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RESEARCH ARTICLE

INFECTIVE VERSUS NON-INFECTIVE RESPIRATORY ILLNESS ADMISSIONS: COMPARATIVE COST ANALYSIS IN A TERTIARY HOSPITAL IN MALAYSIA

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ABSTRACT

BACKGROUND:

Severe Acute Respiratory Infection (SARI) that is mainly caused by the Influenza virus, poses a significant public health threat, demanding timely detection and preventive measures. This study assesses the financial implications of managing two distinct respiratory conditions: SARI and Acute Exacerbation of Bronchial Asthma (AEBA).

METHOD:

Data were collected for 100 patients, with 50 cases of SARI and 50 cases of AEBA, admitted to Hospital Canselor Tuanku Muhriz (HCTM) from July to December 2022. Cost analysis was conducted from a provider perspective, considering factors such as building, asset, emolument, overhead, utility, medication, consumables, and laboratory and imaging expenses.

RESULTS:

The study revealed that the average total cost of treating SARI patients was RM 1,587.11 ($US334.80), significantly higher (30.7%) than AEBA patients at RM 1,214.41 ($US256.18). This was mainly due to the acute and severe nature of SARI, requiring more intensive medical interventions, potentially leading to complications and greater strain on healthcare resources. The study highlighted the economic challenges posed by SARI, provided valuable insights for resource allocation and public health planning. The study's limitations include retrospective data collection and potential underestimation of actual costs due to top-down costing methodology.

CONCLUSION:

SARI, especially in the elderly population, leads to substantial healthcare costs and economic impact. Effective preventive measures, such as vaccination, are crucial in reducing the burden of influenza-related illnesses. Health financing plays a vital role in addressing communicable diseases and ensuring the well-being of the population.

KEYWORDS

influenza; hospital management; health financing; cost analysis

BACKGROUND

Severe Acute Respiratory Infection (SARI) is an emerging respiratory infection diagnosis, which is currently closely linked to COVID-19. According to the World Health Organisation (WHO), SARI is diagnosed when an individual has an acute respiratory infection with symptoms within 10 days after presentation, a cough, a fever, and hospitalisation [1]. By using these criteria for diagnosis, global influenza surveillance is standardised, although not every case will be detected. Influenza is a primary contributor to SARI, including pneumonia, and is linked to significant illness and death on a global scale. The elderly population is especially susceptible to influenza and has an increased likelihood of experiencing serious consequences, such as pneumonia, that can result in hospitalisation and mortality [2,3]. This might lead to increased healthcare expenses as a result of the requirement for intensive care and hospitalisation [4].

SARI is often compared to acute exacerbation of bronchial asthma (AEBA) which is a non-infective respiratory condition. While both SARI and AEBA are respiratory conditions, their preventive measures differ. SARI prevention focuses on general hygiene, vaccination and infection control; whereas AEBA prevention revolves around managing asthma effectively and avoiding specific triggers that can lead to exacerbations [1]. The cost of admission for influenza in the United States (US) was estimated to be $US8,330 for hospitalised patients aged 65-84 years old which was mainly due to their prolonged stay in hospital [5]. The annual per-person medical cost of asthma in the US was $US3,266, with $US529 for hospitalizations and $US105 for emergency room care [6].

An increasing rate of influenza infection can have a significant impact on public health, healthcare systems and the economy; primarily due to the associated rise in admissions for respiratory complications, especially SARI [2,7]. This leads to some serious consequences such as increased in hospital admissions, strain on healthcare resources, higher morbidity and mortality rates, increased healthcare costs, healthcare financing challenges and economic impact [2,8]. The function of health financing is of utmost importance to effectively addressing and the management of communicable illnesses. Communicable diseases encompass a range of disorders that possess the ability to be transmitted from one individual to another. Examples of such diseases include HIV/ AIDS, tuberculosis, malaria, COVID-19, and a variety of vaccine-preventable disease. The importance of health financing in combating communicable diseases include prevention and control, early detection and surveillance, research and development, health infrastructure, treatment and care, and emergency response [9]. The aim of this study is to assess the financial implications associated with the admission and management of two distinct respiratory conditions: SARI, which is infectious in nature, and AEBA, which is non-infectious.

