COST OF TREATMENT FOR DIABETIC PATIENTS AT A TEACHING HOSPITAL, FISCAL YEAR 2002-2003

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COST OF TREATMENT FOR DIABETIC PATIENTS AT A TEACHING HOSPITAL, FISCAL YEAR 2002-2003

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ABSTRACT

This study was designed to determine resource utilization and cost of diabetes from a societal perspective. A Retrospective database of resource utilization was used to determine cost of treatment. All outpatients and inpatients that were treated for diabetes at a teaching hospital in Thailand during October 2001 to September 2003 were the population. Diabetes patients were identified by their primary diagnosis using ICD-10 (International Classification of Disease, Tenth revision) code E10-E14 and by a diagnosis of Diabetes Mellitus (DM) from the database. Microsoft Excel and Microsoft Access were used for data management and analysis. Descriptive statistics were used to describe epidemiological data of the disease and its complications.

The study found that total numbers of patients were increasing during the 2 years, from 12,641 to 15,822(25.16%). Patients' utilization for outpatient only, inpatient only, and both utilizations were all increasing. Demographic characteristics of diabetes patients should more females than males in both years. Average age of diabetes outpatients was 59.54 and 58.94 during fiscal years 2002 and 2003, respectively, less than the average ages of diabetes inpatients, which were 62.06 and 61.57. Drug and medical supplies were cost predictors of treatment especially cost of diabetes outpatients' treatment, which was 90,071,592 Baht (72.14%) and 130,986,224 Baht (71.84%) during fiscal years 2002 and 2003, respectively. The average outpatient cost of diabetes with complications per person was much more than cost without complications, 12,586.73 Baht and 14,550.79 Baht during fiscal years 2002 and 2003 respectively. In the same way, the average inpatient cost of diabetes with complications per person was higher than cost without complications, 76,598.61 Baht and 80,966.35 Baht during fiscal years 2002 and 2003, respectively. Type of complications showed that, DM with multiple complications was the highest complication costs for both outpatients and inpatients.

The results from this study could be used as information for forecasting the burden of diabetes in hospital. Furthermore, it could be a tool for disease management and public health planning. Also, this preliminary research could be the basis for further study of diabetes in Thailand.

KEY WORDS: COST / DIABETIC /

41 pp.

ต้นทุนของการรักษาผู้ป่วยเบาหวานที่โรงพยาบาลโรงเรียนแพทย์ในปีงบประมาณ 2545-2546 (COST OF TREATMENT FOR DIABETIC PATIENTS AT TEACHING HOSPITAL, FISCAL YEAR 2002-2003)

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บทคัดย่อ

วัตถุประสงค์ของการศึกษาเพื่อศึกษาการใช้บริการและต้นทุนของการรักษาผู้ป่วยเบาหวาน โดยใช้ฐานข้อมูลของผู้ป่วยเบาหวานทั้งผู้ป่วยนอกและผู้ป่วยในที่มารับบริการที่โรงพยาบาลโรงเรียนแพทย์ตั้งแต่ 1 ตุลาคม 2544 ถึง 30 กันยายน 2546 โดยใช้การบันทึกรหัส ICD-10 ซึ่งระบุรหัส E10-E14 เป็นเกณฑ์ในการคัดเลือกข้อมูลในการวิเคราะห์โดยใช้โปรแกรม Microsoft Excel และ Microsoft Access ในการวิเคราะห์และรายงานผลการศึกษาในรูปแบบสถิติเชิงพรรณนา

พบว่าจำนวนผู้ป่วยในช่วง2ปีเพิ่มขึ้นจาก12,641 คน เป็น 15,822 คน (คิดเป็นร้อยละ 25.16) โดยเพิ่มขึ้นทั้งจำนวนผู้ป่วยนอก ผู้ป่วยใน ผู้ป่วยที่มาใช้บริการเป็นเพศหญิงมากกว่าเพศชาย โดยอายุเฉลี่ยของผู้ป่วยนอกเท่ากับ 59.54 ปีและ58.94 ปีในปี2545และ2546ตามลำดับ ในขณะที่อายุเฉลี่ยของผู้ป่วยในเท่ากับ 62.06 ปีและ61.57 ปีในปี2545และ2546ตามลำดับ ค่ายาและเวชภัณฑ์เป็นสัดส่วนสูงสุดของการรักษาโดยเฉพาะอย่างยิ่งในผู้ป่วยนอก ค่ายาเท่ากับ 90,071,592 บาท(คิดเป็นร้อยละ 72.14) และ 130,986,224 บาท(คิดเป็นร้อยละ 71.84)ในปี2545และ2546 ตามลำดับ ต้นทุนของการรักษาผู้ป่วยนอกต่อคนต่อปีที่มีภาวะแทรกซ้อนเท่ากับ 12,586.73 บาท และ 14,550.79 บาทในปี2545และ2546ตามลำดับ และ ต้นทุนของการรักษาผู้ป่วยในต่อคนต่อปีที่มีภาวะแทรกซ้อนเท่ากับ 76,598.61 บาทและ 80,966.35 บาทในปี2545และ2546ตามลำดับ โดยเมื่อศึกษาถึงประเภทของภาวะแทรกซ้อนพบว่าผู้ป่วยที่มีภาวะแทรกซ้อนมากกว่า 1 ชนิด จะมีต้นทุนในการรักษาสูงสุดทั้งในผู้ป่วยนอกและผู้ป่วยใน

ผลจากการศึกษาสามารถนำไปใช้ในการประเมินภาระของโรคเบาหวานในโรงพยาบาล นอกจากนี้อาจนำไปใช้เป็นเครื่องมือในการวางแผนในการบริหารจัดการระบบสุขภาพ และนอกจากนั้นผลการศึกษานี้อาจใช้เป็นข้อมูลเบื้องต้นในการศึกษาเกี่ยวกับโรคเบาหวานในประเทศไทย

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CHAPTER I
INTRODUCTION

Diabetes mellitus is recognized as a group of heterogeneous disorders with the common elements of hyperglycemia and glucose intolerance, due to insulin deficiency, impaired effectiveness of insulin action, or both (1). Diabetes can now be found in almost every population in the world and epidemiological evidence suggests that, without effective prevention and control program, diabetes will continue to increase globally (2). In a 1997 study by Amos et al., it is estimated that by 2010, diabetic patients in the world will be over 220 millions (3). In Sweden, the prevalence of diabetes is about 3-4% of total population (4). But in India, the 1994-1995 prevalence rate of type2 diabetes is increased to 11.6% in urban populations (5). The Annual World Health Statistics of 1978 to 1985 showed that mortality rate of diabetes was 10-30 per 1,000 population in industrialized countries, and was 4-40 per 1,000 population in other countries (6). In Thailand, a study of the Bureau of Health Policy and Planning, the Ministry of Public Health in 1999, found that diabetes was ranked eighth as cause of death in male (3%) and third in female (8%) (7). In a recent publication (8), it is estimated that prevalence of diabetes in Thai adults in 2,000 was 9.6% or 2.4 million people.

For burden of the disease, diabetes is not only related to direct health care costs, but also to indirect costs because of loss productivity from disability and premature mortality. More details of cost determinations were published in several studies (4, 9-13). In a study by Carral et al (14), found that people with diabetes accounted for 10.9% of total hospital discharges (2453 discharges), 15.3% of total stays (30,771 days) and 16.1% of total cost (€7,417,688). The hospitalization rate is 135 per 1000 persons with diabetes (compared with 95 per 1000 non-diabetic persons). Diabetic patients were hospitalized, on average, for 4 days longer than non-diabetic patients and had higher risks of readmission {RR: 2.29 (95% CI: 1.91–2.74)}

than non-diabetic patients. The overall hospitalization cost was significantly higher in diabetic (€3023±3463) than in non-diabetic patients (€1949±2528), 55% higher than the average general cost.

