Economic Burden of Hospitalization with Acute Wheezing in Preschool Children: A Multi-Center Study

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Background: *Wheezing is an important health problem in Thailand especially among preschool age.*
Objective: *The aim of this study was to estimate costs of wheezing for hospitalization in preschool children under patient, provider, and societal perspectives.*
Material and Method: *Two hundred and thirty-four participants who were admitted with acute wheezing at 4 hospitals including Thammasat University Hospital, Saraburi Hospital, Bhumibol Adulyadej Hospital and King Chulalongkorn Memorial Hospital during July 2014 to June 2015 were included in the present study. Data from hospital financial database and caregivers' expenses were collected. Cost-to-charge ratio method was employed for valuation of direct medical costs. Informal care costs were determined by human capital approach.*
Results: *The means of patient, provider and societal costs per admission were 3,020 THB (SD = 6,632 THB), 18,126 THB (SD = 16,898 THB), and 20,269 THB (SD = 20,537 THB) respectively. The main cost component in provider and societal perspective were accommodation costs during admission. Informal care cost was a major cost component for direct non-medical costs. The economic burden of acute wheezing admission of preschool children in Thailand was estimated as 759 million THB per year.*
Conclusion: *These costs of illness analysis provided an evidence of economic burden and costs of preschool wheezing in hospitalization in Thailand.*

Keywords: *Preschool wheezing, Economic burden, Cost*

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Economics of healthcare are increasingly important because health budgets cannot meet all possible demands and choices have to be made as to the best use of resources. Estimation costs of providing healthcare can help to identify potential cost savings by adoption of cost-effective healthcare technologies. Diseases can cause economic loss in several ways including direct costs through resource consumption and indirect costs through loss of activities.

Asthma, a chronic inflammation of the airways, represents a major public health problem of increasing concern worldwide[1]. It is associated with the loss of future potential earnings related to both morbidity and mortality[2]. Preschool wheeze can precede the development of asthma in later life and has an impact on the quality of life of children and their families[3]. In Singaporean children, it is estimated that 25% have wheezing before age of 2 years[4]. Preschool wheezing burden included not only healthcare costs but also costs of time off work for caregivers[5]. In the UK, it is estimated that the total annual costs of the healthcare service, family and society for 1-5 year-olds with wheezing were 53 million Great British Pound (GBP) or 0.15% of total national health service (NHS) expenditure in 1998/1999[6]. In Thailand, only few studies of economic burden of wheezing have been reported. Therefore, the present study aims to explore costs of hospitalization with acute wheezing in preschool children and to estimate their economic burden in Thailand.

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Material and Method

This study was carried out during the 12-month period during July 2014 to June 2015, at four hospitals including Thammasat University Hospital in Pathumthani, Bhumibol Adulyadej Hospital and King Chulalongkorn Memorial Hospital in Bangkok, and Saraburi Hospital in Saraburi, Thailand. The study was approved by the human ethics committee of all four hospitals.

Study population

The study enrolled pediatric patients, aged between 6 months and 5 years, who were admitted to the studied hospitals with acute wheezing, either the first or recurrent episodes. The informed consents were obtained from their caregivers. They would be excluded from the study if they had onset of wheezing in perinatal period and chronic diseases including congenital heart diseases, bronchopulmonary dysplasia, structural airway malformation, acquired immune deficiency syndrome (AIDs), and cerebral palsy.

Study design

The study design was prevalence-based cost of illness analysis, employed three perspectives, including patient, provider, and societal perspectives. These different perspectives affected to the identification of resources utilization for wheezing treatment. Under the provider's perspective, only direct medical costs were included in the cost analysis. While a cost analysis under societal perspective included direct medical costs, direct non-medical costs and indirect costs. All out-of-pocket expenses related to wheezing were included in patient's perspective.

All resources used for treatment of wheezing, before hospitalization, during hospitalization and after hospitalization, were identified. The costs incurred before hospitalization were costs of treatment at primary care center, drug store or private clinic depending on the episode of wheezing. During hospitalization, accommodation costs and costs of medication, laboratory, imaging, nursing care, treatment procedures and fees for service were identified as direct medical costs. The costs related to the episode of wheezing after hospitalization, e.g. fee for service at outpatient department (OPD) or additional costs of treatment were explored. In all periods of the study, direct non-medical costs including costs of traveling, extra-food and costs of caregivers were identified.

