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ORIGINAL ARTICLE

Cost Benefit Analysis of the Diabetes Self Management Program at a University Health Centre in Malaysia

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ABSTRACT

Objectives: This study aims to conduct the Cost Benefit Analysis for the diabetes self management program using the payment card contingent valuation technique at the Health Center of Universiti Sains, Malaysia.

Setting: Health centre of Universiti Sains, Malaysia.

Methods And Materials: A cross sectional study design was used to elicit the patients' maximum willingness to pay money for the diabetes self management program. All costs and benefits of the program were measured for the cost benefit analysis evaluation.

Statistical Analysis: All data were analyzed by using the SPSS software package 12 at a significance level of less than 0.05.

Results: The net benefit of the diabetes self management program was RM7374.50, while the benefit to the cost ratio was equal to 1.2:1. On the other hand, the diabetes self management program would result in a net benefit of RM211418.67, if it resulted in the prevention of the development of one case of end stage renal disease. This study showed that patients with diabetes for more than 2 years had significant higher WTP amounts than those with lower diabetes length. In addition, more educated patients and those with higher incomes showed significant higher WTP amounts than less educated and lower income patients.

Conclusion: WTP has been approved to be a suitable tool for measuring the benefits of the intervention of the diabetes self management program. The diabetes self management program was found to be an effective intervention which would result in net benefits and large savings.

Key Words: CBA; Malaysia; WTP; DSMP; cost

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Introduction

It has been estimated that by the year 2025, the number of diabetic patients will reach up to 250-300 million worldwide [1]. The first and second National Health and Morbidity surveys found that the prevalence of diabetes in Malaysia has increased from 6.3% in 1985 [2] to 8.3% in 1996 [3] and is

expected to worsen with the increase in the life expectancy of the Malaysians [4].

The large cost which is associated with diabetes and its treatment is unsustainable by most health care systems and hence there is increasing use of economic evaluation as a tool to allocate resources. These evaluations can track the current costs and assess the future expenses and resource allocation, which leads to the improvement of the quality of healthcare [5].

Economists within the healthcare sector favour the advice to them on scarce resource allocation by using cost benefit analysis (CBA) [6]. The cost benefit analysis facilitates decision making regarding the implementing, withdrawing, or continuing of a program. Net social gains or loss make it easy for making decisions. Furthermore, CBA studies facilitate comparisons between different programs with different outcomes, since all outcomes are converted into monetary values [7].

Willingness to Pay (WTP), which has been widely used in the healthcare and non healthcare areas [8-11], measures both the direct and indirect benefits and provides a method of measuring the individuals' preferences by asking them how much they are willing to pay for a specific program [12]. In addition, the WTP approach is derived directly from the theory of welfare economics, which is considered to be an appropriate method for measuring the individuals' preferences from a welfare perspective [13]. WTP simply means, 'willingness to forgo (sacrifice)'. The more one is willing to pay, the more he is willing to forgo and the more strongly one feels.

Contingent Valuation (CV) is one of the commonly used techniques for eliciting WTP [14]. In CV methods, a hypothetical questionnaire is used to measure the people's preference for a specific good. This measurement is done by asking people about the maximum amount of money that they are willing to pay in order to have an

access to that good or service [15]. Therefore, this study aims to conduct a CBA for the diabetes self management program at Universiti Sains, Malaysia (USM), by using the payment card contingent valuation technique.

Materials and Methods

Study Design

This cross sectional study was conducted between August 2005 and January 2006.

Questionnaire Design

A payment card WTP CV survey was undertaken to measure the patients' maximum WTP for the Diabetes Self Management Program (DSMP) [Table/Fig 1] appendix 1. In this questionnaire, patients were briefed about diabetes and the prevalence and the burden of diabetes on the diabetic patients. Then, they were briefed on the impact and the advantages of DSMP. Finally, they were asked to choose an amount that they are willing to pay to join DSMP from a scale given at the end of the page (Appendix1). They were reminded that the amount that they paid could be used for other things if they chose not to join the program, by telling them, "Keep in mind your current income and what would you give up if you made the payment".

