthcare payer, patient and hospital perspectives. This study was conducted at Trung-Vuong Hospital, located in Ho Chi Minh City in Southern Vietnam. Trung-Vuong Hospital is a central level hospital with a crew of 964 staff working in 27 departments and a capacity of 700 beds. The average number of outpatient visits at this hospital was between 1,500 and 2,000 in 2014 and the total number of outpatients and inpatients in 2015 were 506,069 and 41,201, respectively (unpublished data).

Data Collection

The data were extracted from the hospital's electronic database after ethical approval from the hospital. The inpatients treated in the Department of Respiratory at Trung-Vuong Hospital included all mandatorily reported CAP patients, diagnosed using J10–J18 (International Classification of Diseases, 10th revision) during the selection window between January, 2015 and December, 2016 [14].

This study obtained access to the database from the hospital and extracted the necessary information. The study excluded CAP patients who had a lack of information and patients who were discharged because of a change in diagnosis. The hospital database was divided into two general categories, including demographic characteristics (age, gender, diagnosis, average length of hospitalisation, comorbidity, insurance reimbursement and payment scheme), and resource utilisation (pharmaceuticals and supplies, laboratories, diagnostic examinations, hospitalisation, surgery, procedures and hospital charges). Comorbidity was defined by Trung-Vuong hospital as the chronic conditions that previously long-term diagnosed and/or treated. In this study, the five chronic conditions that have vital influence on CAP were chronic lung disease, disease in cardiovascular system, gastrointestinal system, renal disease and diabetes. Endocrinological and psychological diseases were presented as other disease.

Estimating Costs

The direct medical costs related to CAP patients were estimated by combining health care use data from the collection, including the costs of operations, pharmaceuticals, diagnoses, hospital beds, laboratory tests, medical supplies (e.g., syringe, needle, gauze), and other services. Trung-Vuong Hospital had no standard unit cost of medical services, so the reference unit cost of medical services utilised by Trung QV et al., was used [15]. The patients had to pay the costs of drug equivalent to the purchase price from the hospital. All costs are expressed in US Dollars (USD) using the exchange rate of June 2017 (1 USD = 22,399 Vietnam Dong).

Data Analysis

Resource consumption and costs with Standard Deviation (SD) were calculated for data management and analysis using the Microsoft Excel 2013 statistical software with Analysis Toolpak function. Descriptive statistics were employed to present the costs, which were classified by independent variables and tested for statistical difference. This study was used the t-test to compare groups with two variables and the ANOVA test was used for multiple comparisons. In all tests, the significance level was $p<0.05$.

Sensitivity Analysis

The total treatment cost of CAP as the baseline cost of illness was used to perform an co-variate sensitivity analysis. This study changed the proportion of costs of health care services to determine the impact on the Cost Of Illness (COI) cost centres. Upper and lower scenarios provided a process to estimate shifts in the value of economic burden.

Ethic Statements

The study protocol was approved by the Trung-Vuong Hospital review committee. The information was used only for research purposes during data collection, and each patient was identified anonymously by creating alphanumeric codes in the study.

RESULTS

Characteristic of the Study Participants (N=1,854)

[Table/Fig-1] shows that the number of patients diagnosed with CAP was higher in 2015 (n=950) than in 2016 (n=904). For the 1,854

Characteristic	2015 (n=950)	2016 (n=904)	2015–2016 (N=1,854)
Age (years)			
Mean (SD)	66.6 (16.2)	66.6 (16.8)	66.6 (16.5)
Median (IQR)	69.5 (57-79)	69 (56-79)	69 (57-79)
15-49	136 (14.3)	135 (14.9)	271 (14.6)
50-64	246 (25.9)	224 (24.8)	470 (25.4)
65-74	227 (23.9)	197 (21.8)	424 (22.9)
75-84	229 (24.1)	239 (26.4)	468 (25.2)
≥85	112 (11.8)	109 (12.1)	221 (11.9)
Gender			
Male	483 (50.8)	487 (53.9)	970 (52.3)
Female	467 (49.2)	417 (46.1)	884 (47.7)
ICD-10[a]			
J15.0	19 (2.0)	376 (41.6)	395 (21.3)
J15.3, J15.5, J15.8	-	3 (0.3)	3 (0.2)
J15.9	931 (98.0)	523 (57.9)	1,454 (78.4)
J18.0	-	2 (0.2)	2 (0.1)
Length of stay (days)			
Mean (SD)	10.6 (6.7)	11.0 (6.8)	10.8 (6.8)
Median	10	11	10
Min-Max	1.0-72.0	1.0-64.0	1.0-72.0
Health insurance (%)			
0[b]	116 (12.2)	105 (11.6)	221 (11.9)
48	20 (2.1)	15 (1.7)	35 (1.9)
60	19 (2.0)	20 (2.2)	39 (2.1)
80	502 (52.8)	483 (53.4)	985 (53.1)
95	53 (5.6)	51 (5.7)	104 (5.6)
100	240 (25.3)	230 (25.4)	470 (25.4)
Comorbidity (%)			
Lung disease	576 (60.6)	499 (55.2)	1,075 (58.0)
Cardiovascular disease	445 (46.8)	456 (50.4)	901 (48.6)
Renal disease	33 (3.5)	52 (5.8)	85 (4.6)
Diabetes	192 (20.2)	163 (18.0)	355 (19.1)
Digestive system disease	417 (43.9)	387 (42.8)	804 (43.4)
Others disease	381 (40.1)	361 (39.9)	742 (40.0)

