Original Article

Factors Associated with Healthcare Expenditures and Hospitalizations in Thai Patients with Diabetes at Four Public Hospitals

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Abstract The objective of this study is to investigate factors associated with healthcare expenditures and hospitalizations in patients with diabetes in four public hospitals in Thailand. A retrospective study was conducted by using electronic claims data of diabetic patients from October 1, 2002 to September 30, 2003. Dependent variables were total healthcare expenditures and hospitalizations. Demographic factors, healthcare utilization, complications, comorbidities and payment methods were used as independent variables. Multivariate statistical analyses were applied. The results of this study suggested that demographic factors of patients (e.g. age and male gender), payment methods (i.e. CSMBS and UC) were significantly associated with higher healthcare expenditures and probability of hospitalization. Patients receiving treatment from teaching hospitals significantly consumed higher healthcare expenditures. In addition, the more healthcare utilizations (e.g. hospitalization, outpatient visit and insulin utilization), the higher healthcare expenditures the patients significantly had. Diabetic patients taking insulin had significantly higher risk of hospitalization. Furthermore, comorbidities (e.g. hypertension, hyperlipidemia and cancer) and complications (e.g. nephropathy, neuropathy, retinopathy, CAD and PVD) were related to an increase in healthcare expenditures and hospitalization. Factors associated with healthcare expenditures and hospitalizations may help healthcare providers intervene to improve patient management and possibly reduce healthcare expenditures. ©All right reserved.

Keywords: diabetes, healthcare expenditures, hospitalizations, risk factors

INTRODUCTION

Diabetes is a common, serious and chronic disease causing major long-term complications and comorbidities. For all age groups world-wide, the prevalence of diabetes was estimated to be 2.8% in 2000 and 4.4% in 2030.[1] Especially in the economically developing countries, it is predicted to have the greatest increase.[2] Among Thai people, the prevalence of diabetes was estimated to be 2.4% in 1995 and 3.5% in 2025.[2] The rise in prevalence of diabetes leads to an increase in prevalence of diabetic complications [e.g. retinopathy (23%), nephropathy (24%), amputation (1.6%), coronary disease (8.2%) and stroke (4.4%)] and diabetic comorbidities [e.g. hypertension (63.6%) and dyslipidemia (73.3%)].[3] Diabetic related complications and comorbidities largely affect patient outcomes and healthcare expenditures. In the US, the total expenditure of diabetes was $132 billion [i.e. direct (69.7%) and indirect expenditures (30.3%)].[4] In Thailand, there are only few studies estimating the expenditure of diabetes. Based on the study determining the expenditures of patients with diabetes in seven Thai government hospital located in four regions

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of Thailand and Bangkok, the annual average expenditure per patient with diabetes was 6,017.50 baht which was significantly higher than those without diabetes.[5] In addition, other studies showed that the annual total expenditure of diabetes was 13,751 baht [e.g. direct (82.26%) and indirect expenditures (17.74%)][6] and 1,206.19 baht per outpatient visit.[7] There are few studies investigating the impact of factors [e.g. demographic, number of diabetic complications, number of healthcare utilization, length of stay (LOS), or payment method] on healthcare expenditures.[8,9] In Thailand, only two studies determined the factors associated with direct medical expenditures, but no study has ever investigated the association between factors and the occurrence of hospitalization.[6,10] Therefore, the objective of this study is to investigate the factors associated with total healthcare expenditures and hospitalizations. Knowing of these factors may help healthcare providers intervene to improve patient management and possibly reduce healthcare expenditures.

MATERIALS AND METHODS

Data Source

A retrospective study was conducted by using electronic databases obtained from four Thai government hospitals during October 1, 2002 and September 30, 2003. These data were allowed to use in this study by hospital administrators. Data included demographic characteristics, medical history of illness, healthcare utilizations and medical expenditures. Medical expenditure data were all charges of patients with four payment methods [i.e. civil servant medical benefits scheme (CSMBS), social security scheme (SSS), universal coverage (UC) and self pay]. Although patients under SSS or UC did not really pay for total charges, their medical charge data were still recorded on hospitals' databases.

Patient Selection

Diabetic patients must have at least one claim with the diagnosis of diabetes mellitus based on the International Statistics Classification Diagnostics and Health Problem tenth revision (ICD-10 codes = E10-E14).