Willingness to Pay Amounts

A pilot study was conducted to measure the WTP amounts by using an open-ended questionnaire. The amounts that patients were willing to pay in the pilot study were used as a guide to set up the WTP amounts in the final study. Bids in the final study ranged from RM0 to RM400, with RM25 as an incremental (RM0, RM25, RM50, RM75, up to RM400) value. People who were willing to pay more than RM400 were given the opportunity to set up the maximum amount that they were willing to pay for the program, by giving them space to state that amount. This study differs a bit from the previous studies in which WTP amounts were written on a scale, rather than written

separately. Putting WTP amounts in a scale gave the respondents the freedom to precisely select the exact amount that they were willing to pay. In the old method, patients are provided with a series of amounts and they had to select the maximum amount that they are willing to pay. In the old method, patients who are willing to pay a bit more than the selected amount, but less than the next stated amount, would have to choose the lower amount which was close to their intended amount. For example, let us say that the series of amounts are RM10, RM20, RM30, etc. and respondent was willing to pay RM14. But the stated amounts were either RM10 or RM20. Therefore, they would choose RM10. In the current study, patients had the choice to exactly select the maximum amount that they are willing to pay, by ticking their maximum WTP amount on the provided scale.

(Table/Fig 1)

Appendix 1

Diabetes Self Management Program:

Diabetes costs society a lot each year. This goes not only for the treatment of diabetic patients, but also for the management of the complications of the disease if the glucose level is not being well controlled. Diabetes indeed may cause many serious complications which sometimes may lead to death. These include: stroke, congestive heart failure and renal failure. It was scientifically proven that all these complications do indeed increase mortality amongst both the young and the old populations.

It has been found in the literature that Diabetes Self Management Programs may lead to controlling blood sugar, as well as, reducing the risks of diabetes complications. Diabetes Self Management Programs have been implemented in most western countries; for example, such programs have been applied in the USA, Australia, Canada and many European countries. In the different places, the programs have proven their effectiveness in reducing: blood glucose, body weight, cholesterol and many diabetes complications.

This question concerns how much RM would you be willing to pay out-of-your pocket, and for one time, in order to be capable to participate at such a Diabetes Self Management Program. This program includes one class per month for a period of four months. This means that if you register in this program, you will be able to attend four classes for the whole period of the program. Every class will focus on specific topics. The aim is to inform you: detail information about diabetes and food planning, type of food that you can eat, type of food you should avoid, the important role of food nutrition and how to calculate total calories for each meal. On the other hand, you should be informed about the medications used for diabetes treatment, how to deal if you missed doses and the importance of compliance. Furthermore, you shall be informed about diabetes complications, how to delay the onset of their development, and finally foot care and the safe exercises that can be performed.

Assume that the amount you would select from the scale below might represent your separate bill for diabetes care. Keep in mind your current income and what would you give up if you made the payment. You should also notice that you can continue to receive such information in an unsystematic manner through the current treatment channels you opted for. Please specify the amount of money you would be willing to pay out of your pocket for attending a Diabetes Self Management Program. Your payment will be paid only once for the whole program (4 months). Please select your answer from the scale below:



Study Population and Participants

The USM Health Centre serves around 350 type 2 diabetic patients, which vary in their educational and ethnic backgrounds. Staffs,

pensioners and dependents who were type 2 diabetic at the USM main campus and were willing to join DSMP were eligible to be included in the study. Out of 350 patients, 135 patients successfully answered the questionnaire.

Cost Benefit Analysis Study Perspective:

This study was conducted from the societal perspective by using the WTP technique which measured both indirect and intangible benefits.

Data Collection Procedure

All type 2 diabetic patients at the USM main campus who agreed to join the study were contacted and a specific date and time was set to meet and interview them. During the interview, the patients were informed about the study and verbal informed consent was obtained from each of them. They were given an average of 15 minutes to complete the questionnaire. All costs incurred in this study were obtained from the Human Resource Department of Health Centre.