Complications have a major impact on cost of diabetes. The CODE-2 Study in 2002(15) found that annual cost of a patient with no complication was EUR 1,505 in direct medical cost. The presence of microvascular complications would lead to a 70% increase in cost (EUR 2,563), compared to patient with no complications. Moreover, costs for patients with macrovascular complications (EUR 3,148) were twice as high as patients with no complications. Those patients with both complications (EUR 5,226) increased costs by 3.5 fold over those without complications. In 1996, 36.4% of health care expenditures for diabetes patient in Canada were attributable to cardiovascular, renal and eye complication (16).

In the Asia-Pacific region, the acute and chronic complications of diabetes mellitus are major causes of hospital admissions, blindness, renal failure, amputations, stroke, and coronary heart disease. Compared with the general population, the annual per capita health care expenditure is estimated to be four-fold for people with diabetes (17). The result is same as the study of Rubin et al, 1998(18) and Barcelo et al, 2003(19) that found the medical expenditures for people with diabetes are 2 to 4 times higher than for those not affected by diabetes.

There were several researches on long-term cost of diabetes in various countries but in Thailand, this kind of analysis is usually carried out for a specific period of time as cross-sectional studies. For example, a cross-sectional study conducted at seven government hospitals located in four regions of the country and in Bangkok was carried out to determine the expenditures in patient perspective in 1998. The result showed that average annual cost per diabetic patient was 6,017.50 baht and it was significantly higher than that of other diseases (20). In Samutsongkram Province, results from Ampawa Hospital (30 bed) showed that the average annual cost of outpatient care per diabetic patient in 2001 was 13,731 baht (21).

However, no further details of what are the cost drivers of the disease. In another study by Jansaropas in 2001 at Chaoprayayommaraj Hospital (509 bed), unit

cost per visit in provider perspective is calculated. It was found that unit cost of diabetic clinic was 1,206.19 baht and it has the highest drug cost per visit, 976.66 baht, which is approximately 80% of total unit cost of providing care to a diabetic patient (22). Furthermore, the study locations were usually conducted in public hospitals.

With the limitations of previous cost data of diabetes in Thailand, this study is focused on the long-term cost of caring for diabetic patients. These data will be used to help improve treatment and reduce the costs of healthcare in Thailand in the future. The results will be beneficial to policy makers to optimize resource allocation and to evaluate different approaches for diabetic management.

In view of the severity of the long-term complications of diabetes, the health consequences of this epidemic will become increasingly devastating and threaten to overwhelm the health care systems in the most vulnerable countries. There is an urgent need for prioritization of diabetes as a key issue by governments throughout the region.

General objective

To determine the cost of treatment for diabetes mellitus patients at a teaching hospital, fiscal year 2002-2003.

Specific objectives

The specific objectives of this research are;

1. To determine direct cost of diabetes patients at a teaching hospital.
2. To determine cost predictors of diabetic care.
3. To determine the impact of diabetes-related complications on healthcare cost.

Expected Outcomes and Benefits

The results of this study could be used as information for forecasting the burden of diabetes in teaching hospitals in Thailand. Furthermore, it could be a tool for disease management and public health planning. Also, this preliminary research could be the basis for further study of diabetes in Thailand.

Definition of Terms

Direct medical cost is expenditures associated with medical treatments such as hospitalization, prescription drugs, laboratory tests, medical supplies, and other medical professional services.

Direct non-medical cost is expenditures incurred by patient such as transportation to hospital, food, and hiring caretaker.

Indirect cost is the value of output that is lost because people are too ill to work or have died prematurely.

Cost to charge ratio (CCR) is a method used to estimate cost of each service from the relevant charge information. For example, if total charges are 100 baht and total costs are 80 baht, the CCR will be calculated as 0.80.

CHAPTER II
LITERATURE REVIEW

Signs and symptoms

Diabetes mellitus is a syndrome characterized by disordered metabolism and inappropriately high blood sugar (hyperglycaemia) resulting from either low levels of the hormone insulin or from abnormal resistance to insulin's effects coupled with inadequate levels of insulin secretion to compensate.

The classical triad of diabetes symptoms is polyuria, polydipsia and polyphagia, which are, respectively, frequent urination; increased thirst and consequent increased fluid intake; and increased appetite.

When the glucose concentration in the blood is raised beyond the renal threshold, reabsorption of glucose in the proximal renal tubuli is incomplete, and part of the glucose remains in the urine (glycosuria). This increases the osmotic pressure of the urine and inhibits the reabsorption of water by the kidney, resulting in increased urine production (polyuria) and increased fluid loss. Lost blood volume will be replaced osmotically from water held in body cells, causing dehydration and increased thirst.

A rarer but equally severe possibility is hyperosmolar nonketotic state, which is more common in type 2 diabetes and is mainly the result of dehydration due to loss of body water. Often, the patient has been drinking extreme amounts of sugar-containing drinks, leading to a vicious circle in regard to the water loss.

Classification

The term diabetes, without qualification, usually refers to diabetes mellitus, which is associated with excessive sweet urine but there are several rarer conditions also named diabetes. The most common of these is diabetes insipidus in which the urine is not sweet (insipidus meaning "without taste" in Latin); it can be caused by either kidney or pituitary gland damage. The principal two idiopathic forms of diabetes mellitus are known as types 1 and 2. The term "type 1 diabetes" has

universally replaced several former terms, including childhood-onset diabetes, juvenile diabetes, and insulin-dependent diabetes (IDDM). Likewise, the term "type 2 diabetes" has replaced several former terms, including adult-onset diabetes, obesity-related diabetes, and non-insulin-dependent diabetes (NIDDM). Beyond these two types, there is no agreed-upon standard nomenclature. Various sources have defined "type 3 diabetes" as, among others, gestational diabetes, insulin-resistant type 1 diabetes (or "double diabetes"), type 2 diabetes which has progressed to require injected insulin, and latent autoimmune diabetes of adults.

Type 1 diabetes mellitus

Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans in the pancreas, leading to a deficiency of insulin. The main cause of this beta cell loss is a T-cell mediated autoimmune attack. Most affected people are otherwise healthy and of a healthy weight when onset occurs. Sensitivity and responsiveness to insulin are usually normal, especially in the early stages. Type 1 diabetes can affect children or adults but was traditionally termed "juvenile diabetes" because it represents a majority of cases of diabetes affecting children.

The principal treatment of type 1 diabetes, even from the earliest stages, is replacement of insulin combined with careful monitoring of blood glucose levels using blood testing monitors. Without insulin, diabetic ketoacidosis can develop and may result in coma or death. Emphasis is also placed on lifestyle adjustments (diet and exercise) though these cannot reverse the loss. Apart from the common subcutaneous injections, it is also possible to deliver insulin by a pump, which allows continuous infusion of insulin 24 hours a day at preset levels, and the ability to program doses (a bolus) of insulin as needed at meal times.

Type 1 treatment must be continued indefinitely. Treatment does not impair normal activities, if sufficient awareness, appropriate care, and discipline in testing and medication is taken. The average glucose level for the type 1 patient should be as close to normal (80–120 mg/dl, 4–6 mmol/l) as possible.