Statistical Analysis

Univariate and multivariate statistical analyses [e.g. ordinary least square (OLS)] regression and logistic regression analyses] were applied. Multiple linear regression analysis and log transformation were used when a dependent variable was total healthcare expenditures (e.g. the summation expenditures of drug, medical supply, laboratory tests, surgery, hospitalizations and other services). Logistic regression analysis was applied when the occurrence of hospitalization was a dependent variable. In addition, the occurrence of hospitalization was also used as one of independent variables when a dependent variable was total healthcare expenditures. Other independent variables included demographic factors (e.g. age and gender), payment methods (e.g. SSS, CSMBS, UC and self pay), hospital characteristics (e.g. teaching hospitals), healthcare and drug utilizations (e.g. outpatient visits and insulin utilization), comorbidities (e.g. hypertension, hyperlipidemia and cancer), microvascular complications (e.g. retinopathy, nephropathy and neuropathy) and macrovascular complications [e.g. coronary artery disease (CAD), cardiovascular disease (CVD), peripheral vascular disease (PVD)]. SPSS program version 11.0 was used for statistical analyses. All variables used in the analysis and the reference categories of dummy variables are presented in Table 1.

RESULTS

Table 2 shows the results of the descriptive statistics of the sample. There were 24,051 diabetic patients with average age of 59 years old. Sixty-six percent of patients with diabetes were female and 99% had type 2 diabetes. In this study, there were four methods of payment such as SSS, CSMBS, UC and self pay. The social security office pays a fixed amount of money per year to hospitals for covering healthcare benefits of employees who enrolled under SSS. Under CSMBS, the government provides full healthcare coverage for government officers and their dependents (e.g. parents, spouse and up to three children). The national health security office pays a fixed amount of money per year to hospitals for covering healthcare benefits of patients who enrolled under UC

and patients also pay 30 baht per visit. Self pay is that patients pay their healthcare expenditures by themselves. In this study, diabetic patients paid their healthcare expenditures by SSS (6%), CSMBS (19%), UC (28%) and self pay (47%). Moreover, there are 61% of patients received their treatment at

Table 1. Variables used in the analysis

Variables	Type (reference category)
Dependent variables	
healthcare expenditures	continuous (baht)
hospitalization	dummy (yes = 1, no = 0)
Independent variables	
Demographics	
age	continuous (years)
female	dummy (female = 1, male = 0)
Payment method	
SSS	dummy (yes = 1, no = 0)
CSMBS	dummy (yes = 1, no = 0)
UC	dummy (yes = 1, no = 0)
self pay	dummy (yes = 1, no = 0)
Hospital characteristics	
teaching hospital	dummy (teaching = 1, non-teaching = 0)
Healthcare utilization	
outpatient visits	continuous (times)
insulin utilization	dummy (insulin users = 1, non-insulin users = 0)
Comorbidity	
hypertension	dummy (yes = 1, no = 0)
hyperlipidemia	dummy (yes = 1, no = 0)
cancer	dummy (yes = 1, no = 0)
Microvascular complications	
retinopathy	dummy (yes = 1, no = 0)
nephropathy	dummy (yes = 1, no = 0)
neuropathy	dummy (yes = 1, no = 0)
Macrovascular complications	
CAD	dummy (yes = 1, no = 0)
CVD	dummy (yes = 1, no = 0)
PVD	dummy (yes = 1, no = 0)

CAD = coronary artery disease,
CSMBS = civil servant medical benefits scheme,
CVD = cardiovascular disease,
PVD = peripheral vascular disease,
SSS = social security scheme,
UC = universal coverage.

Table 2. Descriptive statistics of the sample

Variables	Statistical values n = 24,051
Demographics	
average age (years)	59 (13.14)
female gender	66%
type 2 diabetes	99%
Payment method	
social security scheme (SSS)	6%
civil servant medical benefit scheme (CSMBS)	19%
universal coverage (UC)	28%
self pay	47%
Hospital characteristics	
number of patients in a teaching hospital	61%
Healthcare expenditures and utilization	
average annual expenditure per person (baht)	19,299 (64,754)
median annual expenditure per person (baht)	5,658 (IQR = 14,209)
average annual length of stay per person (day)	2.52 (9.10)
average annual number of hospitalizations per person	0.35 (0.89)
average annual number of outpatient visits per person	7.39 (6.20)
number of patients with only outpatient visits in all hospitals	77%
number of patients admitted to all hospitals	21%
average annual number of hospitalizations per person	1.63 (1.26)
number of patients admitted to a teaching hospital	11%
Insulin utilization	
Number of diabetic patients taking insulin	12%
Comorbidity conditions (% patients)	
coronary artery diseases	6.15%
cardiovascular diseases	1.46%
peripheral vascular diseases	0.59%
hyperlipidemia	12.79%
hypertension	33.33%
cancer	4.10%
Complication conditions (% patients)	
nephropathy	1.77%
neuropathy	3.95%
retinopathy	8.67%

S.D. values are indicated in parentheses.