[Table/Fig-1]: Demographic characteristics of enrolled patients with CAP (N=1,854) by medical setting and comorbidity status between 2015 and 2016 at Trung-VuongHospital, n (%).

Notes:

[a]J15.0: Pneumonia due to *Klebsiella pneumoniae*
J15.3: Pneumonia due to *streptococcus*, group B
J15.5: Pneumonia due to *Escherichia coli*
J15.8: Other bacterial pneumonia
J15.9: Bacterial pneumonia, unspecified
J18.0: Bronchopneumonia, unspecified

[b]Out-of-pocket

Abbreviations: IQR, Interquartile 25&-75% range; SD, Standard Deviation

patients, the total mean age was 66.6±16.5 years in the period of from 2015 to 2016. The group aged 50–64 years accounted for the highest overall number of patients (470 cases; 25.4%). By contrast, the number of patients aged ≥85 accounted for the lowest number, with 221 cases (11.9%). Throughout the survey, the number of patients aged 50–64 was recorded at 246 cases (25.9%) in 2015 and 224 cases (24.8%) in 2016. The number of patients aged ≥85 in 2015 and 2016 were 112 cases (11.8%) and 109 cases (12.1%), respectively. The percentage of CAP cases between males and females did not fluctuate noticeably within the two years (52.3% and 47.7%). The number of males accounted for a slightly higher proportion than the number of females each year. There were 483 males (50.8%) in 2015 and 487 males (53.9%) in 2016.

In this study, ICD-10 was used during the classification of diseases. The results of the research showed that cases diagnosed with CAP were predominantly classified as J15.9 (78.4%). Conversely, the number of cases classified as J15.3, J15.5, J15.8 and J18.0 were a negligible percentage (0.3%). The average treatment time was 10.8±6.8 days but range from one day to 72 days (2015) and 64 days (2016). The insurance reimbursement to the patients was divided into six levels of 0, 48, 60, 80, 95 and 100%, and 80% was the most common reimbursement level, with 985 cases (53.1%), whereas the 48% reimbursement level was of the least common, with only 35 cases (1.9 %). The number of patients with the 80% level accounted for highest proportion each year. Further investigation indicated that the total proportion of 80% reimbursement slightly increased from 2015 to 2016 (from 52.8% to 53.4%). In 2016, the 48% reimbursement proportions the lowest, with 15 cases (1.7%). The 60% reimbursement level was the lowest in 2015, with 19 cases (2.0%). Of the 1,854 participants, 1075 (58.0%) had comorbidity with lung disease, which accounted for the highest percentage of comorbidity. Cardiovascular disease and digestive system disease also had high proportions, at 48.6% and 43.4%, respectively.

Estimated Economic and Disease Burden

[Table/Fig-2] shows the total costs of CAP from 2015 to 2016 at Trung-Vuong Hospital, Ho Chi Minh City. The total costs for healthcare decreased from 2015 to 2016 (from $760,155.2 to $714,060.1, respectively). The average treatment cost per case during 2015–2016 was $795.2/$86.2, with the cost in 2015 ($800.2/$92.5) higher than in 2016 ($789.9/$79.4).

Considering specific health-related costs, the differences between cost components were clearly visible. As shown in [Table/Fig-2], the total cost of CAP in Vietnam was derived from seven components included in: the costs of operations (7.5%), pharmaceuticals (65.9%), diagnostics (6.4%), hospital beds (8.0%), laboratory tests (7.5%), medical supplies (1.9%) and other services (2.7%). In the study period, the highest cost components in 2015 and 2016 were pharmaceuticals, at $504,126.9 (66.3%) and $467,519.1 (65.5%), respectively. By contrast, the lowest cost component was for medical supplies, at $15,653.1 (2.1%) in 2015 and $12,292.1 (1.7%) in 2016. Healthcare payers had to pay higher costs than the patient. From the payer perspective, the healthcare payer paid $1,195,007.8 (81.1%) during 2015–2016 whereas patients paid significantly lower costs, at only $279,207.5 (18.9%) from patient perspective. In 2015, the average treatment costs per case paid by the healthcare payer and patient were $648.0/$80.4 and $152.2/$24.2, respectively. In 2016, these costs for the healthcare payer and patient were $641.0/$69.8 and $148.9/$22.6, respectively.