Resource utilization during hospitalization of each patient was determined by using the out-patient and in-patient financial hospital electronic database. All patients' expenses and length of stay (LOS) were collected. A structured interview was conducted to collect all the costs incurred before hospitalization, after hospitalization as well as the direct non-medical costs during hospitalization.

The valuation of admission costs or direct costs in the present study employed the cost-to-charge ratio (CCR) method. The cost-to-charge ratio for each hospital was obtained from a published study[5] provided an average cost-to-charge ratio of all categories of patient's expenses in teaching hospitals and hospitals of the Ministry of Public Health (MOPH) in Thailand. The expenses gathered from hospital database were multiplied by cost-to-charge ratio associated to its category to reveal the economic costs of wheezing treatment during hospitalization. For time costs of caregiver incurred due to leaving their work to take care their child before, during, and after the hospitalization. The valuation of productivity losses were done by human capital approach method using minimum wage rate per day in 2015. For patient's perspective, all out-of-pocket expenses related to wheezing were determined as patients' costs.

Statistical analysis

Descriptive statistics, mean, standard deviation, proportion were used to summarize total costs for each perspective and each cost component.

Results

Demographics

234 hospitalized pediatric patients with acute wheezing were included in this study. Of those, 98 (42%), 85 (36%), 30 (13%) and 21 (9%) were recruited from Thammasat University Hospital, Saraburi Hospital, Bhumibol Adulyadej Hospital and King Chulalongkorn Memorial Hospital, respectively. The mean age was 27 months (SD = 12 months) with boys representing 63 percent. Most of them had universal coverage scheme for health insurance.

Provider costs

The total hospitalization costs for 234 patients were 4,241,574 Thai baht (THB). An average hospitalization cost per patients was 18,126 THB (SD = 16,898 THB) as shown in Table 2. Under provider perspective, direct medical costs were evaluated for cost components. Accommodation costs were the major cost component of the total hospitalization costs (37.52%). They consisted of costs of routine services

Table 1. Demographic data of patients and caregivers (n = 234)

Demographic data of patients	Mean ± SD or N (%)
Age (months)	27±12
Sex (boys/girls)	148 (63)/86 (37)
Health insurance	
Universal coverage (UC)	51 (22)
Civil servant medical benefit scheme (CSMBS)	27 (12)
Private	156 (66)
Demographic data of Caregivers	**Mean ± SD or N %**
Age (years)	32±13
Education	
Lower than bachelor's degree	176 (75)
Bachelor's degree	40 (17)
Higher than bachelor's degree	18 (8)

Table 2. Cost analysis of preschool wheezing, provider's perspective (n = 234)

Cost components	Hospitalization costs (THB)				
	Sum	Mean	Median	IQR	%
Direct medical costs					
Accommodation costs	1,591,646	6,802	4,256	2,432-7,868	37.5
Nursing care costs	1,075,139	4,595	2,796	1,599-5,126	25.3
Medical supply costs	667,154	2,851	1,875	839-3,399	15.7
Medicine costs	496,941	2,124	1,268	474-2,407	11.7
Laboratory costs	340,894	1,457	1,033	360-1,715	8.0
Imaging costs	40,353	172	150	114-205	1.0
Procedure costs	22,740	97	0	0	0.5
Rehabilitation costs	6,707	134	0	0-210	0.2
Total hospitalization costs	4,241,574	18,126	12,782	8,455-22,071	100.00

in inpatient wards, inpatient rooms, food and facilities. The next important cost components were nursing care costs (25.35%), medical supply costs (15.73%) and medication costs (11.72%). The average provider costs of medical school's teaching hospitals including Thammasat University Hospital and King Chulalongkorn Memorial Hospital, were higher than non-medical school hospitals including Bhumibl Adulyadej Hospital and Saraburi Hospital (23,475±19,924 THB vs. 12,684±10,743 THB), not shown in the table.