teaching hospitals. The average annual expenditure per patient was 19,299 baht. The median annual expenditure per person was 5,658 baht (interquartile change, IQR = 14,209). The average annual length of stay per person was 2.52. The average annual number of hospitalizations per person was 0.35 and the average annual number of outpatient visits per person was 7.39. In this analysis, there were 77% of patients who had only outpatient visits. Only 21% of patients were admitted to the hospitals and average annual number of hospitalizations per person of these patients was 1.63 which was lower than that of total patients (0.35). In addition, there were 12% of diabetic patients taking insulin. In this study, the top three comorbidities of diabetic patients were hypertension (33.33%), hyperlipidemia (12.79%) and CAD (6.15%). The complications of diabetic patients were retinopathy (8.67%), neuropathy (3.95%) and nephropathy (1.77%).

Table 3 shows the results of OLS and logistic regression analyses. Age (PE = 0.006, $p < 0.001$) or male gender (PE = -0.021, $p < 0.001$) had a significant impact on an increase in healthcare expenditures. Payment methods [e.g. UC (PE = 0.103, $p < 0.001$), CSMBS (PE = 0.217, $p < 0.001$) and self pay (PE = 0.046, $p < 0.001$)] had a significant positive effect on an increase in healthcare expenditures. However, there was no statistical significant association between an increase in healthcare expenditures and payment by SSS (PE = 0.007, $p < 0.604$). In addition, diabetic patients under UC (PE = 2.358, OR = 10.56, $p < 0.001$) or CSMBS (PE = 2.476, OR = 11.89, $p < 0.001$) were more likely to have higher hospitalizations compared to those under SSS (PE = 0.809, OR = 2.24, $p < 0.001$) or self pay (PE = 1.641, OR = 5.16, $p < 0.001$). Diabetic patients receiving treatment from a teaching hospital had significantly higher healthcare expenditures (PE = 0.378, $p < 0.001$), but they were less likely to have hospitalizations (PE = -1.605, OR = 0.20, $p < 0.001$).

Table 3. Results of regression analysis

Variables	Multiple linear regression analysis		Logistic regression analysis		
	Parameter estimates (PE)	*p*-Value	Parameter estimates (PE)	Odds ratio (OR)	*p*-Value
Age	0.006	< 0.001	0.018	1.10	< 0.001
Female	-0.021	0.001	-0.142	0.86	< 0.001
Universal coverage	0.103	< 0.001	2.358	10.56	< 0.001
Civil servant medical benefit scheme	0.217	< 0.001	2. 476	11.89	< 0.001
Social security scheme	0.007	0.604	0.809	2.24	< 0.001
Self pay	0.046	0.001	1.641	5.16	< 0.001
Teaching hospital	0.378	< 0.001	-1.605	0.20	< 0.001
Hospitalization	0.611	< 0.001	-	-	-
Outpatient visit	0.041	< 0.001	-0.022	0.97	< 0.001
Insulin utilization	0.343	< 0.001	1.336	3.80	< 0.001
Hypertension	0.096	< 0.001	0.834	2.30	< 0.001
Hyperlipidemia	0.030	0.001	0.067	1.06	0.329
Cancer	0.153	< 0.001	1.549	4.70	< 0.001
Nephropathy	0.017	< 0.001	2.914	18.43	< 0.001
Neuropathy	0.063	< 0.001	1.849	6.35	< 0.001
Retinopathy	0.034	< 0.001	0.544	1.72	< 0.001
Coronary artery disease	0.140	< 0.002	1.995	7.35	< 0.001
Cardiovascular disease	0.058	0.206	0.203	1.22	0.138
Peripheral vascular disease	0.212	< 0.001	1.223	3.39	< 0.001

Statistically significant was set at $p < 0.05$.
Adjusted *R*-square was 0.54 for multiple linear regression analysis.

Patients admitted to hospitals (PE = 0.611, p < 0.001) were significantly associated with an increase in healthcare expenditures. Patients with more outpatient visits significantly consumed higher healthcare expenditures (PE = 0.041, p < 0.001). Insulin users significantly had higher healthcare expenditures (PE = 0.343, p < 0.001) and were about four times more likely to have hospitalizations compared to non-insulin users (PE = 1.336, OR = 3.80, p < 0.001).

