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PUBLIC HEALTH RESEARCH

The Use of Casemix System to Estimate Providers` Inpatients' Cost of Influenza Related Sari Diseases in Malaysia

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ABSTRACT

Introduction	Influenza is an upper respiratory tract infection caused by the influenza virus. It occurs throughout the whole year in Malaysia with occasional outbreaks. Influenza-like illnesses (ILI) are generally treated as outpatient care while the more severe acute respiratory illness (SARI) is managed in patient care. The Casemix system, used in healthcare professionals' practices, may help in estimating the cost of influenza management.
Methods	This cross-sectional study extracts the cost of influenza management from different public hospitals in years 2016, 2017 and 2018. Data used was selected based on ICD-10 codes, and the cost was abstracted from Malaysian Diagnostic Related Groups (MyDRG) software. The secondary data were from two sources, an urban teaching hospital Hospital Cancellor Tuanku Muhriz (HCTM) and Ministry of Health (MoH) inpatient hospitals database. The sample size of the study was 586, while a structured data sheet collating patients' sociodemographic data and cost of admission, per case, was obtained from the MyDRG software. Microsoft Excel and SPSS software were used in the analysis.
Results	Most influenza cases (61.8%) are between the ages of 0 and 10, Malays, and had similar gender proportions. Overall, the influenza treatment cost for inpatient care, was RM71,463,989.16 for 2017, RM78,809,565.60 for 2018 and RM143,743,557.48 for 2019. With the estimated 3.69%, 3.7% and 3.75% of GDP year 2016, 2017 and 2018 for health consumption, the three years trend of influenza consume 0.16% to 0.27% of 2017 and 2018's GDP. The incremental cost was 40% in year 2018.
Conclusions	Influenza vaccination, health education and treatment compliance should be scaled-up to minimize the cost of influenza management of the public providers.
Keywords	Influenza - Respiratory system - ICD-10 - Casemix - Healthcare cost.

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INTRODUCTION

Influenza is a seasonal illness and is prominent among susceptible populations. Unique genetic makeup of influenza virus enables it to undergo constant changes over time. The changes caused high viral persistence in human bodies, which makes the condition hard to treat and/or the production of a new strain where human immunity against it becomes low, and subsequently results in outbreak at both national and global levels. Influenza prevention requires dissemination of right information, surveillance, vaccines supply and anti-viral drugs.

Influenza viral load is more prevalent among the high-risk groups such as the elderlies, comorbid patients and young children. Influenza conditions are more active during winter, which are dominated by influenza type A (H1N1) and influenza type B (Yamagata) lineage. In Malaysia, influenza surveillance is done at primary healthcare setting to detect Influenza-like Illness (ILI) and inpatients data, admitted with Severe Acute Respiratory Infection (SARI) related cases. Information on the cost of managing influenza is collected annually from the government hospitals.

Epidemiology of influenza virus

Influenza is an infectious disease that cause serious public health concern. It had caused year-round severe morbidity which heightens the need for awareness of the disease. In developing countries, there are estimated 28,000 to 111,500 deaths occur annually in children under 5 years old. Furthermore, a molecular study by Su Mei Yu et al found that the positivity rate was 79.9% with co-infection rate of 13.2% which was caused by 2 or 3 respiratory viruses.[21] Because of the unique genetic makeup of the influenza virus, there are always possibilities of genetic changes over time. The two main mechanisms for genetic changes are called antigenic drift and antigenic shift.[1] Antigenic drift is small changes in the genes of the virus, which occurs continually over time as the virus replicates. However, these small genetic changes can accumulate over a period and can result in antigenically different virus, which may not be recognized by our immune system. Antigenic shift is a more drastic change in the genetic makeup of the virus where it can result in an influenza subtype where humans may not have immunity against this new subtype, and therefore, causing an outbreak. An example is the 2009 pandemic influenza where a "shift" occurred to the influenza virus genes, causing an H1N1 virus with new combination of genes, causing pandemic outbreaks.[2] There is a need to improve health at national, regional and global levels including prevention of infectious diseases in lower resource countries.[3] The Centre for Disease Control (CDC) estimated that the influenza disease burden to about 39 to 56 million of flu illnesses, 18 to 26 million flu related medical visits, 410 to 740 thousand flu hospitalizations and 24 thousand to 62 thousand of flu deaths across United States. The elderly, obese, pregnant and patients with comorbidity (e.g., hypertension, pulmonary disease, diabetes mellitus and immunosuppression) are at high risk of hospitalisation and increase mortality due to influenza.[4] Epidemiological data on influenza burden and the cost of managing it are scarce in South East Asian countries, despite its significance contribution to morbidity and mortality rates.[5–7]