Societal costs

The total societal costs for 183 patients with acute wheezing were 3,709,146 THB. The average societal costs were 20,269 THB (SD = 20,537 THB) per patient. Most of societal costs were incurred during hospitalization (94.59%). The costs incurred before and after hospitalization were 5.22% and 0.19%, respectively. The average direct medical costs for all period were 18,005 THB (88.83%) and direct non-medical costs were 1,098 THB (5.42%). The time costs of parents or informal care was a major cost component of total direct non-medical costs. The informal care costs accounted for 5.83% of total societal costs (Table 3).

Patient costs

The total costs under patient's perspective were 577,072 THB. The average patient costs were 3,020 THB (SD = 6,632 THB) per patient. Most of patient

costs incurred during hospitalization (68.89%). The costs incurred before and after hospitalization were 29.76% and 1.35%, respectively. From patient's perspective, it is indicated that for all periods, total direct medical costs were much higher than direct non-medical costs (63.22% vs. 36.78%), but during hospitalization, the proportion of direct non-medical costs including traveling and extra-food costs were higher than other perspectives, as shown in Table 4.

Economic burden of hospitalization due to acute wheezing in preschool children

An economic burden of preschool wheezing was explored in the present study. A total population of age 0-5 years in Thailand in 2015 was 4.46 million of children. The prevalence of wheezing in preschool children was not reported yet, but there was a report of the prevalence of asthma in Thai children that was approximately 10%[6]. This study employed such prevalence to estimate economic burden of wheezing. Trakultivakorn et al[6] also reported an admission rate of asthma in Thailand as 8.4%. The societal costs of preschool wheezing were 20,269 THB for each episode. Thus, the economic burden of preschool wheezing who were admitted in the hospital was 759 million THB.

Discussion

This present study explored the costs of preschool wheezing in different perspectives. The

Table 3. Cost analysis of preschool wheezing, societal perspective (n = 183)

Cost components	Costs (THB)				
	Sum	Mean	Median	IQR	%
Before hospitalization					
Direct medical costs	139,790	984	0	0-300	3.77
Direct non-medical costs					
Traveling costs	18,020	128	0	0-100	0.49
Extra-food costs	10,600	74	0	0	0.29
Hired caregivers	3,300	23	0	0	0.09
Informal care costs	21,900	120	0	0	0.59
Total cost before hospitalization	193,610	1,058	0	0-445	5.22
During hospitalization					
Direct medical costs					
Accommodation costs	1,325,834	7,245	4,496	2,544-7,868	35.74
Nursing care costs	756,487	4,134	2,394	1,460-4,509	20.40
Medical supply costs	467,897	2,557	1,753	630-2,982	12.61
Medicine costs	291,433	1,593	1,033	635-1,693	7.86
Laboratory costs	253,618	1,386	764	258-1,526	6.84
Imaging costs	30,348	166	150	0-205	0.82
Procedure costs	20,040	110	0	0	0.54
Rehabilitation costs	6,707	134	0	0-210	0.18
Direct non-medical costs					
Traveling costs	70,992	401	120	100-300	1.91
Extra-food costs	87,240	490	200	200-500	2.35
Hired caregivers costs	5,500	34	0	0	0.15
Informal care costs	192,300	1,051	900	0-1,650	5.18
Total costs during hospitalization	3,508,396	19,172	13,481	9,799-217,84	94.59
After hospitalization					
Direct medical costs	2,775	24	0	0	0.07
Direct non-medical costs					
Traveling costs	2,490	22	0	0	0.07
Extra-food costs	2,550	22	0	0	0.07
Informal care costs	2,100	18	0	0	0.06
Total cost after hospitalization	7,140	39	0	0	0.19
Total societal costs	3,709,146	20,269	14,159	10,265-22,610	100.00

highest cost was evident by calculation under societal perspective. The societal costs included all resource utilizations during hospitalization costs, out-of-pocket expenses by family and also time cost of family and caregivers. While the provider costs composed of only direct medical costs during hospitalization and the patient costs included out-of-pocket expensed and time cost of caregivers. The main cost component in provider perspective was accommodation costs as well as those in societal perspective. But for patient perspective, informal care or time cost of caregivers was the major cost component instead of accommodation costs because patient's insurance was allowed to reimburse room and food expenses, essential drug, and other direct medical costs. So the direct medical costs of patient costs were less than other perspectives. The strength of this study is that analyses were performed for each perspective. Costs, before and after hospitalization, of each wheezing episode were taken into account.

