DRUG UTILIZATION OF DIABETIC PATIENTS AT PHRAE HOSPITAL AND MAHARAT NAKHON RATCHASIMA HOSPITAL, FISCAL YEAR 2002-2003

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE IN PHARMACY
(PHARMACY ADMINISTRATION)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2005

ISBN 974-04-6589-7

Thesis
Entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science in Pharmacy
(Pharmacy Administration)
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ACKNOWLEDGEMENT

There were many people that helped me along this thesis, first I would like to express my sincere gratitude and deep appreciation to Assoc. Prof. Petcharat Pongcharoensuk, my major advisor, who has helped me in every step of this study, for giving suggestions for improvement, thoughtful guidance, and valuable advice.

Second, I would like to thank Assoc. Prof. Boontium Kongsaktrakoon, my co-advisor for his great assistance in programming, solving technical problems and helpful encouragement.

Third, my sincere and grateful appreciation is also to express to Mr. Sathin Srinual and Mr. Mungkorn Aungsanun who supported and helped me for data retrieval at Phrae Hospital and Maharat Nakhon Ratchasima Hospital respectively.

Additionally, my special thanks are sincerely to pharmacists at Phrae Hospital and Maharat Nakhon Ratchasima Hospital who participated in this study for their medical chart reviews

Finally, I am grateful to my family for their financial support, entirely care, and love. The usefulness of this thesis, I dedicate to my father, my mother and all the teachers who have taught me since my childhood.

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DRUG UTILIZATION OF DIABETIC PATIENTS AT PHRAE HOSPITAL AND MAHARAT NAKHON RATCHASIMA HOSPITAL, FISCAL YEAR 2002-2003.

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ABSTRACT

This study was a retrospective descriptive research. The objective was to determine drug utilization of diabetic patients and clinical outcomes at Phrae Hospital (general hospital) and Maharat Nakhon Ratchasima Hospital (regional hospital) during fiscal year 2002-2003. Data of drug use (number of prescriptions per patient per year and drug expenditure per patient per year) and clinical outcomes (FBS, HbA_{1C}, TG, LDL, HDL, and BP) were obtained from hospitals' electronic databases and medical chart reviews respectively.

Results revealed that 2,991 and 3,619 diabetic patients at Phrae Hospital were identified in 2002 and 2003 (53.69% and 27.66% without complications respectively), whereas diabetic patients at Maharat Nakhon Ratchasima Hospital were 4,559 and 4,875 (69.97% and 61.60% without complications respectively).

Diabetes complications would increase drug utilization, particularly use of cardiovascular drugs. In 2003, the number of prescriptions per outpatient per year for diabetic outpatients with macrovascular, microvascular, and both complications at Phrae Hospital were 4.14, 6.97, and 8.20 respectively, while for those without complications it was only 3.57. Drug expenditure per patient per year for diabetic patients with microvascular, macrovascular, and both complications were 3,291, 4,640, and 6,336 baht respectively, while for those without complications it was only 1,823 baht. For health insurance, government officers had higher drug expenditure per patient per year than others. When comparing drug expenditure of diabetic patients between the two hospitals, the regional hospital had higher drug expenditure than the general hospital. For clinical outcomes, the percentage of patients with good control of blood sugar and blood pressure was low (35.87%, 31.09%, and 23.63% for FBS, HbA_{1C}, and BP respectively), while the percentage of patients with good control of lipid was high (59.02%, 48.72%, and 73.33% for TG, LDL, and HDL respectively).

These findings indicated that diabetic patients with complications used more drugs and with high expenditure, particularly in regional hospital. Also, the type of health insurance affected drug utilization. A drug utilization review could be done from available electronic databases and medical chart reviews that provides useful information for efficient use of health resources and optimized patient care while controlling costs.

KEY WORDS: DRUG UTILIZATION / CLINICAL OUTCOMES / ELECTRONIC DATABASES / DIABETES MELLITUS

129 P. ISBN 974-04-6589-7

การใช้ยาของผู้ป่วยเบาหวานในโรงพยาบาลแพร่และโรงพยาบาลมหาราชนครราชสีมาใน ปีงบประมาณ 2545-2546 (DRUG UTILIZATION OF DIABETIC PATIENTS AT PHRAE HOSPITAL AND MAHARAT NAKHON RATCHASIMA HOSPITAL, FISCAL YEAR 2002-2003)

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บทคัดย่อ

การศึกษาครั้งนี้เป็นการศึกษาแบบเก็บข้อมูลย้อนหลัง มีวัตถุประสงค์เพื่อประเมินการใช้ยาและผลที่ได้ของผู้ป่วยเบาหวานที่โรงพยาบาลแพร่ (โรงพยาบาลทั่วไป) และโรงพยาบาลมหาราชนครราชสีมา (โรงพยาบาลศูนย์) ปีงบประมาณ 2545-2546 ซึ่งข้อมูลการใช้ยา (จำนวนใบสั่งยาของผู้ป่วยแต่ละคนในหนึ่งปีและค่ายาของผู้ป่วยแต่ละคนในหนึ่งปี) และผลลัพธ์ทางคลินิก (ระดับน้ำตาลในเลือด, HbA_{1C}, TG, LDL, HDL, และความดันโลหิต) ได้มาจากฐานข้อมูลทางอิเลคทรอนิกส์และการทบทวนเวชระเบียนตามลำดับ

ผลการศึกษาพบว่า จำนวนผู้ป่วยเบาหวานที่มารับการรักษาที่โรงพยาบาลแพร่มีทั้งหมด 2,991 และ 3,619 คนในปี 2545 และ 2546 (คิดเป็นผู้ที่ไม่มีภาวะแทรกซ้อนร้อยละ 53.69 และ 27.66 ตามลำดับ) ในขณะที่ผู้ป่วยเบาหวานที่มารับการรักษาพยาบาลที่โรงพยาบาลมหาราชนครราชสีมาทั้งหมด 4,559 และ 4,875 คน (คิดเป็นผู้ที่ไม่มีภาวะแทรกซ้อนร้อยละ 69.97 และ 61.60 ตามลำดับ)

ภาวะแทรกซ้อนของโรคเบาหวานทำให้มีการใช้ยาเพิ่มมากขึ้นโดยเฉพาะยาโรคหัวใจและหลอดเลือด ในปี 2546 จำนวนใบสั่งยาของผู้ป่วยนอกโรคเบาหวานที่มีภาวะแทรกซ้อนของหลอดเลือดแดงขนาดใหญ่, ขนาดเล็ก, และทั้งสองประเภทที่โรงพยาบาลแพร่ต่อคนต่อปีคือ 4.14, 6.97, และ 8.20 ตามลำดับ ขณะที่ผู้ไม่มีภาวะแทรกซ้อนใช้เพียง 3.57 ตามลำดับ ค่ายาของผู้ป่วยโรคเบาหวานที่มีภาวะแทรกซ้อนของหลอดเลือดแดงขนาดเล็ก, ขนาดใหญ่, และทั้งสองประเภทต่อคนต่อปีคือ 3,291, 4,640, และ 6,336 บาทตามลำดับ ขณะที่ผู้ไม่มีภาวะแทรกซ้อนใช้เพียง 1,823 บาท สำหรับสิทธิการรักษาสุขภาพพบว่า ข้าราชการมีค่าใช้จ่ายด้านยาสูงกว่าสิทธิอื่นๆ เมื่อเปรียบเทียบค่ายาของผู้ป่วยเบาหวานระหว่างสองโรงพยาบาล พบว่าโรงพยาบาลศูนย์มีค่าใช้จ่ายด้านยาเฉลี่ยต่อคนต่อปีสูงกว่าโรงพยาบาลทั่วไป สำหรับผลลัพธ์ทางคลินิกพบว่าร้อยละของผู้ที่สามารถควบคุมระดับน้ำตาลและความดันโลหิตให้อยู่ในเกณฑ์ที่เหมาะสมมีจำนวนน้อย (ร้อยละ 35.87, 31.09, และ 23.63 สำหรับ FBS, HbA_{1C}, และ BP ตามลำดับ) ในขณะที่ร้อยละของผู้ที่สามารถควบคุมระดับไขมันได้มีจำนวนมากกว่า (ร้อยละ 59.02, 48.72, และ 73.33 สำหรับ TG, LDL, และ HDL ตามลำดับ)

ผลที่ได้จากการศึกษาบ่งชี้ว่าผู้ป่วยเบาหวานที่มีภาวะแทรกซ้อนมีการใช้ยาในปริมาณมากและมีค่าใช้จ่ายสูง โดยเฉพาะอย่างยิ่งผู้ป่วยที่มารับบริการที่โรงพยาบาลศูนย์จะมีค่าใช้จ่ายเพิ่มมากขึ้น รวมทั้งสิทธิการรักษาพยาบาลยังส่งผลต่อการใช้ยาด้วย ดังนั้นการศึกษาการใช้ยาโดยใช้ข้อมูลอิเล็กทรอนิกส์ที่มีอยู่โรงพยาบาลและการทบทวนเวชระเบียนสามารถใช้เป็นข้อมูลพื้นฐานในการบริหารจัดการทรัพยากรสุขภาพที่มีอยู่อย่างจำกัดให้เกิดประสิทธิภาพและประโยชน์สูงสุด

129 หน้า ISBN 974-04-6589-7

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CHAPTER I

INTRODUCTION

Background and rationale

Diabetes is a widely prevalent disease that occurs as a result of reduced production of insulin by the body, decreased blood glucose (sugar) usage, or increased glucose production. As a result, the metabolic system becomes unregulated, which can lead to complications on a variety of systems throughout the body (1). The World Health Organization estimated that in 1995, 135 million adults had diabetes, and it forecasts that 300 million (a 120% increase) will have it in the year 2025 (2). In Thailand, it estimated that national prevalence of diabetes in Thai adults (aged 35 years or older) in the year 2000 was 9.6% or 2.4 million people (3). Of these, 4.8% was previously diagnosed diabetic patients and 4.8% was newly diagnosed diabetic patients.

In addition to being one of the most common chronic diseases, diabetes is also costly. In the United States (4), the estimated total costs (direct and indirect) of diabetes increased from $23 billion in 1969 to $132 billion in 2002. Even if incidence rates flatten and the population prevalence rate for the disease remains constant, the total cost could increase to $156 billion by 2010 and to $192 billion by 2020.

Growing cost of diabetes is related to high incidence rate of health care resource use. The study by Hart et al. (5) had estimated the cost and evaluation of the portion of health care resource use attributable to diabetes. The result showed that total costs associated with diabetes in 1994 were €54.8 million, with an average annual cost of €381 per diabetic patient. Hospitalizations represent the main portion of all costs (36%), followed by doctor and hospital outpatient visits (14.1%), antidiabetic drug (13.2%), laboratory test (10%), and dialysis (9.4%).

In Spain, a study by Oliva et al (6) found that the estimated direct cost of diabetes in 2002 rages from €2.4 to 2.7 billion. Hospital costs were the major part (€933 million), followed by noninsulin, nonhypoglycemic agent drugs (€777-932 million). Much lower are the costs of insulin and oral hypoglycemic agents (€311 million), primary care visits (€181-272 million) specialized visits (€127-145 million), and disable elements (€70-81 million). The direct health care costs of diabetic patients are high (6.3-7.4% of total National Health System expenditure). Their average annual cost per patient was €1,290-1,476, compared with €865 for individuals without diabetes.

This chronic disorder is associated with numerous serious and costly complications, including blindness, cardiovascular disease, kidney disease, and nerve damage. In 2002, a study by Williams et al (7) found that annual cost of a diabetic patient without complication was €1,505 in direct medical cost. The presence of microvascular complications would lead to a 70% increase in cost (€2,563), compared to patient without complication. Moreover, costs for patients with macrovascular complications (€3,148) were twice as high as patients without complication. Those patients with both complications (€5,226) increased costs by 3.5 fold over those without complication. In the U.K., a study by Morsanutto et al (8) found that the annual medical costs increased with the number of complications from €1,039.59 ($1,320) to €1,808.17 ($2,296) and to €3,141.21 ($3,989) in type 2 diabetes patients with none, one, and two and more complications, respectively.

Prescription drug use is a significant portion of the increased direct health care costs. In Germany, a study by Ruthmann et al (9) in 1992-1995 has found that diabetic patients had an increased prescription use for most drugs. A substantial increased use was found for cardiovascular drugs, fibrates, gout medications, laxatives, and wound care products. Diabetes subjects (7.9% of all patients) accounted for 21% of total annual prescription costs in the practices. Total costs (U.S. dollars) per patient year were threefold higher (diabetes $384; control subjects $123). After excluding antidiabetic agents and age- and sex-standardization, relative costs were still 1.5 times higher ($p<0.55$). Diabetes treatment accounted for 24% of total costs in diabetic patients (insulin 12% and oral antidiabetic drugs 6%). The most

important cost factor was cardiovascular drugs (CVDs) (39%). Three CVD groups accounted for about 50% of total CVD costs in diabetic patients (ACE inhibitors 25%, Ca antagonists 16%, and nitrates 10%).

In Spain, a study of Oliva et al (6) that found the estimated direct cost of diabetes in 2002 had ranged €2.4-2.67 billion. Expenditures for all drugs and consumable goods ranged between €1.16 and 1.3 billion, representing 48-49% of total cost, which is 15% higher than hospital costs. In Thailand, a study by Jansaropas (10) at Chaoprayayommaraj Hospital (509 beds), in 2001, found that diabetes care had the highest drug cost per visit, 976.66 baht, which was approximately 80% of total cost, 1,206.19 baht.

To have a burden of drug utilization of diabetic patients, it is necessary to set strategy to economize the utilization of drugs. However, until recently, drug utilization study of diabetes and complications in Thailand was unclear and underestimated. To make informed decision about diabetes-related care and new therapeutic interventions, these decision makers need to have specific cost information (11). The aim of this study was designed to determine drug utilization for treatment of diabetic patients and its clinical outcomes in a general hospital (Phrae Hospital) and a regional hospital (Maharat Nakhon Ratchasima Hospital) in Thailand.

Objectives

General objective

To determine drug utilization of diabetic patients and clinical outcomes at Phrae Hospital and Maharat Nakhon Ratchasima Hospital during fiscal year 2002-2003.

Specific objectives

1. To determine type and expenditure of drug used to treat diabetic patients with and without complications.
2. To compare drug expenditure classified by diabetic complications between Phrae Hospital and Maharat Nakhon Ratchasima Hospital.
3. To compare drug expenditure classified by types of health insurance between Phrae Hospital and Maharat Nakhon Ratchasima Hospital.
4. To determine clinical outcomes of drug use.

Benefits

The results of this study can be used to make evidence-based information for drug utilization in Thailand. It was a tool for resource allocation and public health planning. Disease management strategy could be implemented and assessed for better long-term patients care as well as more efficient use of health care resources.

CHAPTER II

LITERATURE REVIEW

1. Diabetes Mellitus

1.1 Definition and description (12-14)

Diabetes mellitus (DM) is a heterogeneous group of metabolic disorders characterized by hyperglycemia with disturbances of carbohydrate, fat and protein metabolism. It results from absolute or relative deficiencies in insulin action and/or insulin secretion. The chronic hyperglycemia of diabetes contributes to the development of macrovascular complications, e.g. cardiovascular disease as well as microvascular complications, e.g. retinopathy, neuropathy, and nephropathy.

The typical symptoms of diabetes include polyuria, polydipsia, fatigue, unexplained weight loss despite normal of excessive food intake (polyphagia), sometimes with blurred vision, tingling or numbness of extremities, itching, and drowsiness. Recurrent infections may be present in patient with diabetes.

The two main types of diabetes are type I and type II. Type I diabetes presents mainly in childhood and adolescents. Autoimmune destruction of β-cells of the pancreas accounts for the development of type I diabetes. Individuals with type I diabetes are prone to ketoacidosis. Type II diabetes, accounting for 90% to 95% of diabetic population, usually occurs in the middle-aged and the elderly but recent reports stated it may occur in obese young patients, approximately 80% of type II diabetes patients. The cause of type II diabetes is a combination of insulin resistance and impaired insulin secretion. Type II diabetes, an insidious disease, is often asymptomatic in its early stages and can remain undiagnosed for many years, of which microvascular and macrovascular complications may develop during this period.

1.2 Epidemiology of diabetes

Currently, an estimated 150 million people worldwide have diabetes and the WHO predicts a rise to an alarming 300 million people by 2025 (15). Of these, diabetes is expected to increase to 228 million people in developing countries and 72 million people in developed countries. WHO attributes this to elderly population and people with obesity, unhealthy diets, and sedentary lifestyle. Based on the survey of the International Collaborative Study of Cardiovascular Disease in Asia (3) in 2000, the estimated national prevalence of diabetes was 9.6% (2.4 million people) among Thai adults aged 35 years of older. Of these, 4.8% was previously diagnosed diabetic patients and 4.8% was newly diagnosed diabetes patients. The prevalence of impaired fasting glucose (IFG), defined as a fasting plasma glucose value of 110-125 mg/d in the absence of previous diagnosis of diabetes, was 5.4% (1.4 million people). Factors associated with development of diabetes and IFG included greater age, body mass index, waist-to-hip ratio, systolic blood pressure, total cholesterol, and serum creatinine levels.

1.3 Classification of diabetes (12-13)

The classification of diabetes mellitus was originally developed in 1979 by the National Diabetes Data Group (NDDG). WHO expert committee on diabetes in 1980 and, later, the WHO Study Group on Diabetes Mellitus (1985) endorsed the substantive recommendations of the NDDG. Diabetes mellitus was divided into five types, which was based on a combination of clinical manifestations or treatment requirements and pathogenesis. In 1997, the International Expert Committee supported by the American Diabetes Association (ADA) revised and recommended several changes to the NDDG/WHO classification. The terms insulin dependent diabetes mellitus (IDDM), non-insulin-dependent diabetes mellitus (NIDDM) were eliminated to limit confusing in classifying the patient based on treatment rather than etiology. The terms type I and type II are retained with Arabic numerals. The stage termed impaired glucose tolerance (IGT) has been retained. The analogous intermediate stage, between normal glucose homeostasis and diabetes, of fasting plasma glucose is named impaired fasting plasma glucose (IFG). The termed

gestational diabetes mellitus (GDM) is retained as defined by the WHO and NDDG. Summarizes of etiologic classification systems are followed.

a. Type I diabetes (β-cells destruction, usually leading to absolute insulin deficiency)

b. Type II diabetes (may range from predominantly insulin resistance with reactive insulin deficiency to a predominantly secretory defect with insulin resistance)

c. Other specific types

- Genetic defects of β-cells function
- Genetic defects in insulin action
- Diseases of the exocrine pancreas
- Endocrinopathies
- Drug- or chemical-induced
- Infections
- Uncommon forms of immune-mediated diabetes
- Other genetic syndromes sometimes associated with diabetes

d. Gestational diabetes mellitus (GDM)

1.4 Diagnostic criteria (12-13)

Similarly, the diagnostic criteria for diabetes, previously developed by the NDDG and WHO, was revised by the expert committee of the ADA in 1997. Diabetes mellitus can be diagnosed in any one of three ways, and confirmed on a subsequent day by any one of three tests.

a. Symptoms of diabetes plus casual plasma glucose concentration ≥ 200 mg/dl (111.1 mmol/dl). Casual is defined as any time of day without regard to time since last meal. The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss.

b. Fasting plama glucose ≥ 126mg/dl (7.0 mmol/dl). Fasting is defined as no caloric intake for at least 8 hours.

c. 2-hour plasma glucose ≥ 200 mg/dl (11.1 mmol/dl) during an oral glucose tolerance test (OGTT). The test should be performed as described by WHO, using glucose load containing the equivalent of 75-g anhydrous glucose dissolved in water.