MATERIAL AND METHOD

The study involved Hospital Canselor Tuanku Muhriz, Kuala Lumpur, Malaysia (HCTM) SARI and for AEBA patients from July 1 to December 31, 2022. Patients that were in the ICD-10-coded HCTM casemix database who were admitted for SARI and AEBA were in the sampling frame. 100 patients (50 SARI and 50 AEBA) were recruited by simple random sampling as they are representative of the patient population and there is limited variability among the SARI and AEBA patients [7]. All SARI and AEBA patients, irrespective of whether being primary or secondary diagnosis and severity of the illnesses, were included in the study sample. Relevant information was obtained from these patients' medical records in the Medical Record Department. This provider-based cost analysis focused on HCTM medical ward patients. All prices are in Ringgit Malaysia (RM) and $US Dollars afterward. The number of medical staff working on a patient (human resource), diagnostic procedures, medications, medical procedures, items used on patients in the Emergency Department (ED) and medical ward, and Average Length of Stay (ALOS) are collected from patient files. Data were entered into a Microsoft Excel spreadsheet for calculation.

Each patient's inpatient treatment costs were determined. The fee included the stay, bed occupancy, laboratory testing, imaging studies, and ED and medical ward items. Emolument costs were sourced from Public Services Commission of Malaysia's website [10], while procedural costs were from HTCM's Department of Finance which included capital costs. Medication and consumable costs were sourced from the Pharmaceutical Services Department, Ministry of Health Malaysia website and local public hospital statistics [11]. This study uses step-down and activity-based costing. Step-down costing is utilised when departments or activities pool resources to deliver a result. The ED and Medical Ward treat a variety of diagnoses and

undertake procedures. To estimate the cost, total expenditures were divided by a measure of chosen allocation parameters (number of patients admitted) to get the average cost per patient per admission. Capital (building, equipment over RM500 per unit) and recurrent (utilities, maintenance) expenditures were evaluated using this method. On the other hand, ABC costs analysis is calculated for individual activities namely direct manpower, investigations, consumables and medications [12].

HCTM building cost was computed using 26 years of life expectancy and 5% discount rate. A 14.375 annualization factor was employed. The building's value was proportional to the medical ward's floor space employed for studied activities [12]. The cost of an electrocardiogram (ECG) machine was discounted over 10 years at 5%. The annualization factor was 7.722. All healthcare workers who manage SARI or AEBA patients receive basic pay, bonuses, and allowances for the year. Time spent on important tasks like ward reviews and medical procedures determined the cost. Health care workers' gross salary was divided by 8640 to get their emolument cost per minute [12]. This assumes 18 working days per month, 8 hours per day, 60 minutes per day = 8,640 minutes. Consumables costs include all drug and non-drug purchases (medical procedure material, disposable gloves and other associated products). Utility expenditures are allocated to the activity's floor space and include water, power, telephone, waste management, and others. Finally, the total cost of therapy for each patient was computed to include all their expenses while in the HCTM Medical Department for SARI and AEBA diagnoses. SARI and AEBA patients' total costs were then compared.

This study was approved by the Ministry of Health Medical Research Ethics Committee and HCTM, Universiti Kebangsaan Malaysia Research Ethical Committee. Permission to use this secondary data for publication purposes was also obtained. No patient-identifiable information was recorded; thus, the confidentiality of each patient is maintained.

RESULTS

Patients in this study were admitted for either SARI or AEBA between 1 July and 31 December 2022 in HCTM. In total, there are 50 patients recruited who had SARI and 50 patients with AEBA. Patients' age, sex and ALOS were compared. It was found that patients' demographics and clinical characteristics to be statistically similar for both groups. This was evident for patient sex as both male and female have equal distribution between the two diagnoses. The mean age for SARI patients was 65 years whereas the mean age for AEBA patients was 45 years. The ALOS for AEBA patients were shorter compared to those who are diagnosed with SARI which are 3.5 days and 6.3 days respectively (Table 1).