[Table/Fig-3] shows the results for medical services generally used in the treatment of CAP for the period of 2015–2016. Pharmaceuticals were divided into four groups comprising: antibiotics, drugs affecting the respiratory system, analgesic drugs and other drugs. Pharmaceutical costs for CAP were driven primarily by antibiotics, as $705,487.6 (72.6%) of the pharmaceutical cost for CAP was attributable to antibiotics. The cost of drugs affecting the respiratory system, analgesic drugs and other drugs accounted for only 3.0% ($29,424.7), 3.0% ($29,535.9) and 21.4% ($207,197.8), respectively. In the antibiotics group, five groups of main active ingredients were identified such as: beta-lactam, aminoglycoside, peptide, quinolone and other antibiotic groups. Among these five groups, the costs for beta-lactam were $437,369.3 accounted for 45.0% the costs for total antibiotics whereas the costs for other antibiotics accounted for only 0.3% ($2,946.9). The average number of antibiotic units used was 52.0/18.2.

The costs of diagnostics included the costs of imaging techniques and the costs of physicians. The cost of imaging techniques (99.8%) accounted for the predominant proportion when compared to the cost of the physician (0.2%). Four types of imaging techniques were identified in this study consisted of: radiographs, CT scans, MRI and ultrasonography. Radiographs were the most common, accounting for 52.5%, and incurred the highest cost ($67,326.1; 71.3%). MRI

Cost components	Jan to Dec 2015 (n = 950)			Jan to Dec 2016 (n = 904)			Jan 2015 to Dec 2016 (N = 1,854)		
	Healthcare payer (Total cost, %)	Patient (Total cost, %)	Hospital (Total cost, %)	Healthcare payer (Total cost, %)	Patient (Total cost, %)	Hospital (Total cost, %)	Healthcare payer (Total cost, %)	Patient (Total cost, %)	Hospital (Total cost, %)
Operation	47,410.3 (7.7)	10,115.8 (7.0)	57,526.1 (7.6)	41,520.0 (7.2)	12,230.6 (9.1)	53,750.6 (7.5)	88,930.3 (7,5)	22,346.4 (8,0)	111,276.7 (7.5)
Pharmaceutical	411,662.1 (66.9)	92,464.8 (64.0)	504,126.9 (66.3)	385,011.9 (66.4)	82,507.2 (61.2)	467,519.1 (65.5)	796,674.0 (66,7)	174,972.0 (62,7)	971,646.0 (65.9)
Diagnostic	34,237.1 (5.6)	9,674.8 (6.7)	43,911.9 (5.8)	38,457.0 (6.6)	12,056.2 (9.0)	50,513.2 (7.1)	72,694.1 (6,1)	21,731.0 (7,8)	94,425.1 (6.4)
Hospital bed	42,457.7 (6.9)	10,977.9 (7.5)	53,435.6 (7.0)	52,274.0 (9.0)	12,276.6 (9.1)	64,550.6 (9.0)	94,731.7 (7,9)	23,254.5 (8,3)	117,986.2 (8.0)
Laboratory cost	45,491.1 (7.3)	12,981.9 (9.0)	58,473.0 (7.7)	41,592.4 (7.2)	10,806.5 (8.0)	52,398.9 (7.3)	87,083.5 (7,3)	23,788.4 (8,5)	110,871.9 (7.5)
Medical supplies	12,291.6 (2.0)	3,361.5 (2.3)	15,653.1 (2.1)	9,754.0 (1.7)	2,538.1 (1.9)	12,292.1 (1.7)	22,045.6 (1,8)	5,899.6 (2,1)	27,945.2 (1.9)
Other service utilisation cost	22,034.8 (3.6)	4,993.8 (3.5)	27,028.6 (3.6)	10,813.8 (1.9)	2,221.8 (1.7)	13,035.6 (1.8)	32,848.6 (2,7)	7,215.6 (2,6)	40,064.2 (2.7)
Total cost	615,584.7 (100.0)	144,570.5 (100.0)	760,155.2 (100.0)	579,423.1 (100.0)	134,637.0 (100.0)	714,060.1 (100.0)	1,195,007.8 (100,0)	279,207.5 (100,0)	1,474,215.3 (100.0)
Average treatment cost per case ± SD	648.0±80.4	152.2±24.2	800.2±92.5	641.0±69.8	148.9±22.6	789.9±79.4	644.6±75.2	150.6±23.4	795.2±86.2

[Table/Fig-2]: Economic burden for adjusted community-acquired pneumonia (CAP) at Trung-Vuong Hospital from the healthcare payer, patient and hospital perspectives, 2015–2016, (2017, US dollars).

was the least commonly used, at 0.4%, and had the lowest cost ($238.3; 0.3%). The cost of CT scans was $19,283.3 (20.4%), which was higher than cost of ultrasonography, at $7,375.4(7.8%).