Type 2 Diabetes Mellitus

Type 2 diabetes mellitus is due to insulin resistance or reduced insulin sensitivity, combined with reduced insulin secretion. The defective responsiveness of

body tissues to insulin almost certainly involves the insulin receptor in cell membranes. In the early stage the predominant abnormality is reduced insulin sensitivity, characterized by elevated levels of insulin in the blood. At this stage hyperglycemia can be reversed by a variety of measures and medications that improve insulin sensitivity or reduce glucose production by the liver. As the disease progresses the impairment of insulin secretion worsens, and therapeutic replacement of insulin often becomes necessary.

There are numerous theories as to the exact cause and mechanism in type 2 diabetes. Central obesity (fat concentrated around the waist in relation to abdominal organs, but not subcutaneous fat) is known to predispose individuals for insulin resistance. Abdominal fat is especially active hormonally, secreting a group of hormones called adipokines that may possibly impair glucose tolerance. Obesity is found in approximately 55% of patients diagnosed with type 2 diabetes. Other factors include aging (about 20% of elderly patients in North America have diabetes) and family history (type 2 is much more common in those with close relatives who have had it). In the last decade, type 2 diabetes has increasingly begun to affect children and adolescents, likely in connection with the increased prevalence of childhood obesity seen in recent decades in some places.

Type 2 diabetes may go unnoticed for years because visible symptoms are typically mild, non-existent or sporadic, and usually there are no ketoacidotic episodes. However, severe long-term complications can result from unnoticed type 2 diabetes, including renal failure due to diabetic nephropathy, vascular disease (including coronary artery disease), vision damage due to diabetic retinopathy, loss of sensation or pain due to diabetic neuropathy, and liver damage from non-alcoholic steatohepatitis.

Type 2 diabetes is usually first treated by increasing physical activity, decreasing carbohydrate intake, and losing weight. These can restore insulin sensitivity even when the weight loss is modest, for example around 5 kg (10 to 15 lb), most especially when it is in abdominal fat deposits. It is sometimes possible to achieve long-term, satisfactory glucose control with these measures alone. However, the underlying tendency to insulin resistance is not lost, and so attention to diet, exercise, and weight loss must continue. The usual next step, if necessary, is treatment

with oral antidiabetic drugs. Insulin production is initially only moderately impaired in type 2 diabetes, so oral medication (often used in various combinations) can be used to improve insulin production (e.g., sulfonylureas), to regulate inappropriate release of glucose by the liver and attenuate insulin resistance to some extent (e.g., metformin), and to substantially attenuate insulin resistance (e.g., thiazolidinediones). According to one study, overweight patients treated with metformin compared with diet alone, had relative risk reductions of 32% for any diabetes endpoint, 42% for diabetes related death and 36% for all cause mortality and stroke. Oral medication may eventually fail due to further impairment of beta cell insulin secretion. At this point, insulin therapy is necessary to maintain normal or near normal glucose levels.

Gestational diabetes

Gestational diabetes mellitus (GDM) resembles type 2 diabetes in several respects, involving a combination of inadequate insulin secretion and responsiveness. It occurs in about 2%–5% of all pregnancies and may improve or disappear after delivery. Gestational diabetes is fully treatable but requires careful medical supervision throughout the pregnancy. About 20%–50% of affected women develop type 2 diabetes later in life.

Even though it may be transient, untreated gestational diabetes can damage the health of the fetus or mother. Risks to the baby include macrosomia (high birth weight), congenital cardiac and central nervous system anomalies, and skeletal muscle malformations. Increased fetal insulin may inhibit fetal surfactant production and cause respiratory distress syndrome. Hyperbilirubinemia may result from red blood cell destruction. In severe cases, perinatal death may occur, most commonly as a result of poor placental profusion due to vascular impairment. Induction may be indicated with decreased placental function. A cesarean section may be performed if there is marked fetal distress or an increased risk of injury associated with macrosomia, such as shoulder dystocia

Other types

There are several rare causes of diabetes mellitus that do not fit into type 1, type 2, or gestational diabetes; attempts to classify them remain controversial. Some cases of diabetes are caused by the body's tissue receptors not responding to insulin

(even when insulin levels are normal, which is what separates it from type 2 diabetes); this form is very uncommon. Genetic mutations (autosomal or mitochondrial) can lead to defects in beta cell function. Abnormal insulin action may also been genetically determined in some cases. Any disease that causes extensive damage to the pancreas may lead to diabetes (for example, chronic pancreatitis and cystic fibrosis). Diseases associated with excessive secretion of insulin-antagonistic hormones can cause diabetes (which is typically resolved once the hormone excess is removed). Many drugs impair insulin secretion and some toxins damage pancreatic beta cells.

Diagnosis

The diagnosis of type 1 diabetes, and many cases of type 2, is usually prompted by recent-onset symptoms of excessive urination (polyuria) and excessive thirst (polydipsia), often accompanied by weight loss. These symptoms typically worsen over days to weeks; about a quarter of people with new type 1 diabetes have developed some degree of diabetic ketoacidosis by the time the diabetes is recognized. The diagnosis of other types of diabetes is usually made in other ways. These include ordinary health screening; detection of hyperglycemia during other medical investigations; and secondary symptoms such as vision changes or unexplainable fatigue. Diabetes is often detected when a person suffers a problem that is frequently caused by diabetes, such as a heart attack, stroke, neuropathy, poor wound healing or a foot ulcer, certain eye problems, certain fungal infections, or delivering a baby with macrosomia or hypoglycemia.

Criteria for the diagnosis of diabetes (24)

1.1 Symptoms of diabetes plus causal plasma glucose concentration > 200 mg/dl (11.1 mmol/l). Casual is defined as any time without regard to time since last meal. The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss.

1.2 Fasting plasma glucose $\geq$ 126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 hours.

1.3 Two hours plasma glucose $\geq$ 200 mg/dl (11.1 mmol/l) during an oral

glucose tolerance test. This test should be performed as described by World Health Organization, using an equivalent of 75 grams anhydrous glucose dissolved in water (25).

Risk factors

Risk factors for Diabetes are factors that do not seem to be a direct cause of the disease, but seem to be associated in some way. Having a risk factor for Diabetes makes the chances of getting a condition higher but does not always lead to Diabetes.

The American Diabetes Association takes a message about ten risk factors of diabetes (26): Age greater than 45 years, diabetes during a previous pregnancy, excess body weight (especially around the waist), family history of diabetes, given birth to a baby weighing more than 9 pounds, HDL cholesterol under 35, high blood levels of triglycerides, a type of fat molecule (250 mg/dL or more), impaired glucose tolerance, low activity level, and poor diet.

A large proportion of the South Australian population exhibit one or more of these risk factors, which must be modified if increasing prevalence of diabetes is to be addressed. Age, family history, and obesity are appropriate criteria for screening to detect the condition early and to implement management strategies that prevent complications (27).

Risk factors for developing diabetes in any country are the same in most factors include a family history of diabetes, older age, obesity and physical inactivity but some ethnic groups, including African Americans, Hispanic Americans, and Native Americans, all have high rates of diabetes**.**

Complications

Diabetes is associated with long-term complications that affect almost every part of the body. The disease often leads to blindness, heart and blood vessel disease, strokes, kidney failure, amputations, and nerve damage. The complications of diabetes are generally as either macrovascular and microvascular complication. (28)

Macrovascular complications of diabetes include cerebrovascular, cardiovascular and peripheral vascular disease. With diabetes, these vessels are more

prone to occlusion leading to coronary heart disease, stroke, or foot amputation resulted from peripheral vascular disease.

Microvascular complications arise from degree and duration of hyperglycemia. The progression of the disease can lead to diabetic nephropathy, retinopathy and neuropathy.