In Malaysia, the H1N1 pandemic that happened in May 2009 was reported with 12,307 cases and 77 deaths. Most of the cases occurred during August-September. In a national review, among 1,362 children hospitalised with pandemic H1N1, they found that the risk of death was 4.4 times higher in patient with presence of one comorbidity. A seroprevalence study carried out before and after the pandemic in Kuala Lumpur showed a cumulative incidence of 18.1%. However, we only had one publication regarding the cost of management of SARI that had been published which showed the total direct healthcare costs was USD510, 44% higher than per capita national expenditure of USD353 in 2009. This shows limited published evidence-based data on the disease burden.[7,8] Influenza in Malaysia, is not a notifiable disease, hence it does not reflect true cases and most cases are not certified via lab tests. However, increased surveillance via clinical based diagnosis and laboratory-based data collection were started in 2003. A study conducted in 2010 showed that influenza was not perceived as a severe disease, which may not reflect the actual situation among the community, where some cases need inpatient hospital stay and aggressive treatment.[9] Additionally, the highest ILI incidence was recorded among children and youths aged ≤19 years respectively.[9] Malaysian uptake for influenza vaccination is very low as the distribution rate is only 7.48 doses per 1000 population in 2013. This is because in Malaysia, influenza vaccines are self-funded except for healthcare workers. There is a constant genetic change in the influenza variant, hence the vaccine component for influenza vaccine must match with the circulating influenza viruses. Vaccinations are advice to be renewed annually, while at-risk groups are advised to be vaccinated through self-fund, and there is no mass vaccination program publicly funded via the government.[10]

ILIs are milder cases of influenza and are managed in the primary healthcare and/or out of patient setting. ILI is defined based on the diseases history of cough and fever measured at ≥ 38°C.[11] While, SARI is an in-patient case treated in hospital settings. Therefore, severe acute respiratory infection is measured as fever of ≥ 38°C; with cough onset within the last ten (10) days of the incubation period.[11]

Estimation of influenza burden

The World Health Organization (WHO) strongly advocates establishment of surveillance, the studies of disease epidemiology and disease burden, particularly in developing countries where such data is lacking, hence weakens public health strategy. There are a few global studies conducted, that presents the health cost of influenza management. An influenza pandemic study conducted in Malaysia in the year 2009, estimated the healthcare cost per hospitalized patient was USD510, which was 44% costlier than the traditional per capita national healthcare expenditure with USD353.[7,12,13] Putri et al.[14] found that on average, the annual economic burden of influenza on the healthcare system and the society at large was around USD11.2 billion. He further estimated the average direct medical costs at USD3.2 billion, and the average indirect costs was at USD8 billion. These overall costs were established on the estimated average numbers of ill-non medically attended patients, office-based outpatient visits, emergency department visits, hospitalisation, deaths and productivity lost days.

In Malaysia, surveillance is done throughout the country, based on primary care data of ILI and from hospital data for in patients' SARI cases. The cost of treating the ILIs are being collected every year, which are based on admissions in government hospital, teaching-based hospital and private hospital. However, not all cases are routinely investigated via laboratory results and most are admitted based on clinical suspicion.

Casemix system in Malaysia

Casemix is a system of patient classification that categorized patients according to their condition. Casemix systems classified patient with similar clinical characteristics into homogeneous costing group. Casemix system was developed by Bob Fetter and John Thompson of Yale University in 1976. The system was first used by a group called Diagnosis Related Group (DRG); it was used as a means of classifying patients according to their type of condition and cost of treatment incurred by a hospital.[15] The Malaysia DRG (MyDRG) use the Malaysia's casemix system, it is owned by the government, whereby the healthcare activities involved in the wards are monitored. This can be used to monitor hospital services output such as morbidity, mortality, length of day admission and severity of illness (based on diagnosis and comorbidities of patients). Casemix system information is important in planning budget allocation, forecasting of healthcare spending and can be used for hospital reimbursement (Fig. 1). Casemix system in Malaysian uses the DRG's classification. The DRG classified conditions are divided into medical and surgical divisions based on clinical diagnosis, which are allocated via the International Classification of Diseases (ICD)-version 10 upon discharged from wards. For example, medical cases refer to ICD-10 code, which has around 3000 codes, that guides the identification of main medical condition such as neoplasm: specific conditions and the identified patients' symptoms. While surgical procedures refer to the ICD-9 code which consists of 3900 codes, and this includes major and minor surgical procedures that are performed by respective healthcare providers. By the year 2017 and 2018, the clinical diagnosis of 'unspecified pneumonia' is top 3 common DRG code in Malaysia elucidating this is a common diagnosis affecting Malaysia with unknown causes.