Diabetic patients with comorbidities [e.g. hypertension (PE = 0.096, p < 0.001), hyperlipidemia (PE = 0.030, p < 0.001) and cancer (PE = 0.153, p < 0.001)] had significantly higher healthcare expenditures than those without comorbidities. In addition, diabetic patients with hypertension (PE = 0.834, OR = 2.30, p < 0.001) or cancer (PE = 1.549, OR = 4.70, p < 0.001) were about two or four times more likely to hospitalize compared to those without hypertension or cancer, respectively. Furthermore, patients with microvascular complications [e.g. nephropathy (PE = 0.017, p < 0.001), neuropathy (PE = 0.063, p < 0.001) and retinopathy (PE = 0.034, p < 0.001)] had a positive impact on healthcare expenditures. Especially, diabetic patients with nephropathy (PE = 2.914, OR = 18.43, p < 0.001), neuropathy (PE = 1.849, OR = 6.35, p < 0.001), or retinopathy (PE = 0.544, OR = 1.72, p < 0.001) were about eighteen, six, or two times more likely to have hospitalizations than those without nephropathy, neuropathy, or retinopathy, respectively. Diabetic patients with macrovascular complications [e.g. CAD (PE = 0.140, p < 0.002) and PVD (PE = 0.212, p < 0.001)] were positively associated with higher healthcare expenditures. In addition, diabetic patients with CAD (PE = 1.995, OR = 7.35, p < 0.001) or PVD (PE = 1.223, OR = 3.39, p < 0.001) were seven or three times more likely to hospitalize compared to those without CAD or PVD, respectively. However, there was no statistical significant association between an increase in healthcare expenditures and having cardiovascular diseases (PE = 0.058, p < 0.206). Multiple linear and logistic regression models were significant (p < 0.001) and the adjusted R-square was 54%, meaning that all significant factors in the model were able to explain 54% of the variation in total healthcare expenditures.

DISCUSSION

The results of this study suggested that demographic factors of patients (e.g. age and male gender), payment methods (e.g. CSMBS, UC and self pay) were significantly associated with higher healthcare expenditures and hospitalizations. Particularly, patients under CSMBS or UC significantly had higher healthcare expenditures and hospitalizations compared to those under SSS or self-pay. Since all healthcare expenditures of patients under CSMBS were covered by the government and patients under UC would pay only 30 baht per visit for their treatment, these patients could easily acquire their treatment as much as they needed. Therefore, they tended to consume higher healthcare expenditures and hospitalizations. This could suggest that patients' eligible benefits (i.e. CSMBS and UC) could be an important indicator of the cost drivers. Mostly patients under SSS were adults in a working age and seemed to be healthier than the patients under UC, so that they would consume less healthcare expenditures and hospitalizations.

For hospital characteristic factor (e.g. teaching hospitals), it was found that patients receiving treatment from teaching hospitals significantly consumed higher healthcare expenditures, but had less probability of hospitalization. This could explain that most patients receiving healthcare services at a teaching hospital were usually referred from other hospitals. These patients mostly had only outpatient visits and were not admitted to a teaching hospital. It was found that more patients receiving treatment at a teaching hospital had only outpatient visits (86%) compared to those receiving treatment at non-teaching hospitals (61%), and fewer patients were admitted to teaching hospital (11%) compared to those admitted to non-teaching hospitals (37%). In addition, the more healthcare utilizations (e.g. hospitalization,

outpatient visit and insulin utilization), the higher healthcare expenditures the patients significantly had. Moreover, diabetic patients taking insulin had significantly higher risk of hospitalization.

Furthermore, comorbidities and complications were related to an increase in healthcare expenditures and hospitalization. Diabetic patients with comorbidities, (e.g. hypertension, hyperlipidemia and cancer) had significantly higher healthcare expenditures and diabetic patients with hypertension or cancer tended to have higher hospitalizations. Patients with diabetes and microvascular complications (e.g. nephropathy, neuropathy and retinopathy) had significantly higher healthcare expenditures and hospitalizations. Diabetic patients with macrovascular complications (e.g. CAD and PVD) had significantly higher healthcare expenditures and hospitalizations. The results of this study were similar to other studies showing that age, male gender, number of diabetic complications, number of hospitalizations and number of outpatient visit were positively related to total direct healthcare expenditures.[8-10] Based on the results of this study, it would suggest that healthcare providers may need to focus on the factors associated with an increase in healthcare expenditures and hospitalizations such as patients with older age, male gender, comorbidities, complications, patients under CSMBS or UC and patients taking insulin. Significant policy options can be made for those patients who had these risk factors. Healthcare providers may set up the interventions such as diabetic patient counseling, pharmaceutical care, or disease management to prevent comorbidities or complications that diabetic patients may have in the future. Although patients under CSMBS or UC have significantly higher healthcare expenditures and hospitalization, these patients may not be at risk. This factor signals the eligible benefits rather than the personal prognostic factors of healthcare expenditures and utilizations. This may relatively signal the issue of inequity in healthcare rather than disease severity. It may be used as the information for health policy makers to solve the inequity problem. An investigation of factors associated with healthcare expenditures and hospitalizations may help healthcare providers and administrators intervene to improve patient management and possibly reduce healthcare expenditures.

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