TABLE 1 DESCRIPTIVE STATISTICS OF SARI AND AEBA PATIENTS

		SARI		AEBA	
		Mean	Frequency (%)	Mean	Frequency (%)
Samples			50 (50%)		50 (50%)
Age		65		45	
Sex	Female	26 (52%)		26 (52%)	
	Male	24 (48%)		24 (48%)	
Average length of stay (days)		6.29		3.53	

CAPITAL COSTS IN THIS STUDY

Capital costs are funding that a corporation uses to purchase, improve or maintain long-term assets to improve the company's efficiency or capacity. Building and equipment costs are the capital costs involved in this study. Since its inception in 1997, HCTM has undergone various construction projects, renovations and improvements. The present value of the existing buildings was estimated in this study by comparing them to the expenses made during the main project's construction in 1997. Because information on the construction costs of the existing structures was lacking and may no longer be applicable owing to ongoing restorations and improvements, this estimation was required. The HTCM building originally cost RM 50,355,907.98, and its current value was estimated using an

annualization factor of 14.375. The overall floor area of the HCTM building was 240,036 square feet, resulting in a construction cost of RM 14.59 per square foot. The building cost per day for a hospital facility patient is calculated by building cost per square feet (RM 14.59) multiply total medical ward floor space (5,352 square feet) divided by total medical inpatient days (56,056), which is equal to RM 1.39. The building cost of a SARI patient per admission is RM 8.76 (RM 1.39 x 6.29), while for AEBA patient is RM 4.92 (RM 1.39 x 3.53).

In general, the asset's cost was calculated using a five-year useful lifespan and a 5% discount rate. In all approaches, an annualization factor of 4.329 was used to calculate the asset's cost. The asset cost of SARI patient per admission is RM 12.23 (RM 1.94 x 6.29) while for AEBA patient is RM 6.79 (RM 1.94 x 3.53).

RECURRENT COSTS IN THIS STUDY

Recurring costs are the continuing expenses needed to run a firm in its chosen line of business. They appear on the income statement as indirect costs and factor into the balance sheet and cash flow statements. We considered salary, overhead, utility and maintenance, laboratory and imaging, medication, and consumables in our analysis. The labour cost was computed by adding the emolument cost of all contact time in minutes for each category of ED and medical ward staff. The ED's manpower costs include registration, admission clerking, blood taking, ECG, radiological tests, Medical Officer/Specialist evaluation, and Medical Department review before ward admission. The duration of each encounter was estimated using time-motion studies and patient records. In the medical ward, labour costs comprise specialist, medical officer, house officer, and nurse contact frequency. The medical ward labour cost was estimated by multiplying the emolument cost per minute by the average contact time and frequency. Reviewing clinical pathways in Emergency and Medical wards and patient records revealed average contact time and frequency. It was found that the average of labour cost for SARI was RM 332.07, meanwhile for AEBA was RM 325.65.

Overhead or administrative cost is the administration cost incurred while a patient is admitted in the hospital. The calculation is based on the total emolument of all staff of HTCM, including the non-clinical and administrative staff in 2022. The administration cost per day was calculated by total administration cost divided by total inpatient days. Then, the administration cost for SARI was calculated by multiplying 6.29 (ALOS SARI) and RM 5.17 (total administration cost per day), which was RM 32.54. The total administration cost for AEBA was found to be RM 18.26 (3.53 X RM 5.17).

The total cost of utilities and maintenance of the HTCM building in 2022 was RM 60,611,920.69 and the HCTM building floor space is 240,036 square feet. Therefore, the cost of utility and maintenance per square feet was calculated to be RM 252.51 (RM 60,611,920.29/ 240,036). The cost per patient is the calculated by using the inpatient days and ALOS for the respective conditions. The cost per SARI patient was RM 151.64 and for AEBA was RM 85.10. The medication cost was calculated and itemised. All drugs included in the management of SARI and AEBA patients were added. This includes oral medication, parenteral administration, nebulisations and metered dose inhalers. The medication that patients were discharged with was included. The medication cost for an average admission for SARI was RM 496.93 while AEBA was RM 392.42.