In this study, MyDRG codes and cost of management were extracted from the patients' health records using the ICD-10 codes classifications. The extracted cases were presented along with patients' socio-demographic data, comorbidity status, duration of stay and severity of the illnesses (SOI) based on ICD codes of main and secondary diagnosis. From the DRG codes, estimates of cost management of the hospitalized patients for influenza cases were extracted from the MyDRG software. Other additional data were the different hospital settings and were tabulated based on the specific hospital-based rates. The data source of this study was exclusively extracted from the ICD-10 code database and the casemix data cost of SARI tariffs' in MoH and the teaching hospital in central city of Kuala Lumpur. The Diagnosis-Related Group for SARI was based on these 3 DRG codes. Firstly, DRG code 04581 namely respiratory failures but with the lowest severity of illness, as it has no diagnosis indicating complication and comorbidity. Secondly, DRG code 04582 namely respiratory failures with moderate severity of illness. This are cases admitted but developed complication or with existing comorbidity. Lastly, DRG code 04583 namely respiratory failures with the highest severity of illness; with major complication and comorbidity events on patients. For this study, the DRG codes that were used were 04581 to 04583 which were for severe acute respiratory syndrome (SARS), including ICD for unspecified causes (U04.9).

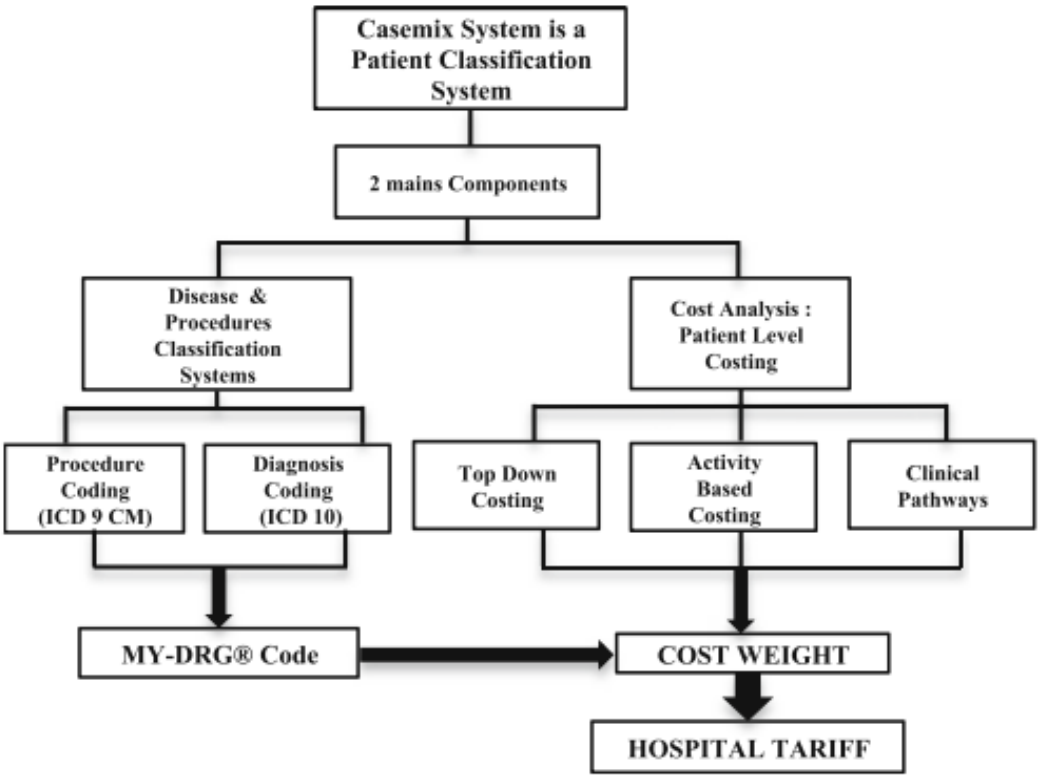

Figure 1 The Flow of the Casemix System and My-DRG in Malaysia

METHODS

Study design and sample size

The study is a cross-sectional study design, using three years retrospective secondary data (from 2016, 2017 and 2018), collected from the repository of a teaching hospital in central Kuala Lumpur, named Hospital Canselor Tuanku Muhriz (HCTM) and the MoH hospitals database. HCTM, formerly known as Hospital Universiti Kebangsaan Malaysia (HUKM), is one of the five University hospitals in Malaysia. The sites and year of data collection were selected based on the date of this research was conducted, to see the trend in three recent years and HUKM was selected as they are pioneer in the Casemix usage for costing. Approximately 60% of the beds were occupied with Average length of stay (ALOS) of between 5.1 to 5.2 days, in year 2016 to 2018 in HCTM. In comparison, the MoH ALOS were 3.4 and 3.2 days respectively. HCTM had higher ALOS compared to MoH likely due to their interest in molecular laboratory study that was more time-consuming. HCTM received a total of 629,019 patients in 2018 (an increase of 4% from the year 2017), 603,305 patients in 2017 (2% increase from 2016) and a total of 592,494 patients seeking services in 2016. The study was approved by the ethics committees from the Head of Medical Division, MoH Malaysia, UKM Institutional Ethics Committee (UKM PPI/111/8/JEP-2019-533) as well as the Medical Research and Ethics Committee (MREC), NMRR-19-971-46248 (IIR). The sample size was calculated using the prevalence of ILI which had prevalence rate of 22.3% resulting 406 from both sites after incorporating the non-response rate of 40%. The following ICD-10 codes were included in the case definition and these codes were based on expert