The following are statistics from various sources about the complications of Diabetes (29): 268 men per 100,000 people are hospitalized for coronary heart disease associated with diabetes in Australia 1998-99. 6 people per 1,000 population over 18 who have diabetes develop diabetic eye disease in Australia 2002. 13 women per 100,000 people are hospitalised for end-stage renal disease associated with diabetes in Australia 1998-99. 152 women per 100,000 people are hospitalised for coronary heart disease associated with diabetes in Australia 1998-99. 17 men per 100,000 people are hospitalised for end-stage renal disease associated with diabetes in Australia 1998-99. 0.7% of diabetics had a lower limb amputation in Australia 2002. 2.1% of diabetic adults attending specialist diabetes services had a stroke in Australia 2002. 2.2% of diabetic adults attending specialist diabetes services had a current foot ulcer in Australia 2002. 26% of diabetic adults attending specialist diabetes services had peripheral neuropathy in Australia 2002. 44% of new cases of end-stage renal disease is due to diabetes in the US. 12,000-24,000 new cases of blindness annually are due to diabetic retinopathy in the US. Risk for stroke amongst diabetics is two to four times higher than those without diabetes in the US.

The International Classification of Diseases, Tenth Revision (ICD-10)

ICD-10 was endorsed by the Forty-third World Health Assembly in May 1990 and came into use in WHO Member States as from 1994(30). The International Statistical Institute adopted the first edition, known as the International List of Causes of Death, in 1893. WHO took over the responsibility for the ICD at its creation in 1948 when the Sixth Revision, which included causes of morbidity for the first time, was published.

The ICD has become the international standard diagnostic classification for all general epidemiological and many health management purposes. These include the analysis of the general health situation of population groups and monitoring of the incidence and prevalence of diseases and other health problems in relation to other

variables such as the characteristics and circumstances of the individuals affected. It is used to classify diseases and other health problems recorded on many types of health and vital records including death certificates and hospital records. In this study, data collection was obtained from code E10-E14, as shown below.

E10 Insulin-dependent diabetes mellitus (IDDM)

E100 IDDM with coma

E101 IDDM with ketoacidosis

E102 IDDM with nephropathy

E103 IDDM with cataract

E104 IDDM with neuropathy

E105 IDDM with gangrene

E106 IDDM with other specified complications

E107 IDDM with multiple complications

E108 IDDM with unspecified complications

E109 IDDM without complications

E11 Non-insulin-dependent diabetes mellitus (NIDDM)

E110 NIDDM with coma

E111 NIDDM with ketoacidosis

E112 NIDDM with nephropathy

E113 NIDDM with cataract

E114 NIDDM with neuropathy

E115 NIDDM with gangrene

E116 NIDDM with other specified complications

E117 NIDDM with multiple complications

E118 NIDDM with unspecified complications

E119 NIDDM without complications

E12 Malnutrition-related diabetes mellitus

E120 Malnutrition-related diabetes mellitus with coma

E121 Malnutrition-related diabetes mellitus with ketoacidosis

E122 Malnutrition-related diabetes mellitus with renal complication

E123 Malnutrition-related diabetes mellitus with ophthalmic complication

E124 Malnutrition-related diabetes mellitus with neurology complication

E125 Malnutrition-related diabetes mellitus with peripheral circulatory complication

E126 Malnutrition-related diabetes mellitus with other specified complications

E127 Malnutrition-related diabetes mellitus with multiple complications

E128 Malnutrition-related diabetes mellitus with unspecified complications

E129 Malnutrition-related diabetes mellitus without complications

E13 Other specified diabetes mellitus

E130 Other specified diabetes mellitus with coma

E131 Other specified diabetes mellitus with ketoacidosis

E132 Other specified diabetes mellitus with renal complication

E133 Other specified diabetes mellitus with ophthalmic complication

E134 Other specified diabetes mellitus with neurology complication

E135 Other specified diabetes mellitus with peripheral circulatory complication

E136 Other specified diabetes mellitus with other specified complications

E137 Other specified diabetes mellitus with multiple complications

E138 Other specified diabetes mellitus with unspecified complications

E139 Other specified diabetes mellitus without complications

E14 Unspecified diabetes mellitus

E140 Unspecified diabetes mellitus with coma

E141 Unspecified diabetes mellitus with ketoacidosis

E142 Unspecified diabetes mellitus with nephropathy

E143 Unspecified diabetes mellitus with cataract

E144 Unspecified diabetes mellitus with neuropathy

E145 Unspecified diabetes mellitus with gangrene

E146 Unspecified diabetes mellitus with other specified complications

E147 Unspecified diabetes mellitus with multiple complications

E148 Unspecified diabetes mellitus with unspecified complications

E149 Unspecified diabetes mellitus without complications

Diabetes with coma

Uncontrolled diabetes may lead to coma or unconsciousness. The two types of coma associated with diabetes include hyperosmolar coma and hypoglycaemic coma.

Severe dehydration and very high blood glucose levels cause hyperosmolarcoma. Events that can lead to high blood glucose levels include: Forgotten diabetes medications or insulin and increasing intake of sugary foods or fluids.

Hyperosmolar coma develops slowly over several days, so if the high blood glucose levels are detected and treated early, coma can be prevented.

Hypoglycaemia, or low blood glucose levels (below 3.5mmol/L), may occur if a person on diabetes medication or insulin: Takes an extra or an increased dose, exercises strenuously without eating extra food or reducing their insulin intake, misses a meal or snack , and drinks too much alcohol or drinks alcohol without eating food. If the blood glucose level falls very low, the person may become unconscious (hypoglycaemic coma) and seizures may occur.

Diabetic ketoacidosis

Diabetic ketoacidosis (DKA) is an acute metabolic complication of diabetes characterized by hyperglycemia, hyperketonemia, and metabolic acidosis. DKA occurs mostly in type 1 diabetes. It causes nausea, vomiting, and abdominal pain and can progress to cerebral edema, coma, and death. DKA is diagnosed by detection of hyperketonemia and anion gap metabolic acidosis in the presence of hyperglycemia. Treatment involves volume expansion, insulin replacement, and prevention of hypokalemia. DKA is most common in patients with type 1 diabetes mellitus (DM) and develops when insulin levels are insufficient to meet the body's basic metabolic requirements. DKA is the first manifestation of type 1 DM in a minority of patients. Insulin deficiency can be absolute (eg, during lapses in the administration of exogenous insulin) or relative (eg, when usual insulin doses do not meet metabolic needs during physiologic stress). Common physiologic stresses that can trigger DKA include acute infection (particularly pneumonia and UTI), MI, stroke, pancreatitis, and trauma. Drugs implicated in causing DKA include corticosteroids, thiazide diuretics, and sympathomimetics. DKA is less common in type 2 DM, but it may occur in situations of unusual physiologic stress.

Diabetic nephropathy

Diabetic nephropathy is kidney disease that develops as a result of diabetes mellitus which progresses through about five predictable stages.

Stage 1 (very early diabetes)—Increased demand upon the kidneys is indicated by an above-normal glomerular filtration rate (GFR).

Stage 2 (developing diabetes)—The GFR remains elevated or has returned to normal, but glomerular damage has progressed to significant microalbuminuria (small but above-normal level of the protein albumin in the urine). Patients in stage 2 excrete more than 30 mg of albumin in the urine over a 24-hour period. Significant microalbuminuria will progress to end-stage renal disease (ESRD). Therefore, all diabetes patients should be screened for microalbuminuria on a routine (yearly) basis.