In terms of laboratory tests, serum biochemistry tests accounted for the highest percentage use (54.6%), followed by other tests, microbiological tests and urine biochemistry tests at 28.6%, 14.6%, and 2.2%, respectively. However, the costs for microbiological tests ($77,322.4) accounted for the highest proportion (69.7%) of the laboratory cost. The costs for serum biochemistry tests, urine biochemistry and other tests were $12,972.6 (11.7%), $557 (0.5%) and $20,017 (18.1%), respectively.

In general, the change in the number of drugs used per episode was not significant. The mean number of total drugs in 2015, 2016 and 2015-2016 were 14.6, 14.8 and 14.7, respectively [Table/Fig-4]. Prescribed antibiotics accounted for nearly a quarter for the overall per episode use. Specifically, prescribed antibiotics were 3.4, 2.9 and 3.1 per episode in 2015, 2016 and 2015-2016, respectively.

Sensitivity Analysis

The mean total cost of the two-year period in five age groups increased gradually. The mean cost increased with age groups 15–49, 50–64, 65–74, 75–84, and ≥85 were significant ($406.8/$60.1, $673.9/$93.0, $773.7/$91.6, $943.0/$81.6, and $1,253.7/$90.3; respectively; P<0.001), which meant the higher age groups had higher mean cost. The mean cost among age groups 15–49, 50–64, 65–74, 75–84, and ≥85 in each year also significantly increased (the year 2015: $408.1/$66.9, $658.2/$100.9, $786.7/$98.5, $927.9/$82.6, and $1,346.6/$100.6, respectively; p<0.001 and the year 2016: $405.6/$53.3, $691.0/$84.6, $758.6/$83.7, $957.4/$80.7, and $1,158.2/$77.4, respectively; p<0.001). According to the data in [Table/Fig-5], the average cost per case from 2015 to 2016 was $795.2/$86.2. Healthcare payers paid $644.6/$75.2, which was higher than what the patients paid ($150.6/$23.4). Regarding gender, the average cost paid by male was higher than by female in both year 2015 and 2016. However, the difference in average cost between two groups of gender was not statistically significant (p>0.05)

Sensitivity analysis for CAP treatment, aimed at changing the percentage of total cost [Table/Fig-6], confirmed that the cost of illness (COI) for CAP related to hospitalisation fell to 1.6% when the cost of hospital beds decreased by 20%. Conversely, the figure was likely to decrease to 1.5% if the cost of laboratory tests or operations decreased by 20%. If the costs for diagnostics decreased by 20%, treatment costs would undergo a reduction of 1.3%. This result can be used as a reference in order to improve outcomes and total treatment costs to reduce the economic burden for patients undergoing treatment of CAP.

Characteristic		Jan to Dec 2015				Jan to Dec 2016				Jan 2015 to Dec 2016			
		No.	%	Cost	%	No.	%	Cost	%	No.	%	Cost	%
Pharmaceutical		225,471	100.0	504,126.9	100.0	211,017	100.0	467,519.1	100.0	436,488	100.0	971,646.0	100.0
Total antibiotics		52,388	23.2	395,683.0	78.5	44,104	20.9	309,804.6	66.3	96,492	22.1	705,487.6	72.6
Beta-lactam[a]		35,822	15.9	255,516.6	50.7	27,431	13.0	181,852.7	38.9	63,253	14.5	437,369.3	45.0
Aminoglycoside[b]		3,139	1.4	8,694.6	1.7	2,369	1.1	6,217.7	1.3	5,508	1.3	14,912.3	1.5
Peptide[c]		2,199	1.0	43,364.6	8.6	2,372	1.1	38,701.9	8.3	4,571	1.0	82,066.6	8.4
Quinolone[d]		10,362	4.6	86,625.4	17.2	10,694	5.1	81,567.3	17.4	21,056	4.8	168,192.7	17.3
Other antibiotic groups[e]		866	0.4	1,481.8	0.3	1,238	0.6	1,465.1	0.3	2,104	0.5	2,946.9	0.3
No. antibiotic/patient		55.1 (19.4)				48.7 (17.4)				52.0 (18.2)			
Generic dug		44,716	85.4	274,552.2	69.4	35,568	80.6	223,106.1	72.0	80,284	83.2	497,658.2	70.5
Brand name drug		7,672	14.6	121,130.8	30.6	8,536	19.4	86,698.5	28.0	16,208	16.8	207,829.3	29.5
Drugs affect the respiratory system[f]		27,183	3.1	15,463.3	12.1	31,024	14.7	13,961.4	3.0	58,207	13.3	29,424.7	3.0
Analgesic drugs[g]		23,765	10.5	17,244.2	3.4	21,541	10.2	12,291.7	2.6	45,306	10.4	29,535.9	3.0
Others		122,135	54.2	75,736.4	15.0	123,957	58.7	131,461.4	28.1	246,092	56.4	207,197.8	21.4
Diagnostics		2,136	100.0	43,911.9	100.0	2,409	100.0	50,510.2	100.0	4,545	100.0	94,422.1	100.0
Imaging techniques	Radiographs	1,208	56.6	32,916.2	75.0	1,178	48.9	34,409.9	68.1	2,386	52.5	67,326.1	71.3
	CT Scanner	208	9.7	7,671.5	17.5	329	13.7	11,611.8	23.0	537	11.8	19,283.3	20.4
	MRI	6	0.3	41.5	0.1	12	0.5	196.8	0.4	18	0.4	238.3	0.3
	Ultrasonic	694	32.5	3,217.6	7.3	778	32.3	4,157.8	8.2	1,472	32.4	7,375.4	7.8
Physician		20	0.9	65.1	0.1	112	4.6	133.9	0.3	132	2.9	198.9	0.2
Laboratory test		19,384	100.0	58,470.0	100.0	19,301	100.0	52,399.0	100.0	38,685	100.0	110,869.0	100.0
Serum biochemistry tests		10,390	53.6	6,150.1	10.5	10,750	55.7	6,822.6	13.0	21,140	54.6	12,972.6	11.7
Urine biochemistry tests		368	1.9	139.9	0.2	474	2.4	417.1	0.8	842	2.2	557.0	0.5
Microbiological tests		2,923	15.1	39,513.1	67.6	2,734	14.2	37,809.3	72.2	5,657	14.6	77,322.4	69.7
Other tests		5,703	29.4	12,667.0	21.7	5,343	27.7	7,350.0	14.0	11,046	28.6	20,017.0	18.1
Operation		970	100.0	57,526.2	100.0	1,443	100.0	53,594.0	100.0	2,413	100.0	111,120.2	100.0
Bed-day		10,223	100.0	53,435.5	100.0	10,971	100.0	64,550.6	100.0	21,194	100.0	117,986.1	100.0
Medical supplies		23,310	100.0	15,653.0	100.0	24,970	100.0	12292.1	100.0	48,280	100.0	27,945.3	100.0
Other service utilisation cost		23,897	100.0	27,028.6	100.0	24,281	100.0	13,035.7	100.0	48,178	100.0	40,064.3	100.0