The fasting plasma glucose (FPG) is preferred for routine testing and diagnosis because of its convenience. In addition, the expert committee categorized between normal blood glucose and diabetes mellitus. A value of 110 mg/dl of FPG is considered as the upper limit of normal blood glucose. The terms IGT and IFG, considered as risk factors for future diabetes and cardiovascular disease, refer to a metabolic stage intermediate between normal glucose homeostasis and diabetes. The term IGT refers to a plasma glucose level of more than 140 mg/dl but less than 200mg/dl resulting from 2-hour oral glucose tolerance test. Individuals are considered to have IFG when their IFG is more than 110 mg/dl but less than 126mg/dl. However, in 2003, the term of IFG was revised. A FPG level of 100 to 125 mg/dl are categorized as IFG (18). Additionally, IFG and IGT have been termed “pre-diabetes”.

1.5 **Pathophysiology of diabetes** (12,16-18)

Normal physiology

In normal glucose homeostasis, insulin acts along with counter-regulatory hormones to maintain plasma glucose concentrations between 80 and 140 mg/dl. After ingestion of glucose, glucose enters into the β-cell of the islets of Langerhans in the pancreas generating adenosine triphosphate (ATP) via glycolysis. This closes the ATP-sensitive potassium channels, leading to membrane depolarization, which then leads to an influx of calcium ions, and triggering the release of insulin. Insulin secretion, in response to glucose, shows a 2-phase secretion. The first phase of insulin secretion begins in 1 to 2 minutes and is generally over within 10 minutes. It is independent of the steady state endogenous prestimulus glucose levels. The Second phase occurs subsequently and continues proportionately to the steady state glucose concentrations. Insulin exerts its biological action to regulate blood glucose level by interacting with its cognate insulin receptor on the cell surface of muscle and fat cells. This leads to a cascade of signaling events within the cell. In the liver, the first-phase insulin secretion inhibits hepatic glucose production in the early postprandial phase,

primarily by inhibiting gycogenolysis and stimulating glucose uptake and glycogen storage. In muscle cells, insulin enhances the recruitment of glucose transport proteins (Glut-4) to the cell surface, increasing glucose uptake into the cell and storage as glycogen. Insulin also stimulates the uptake of amino acids and their conversion to protein. In adipose tissue, glucose is converted to free fatty acids and stored as triglycerides. During the fasting state, counter-regulatory hormones are released and the release of insulin is inhibited. Glycogen in the liver is broken down into glucose and amino acids are transported form muscle to liver and are converted glucose via gluconeogenesis. Finally, triglycerides are broken down into free fatty acids, which are used as alternative fuel sources.

Pathophysiology

Diabetes is a progressive condition, characterized by a dual defect involving impaired β-cell function and insulin resistance. Both genetic and environmental factors, such as visceral obesity, sedentary lifestyle, aging, and family history of diabetes, contribute to the development of this form of diabetes and increase the risk of complications. Insulin resistance is commonly associated with a clustering of clinical and biochemical features known as metabolic 'syndrome X', 'metabolic syndrome', or the 'insulin resistance syndrome'. This consists of glucose intolerance' truncal obesity, hypertension, accelerated atherosclerosis, low serum high density lipoprotein (HDL) cholesterol, high serum triglyceride, and hypofibrinolysis. The pathophysiological characteristics of insulin resistance are poorly understood. Nevertheless, defects in insulin receptor function, insulin receptor-signal transduction pathway, glucose transport and phosphorylation, glycogen synthesis, and glucose oxidation may contribute to insulin resistance. Insulin resistance in the liver, muscle, and adipose tissue leads to decreased glucose uptake in peripheral tissues, increased hepatic glucose production, and increased lipolysis, respectively.

The defects in β-cell function include a markedly reduced first-phase insulin secretion in response to glucose. This leads to exaggerated and prolonged postprandial hyperglycemia, which is an important contributor to the overall loss of glycemic control. Insulin pulsatility is also abnormal in diabetes; thereby, reduction

tissue sensitivity and the processing of proinsulin to insulin is impaired leading to over secretion of proinsulin and its products.

It is controversial which defect; insulin resistance or impaired insulin secretion initiates the natural history of diabetes. However, a 2-step model is commonly usd to describe the progression of diabetes. The first step is transition from normal to IGT, primarily due to the existence of insulin resistance. The resultant hyperglycemia stimulates secretion, to overcome insulin resistance, leading to hyperinsulinemia. The second step is worsening from IGT to overt diabetes in which β-cells can not secrete enough insulin to compensate for the degree of insulin resistance, resulting in diabetes.

1.6 Diabetes complications

The complication of diabetes, generally occurring after several years of diabetes, can be categorized into acute and long-term complications.

1.6.1 Acute complications

Diabetes ketoacidosis and hyperglycemic hyperosmoloar non-ketotic syndrome are the two most acute complications.

Diabetes ketoacidosis (DKA) mostly occurs in type I diabetes patients (19). Relative or absolute insulin deficiency in the presence of counter-regulatory hormones leads to increased hepatic glucose production, impaired peripheral glucose utilization, and promoting lipolysis and metabolism of free fatty acids to ketone bodies. These result in hyperglycemia, changes in osmolality of the extracellular space, ketonemia, and metabolic acidosis. Signs and symptoms of DKA include polyuria, polydipsia, nausea, Kussmaul respiration (fruity breath), abdominal pain, leg cramps, drwsiness, dehydration, hypotension, tachycardia, hyperventilation, alteration in mental status, shock and ultimately coma. The common precipitating causes of ketoacidosis are infections (30%), newly onset type I diabetes (25%), and discontinuation or inadequate insulin in established type I diabetes (20%).

Hyperglycemic hyperosmolar non-ketotic symdrome (HHNS) usually occurs in middle-aged of elderly patients with type II diabetes (20). It is characterized by

marked hyperglycemia (usually > 600 mg/dl) and dehydration, without significant ketosis and acidosis. The absence of ketosis may be due to the residual endogenous insulin suppressing lipolysis. Precipitating causes include infections, diuretic treatment, renal and cardiac diseases. Signs and symptoms of HHNS are similar to DKA except for Kussmaul respiration and abdominal pain.

1.6.2 Long-term complications

The chronic hyperglycemia of diabetes is associated with long-term complications. Approximately 50% of diabetes patients presents with long-term complications of diabetes at the time of diagnosis. Long-term complications are generally categorized as microvascular or macrovascular complications. Both type I and type II diabetes patients are vulnerable to these complications, which cause serious morbidity and mortality (21).

a. Microvascular complications (13,21-26)

Microvascular complications are related to the degree and duration of hyperglycemia. The proposed pathophysiologic mechanisms of microvascular complications include the formation of sorbitol by aldose reductase and the formation of advanced glycosylated end products.

Diabetic retinopathy

Diabetic retinopathy is the leading cause of blindness in the working-aged adults in the Western world. The development of diabetic retinopathy depends on the duration of diabetes. The progression of retinopathy is orderly, advancing from mild nonproliferative (background) retinopathy, characterized by increased vascular permeability leading to the formation of hard exudates, to moderate and severe nonproliferative diabetic retinopathy (NPDR), characterized by vascular closure leading to retinal ischemia with infarctions in the nerve layer of the retina, to proliferative diabetic retinopathy (PDR), characterized by the growth of new blood vessels, which are fragile, on the retina and posterior surface of the vitreous.

Blindness due to diabetic retinopathy can result from maculopathy, vitreous hemorrhage, retinal detachment, and neovascular glaucoma.

Diabetic nephropathy

Diabetic nephropathy is the leading cause of end stage renal disease (ESRD), accounting for 40% of all patients with diabetes in the United States. The risk of nephropathy with progression to ESRD is similar in both type I and type II diabetes. Hyperglycaemia causes intraglumerular hypertension and renal hyperperfusion. Increased glomerular pressure results in the deposition of protein in the mesangium, ultimately leading to glomerulosclerosis and renal failure.

Clinically, the earliest evidence of nephropathy is characterized by the appearance of microalbuminuria or incipient nephropathy. This stage occurs 10 to 15 year after the onset of dibetes. Progression to macroalbuminuria or overt nephropathy occurs over a period of 15 to 20 years after the onset of diabetes. Patients with overt nephropathy eventually develop to have ESRD. Factors associated with a high risk of nephropathy include elevated blood pressure, albuminuria, poor glycemic control, smoking, advancing age, hyperlidemia, and high dietary intake of protein.

Because microalbuminuria is associated with diabetic nephropathy and a marker of increased cardiovascular disease, microlbuminuria should be screened annually. Screening for microalbuminuria can be performed by three methods: 1) measurement of the albumin-to-creatinine ratio in random spot collection; 2) 24-hour collection with creatinine, allowing the simultaneous measurement of creatinine clearance; and 3) timed (e.g. 4-hour or overnight) collection.

Diabetic neuropathy

Diabetes neuropathy is the most commonly found complication in diabetes patients. It occurs in 50% to 60% of patients with type II diabetes. Clinically, the neuropathy presents as peripheral neuropathy of autonomic neuropathy.

Acute hyperglycemia decreases nerve function. Chronic hyperglycemia is associated with the loss of myelinated and unmyelinated fibers, wallerian degenraton,

and blunted nerve-fiber reproduction. The proposed pathophysiologic mechanisms include the formation of sorbitol by aldose reductase and the formation of advanced glycosylation end products. Peripheral neuropathy, characterized by paresthesia and pain in the lower extremities, numbness, tingling, burning sensation, and decreased sensation. It is the major risk factor for foot trauma, ulceration, Charcot arthropathy, and amputation. Autonomic neuropathy may present as gastroparesis, nocturnal diarrhea, bladder dysfunction, erectile dysfunction, and postural hypotension.

b. Macrovascular complications

Besides the well-recognized microvascular complications, diabetes is associated with premature macrovascular complications such as coronary artery disease (CAD), peripheral vascular disease (PVD), and cerebrovascular disease (CVD). The prevalence of macrovascular complications is approximately 2 to 4 times higher in individuals with diabetes than non-diabetes subjects. Coronary artery disease (such as myocardial infarction, heart failure, and angina) is the major cause of premature morbidity and mortality in type II diabetes. The increased risk of coronary heart disease in individuals with diabetes who do not have preexisting cardiovascular heart disease is equivalent to that of non-diabetes patients with a history of cardiovascular disease. These lead to the concept that diabetes is a cardiovascular risk equivalent. Multiple mechanisms contribute to the increased risk of cardiovascular disease in type II diabetes. The metabolic syndrome accompanying diabetes induces vascular dysfunction that predisposes patients with diabetes to atherosclerosis, which leads to the development of macrovascular complications. Patients with diabetes have an adverse long-term prognosis after myocardial infarction including increased rates of reinfarction, congestive heart failure, and death. Also, diabetes increases the risk of stroke-related dementia and stroke-related mortality by three times. Patients with diabetes commonly develop symptomatic forms of PVD, intermittent claudication, skin ulcers, gangrene and amputation. The incidence and extent of PVD is related to the duration and severity of diabetes.

1.7 Management of diabetes mellitus

1.7.1. Glycemic control

The therapeutic goals of treating type II diabetes patients are to prevent acute complications and to reduce the risk of long term complications through normalization or near-normalization of fasting and postprandial blood glucose levels. There is substantial evidence that intensive treatment prevents the development of microvascular complications.

Target for glycemic control

The ADA has established goals for glycemic control of nonpregnant diabetic patients as shown in Table 1. This glycemic control goal is the same as that of the WHO (27). Additional action (such as enhanced diabetes self-management education, co-management with a diabetes team, referral to endocrinologists, change in pharmacological therapy, initiation of or increase in self monitoring blood glucose (SMBG), or more frequent contact with the patient) is indicated if the FPG, PPG, and HbA_{1c} value exceeds 140 mg/dl (7.8 mmol/l), 160 mg/dl (8.9 mmol/l), and 8.0%, respectively. However, the American College of Endocrinology/American Association of Clinical Endocrinology (AACE) has recently proposed new glycemic control goals. An HbA_{1c} value <6.5%, FPG <110 mg/dl, and 2-hour PPG <140 mg/dl are the new target proposed by AACE. The management of type II diabetes includes dietary control, lifestyle modification, and pharmacological therapy. Each of thee components interacts with the others to the extent that no assessment and modification of one can be made without knowledge of the other two. Generally, dietary control and lifestyle modification should be started in patients with newly diagnosed type II diabetes.

Table 1 Glycemic control of nonpregnant individuals with diabetes (27)

Glycemic variable	Normal	Goal	Additional action suggested
Plasma value (mg/dl)			
• Average preprandial glucose	<110	90-130	<90/ >150
• Average bedtime glucose	<120	110-150	<110/ >180
Whole blood value (mg/dl)			
• Average preprandial glucose	<100	80-120	<80/ >140
• Average postprandial glucose	<110	100-140	<100/ >160
A1c	<6	<7	>8

Reference: American Diabetes Association. Standards of medical care for patients with diabetes mellitus. Diabetes Care 2002; 25 (Suppl 1):S33-49.

Pharmacological therapy (14,28-33)

Pharmacological treatment in type II diabetes includes oral antidiabetic medication and insulin therapy. The criteria for drug selection depend on the patient's clinical characteristics (such as stage of the disease, body weight, age, renal function, and so on) and the pharmacological properties of antidiabetic medications (such as mode of action, relative potencies, duration of action, and adverse effects).

Generally, any patients with FPG more than 300 mg/dl should be indicated for short-term insulin therapy to reduce glucose toxicity, in addition to exercise. After the glycemic level has improved, a transition to oral antidiabetic medication can be considered. For patients with FPG more than 200mg/dl, an oral antidiabetic medication should be started accompanying exercise. Patients with FPG less than 200 mg/dl, if, after 3 months, exercise therapy are insufficient to achieve adequate glycemic goals, an oral antidiabetic medication should be initiated. Patients who do not adequately response to monotherapy may undergo gradual dosage titrations until the maximal dosage is reached, or a second agent with different mechanism of action may be added. A third oral agent with a complementary mechanism of action can be added if uncontrolled glycemic levels with combination therapy occur. Alternatively, an evening or bedtime intermediate-acting insulin can be added to the oral regimen and adjusted to achieve the desirable goals. Because of the progressive nature of type II diabetes, failure to achieve glycemic control with oral agents is indicated for insulin therapy.

Insulin

Progressive deterioration of β-cell function may eventually require insulin therapy. Generally, insulin therapy is initiated in type II diabetes patients when 1) newly diagnosed patients with severe hyperglycemia; 2) primary and secondary failure occurs with oral antidiabetic medication therapy. There are several types of insulin as shown in Table 2. Several different insulin regimens can be used. The selected insulin regimen, given alone or in combination with oral antidiabetic agents, should be tailored to the individual needs of the patients. The onset of action, duration of action, effects of mixing and cost of insulin should be considered in choosing insulin therapy. Short- or rapid-acting insulin may be used to treat high PPG. Rapid-acting shows favorable effects on PPG with the added advantage of the flexibility of administration the insulin infection at the beginning of a meal. Premixed insulin usually combined such as oral medication plus morning intermediate-acting insulin, oral medication plus bedtime intermediate-acting insulin, premixed insulin twice daily, regular insulin before meals or intermediate acting insulin at bedtime. A new basal insulin analogue shows a constant peakless profile over a 24-hour period, which provides basal insulin by once daily bedtime dosing. Hypoglycemia is the most frequent adverse effect, mainly because of erratic meal timing, excessive insulin dosage, and unplanned exercise. Lipodystrophy, another adverse effect, can be avoided by rotating insulin injection sites

Table 2 Comparison of insulin products (14,31-32)

Insulin	Onset (hour)	Peak (hour)	Duration (hour)
Rapid-acting insulin			
• Lispro	5-15 mins	1	2-4
• Aspart	5-15 mins	1	2-4
Short-acting insulin			
• Regular	0.5-1	2-3	6-8
Intermediate-acting insulin			
• NPH	1-2	6-14	16-24
Long-acting insulin			
• Ultralente	3-4	9-15	22-28
Premixed insulin			
• NPH 70%, regular 30%	0.5-1	3-12	16-24
• NPH 50%, regular 50%	0.5-1	2-12	16-24
Basal insulin			
• Insulin glargine	-	-	24

Oral agents

Oral antidiabetic medications are diverse and categorized into five classes. These drugs are aimed at correcting the major pathophysiologic processes in II diabetes including hepatic glucose production, diminished insulin secretion, and insulin resistance. Table 3 summarizes available oral antidiabetic agents.