Stage 3 (overt, or dipstick-positive diabetes)—Glomerular damage has progressed to clinical albuminuria. The urine is "dipstick positive," containing more than 300 mg of albumin in a 24-hour period. Hypertension (high blood pressure) typically develops during stage 3.

Stage 4 (late-stage diabetes)—Glomerular damage continues, with increasing amounts of protein albumin in the urine. The kidneys' filtering ability has begun to decline steadily, and blood urea nitrogen (BUN) and creatinine (Cr) has begun to increase. The glomerular filtration rate (GFR) decreases about 10% annually. Almost all patients have hypertension at stage 4.

Stage 5 (end-stage renal disease, ESRD)—GFR has fallen to approximately 10 milliliters per minute (<10 mL/min) and renal replacement therapy (i.e., hemodialysis, peritoneal dialysis, kidney transplantation) is needed.

Diabetes with ophthalmic complication

The lens of the eye is made of fluid containing protein. This can start to cloud over for various reasons; one of them is from diabetes. The treatment of Cataract has advanced greatly in recent times. Surgery is the method of choice and lens is removed and replaced with an artificial one. Cataract surgery is usually very successful and is probably the most commonly performed surgical procedure.

Diabetes mellitus with neuropathy

A common complication of diabetes is damage to the nerves that allow you to feel sensations such as pain. This is called neuropathy. There are four types of neuropathy: peripheral, autonomic, proximal and focal.

The areas of the body most commonly affected by peripheral neuropathy are the feet and legs. Nerve damage in the feet can result in a loss of foot sensation, increasing your risk of foot problems. Injuries and sores on the feet may go unrecognized due to lack of sensation.

Autonomic neuropathy most often affects the digestive system, especially the stomach, blood vessels, urinary system, and sex organs. To prevent autonomic neuropathy, continuously keep your blood glucose levels well controlled.

Proximal neuropathy causes pain (usually on one side) in the thighs, hips, or buttocks. It can also lead to weakness in the legs. Treatment for weakness or pain is usually needed and may include medication and physical therapy. The recovery varies, depending on the type of nerve damage. Prevention consists of keeping blood glucose under tight control.

Focal diabetic neuropathy can also appear suddenly and affect specific nerves, most often in the head or leg, causing muscle weakness or pain.

Diabetes Medications

Insulin

Very Fast acting - The fastest acting insulins are called lispro (Humalog) and insulin aspart (Novolog). They should be injected under the skin within 15 minutes before meal. Patients have to remember to eat within 15 minutes after take a shot. These insulin start working in five to 15 minutes and lower blood sugar most in 45 to 90 minutes. It finishes working in three to four hours. With regular insulin patients have to wait 30 to 45 minutes before eating. Many people like using lispro because it's easier to coordinate eating with this type of insulin.

Fast acting - The fast acting insulin is called regular insulin. It lowers blood sugar most in 2 to 5 hours and finishes its work in 5 to 8 hours.

Intermediate acting - NPH (N) or Lente (L) insulin starts working in one to three hours, lowers blood sugar most in six to 12 hours and finishes working in 20 to 24 hours. With respect to speed of onset and duration of effect, there are prompt, short, intermediate, and long-acting insulins. Lispro (brand name Humalog) is a prompt-

acting insulin. It starts to lower blood sugar in about 15 minutes, reaches its peak sugar-lowering effect after 60 to 90 minutes, and stops affecting blood sugar four to five hours after you inject it. You should inject Lispro just before a meal.

Regular insulin such as Humulin R and Novolin R is defined as short acting. It begins lowering blood sugar from 30 to 60 minutes after you inject it. The peak effect from an injection occurs after two to three hours and the effect lasts for a total of five to seven hours. NPH (Humulin N, Novolin N) is an intermediate-acting insulin. It starts to work within two to four hours after injection, achieves its peak of activity after four to 12 hours, and lasts for a total of 14 to 20 hours.

Insulin glargine (Lantus) is a newer form of long-acting insulin. It starts to work within one to two hours and continues acting for about 24 hours. Lantus is different from other forms of insulin in that is does not have a peak effect. Instead, it lowers blood sugar a relatively constant amount during the 24-hour period it is in the body.

Many people use more than one type of insulin to control their blood sugar. You shouldn't mix certain types of insulin together in the same syringe, so make sure to check with your doctor or pharmacist first. Some people use premixed combinations of regular and NPH. Examples include Humulin 70/30, Novolin 70/30, and Humulin 50/50. 70/30 insulin is 70 percent NPH and 30 percent regular insulin. 50/50 insulin contains 50 percent NPH and 50 percent regular insulin. These insulins provide the same activity as if you injected NPH and regular insulin separately. But they can be easier to use, since you don't have to measure two separate doses.

Insulin Side Effects

Like all prescription medications, there are some side effects you should be aware of when you begin using insulin.

Minor: Insulin can cause redness and rash at the site of injection. Therefore, patient should rotate injection sites in order to avoid this reaction.

Major: Too much insulin can cause hypoglycemia (low blood sugar), which can lead to anxiety, chills, cold sweats, drowsiness, fast heart rate, headache, loss of consciousness, nausea, nervousness, tremors, unusual hunger, or unusual weakness.

Too little insulin can cause symptoms of hyperglycemia (high blood sugar), such as confusion, drowsiness, dry skin, fatigue, flushing, frequent urination, fruitlike breath odor, loss of appetite, or rapid breathing.

Oral Diabetes Medications

Oral diabetes medicines are grouped in categories based on type. There are several categories of oral diabetes medications -- each works differently.

Sulfonylureas. These diabetes pills lower blood glucose by stimulating the pancreas to release more insulin. The first drugs of this type that were developed -- Dymelor, Diabinese, Orinase and Tolinase -- are not as widely used since they tend to be less potent and shorter acting drugs than the newer sulfonylureas. They include Glucotrol, Glucotrol XL, DiaBeta, Micronase, Glynase PresTab and Amaryl. These drugs can cause a decrease in the hemoglobin A1c (HbA1c) of up to 1%-2%.

Biguanides. These diabetes pills improve insulin's ability to move glucose into cells especially into the muscle cells. They also prevent the liver from releasing stored glucose. Biguanides should not be used in people who have kidney damage or heart failure because of the risk of precipitating a severe build up of acid (called lactic acidosis) in these patients. Biguanides can decrease the HbA1c 1%-2%. Examples include metformin (Glucophage, Glucophage XR, Riomet, Fortamet and Glumetza).

Thiazolidinediones. These diabetes pills improve insulin's effectiveness (improving insulin resistance) in muscle and in fat tissue. They lower the amount of glucose released by the liver and make fat cells more sensitive to the effects of insulin. Actos and Avandia are the two drugs of this class. A decrease in the HbA1c of 1%-2% can be seen with this class of oral diabetes medications. These drugs may take a few weeks before they have an effect in lowering blood glucose. They should be used with caution in people with heart failure. Your doctor will do periodic blood testing of your liver function when using this diabetes medicine.

Alpha-glucosidase inhibitors, including Precose and Glyset. These drugs block enzymes that help digest starches, slowing the rise in blood glucose. These diabetes pills may cause diarrhea or gas. They can lower hemoglobin A1c by 0.5%-1%.

Meglitinides, including Prandin and Starlix. These diabetes medicines lower blood glucose by stimulating the pancreas to release more insulin. The effects of these oral diabetes medications depend on the level of glucose. They are said to be glucose

dependent. High sugars make this class of diabetes medicines release insulin. This is unlike the sulfonylureas that cause an increase in insulin release, regardless of glucose levels, and can lead to hypoglycemia.