[Table/Fig-3]: [Cost of medical services in the treatment of CAP (n=1,854) from 2015 to 2016 (2017, US dollars).
Notes: [a]Ceftriaxone, Cefixime, Meropenem, Ceftazidime, Cefoperazone + sulbactam, Cefamandol, Amoxicillin + acid clavulanic, Amoxicillin + Sulbactam, Imipenem, Ertapenem, Piperacillin + Tazobactam, Cefetamet, Cefpirome, Ampicillin + Sulbactam, Tiracillin + kali clavulanate, Cefuroxime, Sultamicillin, Cefepime, Cefmetazole; [b]Amikacin, Tobramycin; [c]Vancomycin, Colistin; [d]Levofloxacin, Ciprofloxacin, Moxifloxacin; [e]Metronidazole, Fosfomycin, Nystatin, Linezolid, Clarithromycin, Azithromycin, Clindamycin; [f]Salbutamol, Theophylline, Fenoterol + Ipratropium, Bromhexine, Salmeterol + Fluticasone propionate, Budesonide + Formoterol, Terbutaline, Acetylcystein, Tiotropium, terpin + codeine; [g]Methyl prednisolone, Budesonide, Fentanyl, Hydrocortisone, Paracetamol, Meloxicam, Paracetamol + tramadol, Prednisolone, Paracetamol + Codeine phosphate, Pethidine, Diclofenac, Piroxicam, Morphine sulfate, Celecoxib, Etoricoxib

	Jan to Dec 2015			Jan to Dec 2016			Jan 2015 to Dec 2016		
	No.	Cost	SD	No.	Cost	SD	No.	Cost	SD
Number of drug	13,834	504,126.9		13,347	467,519.1		27,181	971,646.0	
Number of patients	950			904			1,854		
Drugs/episode[a]	14.6	530.7	92.5	14.8	517.2	98.1	14.7	524.1	95.6
Antibiotics/episode[b]	3.4	416.5	121.1	2.9	342.7	102.5	3.1	380.5	111.8
Beta-lactam	2.1	269.0	103.1	1.5	201.2	73.8	1.8	235.9	88.9
Aminoglycoside	0.2	9.2	67.2	0.1	6.9	5.8	0.2	8.0	31.3
Peptide	0.1	45.6	88.2	0.1	42.8	65.6	0.1	44.3	77.1
Quinolone	0.9	91.2	73.6	1.0	90.2	32.1	0.9	90.7	53.0
Other antibiotic groups	0.1	1.6	67.2	0.2	1.6	3.4	0.1	1.6	35.7
Other drugs/episode	11.2	114.2	64.1	11.9	174.5	94.0	11.6	143.6	79.2