Table 3 Oral antidiabetic agents (33)

Drug	Dose (mg)	Doses/day	Duration (hour)	Elimination
Sulfonylureas				
First generation	-	-	-	
- Tolbutamid	500-3,000	2-3	6-12	Liver
- Tolazamide	100-1,000	1-2	12-18	Liver, kidney
- Chlorpropramide	100-500	1	24-72	Liver, kidney
Second generation				
- Glibenclamid	1.25-20	1-2	18-24	Liver, kidney
- Glipizide	2.5-40	1-2	18-24	Liver
- Glicazide	40-320	1-2	12-16	Liver
- Glimepiride	1-8	1	24	Liver
Biguanide				
- MetformiN	500-3,000	2-3	<12	Liver
αglucosidase ingibitors				
- Acarbose	75-300	3	Not absorbed	-
- Miglitol	75-300	3	Not absorbed	-
- Voglibose	0.21-0.9	3	Not absorbed	-
Meglitinides				
- Repaglinide	3-16	3	<4	Liver
- Nateglinde	3-16	3	3-4	Liver
Thiazolidinediones				
- Rosiglitazone	4-18	1-2	16-24	Liver
- Pioglitazome	15-45	1	>24	Liver

Reference: Lynch JC. Drug therapy for type II diabetes. J Pharm Pract 1999; 12:84-95.

a. Sulfonylureas

Sulfonylureas have been the mainstay of antidiabetic therapy, they stimulate insulin secretion by binding to a specific Sulfonylureas receptor linked closely to the ATP-sensitive potassium channel, facilitating cell membrane, calcium entry into the cell, and insulin secretion. Sulfonylureas are categorized into 2 generations. Both generations of Sulfonylureas have been shown to be equally efficacious in reduction in blood glucose. Ten to 25 percent of patients have a poor initial response to Sulfonylureas, so called primary failure. After a good initial response, the secondary failure rate is about 5% to 10% per year. The major adverse effects of Sulfonylureas are hypoglycemia and weight gain.

b. Meglitinide

Repaglinide and nateglinide are meglitinide analogues. Their mechanism of action is similar to Sulfonylureas although they bind to different site on the ATP-sensitive potassium channel. Unlike Sulfonylureas, they require the presence of glucose to close the ATP-sensitive potassium channels. They are distinguished from Sulfonylureas by their short metabolic half-lives, which result in greater decreasing risk of hypoglycemia, and shorter onset of action, which results in greater attenuating postprandial glucose excursion. Efficacy of meglitinide in reduction of FPG and A1C value is similar to that of Sulfonylureas. Adverse effects include hypoglycemia and weight gain, which are probably less pronounced than that caused by the Sulfonylureas.

c. Biguanide

Metformin, the available remaining biguanides, acts directly on the liver to suppress hepatic glucosneogenesis in the presence of insulin. To a lesser extent, it enhances glucose uptake in the peripheral tissue, mainly the muscle. The most common adverse effects of metformin therapy include nausea, anorexia, and diarrhea. These adverse effects can be minimized with food consumption and slow titration of dose. The most serious adverse effect is lactic acidosis. To reduce the risk of lactic

acidosis, metformin is contraindicated to those who have renal impairment, hepatic dysfunction, congestive heart failure, metabolic acidosis, dehydration, and alcoholism.

d. Thiazolidinedione

The primary actions of thiazolidinediones are improvement in insulin sensitivity in muscle and adipose tissue, and inhibition of hepatic gluconeogenesis. They are pharmacological ligands for a peroxisom-proliferator activated receptor gamma (PPAR-γ). When activated, PPAR-γ alters the expression of genes involved in several metabolic processes (adipogenesis, insulin signaling, glucose transport). This results in a decrease in insulin resistance in peripheral tissues. Their actions depend on the presence of endogenously produced insulin. Additionally, Thiazolidinediones decreased TG concentrations and decreased HDL cholesterol concentrations. Adverse effects of Thiazolidinediones include weight gain, which involves mostly in peripheral subcutaneous site, edema, and elevated liver function test. Patients with advanced congestive heart failure and hepatic impairment should not receive Thiazolidinediones.

e. Alpha-glucosidase inhibitors

Available alpha-glucosidase inhibitors include acarbose, meglitol, and voglibose. They are competitive reversible inhibitors of the alpha-glucosidase enzymes located in the brush border of the proximal small intestinal epithelium. These enzymes serve to break down disaccharides and complex carbohydrates into monosaccharides. By the reversible inhibitor of these enzymes, AGIs delay the absorption of monosaccharides and mitigate postprandial glucose excursions. As monotherapy, these agents do not cause hypoglycemia. Adverse effects of AGIs include flatulence, abdominal discomfort, bloating, and diarrhea. Initiation of therapy with a lower dose and slow titration can minimize these adverse effects. AGIs are contraindicated in patients with inflammatory bowel disease, a plasma creatinine concentration more than 2.0 mg/dl, intestinal obstruction, pregnancy and lactation.

Combination of insulin and oral agents

Combination therapy can target the many defects in type II diabetes. Sulfonylureas only increase insulin secretion. Thiazolidinediones reduce insulin resistance and provide a decrease in cardiovascular risk factors. Metformin primarily reduces hepatic glucose production. Thiazolidinediones are insulin-sensitizing agents that improve insulin resistance by combining with an intranuclear hormone receptor. Thiazolidinediones reduce circulating free fatty acids and suppress adipose-derived cytokines that increase insulin resistance. Additionally, Thiazolidinediones improve endothelial function, and they may prevent or delay the onset of type II diabetes. For example, Thiazolidinediones used in combination with sulphonylureas or metformin effectively treat hyperglycemia and improve the lipid profile. In obese patients with inadequately controlled type II diabetes, adding a Thiazolidinediones to a metformin regimen improves glycemia, insulin sensitivity, and β-cell function to a clinically significant extent. The addition of Thiazolidinediones to sulfonylurea therapy also improves insulin sensitivity and establishes glycemic control in some patients in whom monotherapy has failed.

1.7.2. Cardiovascular treatment

Cardiovascular disease is the major cause of mortality for individuals with diabetes. It is also a major contributor to morbidity and direct and indirect costs of diabetes. Diabetes is a independent risk factor for macrovascular disease and its common coexisting conditions (e.g., hypertension and dyslipidemia) are also risk factors (34).

Target for cardiovascular control

The National Diabetes Education Program (NDEP) had launching awareness campaign to highlight the link between diabetes and cardiovascular disease. The campaign Be Smart About Your Heart: Control the ABCs of Diabetes focuses on managing blood glucose with the A1c, Blood pressure, and Cholesterol level (34,35). The recommended therapy goals for diabetes care are shown in Table 4.

Table 4 Summary of recommendation for adults with diabetes (34)

Glycemic control	
• A1c	<7.0 %
• Preprandial capillary plasma glucose	90-130 mg/dl (5.0-7.2 mmol/l)
• Peak postprandial capillary plasma glucose	<180 mg/dl (<10.0 mmol/l)
Blood pressure control	<130/80 mmHg
Lipid control	
• LDL	<100 mg/dl (<2.6 mmol/l)
• Triglycerides	<150 mg/dl (<1.7 mmol/l)
• HDL	>40 mg/dl (>1.1 mmol/l)

Reference: American Diabetes Association. Standards of medical care in diabetes. Diabetes Care 2005; 28 (Suppl 1):S4-36.

Pharmacological therapy

Thiazide diuretics

Diuretics reduce total body sodium trough their natriuretic action and have been shown to have vasodilatory effects as well (36). Treatment with thiazide diuretics at doses equivalent to 25-50 mg of hydrochlorothiazide has been associated with hypokalemia, hyponatremia, volume depletion, hypercalcemia, and hyperuricemai. Potassium supplementation should be used as clinically indicated. Their efficacy in reducing the risk of stroke and congestive failure in large randomized clinical trial including subjects with mild to severe hypertension has been demonstrated. In elderly populations with isolated systolic hypertension, thiazides have resulted in decreased cardiovascular morbidity.

Loop diuretics

The mechanism of loop diuretics is related to a significant decrease in total body sodium; although acutely, these agents also act as vasodilators. Furosemide in combination with β-adrenergic blockers was used as the mainstay antihypertensive regimen in the treatment of patients with diabetic nephropathy (37). This study showed a significant reduction in the rate of deterioration of the GFR in patients with type I diabetes treated with an aggressive antihypertensive regimen. Treatment with loop diuretics can be associated with hypokalemia, hyponatremia, and volume

depletion. Their use is recommended for patients with decreased renal function, usually in combination with other agents.

Adrenergic blockers

a. Central acting agents

These drugs effectively lower blood pressure by decreasing central sympathetic outflow. However, their effects on the progression or development of microvascular complications of cardiovascular disease have not been studied in detail (38). They are associated with orthostatic hypotension, and they should be used with caution in patients with cardiovascular autonomic neuropathy. Common side effects are drowsiness, impotence, and dry mouth. Less common effects are depression and Coombs-positive anemia (with alpha-methyldopa).

b. β-blockers

β-blockers are competitive inhibitors of the β-adrenergic blockers. Nonselective β-blockers markedly inhibit the β1- and β2-receptors. In the UKPDS-HDS (38), β-blockers demonstrated efficacy in patients with myocardial infarction with relative reductions in mortality of 2.5%. Because diabetes patients with myocardial infarction have a much higher mortality than non-diabetes individuals, the absolute benefit of a given relative reduction may be greater in diabetes patients. Common side effects are was associated with modest weight gain, the development of side effects (e.g., cold extremities, intermittent claudicaton, and bronchospasm).

c. Alpha-adrenergic blockers

Alpha-adrenergic blockers are inhibitors of alpha adrenergic receptors (39). The antihypertensive effects of these medications at the doses approved for clinical use are similar to other groups of agents. No long-term randomized clinical trials examining renal or cardiovascular outcomes have been published using this family of drugs. Alpha-adrenergic blockers have been associated with improved insulin sensitivity in patients with insulin resistance associated with essential hypertension.

Calcium channel blockers

Calcium channel blockers inhibit calcium influx through membrane-bound voltage-dependent calcium channels, resulting in decreased intracellular calcium levels and vasodilatation (40). The family of calcium channel blockers is subdivided in three subclasses that have significant differences in their homodynamic effects. The dihydorpyridine group (DCCBs) has mainly vasodilatory effects and relatively small effects on cardiac inotropism or atrio-ventricular conduction. Reflex tachycardia can be seen, and edema is the most common side effect. The second group, the benzothiazepines have moderate vasodilatory effects and moderate negative inotropic and chronotropic effects. Diltiazem is the only agent available in this group, and several preparations with different pharmacokinetic profiles exist. The third group, the phenylalkylamines, has similar vascular and cardiac effects as diltiazedm. Verapamil is the only agent in this group available in the U.S. It is available in slow- and rapid-release forms with significantly different pharmacokinetics. The benzothiazepine diltiazem and the phenylalkylamine verapamil are referred to as NDCCBs.

ACE Inhibitors

These drugs are useful in the management of hypertension in diabetes patients with and without diabetic nephropathy (38). They are also effective in decreasing cardiovascular mortality and morbidity in patients with congestive heart failure and post-myocardial infarction. ACE inhibitors have been extensively studied in the treatment of diabetic nephropathy and are effective in preventing progression of retinopathy. The most common side effects of ACE inhibitors include cough and, occasionally, acute decreases in renal function. Hyperkalemia can be seen, especially in patients with renal insufficiency, bilateral renal artery stenosis, and hyporeninemic hypoaldosteronism.

Lipid lowering

Using HMG (hydroxymethylglutryl) CoA reductase inhibitors (Statins), patients with diabetes achieved significant reductions in coronary and cerebrovascular

events. There is increasing evidence of the benefits from cholesterol-lowering therapy using statin drugs in the primary and secondary prevention of coronary heart disease in subjects with diabetes. In the Heart Protection Study (41), treatment of diabetes subjects with simvastatin led to a reduction of about a quarter in new coronary events, revascularizations and strokes even in subjects who did not have elevated baseline cholesterol concentrations. Summarized of lipid lowering drugs are shown in table 5.

Table 5 Lipid lowering drugs (42)

Drug class, Agents	Lipid/Lipoprotein Effects	Clinical Trial Results
HMG-CoA reductase inhibitors (Statins)	LDL ↓ 18%-55% HDL ↑ 5%-15% TG ↓ 7%-30%	Reduced major coronary events, CHD deaths, need for coronary procedures, strode, and total mortality
Bile acid sequestrants	LDL ↓ 15%-30% HDL ↑ 3%-5% TG No change	Reduced major coronary events and CHD deaths
Nicotinic acid	LDL ↓ 5%-25% HDL ↑ 15%-35% TG ↓ 20%-50%	Reduced major coronary events, and possibly total mortality
Fibric acid	LDL ↓ 5%-20% (may be increased in patients with high TG) HDL ↑ 10%-20% TG ↓ 20%-50%	Reduced major coronary events

Reference: the National Cholesterol Education Program Adult Treatment Panel III

2. Economic Burdens of Diabetes Mellitus

2.1 Cost of diabetes mellitus

Diabetes is not only a major health problem but also imposes large economic cost. One of the reasons may be that the incidence rate and the mortality rate of diabetes increased over the period of time world-wide. In the United States (43), a study by Ford et al in 2002 estimated that 12.1 million persons who were diagnosed with diabetes, with both the number of new cases (incidence) and the percentage of the population with a diabetes diagnosis (prevalence) rising every year. If diabetes prevalence rates remained constant over time, the number of people diagnosed with diabetes could increase to 14.5 million by 2010 and to 17.4 million by 2020.

Another reason of expenditure impact is high incidence rate and health care resource use. A recent study by the American Diabetes Association (ADA) has estimated diabetes costs in 2002 (44). This study found that total health care expenditures attributable to diabetes were estimated at $132 billion. Of these, $91.8 billion in direct health care expenditures was attributable to diabetes, $39.8 billion in indirect expenditure resulting from lost workdays, restricted activity days, mortality and permanent disability. The largest component of health care costs (41% of the national cost) was institutional care (i.e., hospital inpatient care and nursing home care), followed by outpatient care, at $20 billion (15% of the national cost of diabetes) and outpatient medication and supplies, $17.5 billion (13% of the national cost of diabetes.

The medical expenditures per capita were $13,243 for people with diabetes and $2,560 for people without diabetes (44). Furthermore, when adjusting for difference in age, sex and race/ethnicity between the population with and without diabetes, people with diabetes had medical expenditures that were approximately 2.4 times higher than expenditures that would be incurred by the same group in the absence of diabetes. For economic aspect of diabetes in the United Kingdom (45), it is estimated that the care of people with diabetes accounts for 4-5% of the total health budget. Moreover, health are spending per people with diabetes is more than double what spending would be without diabetes.

According to a study by Oliva et al in 2002 (46), the estimated direct cost of diabetes in Spain raged from €2.4 to 2.7 billion. The direct health care costs of diabetic patients are high (6.3-7.4% of total National Health System expenditure). Their average annual cost per patient was €1,290-1,476. For individuals without diabetes, the average annual cost per patient was €865.

2.2 Cost of diabetes complications

This chronic disorder is associated with numerous serious and costly complications. People with diabetes are at greater risk for neurological disease, peripheral vascular disease, cardiovascular disease, renal disease, endocrine/metabolic complication, ophthalmic disease and other chronic complications. In 2002, a study by Williams et al (47) found that annual cost of a diabetic patient without complication was €1,505 in direct medical cost. The presence of microvascular complications would lead to a 70% increase in cost (€2,563), compared to patient without complication. Moreover, costs for patients with macrovascular complications (€3,148) were twice as high as patients without complication. Those patients with both complications (€5,226) increased costs by 3.5 fold over those without complication. In the U.K., a study by Morsanutto et al (48) found that the annual medical costs increased with the number of complications from €1,039.59 ($1,320) to €1,808.17 ($2,296) and to €3,141.21 ($3,989) in type 2 diabetes patients with none, one, and two and more complications, respectively.

In the year 2002, O'Brien et al (49), studied to estimate the direct medical cost of managing microvascular and macrovascular complication of type II diabetes. The estimated costs were reported in terms of event and state costs. The event cost was associated with resource use specific to the acute episode and subsequent care in the first year. While state costs were the annual costs of continual management. Data were obtained from many sources, including inpatient, ambulatory and emergency department care. This study found that the mean event costs for ischemic stroke was generated a greater financial burden ($40,209 per person). The end-stage renal disease had the highest in the state cost ($37,022 per person). Moreover, complications that are initially relatively low in cost (e.g., microalbuminuria: $10

state cost per person) can progress to more costly advanced stages (e.g., end-stage renal disease). Thus, the high cost of treatment was attributable to the complications of diabetes.

2.3 Cost of drug utilization

Drug is the major part of treatment and is essential to health care for most diabetes individuals. Drug treatment is a costly part of overall health care for diabetes because diabetic patients used a lot of drugs and with high expenditure. There is the study on the patterns and costs of drug prescribing during a 1-year study period (1995) in the UK (50). The overall numbers of drug items dispensed and the proportions of diabetic and non-diabetic patients who received these items were determined. Mean prescribing rate were calculated. Each rate was the average number of drug items dispensed per patient. This study found that the mean dispensed prescribing rates for all drugs (excluding antidiabetic medication) were higher across all age-group for diabetic patients. Meanwhile, patients with type I diabetes were 2.07 times and patients with type II diabetes were 1.70 times more likely to be dispensed a drug item than people without diabetes.

A Finland study (51), showed that cost of medications taken by all individuals with diabetes were 3.5 times greater than costs of medications taken by non-diabetes individuals. Costs of medications for individuals with diabetes accounted for 41% in antidiabetic drugs. These antidiabetic drugs were composed of insulin preparation (61%) and oral antidiabetic drugs (39%). After excluding antidiabetic drugs, costs of medication taken by all individuals with diabetes were still over two times the costs of medication for non-diabetes individual. The costs and distribution of costs differed markedly between individuals with type I and type II diabetes. The costs of all medications for individuals with type I diabetes ($1,272/patient) were 12 times greater than those non-diabetes individuals ($101/patient), whereas type II diabetes, annual medication costs ($1,151/patient) were lower than type I diabetes. Individuals with type I diabetes, insulin treatment accounted of 62% of the total costs of medications, but the costs of medications other than antidiabetic agents were almost 5 times higher in individuals with type I diabetes than in non-diabetes individuals. Thus, the higher

costs were mostly attributable to insulin therapy of individuals with type I diabetes. The higher costs for individuals with type II diabetes were related to the cost of medications other than non-diabetic medications.

A study by Leonard et al (52) is to develop diabetes registry from an outpatient pharmacy database to systematically analyze the prevalence of diabetes, patterns of glycemic medication and glucose monitoring, pharmacy costs, and hospital use related to diabetes care in the Veterans Health Administration in fiscal year 1994. From among 1,180,260 unique patients, 139,646 veterans with diabetes receiving insulin, oral agents, or glucose-monitoring strips were identified, accounting for a prevalence of 11.83% from 62 Veterans Administration Medical Centers. There were 63,078 individuals (52%) who received oral agents, of whom 53.2% received blood glucose-monitoring supplies; and 9,440 individuals (8%) received both oral agents and insulin, with 64.4% receiving blood glucose-monitoring supplies. Only 1,482 (1.2%) individuals received monitoring supplies alone, and 129 patients (0.1%) were provided with an insulin pump. Using an adjusted data set, 12% of veterans accounted for 24% of all outpatient pharmacy costs, with an average expenditure of $622 for veterans with diabetes compared with $276 for veterans without diabetes. There was $454 (73%) for non-diabetes-specific prescriptions and $168 (27%) for prescriptions related to glycemic control. Of pharmacy expenditures for glycemic control $101 (60.1%) was attributed to insulin, oral agents, and supplies, while $67 (39.9%) was attributable to glucose monitoring. Veterans with diabetes were admitted 1.6 times as frequently as veterans without diabetes.