Consumables are referred to any non-asset item purchased by the hospital, directly utilised in providing medical service to patients. This includes syringes, needles, gloves, masks, intravenous drips, gauze and others. It was found that the consumables cost for an average admission for SARI was RM 200.15 while AEBA was RM 86.26. The laboratory and investigation costs were also itemised. Blood investigations, X-rays, swab PCR, culture & sensitivity testing and any other investigations were included. The laboratory and investigation cost for an average admission for SARI was RM 352.79 while AEBA was RM 295.01.

TOTAL COSTS IN THIS STUDY

The total cost of treating AEBA and SARI patients in this study was subjected to documentation of data in patient records obtained from the Medical Records Department of HCTM. From this study, the average total cost of treating patients with SARI is RM 1,587.11 ($US334.80), while the total cost of treating AEBA is RM 1,214.41 ($US256.18). The details of comparison between the two diagnoses are as Table 2 and the difference is RM 372.70 ($US78.62). The cost of an admission of a SARI patient is 30.7% more than that of AEBA patient. The difference between the admission cost was mainly from the medications, consumables and laboratory & investigations.

TABLE 2. DETAILS ON COST COMPARISON BETWEEN TREATING AEBA AND SARI PATIENTS

	SARI		AEBA	
	Ringgit Malaysia (RM)	$US (USD)	Ringgit Malaysia (RM)	$US (USD)
Capital Cost				
Building	8.76	1.85	4.92	1.04
Equipment (≥ RM500)	12.23	2.58	6.79	1.43
Recurrent Cost				
Emolument	332.07	70.05	325.65	68.70
Overhead	32.54	6.86	18.26	3.85
Utility & Maintenance	151.64	31.99	85.10	17.95
Medication	496.93	104.83	392.42	82.78
Consumables	200.15	42.22	86.26	18.20
Laboratory & Imaging	352.79	74.42	295.01	62.23
Total cost per patient	**1,587.11**	**334.80**	**1,214.41**	**256.18**

DISCUSSION

The mean age group for patients with SARI in this study is 65 years. This finding is consistent with other studies which has higher incidence of SARI among elderly [13–16]. The mean age of infective respiratory illness (SARI) is higher than non-infective (AEBA), which was also found in few other studies globally. The elevated prevalence of SARI in the older population can be attributed to the following factors associated with influenza such as age, pre-existing medical conditions and frailty. In developed nations, the majority of influenza-related deaths occur in individuals aged 65 or above [13,14]. Elderly individuals with pre-existing medical disorders, such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer, have a higher propensity to acquire severe illness [17–19]. The elderly, who are fragile, are especially susceptible to influenza and have an increased likelihood of experiencing serious consequences, such as pneumonia, which can result in hospitalisation and death [15,20]. Healthcare professionals face a heightened risk of contracting influenza due to their frequent contact with patients, which also increases the likelihood of spreading the virus to vulnerable persons [1,9]. In this study, there were younger groups of patients as well, whereby, SARI mainly caused by influenza can result in more significant reductions in job productivity among employed [5].

Based on a study conducted in HCTM before previously, it was demonstrated that ALOS increased from 4.42 to 7.05 days, which was consistent with the higher level of sickness of illness [7]. Hence, it is proven that the estimated ALOS in this study for both asthma and SARI patients are nearly the same as the ALOS findings from other studies respectively [21,22]. A study found that the cost of SARI treatment and case management has increased over 3 years in 2016, 2017 and 2018 respectively in accordance with the severity and prevalence of the influenza illness [7]. Cost increments in HCTM was at 7.7% and 3.4% for the years 2017 and 2018, while for the other public hospitals in Malaysia reduced by 4.1% in the year 2017 but increased by 47.2% in the year 2018. This variation occurs due to the length of admission stay per case which was higher in 2018. This might be due to the increased availability and falling costs of molecular assays that made the Influenza Rapid Test kits more accessible and started to be used widely in 2018 [7].