[Table/Fig-4]: Structure of drug use per episode from 2015 to 2016 (2017, US dollars)
[a]Cost of drug per episode = Cost of antibiotics per episode + Cost for other drugs per episode.
[b]Cost of antibiotics per episode = Cost per episode of beta-lactam + aminoglycoside + peptide + quinolone + other antibiotics

	Jan to Dec 2015				Jan to Dec 2016				Jan 2015 to Dec 2016			
	Health care payer	Patient	Hospital	p-value	Health care payer	Patient	Hospital	p-value	Health care payer	Patient	Hospital	p-value
Age												
15-49	240.7 (53.8)	167.4 (30.6)	408.1 (66.9)		271.9 (33.7)	133.6 (34.5)	405.6 (53.3)		256.3 (44.4)	150.6 (32.7)	406.8 (60.1)	
50-64	464.8 (77.8)	193.4 (38.1)	658.2 (100.9)		510.9 (68.1)	180.2 (27.7)	691.0 (84.6)		486.7 (73.1)	187.1 (33.3)	673.9 (93.0)	
65-74	638.8 (86.0)	147.9 (19.0)	786.7 (98.5)	<0.001[a]	604.4 (72.4)	154.2 (17.6)	758.6 (83.7)	<0.001[a]	622.8 (79.7)	150.9 (18.3)	773.7 (91.6)	<0.001[a]
75-84	791.2 (74.4)	136.6 (14.9)	927.9 (82.6)		793.7 (73.9)	163.7 (21.8)	957.4 (80.7)		792.5 (74.2)	150.4 (18.9)	943.0 (81.6)	
≥85	1,265.7 (95.2)	80.9 (15.7)	1,346.6 (100.6)		1,096.5 (76.5)	61.7 (8.6)	1,158.2 (77.4)		1,182.2 (86.8)	71.4 (12.8)	1,253.7 (90.3)	
Gender												
Male	645.2 (77.5)	162.7 (22.4)	807.9 (90.9)		672.1 (70.5)	140.5 (18.4)	812.6 (80.3)		658.7 (74.0)	151.5 (20.4)	810.2 (85.5)	
Female	650.8 (83.2)	141.3 (26.0)	792.1 (94.0)	0.803[b]	604.6 (68.8)	158.8 (26.8)	763.4 (78.1)	0.373[b]	629.0 (76.5)	149.6 (26.4)	778.6 (86.7)	0.450[b]
Total	648.0 (80.4)	152.2 (24.2)	800.2 (92.5)		641.0 (69.8)	148.9 (22.6)	789.9 (79.4)		644.6 (75.2)	150.6 (23.4)	795.2 (86.2)	

[Table/Fig-5]: Mean (SD) cost of illness for different ages and genders between 2015 and 2016 (2017, US dollars)
[a]Comparison of average cost between five subgroups (15–49 years, 50–64 years, 65–74 years, 75-84 years and ≥85 years)
[b]Comparison of average cost between two subgroups: male and female

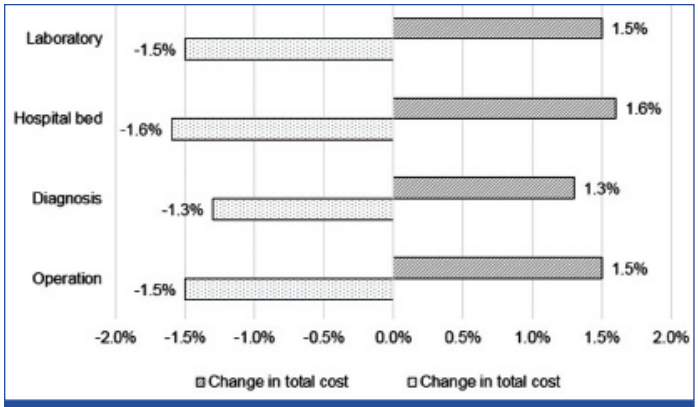
DISCUSSION

The current study was designed to estimate the direct treatment costs of CAP at Trung-Vuong Hospital from 2015 to 2016.

Regarding age, the 50–64 age groups had the highest rate of hospitalisation due to CAP, with 470 patients (25.4%) and the mean age of hospitalisation was 66.6/16.5 years. Gil-Prieto R et al., reported the age group with the highest hospitalisation rate was ≥85 years, and the mean age of hospitalisation was 76/11 years [16]. A study by Jackson ML et al., in Washington state estimated the cost of treating CAP, found that the group aged 65–74 years accounted for the highest proportion, at 53% [5]. The retrospective study of Zhou Q-T et al., based on five years of data (2000–2005) from a Beijing, China hospital, reported an average age for 236 patients of 41.0/19.8 years, which was lower than the age of patients in the study at Trung-Vuong Hospital [17]. In Vietnam, the study conducted in Kien An hospital, Hai Phong province, surveyed 72 patients aged ≥16 diagnosed with CAP from phase 1/2015-7/2016 found that the age of group ≥60 had the highest hospitalisation rate, and accounted for 56.9% of the study population. The average hospitalisation age was 62.51/17.39-year-old [18].