Use of antidiabetic drug is the major part of treatment of diabetes care. In the U.S., Wysowski et al (53) found that 23.4 million outpatient prescriptions of oral antidiabetic agents were dispensed in 1990. By 2001, this number had increased 3.9-fold, to 91.8 million prescriptions. Glipizide and Glyburide, two sulfonylurea medications, accounted for 77% of prescriptions of oral antidiabetic drugs in 1990 and 35.5% of prescriptions in 2001. By 2001, the biguanide metformin (approved in 1995) had captured 33% of prescriptions, and the Thiazolidinediones insulin sensitizers (rosiglitazone and pioglitazone marketed beginning in 1999) accounted for 17% of market share. Compared with patients treated in 1990, those in 2001 were

proportionately younger and they more often used oral antidiabetic drugs and insulin in combination. Internists and general and family practitioners were the primary prescribers of this class of drugs.

Beside use of antidiabetic medications, diabetic patients often need other expensive additional medications. A Germany study in 1992-1995 (54) has found that diabetic patients had an increased prescription use for most drugs. A substantial increased use was found for cardiovascular drugs, fibrates, gout medications, laxatives, and wound care products. Diabetes subjects (7.9% of all patients) accounted for 21% of total annual prescription costs in the practices. Total costs (U.S. dollars) per patient year were threefold higher (diabetes $384; control subjects $123). After excluding antidiabetic agents and age- and sex-standardization, relative costs were still 1.5 times higher ($p<0.55$). Diabetes treatment accounted for 24% of total costs in diabetic patients (insulin 12% and oral antidiabetic drugs 6%). The most important cost factor was cardiovascular drugs (CVDs) (39%). Three CVD groups accounted for about 50% of total CVD costs in diabetic patients (ACE inhibitors 25%, Ca antagonists 16%, and nitrates 10%).

3. Aspect in Drug Utilization Studies

3.1 Definition of drug utilization

Drug utilization has been appeared in the North American literature as “the prescribing, dispensing and ingesting of drugs”. This narrow definition differs from the broader one defined by the WHO as the “marketing, distribution, prescribing, and use of drugs in a society with special emphasis on the resulting medical, social, and economic consequences” (55).

According to the WHO definition of drug use, studies of drug utilization include not only studies of the use of drug (quantitative drug utilization data either in cost of volume, pattern, and quality of drug usage) but also the consequences of drug use at all levels (56-58). For studies on consequences of drug use, Lee and Bergman point out that this definition of drug use implies that the studies on drug use also focus on both medical of non-medical factors influencing process of drug use. This process ranges from prescribing, dispensing, administering and taking of medication.

3.2 Importance of drug utilization

The principal aim of drug utilization research is to facilitate rational use of drugs in populations (55). For the individual patient rational use of a drug implies the prescription of a well-documented drug in an optimal dose on the right indication, with the correct information and at an affordable price. Without knowledge on how drugs are being prescribed and used, it is difficult to initiate a discussion on rational drug use and to suggest measures to change prescribing habits for the better. Information on the past performance of prescribers is the important factor of any auditing system.

Drug utilization research in itself does not necessarily provide answers, but it contributes to rational drug use in three important ways: 1) description of drug use patterns, 2) early signals of irrational use of drugs, and 3) interventions to improve drugs use-follow-up.

3.2.1 Description of drug use patterns

Drug utilization research will increase our understanding of how drugs are being used by:

a. Making estimates of the numbers of patients exposed to drugs within a given time period. Such estimates may either refer to all drug users, regardless of when they started to use the drug (prevalence), or focus on patients who started to use the drug within the selected period (incidence).

b. Describing the extent of use at a certain moment and/or in a certain area (e.g. country, region, community, hospital). Such descriptions are most meaningful when they are part of a continuous evaluation system, i.e. when the patterns are followed over time and trends in drug use can be described.

c. Estimating (e.g. on the basis of epidemiological data on a disease) to what extent drugs are properly used, overused, or underused.

d. Describing the pattern or profile of drug use - assessing which alternative drugs are being used for particular conditions and to what extent.

e. Comparing observed patterns of drug use with current recommendations or guidelines for the treatment of a certain disease.

f. Applying quality indicators to drug utilization patterns. This general indicator can be applied at different levels (individual prescribers, group of prescribers, hospitals, region, county, etc.) to get a rough estimate of the quality of prescribing.

g. Feeding back drug utilization data to prescribers. This is particularly useful when the individual’s drug prescribing can be compared with some form of "gold standard" or best practice, and with the average prescriptions in the country, the region, or the area.

h. Relating the number of case reports about a drug problem or adverse effects to the number of patients exposed in order to assess the potential magnitude of the problem. If it is possible to detect that the reaction is more common in a certain age group, in certain conditions or at a special dose level, improving the information on

proper use such as indications, contraindications and appropriate dosages may be sufficient to assure a safer use. Thereby withdrawal of the drug from the market may be avoided.

3.2.2 Early signals of irrational use of drugs

Drug utilization research may generate hypotheses that set the agenda for further investigations by:

a. Comparing drug utilization patterns and costs between different regions or time periods. Hypotheses can be generated to form the basis for investigations of the reasons for, and health implications of, the differences found. Geographical differences and changes over time in drug use may have medical, social and economic implications both for the individual patient and for society, and are thus important to identify, explain and sometimes correct.

b. Comparing observed patterns of drug use with current recommendations /guidelines for the treatment of a certain disease. Hypotheses can then be generated about whether discrepancies represent less than optimal practice, whether pedagogic interventions (education) are required, or whether the guidelines need to be reviewed in the light of actual practice. These considerations should include both underuse and overuse of drugs.

3.2.3 Interventions to improve drug use – follow-up

Drug utilization research may enable us to assess whether interventions undertaken to improve drug use have had the desired impact by:

a. Monitoring and evaluating the effects of measures taken to improve undesirable patterns of drug use (regional or local formularies, information campaigns, regulatory policies, etc.)

b. Following the impact of regulatory changes or changes in insurance or reimbursement systems. This also requires a broad survey, because the total cost to society may remain the same or may even increase, if other more expensive drugs are used as an alternative.

c. Assessing to which extent promotional activities of the pharmaceutical industry and educational activities of the society impact on the patterns of drug use.

3.3 Sources of drug utilization

Data are collected, or are available, at national, regional and local health facility or household level and may be derived from quantitative or qualitative studies (56,33). Quantitative data may be used to describe the present situation and the trends in drug prescribing and drug use at various levels of the health care system. Quantitative data may be routinely collected data or obtained from surveys. Qualitative studies assess the appropriateness of drug utilization and generally link prescribing data to reasons (indications) for prescribing. Such studies have been referred to as drug utilization review or drug utilization evaluation. The process is one of a therapeutic audit based on defined criteria and is intended to improve the quality of therapeutic care.

The sources of drug utilization data vary from country to country depending on the level of sophistication of record keeping, data collection, analysis and reporting and the operational considerations of the health care system.

3.3.1 Large databases

The increasing interest in efficient use of health care resources has resulted in the establishment of computer databases for studies on drug utilization. Some of the databases can generate statistics for patterns of drug utilization and adverse drug reactions. Data may be collected on drug sales, drug movement at various levels of the drug distribution chain, pharmaceutical and medical billing or samples of prescriptions. The databases may be international, national or local in scope. They may be diagnosis-linked or non-diagnosis-linked. Diagnosis-linked data enable drug use to be analysed according to patient characteristics, therapeutic groups, diseases or conditions and, in the best of cases, clinical outcome. A useful analysis requires an understanding of the sources and organization of the data.

3.3.2 Data from drug regulatory agencies

Drug regulatory agencies have the legal responsibility of ensuring the availability of safe, efficacious and good-quality drugs in their country. They are thus the repositories of data on which drugs have been registered for use, withdrawn or banned within a country. Regulatory agencies also have inspection and enforcement functions, and are responsible for supervising the importation of drugs and for the issuance of permits for drug registration. It is possible, therefore, to obtain data on the number of drugs registered in a country from such agencies. Where the agency issues import permits and supervises drug importation, data on product type (i.e. generic or branded), volume, country of manufacture, batch number and expiry date may be collected. Where the data reflect total national imports, estimates of quantities of drugs in circulation can be obtained for defined periods and for various therapeutic groups. It may be difficult to obtain true estimates if documentation is incomplete and not all trans-actions are recorded. Information on smuggled goods or goods entering the country through illegal routes will not be captured by these data.

3.3.3 Supplier (distribution) data

Data on suppliers may be obtained from drug importers, wholesalers or local manufacturers. In countries where permits or licenses are required from drug regulatory authorities and ministries of health before importation of drugs, data may be available from such sources. Customs services, in the process of clearing imports from the ports of entry, may collect data on drugs. However, the codes used by customs services are not detailed enough to capture all relevant information. National agencies responsible for the collection of excise duty can also provide information on the volume of production and on distribution of drugs from local manufacturers. Data from these sources can generally be used to describe total quantities of specific drugs or drug groups, origins of supplies and type (i.e. branded or generic).

In the absence of a national mechanism for the direct capture of data on drug production or importation, wholesalers become an important source of information on drug acquisition. Such data are reliable insofar as wholesalers are the only legal entity able to import drugs. In some countries, medical, dental and veterinary

practitioners, as well as pharmacists, can import pharmaceutical products. It is usually very difficult to collect comprehensive data from such sources even if there are regulatory requirements about submitting reports. Public sector procurement practices, however, have reasonable documentation but provide data only on that sector.

3.3.4 Practice setting data

Data from health facilities may be used to evaluate specific aspects of health provision and drug use and to generate indicators that provide information on prescribing habits and aspects of patient care. These indicators can be used to determine where drug use problems exist, provide a mechanism for monitoring and supervision and motivate health care providers to adhere to established health care standards.

a. Prescribing data

Prescribing data are usually extracted from outpatient and inpatient prescription forms. Such data may be easily retrieved where records are computerized and computerized data also facilitate trend analysis. In the absence of electronic databases, prescribing data are usually extracted from patient records or from patient intercept studies or retrieved at dispensing points.

Information that may be obtained from prescriptions includes patient demography, drug name, dosage form, strength, dose, frequency of administration and duration of treatment. Where diagnoses are noted on prescriptions, and particularly for inpatient prescription, it is possible to link drug use to indications. Trends in utilization for specific drugs and diseases can also be established. As an example, inpatient data may provide a link to empirical treatment of infections as opposed to treatment based on microbiological assessment. This may be achieved by extracting relevant data from the patient records, but requires that the records be of good quality.

Prescriptions are a good source of information for determining some of the indicators of drug use recommended by WHO including the:

– average number of drugs per prescription (encounter);

– percentage of drugs prescribed by generic name;
– percentage of encounters resulting in prescription of an antibiotic;
– percentage of encounters resulting in prescription of an injection;
– percentage of drugs prescribed from essential drugs list or formulary, and
– average drug cost per encounter.

b. Dispensing data

Drug dispensing is a process that ends with a client leaving a drug outlet with a defined quantity of medication(s) and instructions on how to use it (them). The quantity of drugs dispensed depends on their availability. Thus information available from dispensers may include:

– drug(s) prescribed;
– dose(s) prescribed;
– average number of items per prescription;
– percentage of items prescribed that were actually supplied (an indicator of availability);
– percentage of drugs adequately labeled;
– quantity of medications dispensed; and
– cost of each item or prescription.

These data may be obtained from records kept at the drug outlet either in electronic or manual form.

c. Aggregate data

A number of data sources within the health facility or hospital setting can provide aggregate data on drug utilization. These sources include procurement records, warehouse drug records, pharmacy stock and dispensing records, medication error records, adverse drug reaction records and patient medical records. These data sources can be used to obtain information on various aspects of drug use including:

– the cost of individual drugs and classes of drug;
– the most frequently or infrequently used drugs;
– the most expensive drugs;

– the per capita consumption of specific products;

– the comparisons of two or more drugs used for the same indication;

– the prevalence of adverse drug reactions;

– the percentage of the budget spent on specific drugs or classes of drug.

Aggregate data are often useful for comparing the utilization of a particular drug to that of other drugs and to utilization in other hospitals, regions or countries.

3.4 Studies on drug use

The studies on drug use can initiate from any point along the process of drug use: market surveys, the studies of drug supply, the studies of drug consumption and general prescribing patterns (58). In addition, drug utilization studies can be divided into quantitative and qualitative drug utilization studies.

3.4.1 Quantitative drug utilization studies

This type of drug utilization studies can be called drug utilization survey aimed to describe observation in quantitative terms. The main observation points are the present state, the developmental trends and time course profile of drug usage at various level of health care system, whether national, regional, local or institution level. This quantitative study involves the collection, organization and display of estimates of measurements amount of drug use (59).

In addition, routinely compiled drug statistics or drug utilization data that are the results of such studies can be used to estimate drug utilization in population by age, sex, social class morbidity, and other characteristics, and to identify areas of possible over or under utilization. They also can be used to monitor the effects of informational and regulatory activities (60).

3.4.2 Qualitative drug utilization studies

The second type is qualitative drug utilization study which aims to assess the appropriateness of drug use, usually by linking prescription data to the reasons for drug prescribing (57). The crucial difference between these studies and quantitative

drug utilization studies is that they include the concept of appropriateness In addition, this type of drug utilization studies are called qualitative drug use review studies (DUR). Qualitative DUR studies mainly focus on the utilization of some group of drugs i.e. antibiotic and usually are performed in institutional level i.e. hospitals (61).

3.5 Methodological tools for drug use studies

In the context of quantitative drug utilization studies, the methodological tools used in these studies are drug classification systems and unit for the quantification of drug use (58).

3.5.1 Drug classification systems

There is a need for a single international classification system as a tool for performing comparative studies of both supply and consumption since an early phase of drug utilization research. Such system would provide the only solid basis on which to compare the situation between countries and period of time. In addition, drug classification systems allow researchers to assess drug use at varying level of specificity. Medicine can be classified in various ways: according to their mode of action, the pharmacological of therapeutic groups to which they belong, according to their indications, or according to their structure. A pharmacological/therapeutic classification would regard analgesics, antacids, antiarrhythmic, antibiotic, anticoagulant and diuretic as primary group. A classification according to indication for use would group medicine under such heading as arthritis and rheumatism, hypertension, diabetes or bronchitis. Each classification type has its own advantages and limitations, and the usefulness of each one will depend on the use to which it is to be put.

One of the systems that have attained a dominant position in drug utilization research is the anatomical-therapeutic (AT) classification system. The AT classification system is used by the European Pharmaceutical Market Research Association (EPhMRA) and by the International Pharmaceutical Market Research Group (IPMRG). In addition, this system has been adopted by various European and American countries, it is also used by IMS (International Marketing Services)

3.5.2 Unit for the quantification of drug use

In the context of drug utilization studies, the ideal is a count of the number of patients in a defined population who ingesting a drug of interest during a particular time frame. However, this drug use data are not generally available, the data available are only approximation of this data. The consumption parameters which have been widely used in drug utilization studies are cost data i.e. the overall cost of unit cost of a drug, or consumption expressed in terms of economic expenditure by a particular institution. Other parameters are volume data i.e. number of prescriptions. However, all these parameters have some limitations when comparing consumption at the international level, but they can nevertheless be useful.

3.5.3 Cost studies

Cost studies provide the first “drug statistics” either in terms of total cost or unit cost per package, tablet, dose, prescription, or treatment course. These drug consumption parameters are compiled for administrative or commercial reasons. Public health organizations perform cost studies to monitor expenditure on drug. For example, the study on prescription drug expenditures by Hoffman et al (62) between 1997 and 2001 in the United States showed that expenditures for prescribed drugs increased by 12.3% from $173 billion in 2001 to $194 billion in 2002.

In addition, unit cost of drug use was also the indicator to monitor drug use in health facilities. For example, data for nonfederal hospital drug purchases taken from the IMS Health National Sales Perspectives databases were used to evaluate trends in hospital drug expenditures and to measure the cost of drug treatment (63). These data consisted of purchasing information for 5,091 hospitals. Hospital drug expenditures exceeded $21 billion in 2002, representing a 9.6% increase in drug expenditures compared with 2001, a significant decrease compared with the 13% growth seen between 2000 and 2001. Of note, injectable drugs accounted for 73% ($15.2 billion) of total inpatient drug expenditures. The most significant growth in dollar volume in 2002 was infliximab, which increased expenditures by 45%, while the most significant decreased in expenditures was for abcisimab, which decreased by 16%.

Additionally, cardiology agent, nesiritide, has exhibited dramatic growth with a 165% increase in the first two quarters of 2003 compared with the same time period in 2002.

Although cost of drug consumption data are useful for measuring and comparing the economic impact of drug use, this unit dose not provide information on the amount of drug exposure in the population. For example, the study from The IMS Health National Sales perspectives database (63) showed the volume and variety of drugs decreased by 3.5% in 2002, while drug prices increased by 11.1%. Moreover, cost data are influenced by price fluctuation over time, distribution channels, inflation, exchanges rate fluctuation, and price control measures.

3.5.4 Studies based on number of unit solid

Consideration of consumption of volume data in terms of overall weight of the drug that is sold or the unit volume sold (packages sold) give more precise idea of drug consumption than does economic value. For example, the study in 1999 in Canada (64) showed that the total units of diabetes medications prescribed increased by 44% from 528,896 of total units in 1996 to 847,790 of total units in 2000. This increase was primarily due to the increased use of biguanides and sulphonylureas.

However, tablet sizes are varying, making it difficult to translate weight into even the number of tablets. Moreover, this unit of quantification has some limitation when one is studying the evolution of consumption over a period of time or comparing drug consumption between countries. Since each country has different package of the same drug.

3.5.5 Studies based on prescription volume

The number of prescription issued from a health institution of retail pharmacy is the measuring unit most frequently used in drug use studies. This unit reflects the physician/patient relationship or its variations over a period of time. The studies on drug use at national level in the United States showed that there was a 6% increase in the number of prescriptions filled from 2000 to 2001, which was higher than the 4.8% increase in the number of prescriptions seen in 2002 (62). The estimates of drug use based on prescription volume provide useful information on the extent of prescription

drug use. This data also allow to assess the changing patterns in use and to identify the most common drug exposure.

3.6 Studies on consequences of drug utilization

The studies on consequences of drug use focus on how drug utilization relates to the effect of drug use in terms of medical outcome, economic outcome, and social outcome (56-58). In addition, Tognoni (65) also proposed drug monitoring approaches of which aims and methods resembles to that of the studies on the consequences of drug use. This drug monitoring approach is defined as "the identification and evaluation of the effects of current, acute, or chronic use of pharmacological therapies in the population as a whole of subgroups of patients exposed to specific types of therapy".