Prevalence and admission rate of preschool wheezing in Thailand has not been reported. The present study employed the data of prevalence and admission rate of asthma in children in Thailand instead. Therefore, the economic burden of wheezing may be overestimated. Since the patients in the study were not in the labor market, morbidity costs or productivity loss from wheezing did not included in the societal costs. The productivity loss or time cost of caregivers was identified as informal care costs which were categorized to direct non-medical costs, instead of indirect costs. The finding revealed the importance of informal care costs. Informal care for preschool wheezing attributed to 5.73% of total societal costs.

Concerning period of illness, costs that incurred before and after hospitalization within 2 weeks were calculated although most of costs incurred during hospitalization. The findings reflected all resource

Table 4. Cost analysis of preschool wheezing, patient's perspective (n = 185)

Cost components	Costs (THB)				
	Sum	Mean	Median	IQR	%
Before hospitalization					
Direct medical costs	139,790	749	0	0-150	24.22
Direct non-medical costs					
Traveling costs	18,020	97	0	0-60	3.12
Extra-food costs	10,600	59	0	0	1.84
Hired caregivers	3,300	18	0	0	0.57
Total cost before hospitalization	171,710	912	0	0-370	29.76
During hospitalization					
Direct medical costs					
Accommodation costs	174,700	876	0	0	30.27
Nursing care costs	25,500	138	0	0	4.42
Medical supply costs	12,213	66	0	0-6	2.12
Medicine costs	12,527	68	0	0-50	2.17
Laboratory costs	8,875	64	0	0	1.54
Direct non-medical costs					
Traveling costs	70,992	382	100	100-300	12.30
Extra-food costs	87,240	460	200	150-500	15.12
Hired caregivers costs	5,500	30	0	0	0.95
Total costs during hospitalization	397,547	2,081	578	350-1,865	68.89
After hospitalization					
Direct medical costs	2,775	97	0	0	0.48
Direct non-medical costs					
Traveling costs	2,490	13	0	0	0.43
Extra-food costs	2,550	14	0	0	0.44
Total cost after hospitalization	7,815	42	0	0	1.35
Total patient costs	577,072	3,020	900	400-2,811	100.00

utilization from seeking for wheezing care after wheezing onset by self-medication, consulting pharmacist at drug store or healthcare practitioners at primary care center or private clinic. While 2 weeks after hospital discharge, the costs still incurred e.g. some patients needed a follow-up at hospital or caregivers must leave their work to take care their child at home. These costs were determined about 5.41% of societal costs and 31.11% of patient costs of wheezing care. Accommodation coststhat were the major cost component for provider perspective (37.52%) depends on length of stay (LOS), with an average LOS of 4.53±2.47 days. Therefore, reduction of LOS will be of concern for hospital cost containment.

The societal costs comprising direct medical costs of 88.83% and direct non-medical costs of 5.42% in the present study were comparable to the results from the study of cost of asthma in Wangthong Hospital, Pitsanulok by Chalermpanchai N, el al[7]. The study in Wangthong Hospital reported the direct medical costs, direct non-medical costs, and indirect costs of 81.3%, 11.3% and 7.4%, respectively. Under societal perspective, Gypmantasiri S[8] reported that average costs of asthma per person per year were higher in adults (16,287 THB) compared to those in pediatric patients (8,009 THB). In the present study, the average costs of 20,269 THB per one episode of hospitalization for acute wheezing was much higher than the report of 5,809 THB per admission of asthmatic patient in Surin Hospital in the northeastern Thailand[9] in 2007. This can be explained by differences in age group, diagnosis, and also differences in cost identification, cost measurement and cost valuation.

The economic burden of atopic diseases of young children in Thailand was reported to be 7,800 million THB by Ngamphaiboon et al[10] in 2012. The major cost component was from medication (46%), followed by in-patient care (37%) and out-patient care (12%), respectively. This figure is different from the results in this study for which the utilized medication costs were only 11.72% of direct medical costs; but the costs from in-patient care were comparable.