consensus that influenza related disease were defined as upper respiratory symptoms including diseases from the ear, nose, throat and lungs systems. The ICD-10 codes include other viral agents (B97.8) that causes to diseases such as otitis media (H66.90), acute nasopharyngitis (J00), acute sinusitis (J01.9), unspecified acute upper respiratory infection (J06.9), influenza due to identified novel Influenza A virus with pneumonia (J09.X1, J09.X2), influenza due to identified novel influenza A virus with gastrointestinal manifestations (J09.X3), influenza due to identified novel influenza A viruses (J10.0), influenza due to unidentified influenza virus (J11.0), pneumonia, unspecified organism (J18.0), acute bronchitis, unspecified (J20.9), bronchitis, not specified as acute or chronic (J40), cough (R05), and fever, unspecified (R50.9).

Sampling of respondents

Random sampling technique using table of random numbers was used to select 406 SARI cases for influenza related diseases at all hospitals using ICD-10 in MoH and HCTM teaching hospital.

Study instrument

The first section of the questionnaire contained demographic data, influenza laboratory outcomes

and the second section included the case management cost. The collected data was itemised, tabulated using Microsoft Excel file (Microsoft Office) and SPSS software. Data cleaning which included removal of redundant data and incomplete data were done. Patients' demographic data were presented according to age, gender and comorbidities.

RESULTS

A total of 2982 data from the HCTM teaching hospital and 2104 data from MoH's hospital were identified respectively. The data was arranged according to the ICD-10 casemix classification. Random sampling of 227 cases were then selected from HCTM and 359 cases from MoH. For the cost of case per day, data from hospitals were analysed by entering the ICD-10 codes, the length of stay and severity of illness into MoH's MyDRG software.

Influenza status analysis and associations with age, gender and comorbidity

From the total of 586 cases, the mean age of cases, was 25.2 years and standard deviation of 48.6 years. The minimum age of patient was found to be 81 days, while the maximum age of patient found to be 88 years old. The percentages were equal between the genders. Malay group had the highest frequency of SARI cases compared to other ethnic groups, followed by Indians, Chinese and others. Mean length of stay was 3.4 days ± 2 days. The minimum day of stay as revealed by the HCTM data was one day, while the maximum days of stay were 16 days. On the other hand, data retrieved from MoH showed a mean length of stay to be 5.55 days, with standard deviation of 1.1 day. The minimum days of stay was 4.25 days while the maximum days of stay were 7.3 days. For the comorbidities, the data showed 48% of the cases had no comorbidities, while 25% of them had cardiovascular disease (CVD) such as hypertension and diabetic among others; 12.5% of the cases have other disease such as anemia, Down Syndrome, chronic kidney disease, stroke and pregnancy respectively. The data in Table 1, were derived from 227 HCTM cases and 359 data from MoH with a total number of 586 data set. 25 years old was taken as a cut point of young age and old age, because the mean age from this data set is 25.22.