According to this drug monitoring definition, the observation points are the detectable effects of the drugs. This detectable effect depends on the specific aims of the method selected which will be linked with the type and extent of exposures. However, in the aspect of types of effect of consequences of drug use, the studies on consequences of drug use which follow the WHO definition of drug use go beyond that of Tognoni which mainly focus on medical effect of drug use. Baksaas and Lunde (66) point out that the present and future potential studies on consequences of drug use to be explored follows the WHO definition in the aspects of medical, social and economic, as shown below.

a. Medical

-Benefits: Efficacy in preventing, relieving and curing diseases or their symptoms and complications

-Risks: Short-term and long-term adverse effects, special risk factors associated with genetics, disease and environment, nutrition, age, sex, pregnancy and lactation, etc

b. Social

-Drug and health attitudes and their causes, current trends in the "drug culture" versus persistent of resurgent use of traditional medicines

-Drug abuse and dependence and their cause and trends

-Improper use of drugs (non-compliance, use of drugs for drugs for purposes for which they were not prescribed or recommended)

-Discrimination and social injustice (e.g. unavailability of important drugs to those who need them)

-Effect of informative and regulatory interventions

c. Economic

-Drug and product price and cost; import versus local production; costs of new drugs versus old drugs and of specialties versus generic products; costs of drug versus non-drug treatment

-Drug cost/effectiveness/safety ratios for all the comparisons lists above

-Current and future allocation of national resources (money, manpower, facilities) to the drug and health budget

Both the studies on drug use and the studies on consequences of drug usage have developed along parallel lines using different methods, but may now be regarded as interrelated (65). This interrelation occurred due to the fact that many drug monitoring studies (studies of medical consequence of drug use) are necessarily based on drug use data. In addition, this interrelation stems from the utilization of both studies on drug use and the studies on effects of drug use in problems and decisions making process throughout the drug and health chain. Thus, from this point, the general aims of drug utilization studies include: problem identification and definition; problem analysis in relation to importance, cause, and consequences. Based on this data the other aims of drug utilization studies are an establishment basis for decision on problem solution, and an assessment of the effects of the action taken (66). According to the aims of drug utilization as mentioned above, descriptive drug use studies play and essential role in identifying relevant questions and problem areas. Participants include the health authorities, the drug manufacturers, the academic and clinical health professionals, social scientist, and economists as well as the media and consumer. In addition, it should be strongly emphasized that many of the decisions to

be taken are highly interrelated. The complexity of the problems also called for interdisciplinary collaboration.

3.7 Studies on factors influencing drug utilization

Beside studies of drug use focus on the extent, pattern and consequences of drug use, the factors (67) that influencing drug use are also taken into consideration as shown below.

- Prices
- Entry of New Drug Chemicals
- Volume of Drug Use
  - Population-related
  - Changes in total population
  - Changes in population demographics (age, gender and ethnicity)
  - Changes in health status of a population (emergence of new diseases and epidemics)
- System-related
  - Changes and transition associated with health system reform and restructuring (move towards shorter hospital stays and home/community care)
  - Changes in policies and programs (the extent of formulary listings and eligibility and co-payments)
  - Availability of third party insurance coverage
- Research and technology-related (clinical and informational)
  - New treatment approaches (drugs replacing surgery, drug therapy for previously untreatable diseases, availability of more and/or improved diagnostic technology, and outcomes research, evidence-based preventive or curative treatment)
  - Use of programs and technology in monitoring patients
- Pharmaceutical industry
  - Development of new drug products
  - Promotion of drugs to physicians

- Drug sampling
- Direct to consumer advertising

- Practice and people-related (health care providers and consumers)
  - Changes in prescribing and dispensing practices
  - Number and mix of prescribers (specialists, general practitioners, and others)
  - Multiple doctoring
  - Consumers' expectations and behaviors
  - Wastage

Particularly, the factors that may be unrelated to the actual properties of medicine being taken. These factors have been called non-pharmacological basis of therapeutic which include sociodemographic, behavioral and economic factors. More recently, it has been acknowledged that a complete assessment of drug use should take the social aspects into account. The social sciences can explain how the perception of individuals as well as the social and cultural environment can affect drug use. At the most basic level, the pattern of drug consumption in a country will reflect to a greater or lesser extent that country's scientific and technological traditions as well as its sociodemographic state and cultures. More specific is the influence of traditional medical practices and patients expectations, the structure and organization of health service. Other factors are the economic state of health service (including the pricing of medicines and the nature of health insurance), the promotional activities and information from drug industry.

3.7.1 Influence of health insurance on drug utilization

Type of health insurance (type of third-party payer) is one of the factors that determine the utilization of drug. Each type of health insurance differs from the others in the aspects of types of health service, cost-sharing, limits on reimbursement and types of payment mechanisms to the providers (including hospitals, health center, physicians, dentists, pharmacists). The study of drug utilization in Massachusetts in 1995 by Davis et al (68) showed that an estimate of the percent of Medicare beneficiaries using prescription drugs and the average prescriptions per person shows

86% of Medicare beneficiaries living in the community used at least one prescription drug during 1995. This survey showed that the average beneficiary used 18.5 prescriptions per year. Beneficiaries with drug coverage averaged 20.3 prescriptions per year, while those with no drug coverage averaged 15.3 prescriptions per year.

A comparative study on the types (expensive and lower cost drugs) and amount of pain medication received among hematology and oncology patients with and without prescription drug coverage in LSU medical center in Shreveport, Louisiana in 1993 (69) also showed similar finding. This study found that there was a significant difference in the amount and type of pain medications prescribed between patients with prescription drug coverage and those without. Medicaid patients (patients with prescription drug coverage) especially those with solid tumor malignancies, received the most expensive class of medications at a significantly higher rate than the other patients.

In addition, Magee et al, (70) showed that patient's insurance status affect prescription drug costs. Drug charges were 8.6-10.8% of the hospital charges and were strongly related to hospital charges. No matter which provider payment method will be employed, the types and prices of drugs will remain issues of concern in terms of insurance costing. If capitation payment is used, the types and the prices of drugs will be one of the input factors for calculating capitation rates. There are different levels of drug cost in therapeutic drug class. For example, generic drugs are at lower cost than brand drugs. According to a study by Yesalis et al (71), the implementing of capitation payment would alter dispensing behavior and influence physician's prescribing to lower prescription costs such as substituting lower-cost generic equivalents, changing the quantities of drugs dispensed per prescription, optimizing the drug dosage regimen, changing the types of drugs dispensed within a therapeutic category, switching to nonprescription (OTC) drug.

Health insurance coverage in Thailand can be categorized into 3 systems (72-73). First is through government social welfare program such as civil servant medical benefit (CSMBS) that covers civil servant, current employee and pensioner as well as their relative (parents, children, and spouse). Second is universal health care coverage (UC) that policy makers adopt capitation payment for purchasing ambulatory care and

global budget and Diagnostic Relative Group relative weight to purchase inpatient care from providers. Third is the Social Security Scheme (SSS) that is financed on a tripartite basis with government, employee and employer contributing a total of 4.5% (1.5% each) of employee salaries. From the 2005 Health Policy in Thailand report (72), it shows the coverage of different schemes as of September 2004. There are 47.1 million people registered under UC, this accounts for 75.2% of the total eligible population. While 8.2 million registered were under SSS (13.1%) and the rest 6.8 million populations are under CSMBS (10.9%) showed in Table 6. Both SSS and UC pay a capitation rate, but CSMBS pays free for services (FFS) Wealthy individuals, regardless of their health insurance, can afford to purchase care out of pocket that payment born directly by a patient without the benefit of insurance, thus providing revenue to some premium private providers.

Table 6 Coverage of insurance schemes in Thailand in 2004 (72).

Scheme	Population Coverage (Million)	%	Payment (baht/capita)
UC	47.1	75.2	Capitation (1,308)
SSS	8.2	13.1	Capitation (1,700)
CSMBS	6.8	10.9	Fee for service (> 2,000)
Wait for eligibility	2.8	4.5	-
Total	62.6	100	-

Reference: Health Policy in Thailand 2005. Bureau of Policy and Strategy Health. Ministry of Public Health 2005; 1-71.

Each type of health insurance and medical welfare scheme in Thailand differs form each other in the aspects of medical benefit coverage, payment mechanism, see detail in Table 7 (72). Even though there are various types of health insurance, the studies on drug utilization among patients under different types of health insurance coverage were rarely studied. For example, the use of hospital electronic database for drug utilization analysis by Limwattananon et al (74) in Journal of Health Sciences 2003 presented drug utilization for outpatients and inpatients in five general and regional public hospitals. The percentage of patients that received high cost drugs under the CSMBS was the highest over other schemes, especially the use of epoetin and antiretroviral drugs. Another comparative study by Tangcharoensathien et al (75) showed that in 2001 the average admission rate for patients covered by the civil servants' scheme was higher than the rate for patients on the Low-Income Scheme,

and among the uninsured (0.107 admissions per person-year for civil servants' scheme versus 0.092 for the Low-Income Scheme versus 0.054 for the uninsured).

Table 7 Comparison of characteristics of insurance schemes in Thailand in 2002 (72)

Characteristics	CSMBS	SSS	UC
I. Scheme nature			
Beneficiaries	fringe	benefit	Social Welfare
Model	Public reimbursement	Public contracted	Public contracted
Covered population	Government employees and their dependants	Private formal sector employees with >1	People not covered by SSS or CSMBS worker
II. Benefit package			
Ambulatory services	Public only	Registered public and private	Registered public and private
Inpatient services	Public	Registered public and private	Registered public and private
Choice of provider	Free choice	Registration required	Registration required
Cash benefit	No	Yes	Yes
Conditions excluded	No	15 conditions	12 conditions
Maternity benefits	Yes	Yes	Yes
Annual physical check-ups	Yes	No	Yes
Prevention and health promotion	Yes	Health education, immunization	Yes
Services not covered	Special nurse	Private bed, special nurse	Private bed, special nurse
III. Financing			
Source of funds	General tax	Tripartite, 1.5% of payroll each	General tax
Financing body	Ministry of Finance	Social Security Office	National Health Security Office
Payment mechanism	fee-for-service	Capitation	Capitation for OP; DRG for IP
Co-payment	yes: IP at public/private hospital, IP private limits only for life-threatening care	Maternity, emergency services, if beyond ceiling	yes, 30-baht per visit
Per capita tax subsidy, 1999	2,106 baht	519 baht	1,275 baht

Reference: Health Policy in Thailand 2005. Bureau of Policy and Strategy Health. Ministry of Public Health 2005; 1-71.

CHAPTER III

METHODOLOGY

1. Study design

This study was a retrospective descriptive research.

2. Study locations

Phrae Hospital and Maharat Nakhon Ratchasima Hospital, a 400-bed general hospital and a 1,000-bed regional hospital, were chosen to be studied locations.

3. Study period

Data recorded during October 2001 to September 2003 (fiscal year 2002 and 2003) were studied.

4. Data sources

Data were come from two sources, electronic databases and medical chart reviews. The electronic databases were retrieved from hospital's databases as dBase format and transformed to Microsoft Access data format. The hospital databases were come from medical record department and pharmacy department. The medical record department has data about characteristics and diagnosis of patients who received treatment at Phrae Hospital and Maharat Nakhon Ratchasima Hospital. These data were separated into outpatient and inpatient department. The pharmacy department keeps records of dispensing data. For Phrae Hospital, these data were separated into outpatient and inpatient department. Dispensing data from Maharat Nakhon Ratchasima Hospital were records in PRSCRIPT and PRSCLIST. PRSCRIPT databases keep the major components of prescription. PRSCLIST databases are about drug lists in prescription. Details of data element are shown in appendix B. The medical chart reviews were designed to collecting clinical outcomes.

5. Study population and sampling

From the e-data, all outpatients and inpatients who were given a diagnosis of diabetes at the two chosen hospitals during October 1, 2001 to September 30, 2003 were the population. In addition, a sub-group analysis was done for comparison among diabetic patients with and without complications.

For medical chart reviews, 150 patients and 250 patients from Phrae Hospital and Maharat Nakhon Ratchasima Hospital, were randomly selected from the diabetic patient pool and included if they had availability of service utilization for 2 years.

6. Study procedure and data collection

6.1. Data retrieval and transfer

The e-data were gathered from hospital databases. The hospital databases in dBase (.dbf) file format were converted to file format Access program (.mdb) and MS Excel program (.xls).

6.2 Identification and classification of diabetic patients

The ICD-10 (International Statistics Classification of Diseases and Related and Health Problem Revision 10) was used for patient classification. This system is the international code to classify of diseases and related health problems.

From e-data, patients with diabetes mellitus (DM) disease are identified by 5 major ICD-10 codes:

- E10 (Insulin dependent diabetes mellitus);
- E11 (Non-Insulin dependent diabetes mellitus);
- E12 (Malnutrition-related diabetes mellitus);
- E13 (Other specified diabetes mellitus); and
- E14 (Unspecified diabetes mellitus).

Patients who have either one of these ICD codes, either as principal or other diagnosis were identified as diabetic patients. Patients without diagnosis of E10-E14

were classified as non-diabetes patients. Then all diabetic patients were divided into four groups;

- DM only defined as diabetic patients without any complications.
- DM with microvascular complication defined as patients with either retinopathy (H25-H48), neuropathy (G60-L08), or nephropathy (N08-N19).
- DM with macrovascular complication defined as patients with either coronary artery disease (I20-I50), cerebrovascular disease (I60-I69), peripheral vascular disease (I70-I79), or gangrene (R02).
- The combination of microvascular and macrovascular complications

6.3 Data collection

Data were collected in 3 parts: characteristics of patient population, resource utilization, and clinical outcomes.

6.3.1 Characteristics of patient population

After patient identification and classification, patients' characteristics such as gender, age, and health insurance coverage were collected Types of health insurance were classified as universal coverage, civil's servant medical benefit scheme, social security scheme, and out of pocket.

6.3.2 Resource utilization

Data of resource utilization were separated for outpatient and inpatient services. Data to be retrieved for analysis were hospital number (HN), visit number (VN), admission number (AN), date of visit, date of admission, date of discharge, number of prescriptions, number of drug items, drug name, expenditure of dispensed drugs,

6.3.3 Clinical outcomes of drug use

For medical chart reviews, after patients were randomly selected from the diabetic patient pool and included if they had availability of service utilization for 2 years. Then pharmacists reviewed medical records of these patients. Data to be collected for analysis are clinical outcomes such as fasting blood sugar (FBS; mg/dL), hemoglobin A_{1C} (HbA_{1C}; %), triglyceride (TG; mg/dL), low-density lipoprotein (LDL; mg/dL), high-density lipoprotein (HDL; mg/dL), and blood pressure (BP; mm/Hg). The last test and previous pattern of drug use were determined and compared with goal of standard treatments. The result was classified as good control, defined as concentration level less than standard goal. These criteria were used for all labs except HDL.

7. Data analysis

Data were analyzed as descriptive statistics (percentage and mean) using Microsoft SQL 2000, Microsoft Access 2003, and Microsoft Excel 2003.

7.1 Characteristics of patient population

The frequency of patients' characteristics such as gender, age, and health insurance coverage were determined and compared between diabetes and non-diabetes patients. Moreover, a sub-group analysis was done for comparison among diabetic patients with and without complications. In addition, this part was done separately for the fiscal year 2002 and 2003 in order to evaluate any changes over the two-year periods.

7.2 Hospital utilization

The data of hospital use were separated for outpatient and inpatient services. The indicators of utilization were outpatient and inpatient utilization rate, which were the number of times a patient comes for treatment in a hospital during a period of time (1 year). Outpatient utilization rate was computed as average visits per outpatient per year, while inpatient utilization rate was computed as average admissions per inpatient per year and average hospital bed-day per inpatient per year.

Outpatient utilization rate

$$\text{Average visits/outpatient/yr} = \frac{\text{Total number of visits in a yr}}{\text{Total number of outpatients in a yr}}$$

Inpatient utilization rate

$$\text{Average admissions /inpatient/yr} = \frac{\text{Total number of admissions in a yr}}{\text{Total number of inpatients in a yr}}$$

$$\text{Average hospital bed-day/inpatient/yr} = \frac{\text{Total number of bed-day in a yr}}{\text{Total number of inpatients in a yr}}$$

7.3 Drug utilization

The data of drug use were separated for outpatients and inpatients. The indicators of drug utilization for outpatients were average prescriptions per outpatient per year and average drug items per outpatient per year, while utilization rate for inpatient was computed as average prescriptions per inpatient per year and average drug items per inpatient per year.

Drug utilization for outpatients

$$\text{Average prescriptions/outpatient/yr} = \frac{\text{Total number of prescriptions in a yr}}{\text{Total number of outpatients in a yr}}$$

$$\text{Average drug items/outpatient/yr} = \frac{\text{Total number of drug items in a yr}}{\text{Total number of outpatients in a yr}}$$

Drug utilization for inpatients

$$\text{Average prescriptions/inpatient/yr} = \frac{\text{Total number of prescriptions in a yr}}{\text{Total number of inpatients in a yr}}$$

$$\text{Average drug items/inpatient/yr} = \frac{\text{Total number of drug items in a yr}}{\text{Total number of inpatients in a yr}}$$

Comparison of resource utilization

Resource utilization was compared between diabetes and non-diabetes patients. Moreover, a sub-group analysis was done for comparison among diabetic patients with and without complications.

7.4 Drug expenditure

Expenditure of drug use was separated for outpatients, inpatients and summarized into all patients.

Drug expenditure for outpatients

$$\text{Drug expenditure/outpatient/year} = \frac{\text{Total expenditure of drug use in a yr}}{\text{Total number of outpatients in a yr}}$$

Drug expenditure for inpatients

$$\text{Drug expenditure/inpatient/year} = \frac{\text{Total expenditure of drug use in a yr}}{\text{Total number of inpatients in a yr}}$$

Drug expenditure for all patients

$$\text{Drug expenditure/patient/year} = \frac{\text{Total expenditure of drug use in a yr}}{\text{Total number of patients in a yr}}$$

Comparison of drug expenditure

Expenditure of drug use was analyzed by three relationships that were type and expenditure of drug use, drug expenditure under types of health insurance, and drug expenditure between two hospitals. In addition, all relationships were done separately for the fiscal year 2002 and 2003 in order to evaluate any changes over the two-year periods.

Type and expenditure of drug use were compared between diabetic patients with and without complications. Type of drug use was classified by pharmacological groups, according to national list of essential drugs 1999. Drugs were categorized into two-main classes: cardiovascular and antidiabetic drugs.