The economic burden of preschool wheezing has been reported in the UK. The total annual costs of the healthcare service, family and society for 1-5 years old with wheezing were 53 million GBP or 0.15% of total NHS expenditure in 1998/1999[6]. This confirms the importance of preschool wheezing. To reduce economic burden of preschool wheezing, environment manipulation, such as reduce tobacco smoke exposure, allergen avoidance and parent and patient education, should be managed.

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What is already known on this topic?

Costs of asthma in children including direct and indirect costs have been reported in Thailand.

What this study adds?

Costs of hospitalization with acute wheezing in preschool children were estimated as 759 million THB per year. Informal care cost was the major cost component.

Potential conflicts of interest

None.

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การศึกษาภาระทางเศรษฐศาสตร์ของผู้ป่วยเด็กก่อนวัยเรียนที่มีภาวะหายใจหอบเฉียบพลันและมีเสียงวี้ดที่รับไว้รักษาในโรงพยาบาล: การวิจัยสหสถาบัน

ภาสกร ศรีทิพย์สุโข, ศศวรรณ ชินรัตนพิสิทธิ์, กล่องทิพย์ มัชฌิมดำรง, จิตลัดดา ดีโรจนวงศ์

ภูมิหลัง: *ภาวะหายใจหอบเฉียบพลันและมีเสียงวี้ดเป็นปัญหาสุขภาพที่สำคัญในเด็กก่อนวัยเรียน*

วัตถุประสงค์: *เพื่อประเมินต้นทุนของการรักษาภาวะหายใจหอบมีเสียงวี้ดในเด็กก่อนวัยเรียนที่รับไว้ในโรงพยาบาลภายใต้มุมมองของสังคม มุมมองของสถานพยาบาล และมุมมองของผู้ป่วย*

วัสดุและวิธีการ: *ได้เก็บข้อมูลจากผู้ป่วย 234 รายที่เข้ารับการรักษาเป็นผู้ป่วยในของโรงพยาบาล 4 แห่ง คือ โรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ โรงพยาบาลสระบุรี โรงพยาบาลภูมิพลอดุลยเดช และโรงพยาบาลจุฬาลงกรณ์ สภากาชาดไทย ระหว่างเดือนกรกฎาคม พ.ศ. 2557 ถึง มิถุนายน พ.ศ. 2558 โดยเก็บข้อมูลจากฐานข้อมูลการเงินของโรงพยาบาลและการสัมภาษณ์ผู้ดูแลผู้ป่วย ใช้อัตราส่วนต้นทุนต่อมูลค่าเรียกเก็บของโรงพยาบาลในการประเมินค่าต้นทุนทางตรงทางการแพทย์ และประมาณค่าต้นทุนการดูแลอย่างไม่เป็นทางการของผู้ดูแลด้วยวิธีแนวทางต้นทุนมนุษย์*

ผลการศึกษา: *ค่าเฉลี่ยต้นทุนของการนอนโรงพยาบาลในมุมมองของสังคม, สถานพยาบาลและผู้ป่วยเท่ากับ 20,269 บาท (ส่วนเบี่ยงเบนมาตรฐาน 20,537 บาท), 18,126 บาท (ส่วนเบี่ยงเบนมาตรฐาน 16,898 บาท) และ 3,020 บาท (ส่วนเบี่ยงเบนมาตรฐาน 6,632 บาท) ตามลำดับ องค์ประกอบต้นทุนหลักในมุมมองของสังคมและมุมมองสถานพยาบาล คือ ต้นทุนค่าห้องและค่าอาหารระหว่างการนอนโรงพยาบาล ต้นทุนการดูแลอย่างไม่เป็นทางการเป็นองค์ประกอบต้นทุนหลักของต้นทุนทางตรงที่ไม่เกี่ยวกับการแพทย์ ภาระทางเศรษฐศาสตร์สำหรับผู้ป่วยเด็กก่อนวัยเรียน ที่มีภาวะหายใจหอบและมีเสียงวี้ดที่มีการนอนโรงพยาบาลเท่ากับ 759 ล้านบาทต่อปี*

สรุป: *การศึกษานี้บ่งชี้ภาระทางเศรษฐศาสตร์และต้นทุนความเจ็บป่วยของเด็กก่อนวัยเรียนที่มีภาวะหายใจหอบและมีเสียงวี้ดที่รับรักษาในโรงพยาบาล*