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Research paper

The Estimation of Total Expected Medical Cost for Heart Disease based on Four Major Illnesses: Angina, Heart Failure, Ischemic and Myocardial Infarction

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Abstract

Ischemic Heart Disease is the number one killer in Malaysia and the total number of death has increased statistically. To make matters worse, the cost of medical related to this disease has increased approximately from 10 percent to 15 percent every year. Therefore, it is crucial to know the expected medical cost of heart disease and the risk exposure. This paper discussed on four different type of major illness relating to heart disease and the expected cost of procedure based on type of illness and age. The objectives are to analyse percentage of people getting heart disease based on age, gender and ethnic, calculation of the probability of four major categories of illness in heart disease and to estimate the total expected cost of heart disease. The result showed the expected cost of heart disease varies based on the cost of procedures and the severity of the heart disease of the patient; the higher the rate of severity, the higher the expected cost would be.

Keywords: *Angina; Expected Cost; Ischemic Heart Disease; Myocardial Disease.*

1. Introduction

Heart disease which is also known as cardiovascular disease generally refers to conditions that involve narrowed or blocked blood vessels. There are several types of diseases that link to heart diseases such as myocardial infarction (heart attack), stroke, heart failure, hypertensive heart disease, cardiomyopathy, valvular heart disease, aortic aneurysms, peripheral artery disease, venous thrombosis and etc. Heart disease treatments vary by conditions and type of illnesses that affected the patient. For example, the treatment for a person who suffers from heart failure differ to a person suffering from myocardial infarction.

According to American Heart Association, the health data compiled from 190 countries showed that heart disease is the number one killer around the world with expected 17.3 million deaths per year and the number is expected to rise more than 23.6 million by 2030. Most people that affected by heart disease specifically ischemic disease. In Malaysia, according to World Health Organization (WHO), cardiovascular disease is proven as the number one killer disease with the total number of death, 22,701 that constitutes to about 22.8 percent in 2010 [1]. The number of death kept increasing to 36 percent in 2014. According to Department of Statistics Malaysia, one of the principal causes of death occurred in the year 2016 was ischemic heart disease. It has the highest occurrence among all heart diseases with 13.8 percent [2].

To make matters worse, the medical cost has increased from 10 to 15 percent every year. The increment of medical expenses for each year is mainly because of the improvised, upgraded and high-technology used for the operation of the patients. A study has found that the cost of open-heart surgery in the year 2000 cost around RM 30,000.00 but has increased to RM 62,000.00 in the year 2015 [3]. Therefore, the medical cost for heart disease also varies based on the cost of the procedure.

Heart disease has been the leading cause of death since decades ago and the number of death keep increasing over the years. Therefore, it is important to know the risk of exposure for this disease for precaution. It is a major concern that the age of onset of getting heart disease in Malaysia is younger compared to other countries. According to a study by National Cardiovascular Database Annual Report the mean age of Malaysia patients of getting heart disease is younger at age 58 compared to Global Registry of Acute Coronary Event which is age 66.

As mentioned by [5], according to Credit Counselling and Debt Management Agency (AKPK), 11.5% of those who enrolled into their Debt Management Programme fell into debt due to high medical expenses. Based on a study a coronary angioplasty will cost RM706, 976.98 in 2037. Therefore, it is important to know the expected cost of heart disease for future planning and saving.

This project paper will discuss the different type of illness in heart disease and the cost of procedure based on the type of illness. We will focus on four major illness in heart disease which are myocardial disease, angina, ischemic heart disease and heart failure to find the expected cost for heart disease.

2. Methodology

2.1. Data collection and description

Data collection is a process of gathering and measuring information on the targeted variable in order to get relevant outcomes. In this project, data that is needed are the details of cost of each heart disease patients and the treatment cost. This research used secondary data from a university hospital from the year 2016 to

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June 2017 for patients age 20 and above. The collected data are grouped according to age, gender, ethnic and number of patients. To estimate the expected medical cost, this study required the probability number of patients getting heart disease and cost of procedures.

2.2. Calculating the distribution of people getting heart disease

To analyse the distribution of people suffering from heart disease, the patients will be group according to age, gender and ethnicity. First, it will be analyse based on age. Each patient will be group according to age group starting from age 20 to 29, 30 to 39, 40 to 49 until age 80 and above. Next, the patients will be group based on gender and lastly ethnic. The percentage of each group then will be analysed and in (1) denotes the percentage formulas follows:

Percentage = Number of patients based on group / Total patients x 100 (1)

2.3. Calculating the probability of four major illness in heart disease

The four major illnesses in heart disease for this research are myocardial infarction, angina, ischemic and heart failure. Every patient will be separated based on these illnesses and then will be group according to age group. The method that is used to determine which illness has the highest number of patients according to age group as follows:

Probability = Number of patient affected by one of four major diseases / Total number of patient affected by heart disease (2)