Benefits and Costs Calculations for the Diabetes Self Management Program

The mean amounts that patients were willing to pay were considered as the benefits of the intervention. On the other hand, since DSMP started a few months after the commencement of this survey, all costs included in the DSMP were easily calculated. The DSMP consisted of four sessions, with an average of 90 minutes each. One session was conducted by a medical doctor, two sessions were conducted by two pharmacists and one session was conducted by a lecturer from the School of Pharmacy. During the program, a nurse took blood pressure and Body Mass Index (BMI) measurements during each visit. The HbA1c test was done three times during the program. For each HbA1c test

done, a syringe, a needle, a tube for the blood sample and a swap were used. Materials and refreshments were served to patients at every session. The total costs incurred during the program were calculated. Salaries of the educators were calculated, based on the time spent during the course. All costs of laboratory tests and educational materials were added together and the time spent by the staff for measuring BP and taking blood samples was also calculated. Finally, the costs of using the class room, chairs, laptop, LCD and screen were added to the total cost after assuming 5 years of life span on them and 20 years life span on the counselling room. Finally, the total costs were divided by the total number of patients to calculate the cost per patient who joined the program. Since the counselling room and the equipments were used for other programs and functions, the costs for using them were calculated by using the percentage of utilizing them for the DSMP, which was found to be 12.5%. As part of the sensitivity analysis, DSMP was assumed to result in the prevention of the development of one case of end stage renal disease. Based on this assumption, the age of diabetes onset, life expectancy of the Malaysians, the years of end stage renal disease saved and annual cost of dialysis in Malaysia were considered and measured for CBA.

Statistical Analysis

The Mann Whitney U test was used to measure the difference between WTP amounts, based on the patients' demographics. The Kruskal Wallis test was used to measure the difference whenever there were more than 2 groups. All the analyses were conducted by using the SPSS software package version 12 at a significance level of less than 0.05.

Results

A total of 135 diabetic patients successfully responded to the questionnaire. The mean

WTP amount of the respondents was RM121.19 (1 USD = 3.50 RM). Therefore, the total benefits of the program were RM42416.50, since there were around 350 diabetic patients at the USM Health Centre [Table/Fig 2] summarizes the respondents' characteristics, in which females were willing to pay more than males, but not up to a significant level. On the other hand, patients with diabetes for a period of 2 years or more were significantly willing to pay higher than those with diabetes for a period of less than 2 years ($p=0.033$). Malays were willing to pay more than the Chinese and the Indians, but not significantly. Patients with a family size of less than 5 persons were willing to pay higher than those with a family size more than 5 persons, but not up to a significant level. In contrast, patients who were more educated and with a monthly income of more than RM1500 were willing to pay significantly higher than those who were less educated and earning a monthly income of RM1500 or less ($p<0.001$ and $p=0.004$, respectively).

***Mann Whitney test at significance level of less than 0.05.**

**** Kruskal Wallis test at significance level of less than 0.05.**

On the other hand, [Table/Fig 3] shows the healthcare providers' costs if the DSMP was given by the physician, lecturer and two pharmacists. It was found that the healthcare provider's cost per patient, per program was RM20.18.

(Table/Fig 3) Healthcare providers costs if program is given by medical physician, lecturer and trained pharmacists

(Table/Fig 2) Diabetic patients' characteristics and responses

	Frequency	Percent	WTP Mean (SD) Median RM
Gender			
Male	89	65.9	108.43 (96.87) 75.00
Female	46	34.1	145.87 (188.20) 100.00
p-value*			0.266
Diabetes length			
Less than 2 years	60	44.4	111.50 (167.38) 62.50
Equal or more than 2 years	75	55.6	128.93 (103.91) 100.00
p-value*			0.033
Race			
Malay	111	82.2	125.05 (143.60) 100.00
Chinese	5	3.7	120.00 (103.68) 100.00
Indian	19	14.1	98.95 (88.15) 50.00
p-value**			0.878
Number of People Living at Home			
Less than 5 persons	101	77.7	123.67 (143.14) 100.00
More than 5 persons	34	22.3	112.50 (106.42) 87.50
p-value*			0.789
Length of Study			
School level	99	73.4	86.72 (76.00) 50.00
More than school level	36	26.6	215.97 (203.88) 200
p-value*			<0.001
Income			
Less than Rm1500	60	44.4	85.50 (74.86) 50.00
More than Rm1500	75	55.6	149.73 (164.15) 100
p-value*			0.004

(Table/Fig 3) Healthcare providers costs if program is given by medical physician, lecturer and trained pharmacists