Dipeptidyl peptidase IV (DPP-IV) inhibitors, including Januvia. The DPP-IV inhibitors (Januvia) work to lower blood sugar in patients with type 2 diabetes by increasing insulin secretion from the pancreas and reducing sugar production. These diabetes pills increase insulin secretion when blood sugars are high. They also signal the liver to stop producing excess amounts of sugar. DPP-IV inhibitors control glucose without causing weight gain. The medication may be taken alone or with other medications such as metformin.

Combination therapy. There are several combination diabetes pills that combine two medications into one tablet. One example of this is Glucovance, which combines glyburide (a sulfonylurea) and metformin. Others include Metaglip, which combines glipizide (a sulfonylurea) and metformin, and Avandamet which utilizes both metformin and rosiglitazone (Avandia) in one pill.

Some oral diabetes medications may help prevent diabetes and diabetes-related complications. Both metformin and Precose have been shown to reduce a person's risk of developing type 2 diabetes, particularly when combined with lifestyle changes such as a proper diet and regular exercise program. Actos has been shown to reduce the risk of heart attack, stroke and premature death in those with type 2 diabetes. Researchers continue to look into the preventative benefits of other medications.

Side effects of first- and second-generation sulfonylurea medicine include:

- Hypoglycemia (low blood glucose)
- Upset stomach
- Skin rash or itching
- Weight gain

Side effects for biguanide medications include:

- Upset stomach (nausea, diarrhea)
- Metallic taste in mouth

Side effects for thiazolidinediones are rare but may include:

- Elevated liver enzymes
- Liver failure
- Respiratory infection
- Headache
- Fluid retention

Side effects for alpha-glucosidase inhibitors include:

- Stomach upset (gas, diarrhea, nausea, cramps)

Side effects of meglitinides include:

- Hypoglycemia (low blood glucose)
- Stomach upset

Prevention

Type 1 diabetes risk is known to depend upon a genetic predisposition based on HLA types (particularly types DR3 and DR4), an unknown environmental trigger (suspected to be an infection in most cases), and an uncontrolled autoimmune response that attacks the insulin producing beta cells. Some research has suggested that breastfeeding decreased the risk; various other nutritional risk factors are being studied, but no firm evidence has been found.

Type 2 diabetes risk can be reduced in many cases by making changes in diet and increasing physical activity. The American Diabetes Association (ADA) recommends maintaining a healthy weight, getting at least 2½ hours of exercise per week (a brisk sustained walk appears sufficient), having a modest fat intake, and eating a good amount of fiber and whole grains. The ADA does not recommend alcohol consumption as a preventative, but it is interesting to note that moderate alcohol intake may reduce the risk (though heavy consumption clearly increases damage to body systems significantly). There is inadequate evidence that eating foods of low glycemic index is clinically helpful. Some studies have shown delayed progression to diabetes in predisposed patients through prophylactic use of metformin, rosiglitazone, or valsartan. In patients on hydroxychloroquine for rheumatoid arthritis, incidence of diabetes was reduced by 77%. Breastfeeding might also be associated

with the prevention of type 2 of the disease in mothers. It is possible that adequate copper could help prevent insulin dependant diabetes since it does so for ATZ poisoned mice and copper in drinking water has somewhat of a protective affect. It could be that copper produces its effects through super oxidase dismutase (SOD) because metaloporpherin based superoxide dismutase can prevent or delay the onset of the autoimmune cascade in diabetes, using mice. Children with antibodies treated with vitamin B-3 (niacin) had less than half the onset of diabetes incidence in a 7 year time span as the general population and even lower incidence relative to those with antibodies as above, but no vitamin B-3

Cost study

Perspective of the study

There are four main types of perspective i.e. societal perspective, provider perspective, public sector perspective, and private consumer perspective (31).

A societal perspective is the broadest viewpoint in COI analysis. It would encompass costs incurred by all member of society including the private sector, the public sector and private consumer (i.e. households and individuals).

A provider perspective would exclude costs incurred by private consumers or households.

A public sector perspective would excluded costs incurred by the private sector and private consumers, and collates only those costs incurred by the public sector.

A private consumer perspective would include costs incurred by only individuals and households.

Studies on the cost of diabetes are a common form of diabetes economic analysis in the literature. Most of the reports are specific to the United States experience, but a number of reports have emerged recently from other countries.

CHAPTER III
METHODOLOGY

Study design

This study was designed to determine resource utilization and cost of diabetes in provider perspective. Retrospective database of resource utilization was used to determine direct cost.

Study location

A study location was a teaching hospital (1,076-bed), with availability of electronic database of disease diagnosis and health care resource utilization for both outpatients and inpatients.

Study population

All outpatients and inpatients that were treated for diabetes at the hospital during October 2001 to September 2003 were the population. Diabetic patients were identified by their primary diagnosis using ICD-10 (International Classification of Disease, Tenth revision) and diagnosis DM from database. For co-morbidity and complications, patients who have secondary or tertiary diagnoses such as hypertension, dyslipidemia, nephropathy, neuropathy, or retinopathy, was identified from the database. From previous studies, prevalence of complications varies from study to study: 12.53-30.00% retinopathy; 5.53-12.90% nephropathy; and 7.79-28.00% neuropathy (15, 19, 23), for example.

Study procedure and data collection

The study procedures were divided into two parts.

Part one: Determination of resource utilization.

This part was to determine rate of service utilization by diabetic patients at the hospital, number of outpatient visits and hospital admissions for the year 2002 and 2003. For resource utilization, hospital charges were extracted for each service

recorded in the database: drugs and supplies, laboratories, diagnostic examinations, hospitalization, surgery, procedures and others.

Part two: Determination of complication costs.

Direct medical cost component includes expenditures associated with medical treatments such as hospitalization, prescription drugs, laboratory tests, medical supplies, and other medical services. Costs with and without complications were defined. Cost of services or supplies were obtained from electronic database. For patients who may seek care for diabetes at other hospitals were not included in the study.

Data Analysis

Data were retrieved from the database as dBase file format and transferred to Microsoft Access format. Microsoft Excel and Microsoft Access were used for data management and analysis. Descriptive statistics were used to describe epidemiological data of the disease and its complications; diabetic coma, diabetic ketoacidosis, diabetic nephropathy, diabetic cataract, diabetic neuropathy, diabetic gangrene, and other specified complications. For resource utilization, number of OPD visits and IPD admissions, different types of hospital charges and cost components was tabulated. These were done separately for diabetic patients with and without complications. This is to identify predictors of resource utilization, or cost drivers of the disease.

Resource utilization

Resource utilization was determined for outpatients and in-patients.

Outpatient utilization

Outpatient utilization rate was computed as number of visit per person, for diabetes and other diseases. Diabetes visit was determined by diabetes drug prescribed, x-ray and laboratory for diabetes therapy and ICD10 code.

Hospital utilization was calculated as:

$$\text{Outpatient utilization rate} = \frac{\text{Total number of visits}}{\text{Total number of patients}}$$

$$\text{Diabetes utilization rate} = \frac{\text{Total number of DM visits}}{\text{Total number of patients}}$$

$$\text{Other utilization rate} = \frac{\text{Total number of visits of other diseases}}{\text{Total number of patients}}$$

Average costs per visit and per person were also computed.

$$\text{Cost of service per visit} = \frac{\text{Total cost of services}}{\text{Total number visit of DM patient}}$$

$$\text{Cost of service per person} = \frac{\text{Total cost of service}}{\text{Total number DM patient}}$$

In-patient utilization

Length of stay was computed by the discharge date minus the admission date. Charge and cost per admission and per day were determined for total charge and type of service. Average length of stay was calculated.

$$\text{Cost per admission} = \frac{\text{Total cost of services}}{\text{Total number of admission of DM patient}}$$

$$\text{Cost per day} = \frac{\text{Total cost of services}}{\text{Total hospital bed-days}}$$

CHAPTER IV

RESULTS

Results of the study were presented in three parts, as follows:

Part 1: Diabetes patients' utilization

Part 2: Cost of treatment

Part 3: Complications

Part 1: Diabetes patients' utilization

During fiscal year 2002 and 2003, numbers of diabetes patient were 12,641 and 15,822 respectively, as shown in table 1.