2.4. Expected cost for heart disease

Expected cost is used as risk management control where the future cost is determined by the probability of a person suffering from heart disease and cost of treatment. To calculate the expected cost based on four major illness in heart disease since a person suffers from different illness may undergo the different procedure as treatment, the expected cost for heart disease will be determined by the expected cost of each major illness where the expected cost is denoted as:

Expected Cost = Probability x Cost of Procedures (3)

3. Results and discussion

3.1. To analyse the number of people getting heart disease based on Age, gender and Ethnic

Table 1: Probability of Getting Heart Disease According to Age

Age Group	Probability
20 - 29	0.030864
30 - 39	0.064577
40 – 49	0.159069
50 – 59	0.296771
60 – 69	0.310541
70 - 79	0.122982
≥80	0.015195

The group of age between 60 to 69 years has the highest percentage (31.0541%) of people suffered from heart disease. It is then followed closely by the group of age between 50 to 59 years (29.6771%). However, the group age that has the lowest percentage, 1.5195% of people suffered from heart disease is from those who are age 80 and above. This is because the people at age group 60 to 69 has higher tendency and risk to be affected by heart disease. A person body condition decline based on age. Therefore, it is crucial for people at this age have sufficient savings since they are already at their retirement age. It is also important for people in this group to make a consistent medical check-up as a precaution to detect an early symptom of heart disease.

Table 2: Probability of Getting Heart Disease According to Gender

Gender Group	Probability
Male	0.722222
Female	0.277778

Table 2 showed the probability of gender that has been affected with the heart disease. It can be seen clearly that male has the highest percentage (72.22%) of people who have been affected by heart diseases while female only contributes with a percentage of 27.77%. Moreover, male population tends to have less awareness compare to female as they do not take their health as a priority. Both genders can protect their cardiovascular health by paying attention to their personal heart risk. Lifestyle basics such as getting regular exercise, eating healthy, control blood glucose and cholesterol as well as maintaining a normal body weight apply to everyone.

Table 3: Probability of Getting Heart Disease According to Ethnic

Ethnic Group	Probability
Malay	0.73551757
Chinese	0.13817664
Indian	0.11348528

Table 3 shown that majority of the ethnic that suffered from heart diseases is Malay with a percentage of 73.55%, followed by Chinese (13.81%) and 11.348% for Indian. The remaining probability of 0.01 is from other ethnics than Malay, Chinese and Indian. Malay diets tend to have the highest level of cholesterol compared to other ethnics, where Chinese eat more herbs food and less intake of sugar and salt in their foods while most of the Indian consume vegetarian food. Therefore, they should put in consideration of what they need to change in their eating lifestyle which has been given a big comparison to the other ethnics on the heart diseases result. A healthy diet is good to avoid getting heart diseases. Overweight and develop the high amount of cholesterol lead to heart disease so changing of the lifestyle by eating the healthy diet is one of the good methods to reduce the chances in getting heart disease. Managing stress can help to reduce the risk of heart diseases too. People can reduce their stress by exercising regularly to feel better both physically and mentally.

3.2. To estimate the probability of four majors category of illness in heart disease

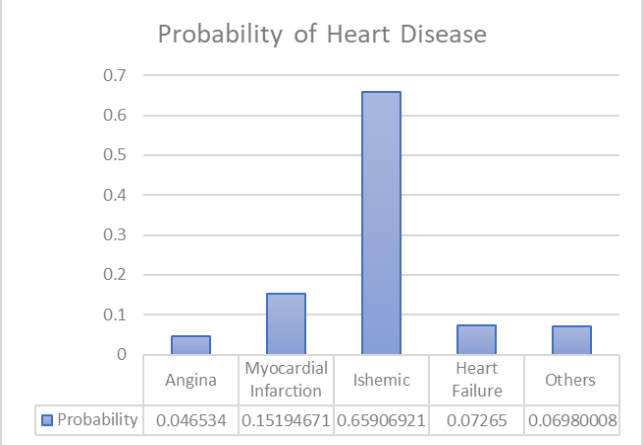

Fig. 1: Probability of heart disease based on four major illness.

Figure 1 showed that most people suffer from heart disease is an Ischemic disease with the probability of 0.6591. Angina is the least that is affected by heart disease patients. The second highest

is myocardial infarction followed by heart failure and others with the probability 0.15195, 0.07265 and 0.0698 respectively. Ischemic is the combination of Angina and Myocardial Infarction and others which then lead to the highest probability of getting heart disease.