Table 1 showed the sociodemographic distributions of cases in the two hospitals. MoH sample represented 61.3% of the data, meanwhile another 38.7% were from HCTM, 52.2% were female, aged 0-10years old and mainly were Malays.

Table 1 The Gender, Age, Ethnicity, and ALOS of SARI cases in HCTM and MoH

Variable	HCTM (n = 227) n, %	MoH (n = 359) n, %
Gender (n=586)		
Male	115 (50.7)	165 (46.0)
Female	112 (49.3)	194 (54.0)
Age (n=200)		
0-10	71 (31.2)	55 (15.3)
11-20	8 (3.5)	10 (2.8)
21-30	5 (2.2)	10 (2.8)
31-40	5 (2.2)	6 (1.7)
41-50	2 (0.9)	4 (1.1)
51-60	3 (1.3)	6 (1.7)
61-70	2 (0.9)	5 (1.4)
71-80	3 (1.3)	3 (0.8)
>80	1 (0.4)	1 (0.3)
Ethnicity (n=195)		
Malay	181(79.7)	258 (71.8)
Chinese	25 (11.0)	22 (6.2)
Indian	19 (8.4)	57 (15.8)
Others	2 (0.9)	22 (6.2)
Length of Stay (Days)	3.4 ± 2.00	5.6 ± 1.1

It was found that the Malay group had the highest frequency of SARI cases based on all the ethnic groups followed by the Indian, Chinese and others. Majority of cases were children less than 10 years old for both centres. From the total of 586 samples, all were tested for Polymerase Chain Reaction (PCR) influenza. However, only 73 (12.5%) samples turned up as positive influenza. Majority of samples were negative PCR and diagnosis of SARI related ICD was based on initial clinical judgements of attending doctors.

Cost of treatment

Table 2 showed the average length of stay, national case weight, national cost-based rate and treatment cost of SARI per case for the three years from 2016

to 2018. The table revealed that the ALOS between DRG codes varied and irrespective of the presence or absence of complications and comorbidity (i.e. severity of illness) for the years 2016 and 2018. It was also shown that ALOS increased, from 4.42 to 7.05 days (lower than the year 2016) which in line with the higher level of severity of illness.

Table 2 National Case Group Weight (CGW), Cost per Admission by DRG and Year 2016-2018

Year	DRG Code & Description	ALOS	Case Group Weight (CGW)	National Base Rate (RM)	Cost Per Admission (RM)
2016	04581: Respiratory Failure (W/O CC)	6.17	1.38	3,834.54	2,304.30
	04582: Respiratory Failure (WCC)	4.79	1.11	3,834.54	2,816.54
	04583: Respiratory Failure (W MCC)	7.30	1.49	3,834.54	4,456.95
2017	04581: Respiratory Failure (W/O CC)	4.42	1.07	3,344.99	3,563.09
	04582: Respiratory Failure (WCC)	4.53	1.12	3,344.99	3,735.23
	04583: Respiratory Failure (W MCC)	7.05	1.72	3,344.99	5,762.30
2018	04581: Respiratory Failure (W/O CC)	4.88	1.43	3,400.09	4,851.25
	04582: Respiratory Failure (WCC)	4.25	1.10	3,400.09	3,742.80
	04583: Respiratory Failure (W MCC)	6.56	1.44	3,400.09	4,907.88

W/O CC- without complications or comorbidity
WCC- with complications or comorbidity
W MCC- with major complications or comorbidity

Based on Table 3 below, cost of SARI treatment was summarised based on the average cost over the three years period in the study. The cost increased according to the years and SOI. However, it varied according to the length of stay per episode of admission. The cost of management in HCTM was lower than MoH, even for similar SOI, due to lower number of beds, patients and resources.