The length of stay in this study was 10.8/6.8 days, which is shorter than that reported in the study by Gil-Prieto R et al., in Spain, at 13/17 days and Zhou Q-T et al., in China at 12.0 days [16,17].

Differences to other studies were also recognized when considering the gender. The present study included 970 males (52.3%) and 884 females (88.7%). Some studies in China, Spain and Vietnam had a higher proportion of males than females [16-18]. For example, the proportion of males in the study by Zhou Q-T et al., was 61.0%, or 144 out of 236 patients [17], whereas in the study by Gil-Prieto R et al., it was 63.9% (178 out of 286 cases) [16]. The study conducted at Kien An hospital in Hai Phong (2016) also had a higher proportion of males (65.9%) than females [18]. However, some studies had higher rates of females with CAP. In particular, the retrospective study of Li A et al., from 2006-2009 in Australia reported the proportion of females as 55% of the 913 study participants [7]. Research by Jackson ML et al., in United States had 58% female [5].



[Table/Fig-6]: Variability of cost-of-illness for community-acquired pneumonia (CAP) according to parameters included in the sensitivity analysis (percentage change in total cost

In comparison to other studies in Vietnam, the economic burden in CAP treatment in this study was much higher. The economic burden of CAP in the period 2015-2016 at Trung-Vuong Hospital was $1,474,215.3, with the highest of $971,646.0 (65.9%). The average treatment cost per case of CAP was $795.2/$86.2. The study by Le P et al., at Bach Mai Hospital mentioned an average treatment

cost for CAP of $318 in 2014 [13]. Quyen BT et al., estimated the average treatment cost per episode was $61.6 in the paediatric Nam Dinh Hospital in 2015 [19]; of which, cost of pharmaceutical was highest (55.29%) and average length of stay was 8.4 days [19]. Compared to studies of some countries around the world, the cost per case for CAP of Trung-Vuong Hospital was lower. The Chinese Ministry of Health reported average hospitalisation costs for CAP was $575.3 in 2005 [20]. In addition, a study by Doruk S et al., conducted in Turkey, estimated the average direct costs for CAP among 114 patients with an average age of 70.9-year-old as 1630.77 Euro in 2009 [9].

Medications were the vital expenditure in CAP treatment, especially for antibiotics. In the period 2015–2016, the mean cost for total drugs per episode was $524.1/$95.6 and for antibiotics was $380.5/$111.8. Of the 3.1 antibiotics used per episode, beta-lactam had the highest number of uses (1.8). Quinolone, aminoglycoside, peptide, and other antibiotic groups followed, with of 0.9, 0.2, 0.1 and 0.1 uses. In 2015, the mean cost for total drugs in an episode was $530.7/$92.5 and for antibiotics was $416.5/$121.1. In 2016, a patient had to pay $342.7/$102.5 for drugs, of which $342.7/$102.5 was for antibiotics. According to the antibiotics group, this study found that the cost of generic drugs ($497,658.2; 70.5%) was higher than the cost of brand name drugs ($207,829.3; 29.5%). In Vietnam, health insurance was compulsory to all citizens but with different co-payment due to his/her priority (e.g., the disabled was free for most of healthcare services, the poor was co-paid 80-95% by the third-party). However, the health insurance system was not applied in private but public hospital and for certain low-price pharmaceuticals. Trung-Vuong was under health insurance payment so that branded medicines which were much more expensive than generic counterparts were not commonly prescribed.

CONCLUSION

Cost evaluations provide critical data for economic evaluations. The direct medical costs of hospitalisation at Trung-Vuong Hospital, Vietnam indicate a heavy economic burden on patients, their families as well as for healthcare payers. The findings of this study which provided researchers and policy-makers with a better understanding of the CAP treatment cost might be a useful reference when setting goals and priorities for healthcare programs.

ACKNOWLEDGEMENTS

The authors would like to express gratitude to Ms Nguyen Thi Sau and Mr Dao Duc Minh for their kind help in this study. Special thanks go to the board of directors and the hospital staff for providing the opportunity to conduct the research.