3.3. To estimate the total expected cost of heart disease

Expected Cost for Heart Disease												
Age	Probability	Total Cost Based on Type of Procedure										
		Myocardial Infarction			Angina			Ischemic			Heart Failure	
		PCI Balloon 1, CABG, COROS	PCI Balloon 2, CABG, COROS	PCI Balloon 3, CABG COROS	PCI Balloon 1, CABG COROS	PCI Balloon 2, CABG COROS	PCI Balloon 3, CABG COROS	PCI Balloon 1, CABG COROS	PCI Balloon 2, CABG COROS	PCI Balloon 3, CABG COROS	Valve 1, COROS, CABG, PPM, CRTD	Valve 2, COROS, CABG, PPM, CRTD
20-29	0.00379867	144.3495	170.9402	201.3295	54.15	64.125	75.525	577.3948	683.757	805.3138	643.354	690.834
30-39	0.0104463	396.9594	470.0835	553.6539	72.162	85.455	100.647	2183.286	2585.47	3045.109	643.354	690.834
40-49	0.019943	757.834	897.435	1056.979	396.948	470.07	553.638	3897.436	4615.385	5435.897	1608.521	1727.231
50-59	0.039886	1515.668	1794.87	2113.958	451.098	534.195	629.163	7867.047	9316.239	10972.46	2444.962	2625.402
60-69	0.0527066	2002.851	2371.797	2793.45	541.31	641.025	754.985	7488.129	8867.521	10443.97	3217.041	3454.461
70-79	0.0232668	884.1384	1047.006	1233.14	252.624	299.16	352.344	2634.377	3119.657	3674.262	1158.119	1243.589
≥80	0.00189934	72.17474	85.47008	100.6648	0	0	0	396.961	470.0854	553.6562	128.725	138.225

Fig. 2: Expected Cost for Heart Disease

A person aged between 50 to 59 who under Percutaneous Coronary Intervention (PCI) with one balloon has a lower expected cost, RM 1, 515.67 compare to a person with the same age group but undergo PCI with three balloons, RM 2, 113.96. Same goes for the expected cost of heart valve surgery where the cost increase as the number of valve increase. The common procedure undergoes by a person suffering from myocardial infarction, angina and ischemic is the same but differ for heart failure. Based on the Figure 2, the expected cost of heart disease is the highest for a person at age group between 50 to 59 who suffer from ischemic and undergo PCI with three balloons, COROS, and Coronary Artery Bypass Graft (CABG) where the total expected cost is RM 10, 972.46. Since people age group 50 to 59 is near to retirement age, it is crucial for them at this age have sufficient savings to support their medical cost because the medical cost increase 10 percent to 15 percent every year. Therefore, the retirement benefit may not be enough to support the medical cost. This group of people can make early savings with the rate of return of at least 10 percent or higher contribution in Employee's Provident Fund (EPF) to ensure they have sufficient savings. Moreover, according to all four types of heart diseases, the top three group age that suffered from the diseases are all of those who are aged 50 years to 79 years. It is also recommended that they buy an insurance since heart disease is a dread disease where medical costs are expensive and it causes a significant impact on life. Since they already have aged, it is impossible to save a lot of money in a short period of time. By buying an insurance at the early age can lessen the burden of their expenses.

4. Conclusion

The data that has been collected to be used in this research are gender, ethnic, age, primary diagnosed and icd-10. The data was collected from a university hospital in Selangor and are obtained from the year 2016 to June 2017. Firstly, it had been analysed all the number of people getting heart disease according to age starting from age 20, ethnic and gender. However, due to the data that has been collected are limited to the patients, we could not calculate for the whole population who suffered from heart disease. Through the methods that we used, we wanted to obtain a meaningful result where we can estimate the expected cost for heart disease specifically angina, heart failure, ischemic and myocardial infarction. Our data had been subdivided according to age, gender, ethnic as well as each heart diseases.

To obtain this result, we had calculated the probability for four types of heart diseases which are Angina, Myocardial Infarction, Heart Failure and Ischemic Heart Disease based on a group of age. According to the findings, it can be concluded that the group age of 60 to 69 years has the highest probability of getting the four types of heart diseases while the group age of 80 years and above has the lowest probability of getting the four types of heart diseases. This is due to the increasing of the age where the body gets weaker and the immune system has decreased.

To estimate the expected cost of the four types of heart diseases, we multiply the probability of getting the disease with the cost of procedures for each disease. The types of procedures used for Angina, Ischemic Heart Disease and Myocardial Infarction are PCI Balloon 1, PCI Balloon 2, PCI Balloon 3, CABG and COROS. In comparison of all the procedures used for the treatment, PCI Balloon 3 has the highest number of users for all ages especially for the group age of 60 to 69 years whereas COROS has the lowest number of users for all ages. However, the procedures used for treating Heart Failure are slightly different compared to the other three heart diseases which are Heart Valve Surgery, COROS, CABG, Cardiac Resynchronization Therapy Device (CRTD) and Permanent Pace Maker (PPM). Among all the procedures used, CRTD had the highest number of users specifically those group age of between 60 to 69 years, meanwhile PPM had the lowest number of users for the treatment of Heart Failure. To conclude all the expected cost for all the four types of heart diseases, Ischemic Heart Disease has the highest expected cost compared to all other types of heart diseases.

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