Item	Cost/month RM	Cost/day RM	Cost/hour RM	Cost/min RM	Time/min	Cost/class RM	Cost/patient/class RM	Times used during the program	Cost/patient/program RM
Medical physician	3300	117.86	14.73	0.25	90	22.10	2.76	1	2.76
Pharmacist	2458	87.79	11.00	0.18	90	16.46	2.06	2	4.12
Lecturer	7000	250.00	31.25	0.52	90	46.88	5.86	1	5.86
Nurse time to take blood sample, BMI and BP	2250	80.36	10.0	0.17	10	13.39	1.7	4	6.70
Nurse time to call patients	1000	35.71	4.46	0.07	20	1.49	0.19	4	0.74
Total costs									20.18

In addition, [Table/Fig 4] shows the costs incurred by other than healthcare providers. These costs include HbA1c tests and the costs of all disposable materials which were used for taking blood samples, such as syringes, needles, plasters and swaps. Other costs included that of the educational

materials given to patients, refreshments during the classes, costs of communications and reminders, the cost of using laptops in addition to the cost of the LCD screen and finally, the cost of using the table, chairs and the room. The life span of the laptop, screen, LCD, tables and chairs were estimated to be 5 years, while the life span of the room was estimated to be 20 years. The total non healthcare provider's costs were found to be RM79.94 per patient, per program. Thus, the total costs of the program equalled the sum of the healthcare providers' costs. The non health providers' costs equalled RM100.12 per patient, per program. Therefore, the total costs for 350 patients were estimated to be RM35, 042.

(Table/Fig 4) Costs incurred by non healthcare providers based on 5 years life expectancy

Item	Item cost RM	Quantity	Total costs RM
HbA1c	16.0	3	48.00
Syringe	0.44	3	1.32
Needle	0.01	3	0.03
Tube	Free	3	0
Plaster	0.05	3	0.15
Swap	0.12	3	0.36
Materials	1	4	4.00
Refreshments	2.5	4	10.00
Communications	0.50	4	2.00
Reminders	0.10	4	0.40
Laptop/patient ^{**a}	3500	1	3.64
Screen/ patient ^{**a}	200	1	0.21
LCD/ patient ^{**a}	3000	1	3.13
Table / patient ^{**a}	300	1	0.31
Chairs / patient ^{**a}	50*10	10	0.52
Room/ patient ^{**a}	16112.5	1	5.87
Total cost/patient			79.94

* based on 5 years life expectancy

**based on 20 years life expectancy

^a [(Item cost*quantity)/life expectancy]/12= cost per month

Cost per month*12.5%= real cost per month

Real cost per month/8 patients= cost per class

Cost per class*4= total cost per patient per program

Cost Benefit Ratio

In this section, the net benefits per patient from the program were calculated. Since there were around 350 diabetic patients at the USM Health Centre, the net benefit of the program was calculated after assuming that all patients would participate in the

program. Based on the assumption that DSMP was conducted by a medical physician, a pharmacy lecturer and 2 pharmacists and that the life span of the equipments = 5 years, the net benefits of DSMP was found to be equal to RM7374.50, while the benefit to cost ratio was found to be equal to 1.2:1.

On the other hand, the net benefits of DSMP were calculated, based on the assumption that DSMP would result in the prevention of the development of one case of end stage renal disease. It was assumed that the age of diabetes onset in the studied group was 47.5 years and that end stage renal disease develops after 20 years from the onset of diabetes. The life expectancy in Malaysia is assumed to be 75 years and the annual cost of dialysis as RM33958 [16]. Therefore, the number of years saved is 7.5 years, which results in a net saving of RM204, 044.17 after 3% discounting. Thus, DSMP would result in a net benefit of RM211, 418.67 by the prevention of the development of one case of end stage renal disease.

Discussion

Scarce resource allocation has been illustrated recently by decision makers. Net benefits can be easily calculated by using CBA, since costs and benefits are in monetary values. In the Cost Effectiveness Analysis (CEA), it is difficult to know whether a new intervention results in a positive net benefit or not. In CEA analysis, the only ratio between the cost and the effectiveness, such as the cost per life year gained, were obtained [17]. Resource allocation based on CEA is difficult due to; (a) CEA evaluations provide decision makers no guidance about the forgone alternative when implementing the program (opportunity cost) and (b) CEA evaluations cannot be used to compare between different programs with different outcomes, since the outcomes should be the same natural units [12]. During budget constraints, CBA can be

used to calculate the net benefits of different interventions and to rank these interventions, based on the net benefit gained. According to the welfare economic theory, "the benefit to an individual of a service or intervention is defined as the individual's maximum willingness to pay for the service or intervention" [17].