Table 3 Cost of SARI Treatment per Admission by DRG, year 2016-2018 in MoH and HCTM

DRG Code & Description	2016	2017	2018	Average cost /admission (RM)
MoH				
04581: Respiratory Failure (W/O CC)	2304.30	3563.09	4851.25	3572.88
04582: Respiratory Failure (W CC)	2816.54	3735.23	3742.80	3431.52
04583: Respiratory Failure (W MCC)	4456.95	5762.30	4907.88	5052.37
HCTM				
04581: Respiratory Failure (W/O CC)	1719.63	1900.50	3,344.99	2490.95
04582: Respiratory Failure (W CC)	2304.30	2552.79	3,344.99	2682.08
04583: Respiratory Failure (W MCC)	4347.16	4450.76	3,344.99	2772.06

W/O CC-without complications or comorbidity
WCC- with complications or comorbidity
W MCC- with major complications or comorbidity

Table 4 showed an average SARI treatment cost, for both HCTM and MoH, compared to the national base rate cost. The national base rate was the average cost of patient admission per episode of admission, which was generated yearly at the national level.

Table 4 Cost of SARI Treatment (per admission), from 2016-2018 in HCTM and MoH, compared with the National base rate cost (RM)

Year	National Base Rate (RM)	Cost (RM) per admission in HCTM	Cost (RM) per admission in MoH
2016	3,834.54	2490.95	3572.88
2017	3,344.99	2682.08	3431.52
2018	3,400.09	2772.06	5052.37

National cost of managing influenza were based on volume and severity of the cases. The number of cases admitted in HCTM and MoH hospital were presented in Table 5 and the sum were totalled as for national cost of financial year 2019. The total cases were extracted from the casemix

system record of HCTM from year 2016-2018 based on the ICD-10 code related to influenza disease. Similar data was extracted from casemix unit of the MoH, retrieved from all the casemix hospital in Malaysia. The total of RM7,866,455.16 was collated cost, for the treatment of influenza related disease for three years in HCTM. A total of RM286,150,657.08 was incurred by MoH Malaysia for the treatment of the influenza related disease. A total of RM294,017,112.24 was totaled cost, from both sites.

Table 5 Treatment Cost of SARI in HCTM and MoH and Total Country's Cost (RM)

Cost	HCTM			MoH		
	2016	2017	2018	2016	2017	2018
Total case (n)	1140	882	960	19,207	22,277	27,924
Cost per admission (RM)	2490.95	2682.08	2772.06	3572.88	3431.52	5052.37
Cost per nation (RM)	2,839,683	2,365,594	2,661,177	68,624,306	76,443,971	141,082,379
Total per site (RM)		7,866,455 (HCTM)			286,150,657 (MoH)	
Total Country Cost (RM)						294,017,112

DISCUSSION

This study was conducted in hospital settings that utilised the casemix system and DRG software. The findings of the study revealed high number (61.8%) of influenza cases were from the group of zero to ten (0-10) years old. This was because most of the cases admitted in the studied hospitals in Malaysia were of the younger age group. A study in 2015 reported that infectious diseases mainly affected children of under 5 years and adults of over 75 years due to lower immune response and susceptibility towards infections.[7] Elhakim et al.[17] stated that the effects of influenza infection, is highest among children of 5 years and below. The World Health Organisation recommends annual influenza vaccinations for high-risk groups that includes pregnant women at any stage of pregnancy; children aged between 6 months to 5 years; aged more than 65; people with chronic medical conditions; and healthcare workers.

According to Department of Statistic Malaysia (DOSM), the total population in Malaysia in 2019 consisted of the ethnic groups of Bumiputera (67.4%), Chinese (24.6%), Indian (7.3%) and others (0.7%). Among the Malaysian citizens, the Malay was the predominant ethnic group in Peninsular Malaysia which constituted 63.1%. Among the Malaysian communities admitted, Malay ethnic group had the highest percentage of 76% of SARI cases, followed by the Indians (12%), Chinese (8.5%) and others (3.5%). This was because the disease can affect any person, and due to the higher percentage of Malays in Malaysia and the more frequent use of government facilities, it was likely Malays will be more affected by SARI than other ethnicity in these two public hospital settings. Furthermore, this study observed that most Malays affected with influenza obtained treatment from the government hospital where the national casemix system was in used. The length of stay in hospital varied, depending on the condition during admission. For example, some of the patient may need only antibiotic therapy, while some might need other support such as respiratory ventilation that may cause longer stay in the ward. Malaysia's influenza immunisation rate is low which is only 2% of the population[18] compared with Korea at 80.7%, Denmark 78.0%, UK 72.4%, New Zealand 69.0%, Japan 66.0% and Sweden 60.4%.[19] In Malaysia, healthcare workers are included in annual immunization programme.