REFERENCES

[1] Sterrantino C, Trifiro G, Lapi F, Pasqua A, Mazzaglia G, Piccinni C, et al. Burden of community-acquired pneumonia in Italian general practice. The European Respiratory Journal. 2013;42(6):1739-42.
[2] Morimoto K, Suzuki M, Ishifuji T, Yaegashi M, Asoh N, Hamashige N, et al. The burden and etiology of community-onset pneumonia in the aging Japanese population: a multicenter prospective study. PloS one. 2015;10(3):e0122247.
[3] File TM, Jr., Marrie TJ. Burden of community-acquired pneumonia in North American adults. Postgraduate Medicine. 2010;122(2):130-41.
[4] Giorgi Rossi P, Agabiti N, Faustini A, Ancona C, Tancioni V, Forastiere F, et al. The burden of hospitalised pneumonia in Lazio, Italy, 1997-1999. The international journal of tuberculosis and lung disease: the official journal of the International Union against Tuberculosis and Lung Disease. 2004;8(5):528-36.
[5] Jackson ML, Neuzil KM, Thompson WW, Shay DK, Yu O, Hanson CA, et al. The burden of community-acquired pneumonia in seniors: results of a population-based study. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America. 2004;39(11):1642-50.
[6] Ministry of Health Vietnam. Quyet dinh 101/QD-BYT: Huong dan xu tri Viem phoi cong dong o Tre em. 09/01/2014.
[7] Li A, Newall AT, Britt H, Macintyre CR. The cost and disease burden of pneumonia in general practice in Australia. Vaccine. 2012;30(5):830-31.
[8] Scott G, Scott H, Turley M, Baker M. Economic cost of community-acquired pneumonia in New Zealand adults. The New Zealand Medical Journal. 2004;117(1196):U933.
[9] Doruk S, Tertemiz KC, Komus N, Ucan ES, Kilinc O, Sevinc C. Community acquired pneumonia and direct hospital cost. Tuberkuloz Ve Toraks. 2009;57(1):48-55.
[10] Xue X, Gao Z. Comparison between the severity criteria of the Chinese guidelines for community acquired pneumonia and Fine's risk classes. Zhonghua jie he he hu xi za zhi = Zhonghua jiehe he huxi zazhi = Chinese journal of tuberculosis and respiratory diseases. 2002;25(12):719-22.
[11] Tumanan-Mendoza BA, Mendoza VL, Punzalan FER, Reganit PFM, Bacolcol SAA. Economic Burden of Community-Acquired Pneumonia among Adults in the Philippines: Its Equity and Policy Implications in the Case Rate Payments of the Philippine Health Insurance Corporation. Value in Health Regional Issues. 2015;6:118-25.
[12] Anh DD, Riewpaiboon A, Tho le H, Kim SA, Nyambat B, Kilgore P. Treatment costs of pneumonia, meningitis, sepsis, and other diseases among hospitalized children in Viet Nam. Journal of Health, Population, and Nutrition. 2010;28(5):436-42.
[13] Le P, Griffiths UK, Anh DD, Franzini L, Chan W, Pham H, et al. The economic burden of pneumonia and meningitis among children less than five years old in Hanoi, Vietnam. Tropical medicine & international health: TM & IH. 2014;19(11):1321-27.
[14] International Classification of Diseases, 10th version World Health Organization [cited 2017 Jan 1st]. Available from: http://apps.who.int/classifications/icd10/browse/2016/en#!/IX.
[15] Chaikledkaew U, Vo TQ, Hoang MV, Nguyen HT, Riewpaiboon A. Hospital service cost analysis in developing countries: a method comparision in Vietnam. Forthcoming. 2016.
[16] Gil-Prieto R, García-García L, Álvaro-Meca A, Méndez C, García A, Gil de Miguel Á. The burden of hospitalisations for community-acquired pneumonia (CAP) and pneumococcal pneumonia in adults in Spain (2003–2007). Vaccine. 2011;29(3):412-16.
[17] Zhou Q-t, He B, Zhu H. Potential for cost-savings in the care of hospitalized low-risk community-acquired pneumonia patients in China. Value in Health. 2009;12(1):40-46.
[18] Khoi Noi-Nhi Benh vien tinh Kien An. Nghien cuu dac diem LS,CLS va KQ dieu tri viem phoi cong dong tai BV Kien An 2015-2016. 2016.
[19] Quyen BT. Phan tich chi phi dieu tri viem phoi mac phai o cong dong tai benh vien nhi tinh Nam Dinh nam 2015. Luan van Duoc si chuyen khoa I. 2015.
[20] Ministry of Health of the People's Republic of China. China health statistical yearbook 2006 [cited December 29, 2006].

PARTICULARS OF CONTRIBUTORS:
1. Lecturer, Department of Pharmacy Administration, Faculty of Pharmacy, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam.
2. Graduate Student, Department of Pharmacy Administration, Faculty of Pharmacy, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam.
3. Director, Ear-Nose-Throat Hospital, Ho Chi Minh City, Vietnam.
4. Staff, Ear-Nose-Throat Hospital, Ho Chi Minh City, Vietnam.
5. Vice-director, Department of Health Insurance, Ministry of Health, Hanoi, Vietnam.
6. Lecturer, Department of Pharmacoeconomics and Management, Hanoi University of Pharmacy, Hanoi, Vietnam.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Trung Quang Vo,
Lecturer, Department of Pharmacy Administration, Faculty of Pharmacy, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City 700000, Vietnam.
E-mail: voquangtrungdk@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Jan 26, 2018**
Date of Peer Review: **Mar 13, 2018**
Date of Acceptance: **May 07, 2018**
Date of Publishing: **Jun 15, 2018**