Table 1 Number of diabetes outpatients and inpatients' utilization

Service utilization	2002		2003	
	N	%	N	%
Outpatient only	11,374	89.98	14,161	89.50
Inpatient only	521	4.12	675	4.27
Both utilization	746	5.90	986	6.23
Total patients	12,641	100	15,822	100

There were 12,120 and 15,147 diabetes outpatients, 41,970 and 51,720 visits during fiscal year 2002 and 2003 respectively. The average numbers of visit were 3.46 and 3.41 respectively, as shown in table 2.

Table 2 Number of diabetes outpatients' utilization

Year	Number of patients	Total visit	Average visit/year
2002	12,120	41,907	3.46
2003	15,147	51,720	3.41

Table 3 presents demographic characteristics of diabetes outpatients. The patients were female more than male in both years. The mean ages were 59.54 and 58.94 respectively.

Table 3 Demographic characteristics of diabetes outpatients

Characteristics	2002		2003	
	N	%	N	%
Gender				
Male	4,108	33.89	4,953	32.70
Female	8,012	66.11	10,194	67.30
Age				
0-10	26	0.21	49	0.32
11-20	43	0.35	120	0.80
21-30	156	1.29	277	1.83
31-40	542	4.47	806	5.32
41-50	1,855	15.31	2,378	15.70
51-60	3,437	28.36	4,046	26.71
61-70	3,837	31.66	4,676	30.87
>70	2,224	18.35	2,795	18.45
Average (year $\pm$ SD)	59.54$\pm$ 9.23		58.94$\pm$ 9.89	

There were 1,267 and 1,661 diabetes inpatients, 1,585 and 2,079 admissions during fiscal year 2002 and 2003 respectively. The average numbers of admissions were 1.25 in both years, as shown in table 4.

Table 4 Number of diabetes inpatients' utilization

Year	Unique HN	AN	Average admission/year	Length of stay (day) Average (range)
2002	1,267	1,585	1.25	9.62(1-303)
2003	1,661	2,079	1.25	8.66(1-220)

Table 5 presents demographic characteristics of diabetes inpatients. The patients were female more than male in both years. The mean ages were 62.06 and 61.57 respectively.

Table 5 Demographic characteristics of diabetes inpatients

Characteristics	2002		2003	
	N	%	N	%
Gender				
Male	584	46.09	713	42.93
Female	683	53.91	948	57.07
Age				
0-10	6	0.48	7	0.42
11-20	13	1.03	9	0.54
21-30	12	0.95	29	1.75
31-40	41	3.24	54	3.25
41-50	138	10.89	169	10.18
51-60	292	23.04	421	25.35
61-70	417	32.91	514	30.94
>70	348	27.46	458	27.57
Average (year $\pm$ SD)	62.06$\pm$ 14.10		61.57$\pm$ 12.14	

Part 2: Cost of treatment

The study found that drug and medical supplies was cost predictor of treatment, especially on diabetes outpatients. Lab and X-Ray was 16.43% and 16.54% in total cost of the year 2002 and 2003 respectively. Other service that not categorized was the third rank on both years that was 8.13% and 8.15% on the year 2002 and 2003 respectively. Surgery was the fourth rank that about 1.80% and 1.88%. From Total cost of services 124,856,657 Baht and 182,330,468 Baht, the study found that average cost per year on 2002 was 10,301.70 Baht and 12,037.40 Baht on the year 2003.

Table 6 Diabetes outpatients' cost by type of services

Type of services	2002		2003	
	Cost (Baht)	%	Cost (Baht)	%
Drug and medical supplies	90,071,592	72.14	130,986,224	71.84
Lab and X-Ray	20,513,948	16.43	30,157,460	16.54
Surgery	2,348,500	1.88	3,280,300	1.80
Others	10,150,846	8.13	14,861,565	8.15
Not classified	1,771,771	1.42	3,044,919	1.67
Total	124,856,657	100	182,330,468	100
Average	10,301.70		12,037.40	

Table 7 Diabetes inpatients' cost by type of services

Type of services	2002		2003	
	Cost (Baht)	%	Cost (Baht)	%
Drug and medical supplies	28,474,405	31.16	44,640,833	34.52
Lab and X-Ray	17,481,237	19.13	24,686,950	19.09
Surgery	3,024,720	3.31	5,211,545	4.03
Hospitalization	21,163,903	23.16	32,536,598	25.16
Others	18,833,680	20.61	19,320,222	14.94
Not classified	2,403,328	2.63	2,922,604	2.26
Total	91,381,273	100	129,318,752	100
Average	72,124.13		77,855.96	

Part 3: Complications

Utilization of diabetes with complication had higher over those without complications. Types of complication were divided to 10 types, using ICD-10 classification. For both outpatients and inpatients, diabetes with multiple complications had highest score on an average cost/patients.

Table 8 Utilization of treatment for diabetes with and without complications

Type	2002		2003	
	DM with complication	DM without complication	DM with complication	DM without complication
Outpatients				
Number	7,774	4,346	9,109	6,038
(%)	(64.14)	(35.86)	(60.14)	(39.86)
Cost	97,849,266	27,007,391	132,543,113	49,787,355
(%)	(78.37)	(21.63)	(72.69)	(27.31)
Cost/Patient	12,586.73	6,214.31	14,550.79	8,245.67
Inpatients				
Number	1,142	125	1,552	109
(%)	(90.13)	(9.87)	(93.44)	(6.56)
Cost	87,475,616	3,905,657	125,659,782	3,658,970
(%)	(95.72)	(4.28)	(97.17)	(2.83)
Cost/Patient	76,598.61	31,245.26	80,966.35	33,568.53

Utilization of treatment for diabetes with and without complications was shown in table 8. Number of patient on DM with complication was 7,774 and 9,109 patient on the year 2002 and 2003 respectively. Compare with Number of patient on DM without complication, this study found that patient with complication was more than patient without complication on both years.

For cost of treatment on both years, patient with complication was higher than patient without complication. Cost per patient on DM with complication was 12,586.73 Baht and 14,550.79 Baht on the year 2002 and 2003 respectively.

For patient on admitting was showed the same result. Thos study found that the number of patient was 1,142 and 1,552 for DM with complication on the year 2002 and 2003 respectively. Cost per patient on DM with complication was 76,598.61 Baht and 80,966.35 Baht on the year 2002 and 2003 respectively.

All DM with complication was higher than DM without complication both number and cost of treatment on outpatient and inpatient utilization.