The study found and summarized the cost of SARI treatment and case management of three years i.e. 2016, 2017 and 2018 respectively. The results showed that the cost increased by year, in accordance to the severity and prevalence of the influenza illness. Increment in HCTM was at 7.7% and 3.4% for the years 2017 and 2018, while MoH reduced by 4.1% in the year 2017, but increased by 47.2% in the year 2018. The variation occured due to the length of admission stay per case which was higher in 2018. This might due to the increase availability and falling costs of molecular assays that made the kits more accessible and started to be used widely in 2018. However, the time consumed may be increased. The influenza related diseases management cost in HCTM was lower than that of MoH, due to higher turnover rate. However, short ALOS was observed in some settings, might be due to inappropriate casemix coding. The findings here was supported by one study which showed 52.1% of the cases had a lower assigned hospital codes with potential loss of income due to the wrong assigning of MyDRG code.[15] Influenza treatment cost for inpatient care, for three years totalled to RM 294,017,112. The GDP for health consumed 3.69% for Malaysia's GDP income of RM 1.2 trillion in

2016, 3.7% for RM1.35million Malaysia GDP for 2017 and 3.75% from RM1.4 trillion in 2018. Estimation of RM 45 billion in 2016 and RM52 billion in 2018 were used for health. Thus, the three years trend of public cost, consumed 0.16-0.27% from Malaysian GDP for year 2016, 2017 and 2018 respectively. This increment was due to the increase volume of patients and availability of the screening modality that offered to the patients. The WHO recommended that northern hemisphere (including Malaysia) influenza season should use both trivalent or quadrivalent vaccines that contain both influenza type A and influenza type B virus (B/Colorado/06/2017-like virus of the 3 B/Victoria/2/87-lineage) with 75% vaccination coverage.

Limitation

This study should be interpreted in light of its limitations. Since this is a retrospective study, we relied on accurate record keeping by the casemix unit of HCTM and MoH. The influenza data used in the study relied on the ICD-10 codes that were approved by experts, to reflect influenza disease burden in Malaysia. Limitation to the collection of primary data imposed by the COVID-19 pandemic, limited the study to the use of secondary data. The study was also limited to three years data trend, as data of other years during the pandemic, were more difficult to obtain, and was delayed in data collation due to resource constraints.

CONCLUSION

Preparedness for prevention and control of any pandemic as well as outbreaks started with clear understanding of the cost of management, cause and season of occurrence. In this regard, identification of the the cost of management for influenza cases will help in determining the composition of the management cost which includes drugs and vaccines procurement. Estimating cost of influenza related diseases under casemix system will facilitate in estimating cost of management and future estimation of cost involved in the prevention of future influenza outbreaks. Evaluation of management cost per case for SARI provides important information for policy makers on the estimation of the economic burden of the influenza related disease for future reference. The use of casemix system is largely hospital based, it is therefore recommended for the government to enhance the use of casemix at the primary care and outpatient's setting. The use of casemix system should be taken seriously, to avoid coding error, upcoding and down coding. This will be exceptionally important if Malaysia indulge in some level of value-based reimbursements and the new intended national healthcare reform and financing. The national influenza management should be reinforced; public educated on the importance of vaccinations, symptoms monitoring and medication health seeking behavior should be ensured early. In doing so, it is envisioned that these can minimize complications, reduce patients' length of stay, reduce the cost of managing influenza related cases in the public healthcare services.

Ethical consideration

Ethical approval for this study was obtained from the head of medical division, MoH Malaysia and director of casemix unit HCTM prior to data extraction. Approval were obtained from UKMMC Institutional Ethics Committee via (UKM PPI/111/8/JEP-2019-533) before the study commencement. Approval from MREC (Medical Research and Ethics Committee) was also obtained through NMRR number: NMRR-19-971-46248 (IIR).

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Conflict of interest

The authors declare that they have no conflict of interest.

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