- Cardiovascular drugs were consisted of ACE inhibitors, AII antagonists, antiarrhythmic drugs, Beta blockers, Ca antagonists, cardiac glycosides, cardiac stimulants, diuretics, nitrates, other vasodilators, and lipid lowering drugs.
- Antidiabetic drugs were consisted of insulin, biguanides, sulphonylureas, thiazolidinediones, and alpha glucosidase inhibitors.

7.5 Clinical outcomes of drug use

This part was to determine the percentage of good control and mean of clinical outcomes of drug use. These drugs were categorized into three-main classes that were antidiabetic, lipid lowering and antihypertensive drug groups.

Antidiabetic drug groups were classified into insulin only, oral agent only, and combination of insulin and oral agent. The clinical outcomes of these drug groups were FBS (mg/dL) and HbA_{1C} (%).

Lipid lowering drug groups were classified into HMG-CoA reductase inhibitors (Statin) only, Non-Statin only, and combination of Statin and Non-Statin. The clinical outcomes of these drug groups were TG (mg/dL), LDL (mg/dL), and HDL (mg/dL).

Antihypertensive drug groups were classified into monotherapy, defined as one type of antihypertensive drug, and combination therapy, defined as more than one types of antihypertensive drugs. The clinical outcomes of these drug groups were systolic BP (mm/Hg) and diastolic BP (mm/Hg).

CHAPTER IV

RESULTS

Results were divided into three sections as follows:

Section I. Characteristics of patient populations;

Section II. Resource utilization; and

Section III. Clinical outcomes of drug use.

Section I. Characteristics of patient populations

1. Diabetes and non-diabetes patients

Gender, age and health insurance coverage of diabetes and non-diabetes patients during 2002 and 2003 at Phrae Hospital and Maharat Nakhon Ratchasima Hospital are shown in table 8 and 9. Characteristics of patients that separated between outpatients and inpatients are shown in appendix B.

1.1 Phrae Hospital

Overall, 4.65% and 5.58% of total number of patients were diagnosed with diabetes in 2002 and 2003 respectively (table 8) with about two-thirds were female. About 90% were older than 40 years of age with an average of 60.05±13.16 and 60.20±12.65 years in 2002 and 2003 respectively. Over half of diabetes patients were under the Universal Coverage program (UC) and about 35-36% were under the health insurance for government officials. Moreover, the percentage of diabetes patients under UC was increased, but decreased for Civil Servants Medical Benefits Scheme (CSMBS). However, some patients had more than one health insurance status, 145 patients and 74 patients in 2002 and 2003 respectively.

1.2 Maharat Nakhon Ratchasima Hospital

There are 3.23% and 3.47% of total number of patients diagnosed with diabetes in 2002 and 2003 respectively (table 9) with about two- thirds were female. About 90% were older than 40 years of age with an average of 62.57±14.22 and 62.36±14.78 years in 2002 and 2003 respectively. For health insurance coverage, about 49.6% and 43.6% of total diabetes patients in 2002 were under the health insurance for government officials and the Universal Coverage program respectively, whereas 74.8% of diabetes patients in 2003 were under CSMBS only. However, it was uncertain whether this was due of coding error or during the time period of transition between health systems. In addition, there are a lot of people with more than one health insurance status per one patient, 3,363 patients and 1,173 patients in 2002 and 2003 respectively.

Table 8 Gender, age group, and health insurance coverage of diabetes and non-diabetes patients at Phrae Hospital, 2002-2003

	2002						2003					
	DM	%	NON-DM	%	Total	%	DM	%	NON-DM	%	Total	%
Gender												
Male	**1,009**	**33.7**	26,609	43.4	27,618	42.9	**1,286**	**35.5**	28,500	46.5	29,786	45.9
Female	**1,980**	**66.2**	31,470	51.3	33,450	52.0	**2,333**	**64.5**	32,525	53.1	34,858	53.7
NA	**2**	**0.01**	3,290	5.4	3,292	5.1	**-**	**-**	236	0.4	236	0.4
Total	**2,991**	**100.0**	61,369	100.0	64,360	100.0	**3,619**	**100.0**	61,261	100.0	64,880	100.0
% Total	**4.65**		95.35		100.00		**5.58**		94.42		100.00	
Age group (years)												
0-10	**29**	**1.0**	6,601	10.8	6,630	10.3	**24**	**0.7**	7,231	11.8	7,255	11.2
11-20	**16**	**0.5**	6,591	10.7	6,607	10.3	**15**	**0.4**	6,692	10.9	6,707	10.3
21-30	**2**	**0.1**	8,613	14.0	8,615	13.4	**8**	**0.2**	8,286	13.5	8,294	12.8
31-40	**120**	**4.0**	8,983	14.6	9,103	14.1	**88**	**2.4**	9,485	15.5	9,573	14.8
41-50	**442**	**14.8**	8,569	14.0	9,011	14.0	**593**	**16.4**	9,433	15.0	10,026	15.5
51-60	**1,048**	**35.0**	7,938	12.9	8,986	14.0	**1,226**	**33.9**	8,375	13.7	9,601	14.8
61-70	**894**	**29.9**	6,213	10.1	7,107	11.0	**1,090**	**30.1**	6,631	10.8	7,721	11.9
>70	**438**	**14.6**	4,634	7.6	5,072	7.9	**575**	**15.9**	4,951	8.1	5,526	8.5
NA	**2**	**0.1**	3,227	5.3	3,229	5.0	**-**	**-**	177	0.3	177	0.3
Total	**2,991**	**100.0**	61,369	100.0	64,360	100.0	**3,619**	**100.0**	61,261	100.0	64,880	100.0
Average	**60.05±13.16**		45.82±15.42		60.05±14.55		**60.20±12.65**		45.95±15.31		60.20±14.82	
Health insurance coverage												
UC	**1,814**	**57.8**	36,987	58.7	38,801	58.6	**2,260**	**61.2**	38,261	60.6	40,521	60.7
CSMBS	**1,123**	**35.8**	14,274	22.6	15,397	23.3	**1,296**	**35.1**	14,382	22.8	15,678	23.5
Self-pay	**162**	**5.2**	8,750	13.9	8,912	13.5	**88**	**2.4**	6,588	10.4	6,676	10.0
SSS	**37**	**1.2**	3,052	4.8	3,089	4.7	**47**	**1.3**	3,801	6.0	3,848	5.8
NA	**-**	**-**	-	-	-	-	**2**	**0.1**	80	0.1	82	0.1
Total	**3,136**	**100.0**	63,063	100.0	66,199	100.0	**3,693**	**100.0**	63,112	100.0	66,805	100.0
Duplicate	**145**	**4.6**	1,694	2.7	1,839	2.8	**74**	**2.0**	1,851	2.9	1,925	2.9

Notes: DM = Diabetes mellitus, NA = not available, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme

Table 9 Gender, age group, and health insurance coverage of diabetes and non-diabetes patients at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002						2003					
	DM	%	NON-DM	%	Total	%	DM	%	NON-DM	%	Total	%
Gender												
Male	**1,424**	**31.2**	50,265	36.7	51,689	36.6	**1,641**	**33.7**	55,905	41.2	57,546	40.9
Female	**3,135**	**68.8**	68,147	49.8	71,282	50.4	**3,234**	**66.3**	74,965	55.2	78,199	55.6
NA	-	-	18,364	13.4	18,364	13.0	-	-	4,903	3.6	4,903	3.5
Total	**4,559**	**100.0**	136,776	100.0	141,335	100.0	**4,875**	**100.0**	135,773	100.0	140,648	100.0
% Total	**3.23**		96.77		100.00		**3.47**		96.53		100.00	
Age group (years)												
0-10	**88**	**1.9**	12,473	9.1	12,561	8.9	**148**	**3.0**	15,253	11.2	15,401	11.0
11-20	**38**	**0.8**	13,119	9.6	13,157	9.3	**85**	**1.7**	14,112	10.4	14,197	10.1
21-30	**13**	**0.3**	20,653	15.1	20,666	14.6	**12**	**0.2**	21,260	15.7	21,272	15.1
31-40	**231**	**5.1**	21,611	15.8	21,842	15.5	**224**	**4.6**	21,331	15.7	21,555	15.3
41-50	**779**	**17.1**	17,333	12.7	18,112	12.8	**743**	**15.2**	22,477	16.6	23,220	16.5
51-60	**1,218**	**26.7**	18,364	13.4	18,364	13.0	**1,335**	**27.4**	14,336	10.6	15,671	11.1
61-70	**1,432**	**31.4**	11,505	8.4	12,937	9.2	**1,473**	**30.2**	12,392	9.1	13,865	9.9
>70	**760**	**16.7**	8,847	6.5	9,607	6.8	**855**	**17.5**	9,709	7.2	10,564	7.5
NA	-	-	12,872	9.4	14,090	10.0	-	-	4,903	3.6	4,903	3.5
Total	**4,559**	**100.0**	136,776	100.0	141,335	100.0	**4,875**	**100.0**	135,773	100.0	140,648	100.0
Average	**62.57±14.22**		42.71±15.89		52.64±15.77		**62.36±14.78**		42.67±16.81		52.52±16.72	
Health insurance coverage												
UC	**3,451**	**43.6**	67,450	39.2	70,901	39.4	**1,338**	**22.1**	50,904	33.0	52,242	32.6
CSMBS	**3,933**	**49.6**	98,591	57.4	102,524	57.0	**4,522**	**74.8**	100,161	65.0	104,683	65.3
Self-pay	**538**	**6.8**	5,808	3.4	6,346	3.5	**180**	**3.0**	2,740	1.8	2,920	1.8
NA	-	-	19	-	19	-	**8**	**0.1**	336	0.2	344	0.2
Total	**7,922**	**100.0**	171,868	100.0	179,790	100.0	**6,048**	**100.0**	154,141	100.0	160,189	100.0
Duplicate	**3,363**	**42.5**	35,092	20.4	38,455	21.4	**1,173**	**19.4**	18,368	11.9	19,541	12.2

Notes: DM = Diabetes mellitus, NA = not available, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme

2. Diabetes patients with and without complications

2.1 Phrae Hospital

The percentage of diabetes patients without complication was decreased (table 10), 53.69% and 27.66% in 2002 and 2003 respectively, whereas diabetes patients with complications had an increasing rate from 2002 to 2003, from 10.06% to 10.14% for macrovascular complications, from 25.46% to 51.48% for microvascular complications, and from 6.79% to 10.72% for both complications. For gender, about two-thirds were female for all groups. When comparing age of diabetes patients with and without complications, an average age of diabetes patients without complications, less than 58 years, was lower than diabetes patients with complications, more than 59 years.

2.2 Maharat Nakhon Ratchasima Hospital

In general (table 11), like the previous hospitals reported above, the percentage of diabetes patients without complication was decreased, 69.97% and 61.60% in 2002 and 2003 respectively, whereas diabetes patients with complications had an increasing rate, from 10.62% to 14.27% for macrovascular complications, from 14.83% to 18.61% for microvascular complications, and from 4.58% to 5.52% for both complications. For gender, over half of these patients were female. In addition, an average age of diabetes patients without complications, about 59 and 58 year in 2002 and 2003 respectively, was lower than diabetes patients with complications, more than 60 years.

Table 10 Gender and age group of diabetes patients with and without complications at Phrae Hospital, 2002-2003

	2002										2003									
	DM	%	Macro	%	Micro	%	Multi	%	Total	%	DM	%	Macro	%	Micro	%	Multi	%	Total	%
Gender																				
Male	**531**	**33.1**	121	40.2	287	32.6	70	34.5	1,009	33.7	**366**	**36.6**	134	36.5	642	34.5	144	37.1	1,286	35.5
Female	**1,075**	**66.9**	178	59.1	594	67.4	133	65.5	1,980	66.2	**635**	**63.4**	233	63.5	1,221	65.5	244	62.9	2,333	64.5
NA	-	-	2	0.7	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Total	**1,606**	**100.0**	301	100.0	881	100.0	203	100.0	2,991	100.0	**1,001**	**100.0**	367	100.0	1,863	100.0	388	100.0	3,619	100.0
% Total	**53.69**		10.06		25.46		6.79		100.00		**27.66**		10.14		51.48		10.72		100.00	
Age group (years)																				
0-10	**2**	**0.1**	-	-	-		-	-	2	0.1	**4**	**0.4**	-	-	4	0.2	-	-	8	0.2
11-20	**13**	**0.8**	1	0.3	2	0.2	-	-	16	0.5	**5**	**0.5**	-	-	9	0.5	1	0.3	15	0.4
21-30	**25**	**1.6**	-	-	3	0.3	1	0.5	29	1.0	**14**	**1.4**	-	-	10	0.5	-	-	24	0.7
31-40	**88**	**5.5**	3	1.0	28	3.2	1	0.5	120	4.0	**36**	**3.6**	4	1.1	45	2.4	3	0.8	88	2.4
41-50	**270**	**16.8**	44	14.6	114	12.9	14	6.9	442	4.8	**205**	**20.5**	37	10.1	318	17.1	33	8.5	593	16.4
51-60	**558**	**34.7**	76	25.2	350	39.7	64	31.5	1,048	35.0	**342**	**34.2**	105	28.6	655	35.2	124	32.0	1,226	33.9
61-70	**450**	**28.0**	105	34.9	258	29.3	81	39.9	894	29.9	**242**	**24.2**	134	36.5	567	30.4	147	37.9	1,090	30.1
>70	**200**	**12.5**	70	23.3	126	14.3	42	20.7	438	14.6	**153**	**15.3**	87	23.7	255	13.7	80	20.6	575	15.9
NA	-	-	2	0.7	-	-	-	-	2	0.1	-	-	-	-	-	-	-	-	-	-
Total	**1,606**	**100.0**	301	100.0	881	100.0	203	100.0	2,991	100.0	**1,001**	**100.0**	367	100.0	1,863	100.0	388	100.0	3,619	100.0
Average	**57.99±12.34**		63.91±13.42		59.84±14.44		63.04±15.72		60.05±13.16		**57.70±11.14**		62.66±15.72		59.33±16.14		62.85±13.74		60.20±12.65	

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

Table 11 Gender and age group of diabetes patients with and without complications at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002										2003									
	DM	%	Macro	%	Micro	%	Multi	%	Total	%	DM	%	Macro	%	Micro	%	Multi	%	Total	%
Gender																				
Male	**932**	**29.2**	204	42.1	209	30.9	79	37.8	1,424	31.2	**971**	**32.3**	276	39.7	283	31.2	111	41.3	1,641	33.7
Female	**2,258**	**70.8**	280	57.9	467	69.1	130	62.2	3,135	68.8	**2,032**	**67.7**	420	60.3	624	68.8	158	58.7	3,234	66.3
Total	**3,190**	**100.0**	484	100.0	676	100.0	209	100.0	4,559	100.0	**3,003**	**100.0**	696	100.0	907	100.0	269	100.0	4,875	100.0
% Total	**69.97**		10.62		14.83		4.58		100.00		**61.60**		14.27		18.61		5.52		100.00	
Age group (years)																				
0-10	**10**	**0.3**	-	-	-	-	3	1.4	13	0.3	**12**	**0.4**	-	-	-	-	-	-	12	0.2
11-20	**23**	**0.7**	-	-	15	2.2	-	-	38	0.8	**50**	**1.7**	10	1.4	22	2.4	3	1.1	85	1.7
21-30	**55**	**1.7**	11	2.3	20	3.0	2	1.0	88	1.9	**126**	**4.2**	16	2.3	-	-	6	2.2	148	3.0
31-40	**200**	**6.3**	-	-	25	3.7	6	2.9	231	5.1	**162**	**5.4**	19	2.7	35	3.9	8	3.0	224	4.6
41-50	**636**	**19.9**	55	11.4	72	10.7	16	7.7	779	17.1	**584**	**19.4**	36	5.2	111	12.2	12	4.5	743	15.2
51-60	**895**	**28.1**	106	21.9	170	25.1	47	22.5	1,218	26.7	**857**	**28.5**	148	21.3	264	29.1	66	24.5	1,335	27.4
61-70	**914**	**28.7**	172	35.5	263	38.9	83	39.7	1,432	31.4	**781**	**26.0**	260	37.4	328	36.2	104	38.7	1,473	30.2
>70	**457**	**14.3**	140	28.9	111	16.4	52	24.9	760	16.7	**431**	**14.4**	207	29.7	147	16.2	70	26.0	855	17.5
Total	**3,190**	**100.0**	484	100.0	676	100.0	209	100.0	4,559	100.0	**3,003**	**100.0**	696	100.0	907	100.0	269	100.0	4,875	100.0
Average	**59.21±12.34**		65.61±13.57		60.94±14.67		64.53±15.66		62.57±14.22		**57.98±13.22**		66.10±16.54		60.78±14.81		64.60±14.55		62.36±14.78	

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

Section II. Resource utilization

Hospital services used by diabetes patients were described first, and then drug utilization was shown.

1. Hospital utilization

1.1 Phrae Hospital

For outpatients (table 12), 5.08% and 5.24% of total number of outpatients were diagnosed with diabetes in 2002 and 2003 respectively. For inpatients, the percentage of patients with diabetes was increased in the year 2003 (5.42%), compared with only 2.49% in 2002.

Diabetes outpatients had 6.13 and 6.02 average visits per patient per year in 2002 and 2003 respectively, while average visits per non-diabetes outpatient per year were only 2.44 and 2.45 respectively. For inpatients, diabetes patients had 1.87 and 1.75 average admissions per patient per year in 2002 and 2003 respectively, while average admissions per non-diabetes inpatient per year were only 1.26. In addition, diabetes patients had 9.19 and 12.34 average hospital bed-days per patient per year in 2002 and 2003 respectively, while average bed-days per non-diabetes inpatient per year were only 7.60 and 9.13 respectively. Overall, utilization rate for diabetes outpatients and inpatients was decreased but increased for average hospital bed-days over the two-year periods.

For diabetes patients with and without complications, table 13 shows that the percentage of diabetes outpatients without complication and with macrovascular complications for outpatients was decreased from 2002 to 2003, but increased for those with microvascular and both complications. The percentage of diabetes inpatients without complication and with microvascular complications was decreased but increased for those with macrovascular and both complications over the two-year periods.

When comparing hospital utilization of diabetes patients with and without complications, diabetes patients with complications had higher average visits per outpatient per year and average admissions per inpatient per year than those without complications over the two-year periods. In addition, the average hospital bed-days of diabetes patients with macrovascular complications was the highest over other groups, more than two weeks and less than 12 days for diabetes patients with macrovascular complications and other groups respectively.