Table 9 Cost of treatment for diabetes outpatient by type of complications

Type of Complication	2002			2003		
	N	Cost (Baht)	Cost/ Patient (Baht)	N	Cost (Baht)	Cost/ Patient (Baht)
Coma	-	-	-	-	-	-
Ketoacidosis	293	2,406,883	8,214.62	214	1,928,636	9,012.32
Nephropathy	542	6,583,647	12,146.95	587	7,997,358	13,624.12
Diabetic cataract	1,536	15,554,985	10,126.94	1,756	20,697,147	11,786.53
Diabetic neuropathy	268	2,316,962	8,645.38	349	3,404,798	9,755.87
Diabetic gangrene	327	3,275,016	10,015.34	537	6,034,183	11,236.84
DM with other specified complication	1,013	13,300,066	13,129.38	1,291	19,510,005	15,112.32
DM with multiple complication	3,267	49,190,173	15,056.68	3,743	65,786,214	17,575.80
DM with unspecified complication	528	5,221,534	9,889.27	632	7,184,772	11,368.31
DM without complication	4,346	27,007,391	6,214.31	6,038	49,787,355	8,245.67
Total	12,120	124,856,657	10,301.70	15,147	182,330,468	12,037.40

Cost of treatment for diabetes outpatient by type of complications was shown in table 9. This table was shown by ICD10 classification. The study found the DM with multiple complications was the highest cost of treatment on both years.

Table 10 Cost of treatment for diabetes inpatient by type of complications

Type of Complications	2002			2003		
	N	Cost (Baht)	Cost /Patient (Baht)	N	Cost (Baht)	Cost /Patient (Baht)
Coma	-	-	-	-	-	-
Ketoacidosis	-	-	-	-	-	-
Nephropathy	75	6,160,899	82,145.32	124	10,580,202	85,324.21
Diabetic cataract	118	4,750,468	40,258.20	311	12,818,076	41,215.68
Diabetic neuropathy	15	528,974	35,264.93	23	870,763	37,859.26
Diabetic gangrene	136	10,355,388	76,142.56	172	13,262,940	77,110.12
DM with other specified complications	81	5,425,005	66,975.37	102	6,989,480	68,524.31
DM with multiple complications	481	48,168,480	100,142.37	536	65,767,855	122,701.22
DM with unspecified complications	236	12,086,402	51,213.57	284	15,370,466	54,121.36
DM without complications	125	3,905,657	31,245.26	109	3,658,970	33,568.53
Total	1,267	91,381,273	72,124.13	1,661	129,318,752	77,855.96

Cost of treatment for diabetes inpatient by type of complications was shown in table 9. This table was shown by ICD10 classification. The study found the DM with multiple complications was the highest cost of treatment on both years

CHAPTER V
DISCUSSION

According to the results of this study, the discussion was divided into four parts, as follows;

Part 1: Diabetes patients' utilization

Part 2: Cost of treatment

Part 3: Impact of diabetes- related complications on cost

Part 4: Limitations of the study

Part 1: Diabetes patients' utilization

Diabetes patients' utilization has an increasing prevalence in 2003 than in 2002. Total numbers of patients were increasing during 2 years, from 12,641 to 15,822(25.16%). Patients' utilization in outpatient only, inpatient only, and both utilizations were all increasing as same as an increasing of numbers.

When looking at outpatients' utilization, numbers of patients were increasing during 2 years, from 12,120 to 15,147(24.97%). An average visits per year were 3.46 and 3.41 in 2002 and 2003 respectively. For gender, diabetes outpatients were female more than male in both years. The mean ages were 59.54 and 58.94 respectively.

There were 1,267 and 1,661 diabetes inpatients, 1,585 and 2,079 admissions during fiscal year 2002 and 2003 respectively. The average numbers of admissions were 1.25 in both years. The patients were female more than male in both years. The mean ages were 62.06 and 61.57 respectively.

This finding on two years was in the same trend of utilization, which utilization has an increasing. Diabetes outpatients' utilizations were more frequency

than inpatients. On the other hand, the mean ages of inpatients were higher than the mean age of outpatient.

Part 2: Cost of treatment

The study found that drug and medical supplies were cost predictor of treatment, especially on diabetes outpatients. Diabetes outpatients' cost divided by type of services shown that drug and medical supplies costs 72.14% and 71.84% of total cost of treatment during fiscal year 2002 and 2003 respectively. For inpatients, cost of treatment for drug and medical supplies were 31.16%and 34.52% of total cost of treatment during fiscal year 2002 and 2003 respectively. The financial burden of diabetes and its complications on people with the disease and on the Canadian healthcare system is enormous. People with diabetes incur medical costs that are two to three times higher than those without diabetes. A person with diabetes can face direct costs for medication and supplies ranging from $1,000 to $15,000 a year.

Part 3: Impact of diabetes-related complications on healthcare cost

Utilization of diabetes with complication had higher over those without complications on both outpatients and inpatients services. The average outpatients cost of diabetes with complications per person was much more than cost without complications, 12,586.73 Baht and 14,550.79 Baht during fiscal year 2002 and 2003 respectively. On the same way, the average inpatients cost of diabetes with complications per person was higher than cost without complications, 76,598.61 Baht and 80,966.35 Baht during fiscal year 2002 and 2003 respectively. Type of complications shown that, DM with multiple complications was a highest rank of complication costs on both outpatients and inpatients.

Part 4: Limitations of the Study

This study has the following limitations;

1. In this study, data were obtained from electronic database therefore it may be underestimated from data inputting process.

2. Underreporting of diabetes as co-morbidity.

3. Result from a teaching hospital in Thailand, may not represent on other hospitals that vary on site of hospital, but this preliminary research will be the basis for further study in other hospitals.

CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

Conclusion

Diabetes is a costly condition in terms of health service use. This study was designed to determine resource utilization and cost of diabetes in societal perspective. Retrospective database of resource utilization was used to determine cost of treatment. All outpatients and inpatients that were treated for diabetes at a hospital during October 2001 to September 2003 were the population. Diabetes patients were identified by their primary diagnosis using ICD-10 (International Classification of Disease, Tenth revision) code E10-E14 and diagnosis Diabetes Mellitus (DM) from database. Microsoft Excel and Microsoft Access were used for data management and analysis. Descriptive statistics were used to describe epidemiological data of the disease and its complications

The study found that total numbers of patients were increasing during 2 years, from 12,641 to 15,822(25.16%). Patients' utilization for outpatient only, inpatient only, and both utilizations were all increasing as same as an increasing of numbers. Demographic characteristics of diabetes patients were female more than male in both years. For an average age of diabetes outpatients were 59.54 and 58.94 during fiscal year 2002 and 2003 respectively, less than an average ages of diabetes inpatients that were 62.06 and 61.57. Drug and medical supplies were cost predictor of treatment, especially on cost of diabetes outpatients' treatment, 90,071,592 Baht (72.14%) and 130,986,224 Baht (71.84%) during fiscal year 2002 and 2003 respectively. Utilization of diabetes with complication had higher over those without complications on both outpatients and inpatients services. The average outpatients cost of diabetes with complications per person was much more than cost without complications, 12,586.73

Baht and 14,550.79 Baht during fiscal year 2002 and 2003 respectively. On the same way, the average inpatients cost of diabetes with complications per person was higher than cost without complications, 76,598.61 Bahtand 80,966.35 Baht during fiscal year 2002 and 2003 respectively. Type of complications shown that, DM with multiple complications was a highest rank of complication costs on both outpatients and inpatients.

Recommendations

Recommendations for result utilization

1. From the results of this study, direct comparisons between the studies are usually not a good thing to do, because the methods used to estimate costs differ significantly between the studies.

2. Drug and medical supplies were the major part of total costs of diabetes. Therefore, the administrators should give insight into the details of these costs in order to determine factors influencing the costs and how to control.

Recommendations for further studies

1. Data validation should be examined not only diagnosis, but also other complications that not notify on database.

2. The part of drug and medical supplies should be evaluated in order to cover broader viewpoint in detail about group of medicine that more costly in the treatments.

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