This study showed that patients with diabetes for more than 2 years had significantly higher WTP amounts than those with lower diabetes length. In addition to that, more educated patients and those with higher incomes showed significantly higher WTP amounts than the less educated and lower income patients. Many other studies found a significant correlation between incomes and WTP amounts [18],[19],[20] and a significant correlation between WTP and education [21]. WTP was found to be significantly correlated with the length of the study, since more educated people had higher incomes and could better understand the future benefits and consequences of the program. On the other hand, no support of range or midpoint bias was found from this study, since a scale of WTP amounts was given to the patients and the patients were given the freedom to choose the exact amount that they were willing to pay. In this study, the range which was given to patients was RM0 to RM400 and the mean and median of the patients' responses were RM121.19 and RM100.00, respectively. Similar findings were found in a study which compared the payment card and dichotomous choice methods, which found no evidence of finding midpoint or range bias in using the PC method [22].

This study resulted in a net benefit of RM7374.50, while resulting in a net benefit of RM211, 418.67 after assuming that DSMP would result in the prevention of the development of one case of end stage renal disease. Based on the findings by Caro et al., (2002), it was found that 52% of the total costs of diabetes complications were due to macrovascular disease, while 21% were due

to nephropathy, 17% were due to neuropathy and 10% were due to retinopathy [23]. Therefore, various serious complications could result from diabetes and in this study, end stage renal disease was the only assumption which was considered in the analysis. Other expensive and costly complications like cardiovascular disease, retinopathy and neuropathy [24] could be prevented by the program. As a result, such educational programs would result in much more economical savings and improving patients' quality of life. Many other studies used WTP as a measurement of the benefits of programs or interventions in CBA evaluations. One study used CBA to evaluate a pharmacy promotion program for hypertensive patients in Canada, which found that the benefits of the pharmacy promotion program were almost ten fold higher than its total costs [25]. Furthermore, WTP was used to calculate CBA for Red Cross Services in Austria, which considered the mean WTP as the benefit of the program. In their study, the benefits of the Red Cross Services were found to be equal or slightly higher than the running costs [26]. Moreover, Insulin Lispro was compared with regular insulin in Australia by conducting the CBA study. The patients were surveyed by using WTP to measure the additional amounts of money that they are willing to pay for insulin Lispro. The net benefits from this study resulted in the listing of new drugs in the Australian formulary [27]. Thus, this study provides valued information for policy makers about the monetary values of DSMP, which can be used to facilitate their decision making process. Therefore, as a conclusion, WTP has been found to be a suitable tool for measuring the benefits of DSMP intervention. Significant higher WTP amounts were found with patients having diabetes for a longer period and those who were more educated and with higher incomes. After evaluating CBA, the net positive benefits which resulted from the analysis were found to be RM7374.50, while RM211, 418.67 could be saved from the prevention of the development of one

case of end stage renal disease. Many other diabetes complications could be prevented with proper diabetes management, which could result in a higher quality of life and reduce the economical burden of diabetes patients and its complications. Therefore, this study provides the decision and policy makers at the USM Health Centre valuable information about the value and benefits which could result from DSMP.

Conclusion

WTP was approved to be a suitable tool for measuring the benefits of the intervention of the diabetes self management program. The benefit-cost ratio was 1.2:1, with net savings of RM7374.50. Many life threatening complications which have not been addressed in this study, could be prevented by the diabetes self management program, that would result in tremendous savings.

Limitations of Study

This study faced many limitations such as the difficulty in recruiting patients and the small sample size and many of the findings were based on assumptions which are very common in pharmacoeconomics evaluations. As diabetes is a chronic disease and results in many serious complications, it was very difficult to measure the exact number of complications that could be prevented due to the program. Therefore, an assumption of preventing the development of one case of renal failure was assumed. Thus, future researches are recommended to include larger sample sizes and to include many other preventable complications due to diabetes in the CBA. Educational programs which would reflect a more accurate picture about the actual impact and the benefit of diabetes educational programs should be included.

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Conflict of Interest

None

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