Table 12 Hospital utilization of outpatient and inpatient services by diabetes and non-diabetes patients at Phrae Hospital, 2002-2003

	2002			2003		
	DM	NON-DM	Total	DM	NON-DM	Total
Outpatient services						
Number of outpatients	2,623	49,058	51,681	2,767	49,993	52,760
%	5.08	94.92	100.00	5.24	94.76	100.00
Number of visits	16,073	119,744	135,817	16,656	122,632	139,288
%	11.83	88.16	100.00	11.95	88.04	100.00
Visits/outpatient	**6.13**	**2.44**	**2.63**	**6.02**	**2.45**	**2.64**
Range, visits	1-37	1-109	1-109	1-59	1-125	1-125
Inpatient services						
Number of inpatients	527	20,600	21,127	1,228	21,427	22,655
%	2.49	97.51	100.00	5.42	94.58	100.00
Number of admissions	985	25,916	26,901	2,153	26,974	29,127
%	3.66	96.33	100.00	7.39	92.60	100.00
Number of bed-days	4,843	156,560	162,467	15,154	195,629	214,316
%	2.98	96.36	100.00	7.07	91.28	100.00
Admissions/inpatient	**1.87**	**1.26**	**1.27**	**1.75**	**1.26**	**1.29**
Range, admissions	1-15	1-17	1-17	1-12	1-24	1-24
Bed-days/inpatient	**9.19**	**7.60**	**7.69**	**12.34**	**9.13**	**9.46**
Range, bed-days	1-68	1-231	1-231	1-134	1-231	1-231

Notes: DM = Diabetes mellitus, NON-DM = non-diabetes mellitus

Table 13 Hospital utilization of outpatient and inpatient services by diabetes patients with and without complications at Phrae Hospital, 2002-2003

	2002					2003				
	DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
Outpatient services										
Number of outpatients	1,454	225	780	164	2,623	627	155	1,698	287	2,767
%	55.43	8.58	29.74	6.25	100.00	22.66	5.60	61.37	10.37	100.00
Number of visits	7,747	1,346	5,521	1,459	16,073	2,195	636	11,543	2,282	16,656
%	48.20	8.37	34.35	9.08	100.00	13.18	3.82	69.30	13.70	100.00
Visits/outpatient	**5.33**	**5.98**	**7.08**	**8.90**	**6.13**	**3.50**	**4.10**	**6.80**	**7.95**	**6.02**
Range, visits	1-35	1-27	1-37	1-29	1-37	1-17	1-16	1-59	1-34	1-59
Inpatient services										
Number of inpatients	210	100	166	51	527	461	273	330	164	1,228
%	39.85	18.98	31.50	9.68	100.00	37.54	22.23	26.87	13.36	100.00
Number of admissions	323	166	340	156	985	655	431	649	418	2,153
%	32.79	16.85	34.52	15.84	100.00	30.42	20.02	30.14	19.41	100.00
Number of bed-days	1,560	1,443	1,204	513	4,843	5,228	5,064	2,812	1,879	15,154
%	32.21	29.79	24.85	10.58	100.00	34.50	33.42	18.55	12.40	100.00
Admissions/inpatient	**1.54**	**1.66**	**2.05**	**3.06**	**1.87**	**1.42**	**1.58**	**1.97**	**2.55**	**1.75**
Range, admissions	1-15	1-5	1-12	1-10	1-15	1-9	1-9	1-11	1-12	1-12
Bed-days/inpatient	**7.43**	**14.43**	**7.25**	**10.05**	**9.19**	**11.34**	**18.55**	**8.52**	**11.46**	**12.34**
Range, bed-days	1-35	1-68	1-40	1-47	1-68	1-134	1-88	1-37	1-45	1-134

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

1.2 Maharat Nakhon Ratchasima Hospital

For outpatients (table 14), 3.18% and 3.57% of total number of outpatients were diagnosed with diabetes in 2002 and 2003 respectively. For inpatients, unlike Phrae hospital, the percentage of patients with diabetes was decreased, 4.42% and 3.04% in 2002 and 2003.

Diabetes outpatients had 6.60 and 6.16 average visits per patient per year in 2002 and 2003 respectively, while average visits per non-diabetes outpatient per year were only 2.38 and 2.37 respectively. For inpatients, diabetes patients had 1.55 and 1.76 average admissions per patient per year in 2002 and 2003 respectively, while average admissions per non-diabetes inpatient per year were only 1.20 and 1.37 respectively. In addition, diabetes patients had 6.14 and 6.82 average hospital bed-days per patient per year in 2002 and 2003 respectively, while average bed-days per non-diabetes inpatient per year were only 5.26 and 5.33 respectively. Overall, utilization rate for diabetes outpatients was decreased but increased for inpatient services over the two-year periods.

When comparing utilization of diabetes patients with and without complications, table 15 shows that diabetes patients with complications had higher average visits per outpatient per year and average admissions per inpatient per year than those without complications over the two-year periods. In addition, the highest of average hospital bed-days per patient were diabetes patients with macrovascular complications in 2002 and diabetes patients with both complications in 2003.

Table 14 Hospital utilization of outpatient and inpatient services by diabetes and non-diabetes patients at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002			2003		
	DM	NON-DM	Total	DM	NON-DM	Total
Outpatient services						
Number of outpatients	4,343	132,389	136,732	4,519	122,233	126,752
%	3.18	96.82	100.00	3.57	96.43	100.00
Number of visits	28,939	315,603	344,542	27,853	290,001	317,854
%	8.40	91.60	100.00	8.76	91.24	100.00
Visits/outpatient	**6.66**	**2.38**	**2.52**	**6.16**	**2.37**	**2.51**
Range, visits	1-70	1-362	1-362	1-62	1-325	1-325
Inpatient services						
Number of inpatients	595	12,880	13,475	959	30,555	31,514
%	4.42	95.58	100.00	3.04	96.96	100.00
Number of admissions	921	15,426	16,347	1,684	41,808	43,492
%	5.63	94.37	100.00	3.87	96.13	100.00
Number of bed-days	3,653	67,749	76,808	6,540	162,858	191,605
%	4.76	88.21	100.00	3.41	85.00	100.00
Admissions/inpatient	**1.55**	**1.20**	**1.21**	**1.76**	**1.37**	**1.38**
Range, admissions	1-7	1-12	1-12	1-12	1-17	1-17
Bed-days/inpatient	**6.14**	**5.26**	**5.70**	**6.82**	**5.33**	**6.08**
Range, bed-days	1-64	1-172	1-172	1-112	1-250	1-250

Notes: DM = Diabetes mellitus, NON-DM = non-diabetes mellitus

Table 15 Hospital utilization of outpatient and inpatient services by diabetes patients with and without complications at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002					2003				
	DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
Outpatient services										
Number of outpatients	3,099	405	643	196	4,343	2,834	573	860	252	4,519
%	71.36	9.33	14.81	4.51	100.00	62.71	12.68	19.03	5.58	100.00
Number of visits	18,846	2,721	5,512	1,860	28,939	15,624	3,318	6,867	2,044	27,853
%	65.12	9.40	19.05	6.43	100.00	56.09	11.91	24.65	7.34	100.00
Visits/outpatient	**6.08**	**6.72**	**8.57**	**9.49**	**6.66**	**5.51**	**5.79**	**7.98**	**8.11**	**6.16**
Range, visits	1-33	1-46	1-40	1-70	1-70	1-34	1-28	1-40	1-62	1-62
Inpatient services										
Number of inpatients	252	185	96	62	595	442	286	148	83	959
%	42.35	31.09	16.13	10.42	100.00	46.09	29.82	15.43	8.65	100.00
Number of admissions	338	274	169	140	921	733	493	285	173	1,684
%	36.70	29.75	18.35	15.20	100.00	43.53	29.28	16.92	10.27	100.00
Number of bed-days	1,318	1,528	415	419	3,653	2,838	1,733	1,020	655	6,540
%	36.08	41.83	11.35	11.47	100.00	43.39	26.50	15.59	10.01	100.00
Admissions/inpatient	**1.34**	**1.48**	**1.76**	**2.26**	**1.55**	**1.66**	**1.72**	**1.93**	**2.08**	**1.76**
Range, admissions	1-4	1-6	1-7	1-7	1-7	1-11	1-5	1-12	1-9	1-12
Bed-days/inpatient	**5.23**	**8.26**	**4.32**	**6.76**	**6.14**	**6.42**	**6.06**	**6.89**	**7.89**	**6.82**
Range, bed-days	1-38	1-64	1-45	1-51	1-64	1-78	1-81	1-112	1-96	1-112

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

2. Drug utilization

Determination of drug utilization was number of prescriptions and drug expenditure.

2.1 Number of prescriptions

2.1.1 Phrae Hospital

The indicators of drug utilization rate are average prescriptions per patient per year and average drug items per patient per year. Table 16 shows that diabetes patients had higher drug utilization than non-diabetes. The average prescriptions per patient per year and average drug items per patient per year for diabetes outpatients in 2003 were 6.17 and 21.03 respectively, while non-diabetes outpatient per year had only 2.48 and 6.87 respectively. For diabetes inpatients, the average prescriptions per patient per year and average drug items per patient per year were 10.59 and 37.02 respectively, while non-diabetes inpatient per year had only 5.51 and 17.88 respectively. Overall, average prescriptions and average drug items for diabetes inpatients were increased but decreased for average prescriptions per diabetes outpatient per year.

For diabetes complications, diabetes patients with complications had higher drug utilization rate than those without complication. Table 17 shows that average prescriptions per diabetes outpatient with macrovascular, microvascular, and both complications were 6.19, 7.47, and 9.51 in 2002, and 4.14, 6.97, and 8.20 in 2003 respectively, whereas those without complication had only 5.51 and 3.57 in 2002 and 2003 respectively. Average drug items per diabetes outpatient with macrovascular, microvascular and both complications were 24.86, 23.30, and 39.10 in 2002, and 17.14, 22.67, and 37.18 in 2003 respectively, whereas those without complication had only 15.98 and 10.17 in 2002 and 2003 respectively. Overall, average prescriptions per patient per year and average drug items per patient per year for diabetes outpatients with and without complications were decreased in 2003 from 2002. For inpatients, similar to outpatients, average prescriptions per diabetes inpatient with macrovascular, microvascular, and both complications were 11.07, 9.68, and 18.01 in 2002, and 11.49, 10.35, and 17.17 in 2003 respectively, whereas those complication

had only 7.60 and 7.88 in 2002 and 2003 respectively. Average drug items per diabetes inpatient with macrovascular, microvascular, and both complications were 36.99, 38.40, and 67.44 in 2002, and 38.72, 38.50, and 65.44 in 2003 respectively, whereas those without complication had only 26.60 and 25.32 in 2002 and 2003 respectively. Overall, average prescriptions per patient per year for diabetes inpatients in 2003 was increased from the previous year, but decreased for those with both complications. Average drug items per patient per year for diabetes inpatients without complication and with more than one complications were decreased in 2003 from 2002, but increased for those with one complication.

Table 16 Drug utilization of outpatient and inpatient services by diabetes and non-diabetes patients at Phrae Hospital, 2002-2003

	2002			2003		
	DM	NON-DM	Total	DM	NON-DM	Total
Outpatient services						
Number of outpatients	2,623	49,058	51,681	2,767	49,993	52,760
%	5.08	94.92	100.00	5.24	94.76	100.00
Number of prescriptions	16,806	122,736	139,542	17,086	124,416	141,502
%	12.04	87.96	100.00	12.07	87.93	100.00
Prescriptions/outpatient	**6.40**	**2.50**	**2.70**	**6.17**	**2.48**	**2.68**
Range, prescriptions	1-11	1-12	1-12	1-3	1-4	1-4
Number of drug items	53,431	334,401	387,832	58,216	343,589	401,805
%	13.78	86.22	100.00	14.49	85.51	100.00
Drug items/outpatient	**20.37**	**6.81**	**7.50**	**21.03**	**6.87**	**7.61**
Range, drug items	1-42	1-65	1-65	1-48	1-51	1-51
Drug items/prescription	3.17	2.72	2.77	3.40	2.76	2.83
Range, drug items	1-15	1-16	1-16	1-13	1-21	1-21
Inpatient services						
Number of inpatients	527	20,600	21,127	1,228	21,427	22,655
%	2.49	97.51	100.00	5.42	94.58	100.00
Number of prescriptions	5,229	107,274	112,503	13,005	118,106	131,111
%	4.65	95.55	100.00	9.92	90.08	100.00
Prescriptions/inpatient	**9.92**	**5.20**	**5.32**	**10.59**	**5.51**	**5.79**
Range, prescriptions	1-73	1-124	1-124	1-153	1-196	1-196
Number of drug items	19,103	353,448	372,551	45,689	383,323	429,012
%	5.13	94.87	100.00	10.65	89.35	100.00
Drug items/inpatient	**36.24**	**17.15**	**17.63**	**37.20**	**17.88**	**18.93**
Range, drug items	1-19	1-16	1-19	1-16	1-16	1-16

Notes: DM = Diabetes mellitus, NON-DM = non-diabetes mellitus

Table 17 Drug utilization by diabetes patients with and without complications at Phrae Hospital, 2002-2003

	2002					2003				
	DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
Outpatient services										
Number of outpatients	1,454	225	780	164	2,623	627	155	1,698	287	2,767
%	55.43	8.58	29.74	6.25	100.00	22.66	5.60	61.37	10.37	100.00
Number of prescriptions	8,023	1,394	5,828	1,561	16,806	2,244	643	11,845	2,354	17,086
%	47.74	8.29	34.68	9.29	100.00	13.13	3.76	69.33	13.78	100.00
Prescriptions/outpatient	**5.51**	**6.19**	**7.47**	**9.51**	**6.40**	**3.57**	**4.14**	**6.97**	**8.20**	**6.17**
Range, prescriptions	1-6	1-11	1-8	1-8	1-11	1-3	1-2	1-3	1-3	1-3
Number of drug items	23,247	5,594	18,177	6,413	53,431	6,381	2,657	38,505	10,673	58,216
%	43.51	10.47	34.02	12.00	100.00	10.96	4.56	66.14	18.33	100.00
Drug items/outpatient	**15.98**	**24.86**	**23.30**	**39.10**	**20.37**	**10.17**	**17.14**	**22.67**	**37.18**	**21.03**
Range, drug items	1-35	1-40	1-42	1-38	1-42	1-21	1-21	1-32	1-48	1-48
Inpatient services										
Number of inpatients	210	100	166	51	527	461	273	330	164	1,228
%	39.85	18.98	31.50	9.68	100.00	37.54	22.23	26.87	13.36	100.00
Number of prescriptions	1,596	1,107	1,607	919	5,229	3,633	3,139	3,417	2,816	13,005
%	30.52	21.17	30.73	17.58	100.00	27.94	24.14	26.27	21.65	100.00
Prescriptions/inpatient	**7.60**	**11.07**	**9.68**	**18.01**	**9.92**	**7.88**	**11.49**	**10.35**	**17.17**	**10.59**
Range, prescriptions	1-51	1-46	1-57	1-73	1-73	1-74	1-92	1-72	1-153	1-153
Number of drug items	5,586	3,699	6,376	3,442	19,103	11,677	10,573	12,706	10,733	45,689
%	29.24	19.36	33.38	18.02	100.00	25.56	23.14	27.81	23.49	100.00
Drug items/inpatient	**26.60**	**36.99**	**38.40**	**67.49**	**36.24**	**25.32**	**38.72**	**38.50**	**65.44**	**37.20**
Range, drug items	1-11	1-12	1-19	1-14	1-19	1-14	1-13	1-16	1-15	1-16

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

2.1.2 Maharat Nakhon Ratchasima Hospital

Table 18 shows that diabetes patients had higher drug utilization than non-diabetes. The average prescriptions per patient per year and average drug items per patient per year for diabetes outpatients in 2003 were 6.26 and 26.67 respectively, while non-diabetes outpatient per year had only 2.40 and 7.07 respectively. For diabetes inpatients, the average prescriptions per patient per year and average drug items per patient per year were 8.36 and 28.60 respectively, while non-diabetes inpatient per year had only 4.27 and 12.47 respectively. Overall, average prescriptions and average drug items for diabetes patients were increased but decreased for average prescriptions per diabetes outpatient per year.

For diabetes complications, diabetes patients with complications had higher drug utilization rate than those without complication. Table 19 shows that average prescription per diabetes outpatient with macrovascular, microvascular, and both complications were 6.89, 8.77, and 9.80 in 2002, and 5.90, 8.12, and 8.34, in 2003 respectively, whereas those without complication had only 6.15 and 5.58 in 2002 and 2003 respectively. Average drug items per diabetes outpatient with macrovascular, microvascular, and both complications were 34.17, 34.51, and 47.26 in 2002, and 33.06, 34.69, and 45.98 in 2003 respectively, whereas those without complication had only 21.84 and 21.22 in 2002 and 2003 respectively. Overall, average prescriptions per patient per year and average drug items per patient per year for most of diabetes outpatient groups were decreased from 2002 to 2003, but average drug items per patient per year for microvascular complications was increased. Unlike outpatients, average prescriptions per diabetes inpatient with macrovascular, microvascular, and both complications were 6.63, 5.89, and 11.06 in 2002, and 8.25, 9.45, and, 14.42 in 2003 respectively, whereas those without complication had only 3.16 and 6.93 in 2002 and 2003 respectively. Average drug items per diabetes inpatient with macrovascular, microvascular, and both complications were 27.78, 26.71, and 54.00 in 2002, and 30.27, 30.26, and 57.51 in 2003 respectively, whereas those without complication had only 11.37 and 21.54 in 2002 and 2003 respectively. Overall, average prescriptions per patient per year and average drug items per patient per year for all diabetes inpatient groups were increased from 2002 to 2003.