Influenza can result in increased treatment expenses, strain on hospital funding, and resource utilisation, resulting in an economic impact. The subsequent search results offer valuable insights into the financial impact of influenza. A study carried out in South Africa found that SARI was significantly underestimated for the overall economic and health impact of influenza-related illnesses [8]. An investigation conducted in multiple centres in Colombia suggested that SARI caused by influenza imposes a significant economic burden on patients and their families. The direct medical costs per patient among senior individuals were three times greater than the median [23]. A study done in India found that hospital-based surveillance for SARI identified two possible situations of under-reporting which were non-SARI hospitalisation (patient admitted with SARI as secondary diagnosis and was not included in SARI surveillance data) and severe SARI

cases where patients refused hospitalization and defaulted on treatment [24]. In this study involving HCTM, all SARI patients, irrespective whether SARI is a primary or secondary admission diagnosis, were included as study samples. A retrospective assessment done in China assessed the economic impact of outpatient visits and hospitalisations related with influenza. However, the estimation of the economic burden associated with influenza in older people may not be accurate [25].

The influenza vaccination rate in Kuala Lumpur and Malaysia is very low at only 3%, as compared to South Korea being 84.4% (one of the highest worldwide) and Thailand being 15-20% for adults more than 65 years of age [9]. Vaccination is particularly crucial for individuals who are at a heightened risk of experiencing complications from influenza, as well as for those who reside with or provide care for such individuals. In healthy people, the influenza vaccine offers protection, even if the spreading viruses do not precisely match the viruses included in the vaccine. However, among the elderly, influenza vaccination may be less effective in preventing illness but reduces severity of disease and incidence of complications and fatalities [1,22]. The COVID-19 pandemic, H1N1 and other outbreaks of respiratory illnesses such as SARI impose a substantial load on healthcare systems and the economy [25]. This is particularly prevalent among the older population, as their hospital stays are extended due to underlying conditions, additional complications of SARI and the need for intensive care [18,22,26]. Additional healthcare resources are required to effectively prevent and treat influenza and SARI. This study demonstrated the much higher cost associated with addressing SARI compared to AEBA. It aids in the allocation of resources for infectious diseases, as well as the preparation of finances, beds, and human resources for outbreaks. Further exploration is required to assess the cost and value of vaccination for elderly and high-risk groups in a population using a cost-benefit analysis (CBA).

This study does possess several limitations. The cost analysis for SARI cases, as well as an AEBA, may not entirely reflect the precise hospitalization and service costs due to the retrospective data collection, which can introduce biases. Additionally, the rapidly evolving treatment approaches for both infectious and non-infectious respiratory diseases can significantly impact the cost-effectiveness of managing these conditions. Challenges were encountered during data collection at various levels, particularly concerning the availability and quality of patient medical records. Furthermore, primary costing methodology used in this study was top-down costing. As a result, it is possible that the actual cost was underestimated.

CONCLUSION

This study has found out that the cost of treatment for SARI is RM1,587.11 ($US334.80), which is much higher (30.7%) in comparison to the cost of treatment for AEBA which is RM1,214.41 ($US256.18). This projects a shorter ALOS for AEBA which is only 3.5 days compared to SARI which is 6.3 days. Though this does not imply that treating AEBA is more cost efficient as each individual patient is dynamic and presents with different co-morbidity and risks. Cost analysis demonstrates that health expenditure on SARI is more than AEBA due to acute and severe nature of the disease, higher intensity of medical interventions, potential complications, and increased strain on healthcare resources. These insights can inform policymakers, healthcare providers, and researchers in resource allocation, public health planning, and developing targeted interventions to address the economic challenges posed by SARI. Health financing constitutes a vital element in addressing communicable diseases. Sufficient and enduring funding is needed in order to efficiently tackle and manage communicable diseases and safeguard the well-being of the general population.

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