Table 18 Drug utilization of outpatient and inpatient services by diabetes and non-diabetes patients at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002			2003		
	DM	NON-DM	Total	DM	NON-DM	Total
Outpatient services						
Number of outpatients	4,343	132,389	136,732	4,519	122,233	126,752
%	3.18	96.82	100.00	3.57	96.43	100.00
Number of prescriptions	29,417	320,041	349,458	28,298	293,471	321,769
%	8.42	91.58	100.00	8.79	91.21	100.00
Prescriptions/outpatient	**6.77**	**2.41**	**2.55**	**6.26**	**2.40**	**2.53**
Range, prescriptions	1-15	1-16	1-16	1-11	1-14	1-14
Number of drug items	113,008	902,784	1,015,792	120,535	864,653	985,188
%	11.13	88.87	100.00	12.23	87.77	100.00
Drug items/outpatient	**26.02**	**6.81**	**7.42**	**26.67**	**7.07**	**7.77**
Range, drug items	1-251	1-1,570	1-1,570	1-227	1-1,509	1-1,509
Drug items/prescription	3.84	0.42	0.40	4.25	0.42	0.40
Range, drug items	1-20	1-18	1-20	1-52	1-49	1-52
Inpatient services						
Number of inpatients	595	12,880	13,475	959	30,555	31,514
%	4.42	95.58	100.00	3.04	96.96	100.00
Number of prescriptions	3,277	28,063	31,340	8,024	130,515	138,539
%	10.46	89.54	100.00	5.79	94.21	100.00
Prescriptions/inpatient	**5.50**	**2.17**	**2.32**	**8.36**	**4.27**	**4.39**
Range, prescriptions	1-109	1-151	1-151	1-216	1-218	1-218
Number of drug items	13,920	128,063	41,983	127,435	381,303	408,738
%	33.16	66.84	100.00	6.71	93.29	100.00
Drug items/inpatient	**23.39**	**9.94**	**10.54**	**28.60**	**12.47**	**12.97**
Range, drug items	1-503	1-602	1-602	1-698	1-875	1-875

Notes: DM = Diabetes mellitus, NON-DM = non-diabetes mellitus

Table 19 Drug utilization by diabetes patients with and without complications at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002					2003				
	DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
Outpatient services										
Number of outpatients	3,099	405	643	196	4,343	2,834	573	860	252	4,519
%	71.36	9.33	14.81	4.51	100.00	62.71	12.68	19.03	5.58	100.00
Number of prescriptions	19,060	2,794	5,641	1,922	29,417	15,822	3,386	6,986	2,104	28,298
%	64.79	9.50	19.18	6.53	100.00	55.91	11.97	24.69	7.44	100.00
Prescriptions/outpatient	**6.15**	**6.89**	**8.77**	**9.80**	**6.77**	**5.58**	**5.90**	**8.12**	**8.34**	**6.26**
Range, prescriptions	1-9	1-11	1-15	1-15	1-15	1-7	1-10	1-11	1-9	1-11
Number of drug items	67,709	13,840	22,195	9,264	113,008	60,164	18,944	29,840	11,587	120,535
%	59.92	12.25	19.64	8.20	100.00	49.91	15.72	24.76	9.61	100.00
Drug items/outpatient	**21.84**	**34.17**	**34.51**	**47.26**	**26.02**	**21.22**	**33.06**	**34.69**	**45.98**	**26.67**
Range, drug items	1-150	1-194	1-181	1-251	1-251	1-184	1-192	1-182	1-227	1-227
Inpatient services										
Number of inpatients	252	185	96	62	595	442	286	148	83	959
%	42.35	31.09	16.13	10.42	100.00	46.09	29.82	15.43	8.65	100.00
Number of prescriptions	797	1,228	566	686	3,277	3,066	2,361	1,400	1,197	8,024
%	24.32	37.47	17.27	20.93	100.00	38.21	29.42	17.45	14.92	100.00
Prescriptions/inpatient	**3.16**	**6.63**	**5.89**	**11.06**	**5.50**	**6.93**	**8.25**	**9.45**	**14.42**	**8.36**
Range, prescriptions	1-51	1-109	1-37	1-63	1-109	1-64	1-79	1-216	1-103	1-216
Number of drug items	2,867	5,140	2,565	3,348	13,920	9,523	8,659	4,479	4,774	27,435
%	20.60	36.93	18.43	24.05	100.00	34.71	31.56	16.33	17.40	100.00
Drug items/inpatient	**11.37**	**27.78**	**26.71**	**54.00**	**23.39**	**21.54**	**30.27**	**30.26**	**57.51**	**28.60**
Range, drug items	1-207	1-503	1-236	1-267	1-503	1-239	1-330	1-698	1-352	1-698

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

2.2. Drug expenditure

The drug expenditure of diabetes patients with and without complications was analyzed by three relationships: types and expenditure of drug use, drug expenditure by health insurance coverage, and drug expenditure by types of hospitals.

2.2.1 Types and expenditure of drug use

Drugs in this part were categorized into three main classes that were cardiovascular, antidiabetic, and other drugs.

2.2.1.1 Phrae Hospital

Table 20 shows that the percentage of diabetes outpatients who used cardiovascular drugs was increased over the two-year periods, from 53.15% to 57.57% in 2002 and 2003 respectively. On the other hand, there was a decreasing rate for the percentage of diabetes outpatients who used antidiabetic drugs, 75.50% and 74.95% in 2002 and 2003 respectively. The result is the same for diabetes inpatients (table 21). The percentage of diabetes inpatients who used cardiovascular drugs was increased over the two-year periods, from 65.09% to 68.65% in 2002 and 2003 respectively. On the other hand, there was a decreasing rate for the percentage of diabetes inpatients who used antidiabetic drugs, 75.71% and 72.72% in 2002 and 2003 respectively. Overall (table 22), the percentage of diabetes patients who used cardiovascular drugs was increased over the two-year periods, from 55.43% to 61.48% in 2002 and 2003 respectively. On the other hand, there was a decreasing rate for the percentage of diabetes patients who used antidiabetic drugs, 75.96% and 74.97% in 2002 and 2003 respectively.

For cardiovascular drugs, diabetes patients with complications had higher average drug expenditure per patient per year than diabetes patients without complication. Table 22 shows that average drug expenditure per patient per year for cardiovascular drug use in 2002 and 2003 was 1,382 baht and 1,003 baht for macrovascular complications, 1,300 baht and 1,007 baht for microvascular complications, and 2,159 baht and 2,841 baht for both complications, while those without complication had only 696 baht and 436 baht in 2002 and 2003 respectively.

For antidiabetic drugs, table 22 shows that diabetes patients with microvascular and both complications had higher average drug expenditure per patient per year than those without complication and with macrovascular complications. Average drug expenditure per patient per year in 2002 and 2003 was 1,036 baht and 1,337 baht for microvascular complications, and 1,007 baht and 1,429 baht for both complications, while diabetes patients without complication had only 724 baht and 373 baht in 2002 and 2003 respectively, and those with macrovascular complications had 611 baht and 550 baht in 2002 and 2003 respectively..

All drugs, diabetes complications would lead to high drug expenditure. Table 22 shows that the average drug expenditure per diabetes patient without complication was 1,541 baht and 1,823 baht in 2002 and 2003 respectively. The presence of macrovascular complications would lead to 2,910 baht and 4,640 baht for average drug expenditure per patient per year in 2002 and 2003 respectively. In addition, the average drug expenditure per diabetes patient with microvascular complications was 4,216 baht and 3,291 baht in 2002 and 2003 respectively. Moreover, these patients with both complications increased drug expenditure to 6,728 baht and 6,336 baht in 2002 and 2003 respectively.

Table 20 Types and expenditure of drug use by diabetes outpatients with and without complications at Phrae Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
CV	Number of outpatients	696	155	403	140	1,394	260	101	995	237	1,593
	%	47.87	68.89	51.67	85.37	53.15	41.47	65.16	58.60	82.58	57.57
	Items/outpatient	6.33	14.32	8.24	15.11	8.65	4.93	10.86	8.92	17.18	9.62
	Expenditure/outpatient	**734.92**	**1,530.17**	**1,121.84**	**2,098.22**	**1,072.12**	**596.64**	**1,240.74**	**987.06**	**2,711.49**	**1,195.98**
DM	Number of outpatients	1,145	126	574	135	1,980	430	83	1,334	227	2,074
	%	78.75	56.00	73.59	82.32	75.49	68.58	53.55	78.56	79.09	74.95
	Items/outpatient	7.40	6.66	9.08	8.76	7.93	3.69	3.51	9.75	8.74	8.13
	Expenditure/outpatient	**732.23**	**740.90**	**1,066.64**	**965.31**	**845.62**	**288.77**	**429.67**	**1,311.42**	**1,412.85**	**1,075.21**
Other	Number of outpatients	1,216	224	742	164	2,346	504	152	1,525	285	2,466
	%	83.63	9.56	95.13	100.00	89.44	80.38	98.06	89.81	99.30	89.12
	Items/outpatient	8.53	11.32	13.00	19.00	10.94	6.97	8.35	10.91	16.20	10.56
	Expenditure/outpatient	**457.14**	**554.59**	**967.95**	**1,359.87**	**691.11**	**471.27**	**605.89**	**723.76**	**1,175.00**	**717.04**
Total	Number of outpatients	1,454	225	780	164	2,623	627	155	1,698	287	2,767
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Items/outpatient	15.99	24.86	23.30	39.10	20.37	10.18	17.14	22.68	37.19	21.04
	Expenditure/outpatient	**1,310.72**	**2,021.15**	**2,285.35**	**3,945.65**	**1,826.23**	**824.27**	**1,632.73**	**2,258.71**	**4,523.40**	**2,133.50**

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications, CV = Cardiovascular drugs, DM = Antidiabetic drugs

Table 21 Types and expenditure of drug use by diabetes inpatients with and without complications at Phrae Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
CV	Number of inpatients	119	63	116	45	343	251	207	243	142	843
	%	56.67	63.00	69.88	88.24	65.09	54.45	75.82	73.64	86.59	68.65
	Expenditure/inpatient	**347.44**	**819.14**	**1,483.31**	**1,865.53**	**1,017.39**	**216.32**	**707.96**	**715.44**	**1,997.23**	**780.91**
DM	Number of inpatients	162	75	123	39	399	362	211	191	129	893
	%	77.14	75.00	74.10	76.47	75.71	78.52	77.29	57.88	78.66	72.72
	Expenditure/inpatient	**445.30**	**287.40**	**598.33**	**893.64**	**506.62**	**398.92**	**493.45**	**882.32**	**882.47**	**594.50**
Other	Number of inpatients	210	99	166	51	526	460	273	329	164	1,226
	%	100.00	99.00	100.00	100.00	99.81	99.78	100.00	99.70	100.00	99.84
	Expenditure/inpatient	**2,169.19**	**3,516.29**	**10,157.24**	**11,763.25**	**5,873.90**	**2,412.57**	**4,392.36**	**5,935.72**	**4,651.67**	**4,098.39**
Total	Number of inpatients	210	100	166	51	527	461	273	330	164	1,228
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/inpatient	**2,709.59**	**4,212.74**	**11,637.11**	**14,092.69**	**6,908.49**	**2,838.36**	**5,310.56**	**6,955.24**	**7,075.12**	**5,060.11**

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications, CV = Cardiovascular drugs, DM = Antidiabetic drugs

Table 22 Types and expenditure of drug use by all diabetes patients with and without complications at Phrae Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
CV	Number of patients	794	209	480	175	1,658	480	271	1,148	326	2,225
	%	49.44	69.44	54.48	86.21	55.43	47.95	73.84	61.62	84.02	61.48
	Expenditure/patient	**696.28**	**1,381.74**	**1,300.35**	**2,158.29**	**1,111.88**	**436.30**	**1,003.18**	**1,006.95**	**2,841.20**	**1,152.13**
DM	Number of patients	1,258	188	662	164	2,272	721	254	1,434	304	2,713
	%	78.33	62.46	75.14	80.79	75.96	72.03	69.21	76.97	78.35	74.97
	Expenditure/patient	**723.80**	**611.21**	**1,036.02**	**1,007.13**	**825.91**	**372.51**	**550.32**	**1,337.49**	**1,429.46**	**1,017.65**
Other	Number of patients	1,373	299	844	203	2,719	891	365	1,694	386	3,336
	%	85.49	99.34	95.80	100.00	90.91	89.01	99.46	90.93	99.48	92.18
	Expenditure/patient	**736.65**	**1,579.74**	**2,848.72**	**4,053.92**	**1,732.63**	**1,512.12**	**3,537.56**	**1,804.36**	**2,843.91**	**2,036.22**
Total	Number of patients	1,606	301	881	203	2,991	1,001	367	1,863	388	3,619
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/patient	**1,540.97**	**2,910.41**	**4,216.04**	**6,728.15**	**2,818.78**	**1,823.48**	**4,639.93**	**3,290.67**	**6,336.43**	**3,348.22**

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications, CV = Cardiovascular drugs, DM = Antidiabetic drugs

2.2.1.2 Maharat Nakhon Ratchasima Hospital

In general (table 23), like Phrae Hospital, the percentage of diabetes outpatients who used cardiovascular drugs, was increased over the two-year periods, with 60.53% and 61.52% in 2002 and 2003 respectively. On the other hand, there was a decreasing rate for the percentage of diabetes outpatients who used antidiabetic drugs, 83.47% and 69.68% in 2002 and 2003 respectively. For diabetes inpatients (table 24), the percentage of diabetes patients who used cardiovascular drugs was decreased over the two-year periods, from 54.62% to 54.43% in 2002 and 2003 respectively. On the other hand, there was an increasing rate for the percentage of diabetes inpatients who used antidiabetic drugs, 48.24% and 53.81% in 2002 and 2003 respectively. Overall (table 25), the percentage of diabetes patients who used cardiovascular drugs was increased over the two-year periods, from 60.54% to 62.13% in 2002 and 2003 respectively. On the other hand, there was a decreasing rate for the percentage of diabetes patients who used antidiabetic drugs, 73.90% and 69.95% in 2002 and 2003 respectively.

For cardiovascular drugs, diabetes patients with complications had higher average drug expenditure per patient per year than diabetes patients without complication. Table 25 shows that average drug expenditure per diabetes outpatient for cardiovascular drug use in 2002 and 2003 were 4,463 baht and 4,978 baht for macrovascular complications, 3,695 baht and 3,967 baht for microvascular complications, and 4,978 baht and 6,045 baht for both complications, while those without complication had only 2,064 baht and 2,962 baht in 2002 and 2003 respectively.

For antidiabetic drugs, table 25 shows that diabetes patients with complications had higher average drug expenditure per patient per year than diabetes patients without complication. Average drug expenditure per patient per year in 2002 and 2003 was 1,480 baht and 1,499 baht for macrovascular complications, and 1,821 baht and 1,994 baht for microvascular complications, and 1,936 baht and 2,323 baht for both complications in 2002 and 2003 respectively, while diabetes patients without complications had the lowest average drug expenditure per year, only 1,380 baht and 1,372 baht in 2002 and 2003 respectively.

All drugs, diabetes complications would lead to high drug expenditure. Table 25 shows that the average drug expenditure per diabetes patient without complication was 3,155 baht and 4,166 baht in 2002 and 2003 respectively.

The presence of microvascular complications would lead to 9,405 baht and 9,308 baht for average drug expenditure per patient per year over those without complications in 2002 and 2003 respectively. In addition, the average drug expenditure per diabetes patient with macrovascular complications was 9,841 baht and 11,174 baht in 2002 and 2003 respectively. Moreover, these patients with both complications increased drug expenditure to 22,049 baht and 24,101 baht in 2002 and 2003 respectively.

Table 23 Types and expenditure of drug use by diabetes outpatients with and without complications at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
CV	Number of outpatients	1,733	322	415	159	2,629	1,542	463	559	216	2,780
	%	55.92	79.51	64.54	81.12	60.53	54.41	80.80	65.00	85.71	61.52
	Items/outpatient	9.43	15.46	11.89	18.33	13.78	9.72	15.07	12.90	16.94	13.66
	Expenditure/outpatient	**2,102.82**	**4,704.54**	**3,634.06**	**4,442.89**	**3,721.08**	**3,127.37**	**5,502.43**	**4,148.44**	**5,924.42**	**4,675.67**
DM	Number of outpatients	2,381	254	495	495	3,625	2,015	354	627	153	3,149
	%	76.83	62.72	76.98	252.55	83.47	71.10	61.78	72.91	60.71	69.68
	Items/outpatient	8.98	6.98	9.86	7.60	8.36	8.26	6.98	10.37	7.59	8.30
	Expenditure/outpatient	**1,395.92**	**1,588.72**	**1,822.67**	**1,817.46**	**1,656.19**	**1,423.87**	**1,659.84**	**2,035.90**	**2,344.81**	**1,866.11**
Other	Number of outpatients	2,712	401	633	196	3,942	2,550	567	851	250	4,218
	%	87.51	99.01	98.44	100.00	90.77	89.98	98.95	98.95	99.21	93.34
	Items/outpatient	11.05	17.67	19.55	27.71	19.00	11.19	16.75	18.94	27.06	18.49
	Expenditure/outpatient	**1,035.05**	**4,161.78**	**3,948.24**	**8,174.77**	**4,329.96**	**1,299.82**	**4,231.57**	**3,878.71**	**11,243.43**	**5,163.38**
Total	Number of outpatients	3,099	405	643	196	4,343	2,834	573	860	252	4,519
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Items/outpatient	21.85	34.17	34.52	47.27	34.45	21.23	33.06	34.70	45.98	33.74
	Expenditure/outpatient	**3,154.22**	**8,857.45**	**7,635.44**	**12,900.96**	**4,789.40**	**3,883.57**	**9,658.83**	**8,018.92**	**17,655.90**	**6,170.86**

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications, CV = Cardiovascular drugs, DM = Antidiabetic drugs

Table 24 Types and expenditure of drug use by diabetes inpatients with and without complications at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
CV	Number of inpatients	83	127	59	56	325	161	205	84	72	522
	%	32.94	68.65	61.46	90.32	54.62	36.43	71.68	56.76	86.75	54.43
	Expenditure/inpatient	**381.77**	**933.74**	**1,865.97**	**2,940.79**	**1,530.57**	**260.21**	**952.18**	**772.51**	**1,957.49**	**985.60**
DM	Number of inpatients	112	107	40	28	287	245	159	67	45	516
	%	44.44	57.84	41.67	45.16	48.24	55.43	55.59	45.27	54.22	53.81
	Expenditure/inpatient	**261.32**	**335.64**	**713.80**	**1,274.04**	**646.20**	**348.54**	**359.72**	**530.73**	**750.11**	**497.28**
Other	Number of inpatients	241	182	93	61	577	428	278	142	83	931
	%	95.63	98.38	96.88	98.39	96.97	96.83	97.20	95.95	100.00	97.08
	Expenditure/inpatient	**950.39**	**5,612.59**	**14,079.77**	**30,806.44**	**12,862.30**	**3,219.21**	**7,158.26**	**10,178.99**	**22,400.81**	**10,739.32**
Total	Number of inpatients	252	185	96	62	595	442	286	148	83	959
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/inpatient	**1,150.79**	**6,356.70**	**15,083.99**	**33,541.13**	**8,392.61**	**3,405.22**	**7,840.52**	**10,445.05**	**24,505.55**	**7,640.59**

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications, CV = Cardiovascular drugs, DM = Antidiabetic drugs

Table 25 Types and expenditure of drug use by all diabetes patients with and without complications at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
CV	Number of patients	1,781	366	438	175	2,760	1,642	551	601	235	3,029
	%	55.83	75.62	64.79	83.73	60.54	54.68	79.17	66.26	87.36	62.13
	Expenditure/patient	**2,063.93**	**4,462.97**	**3,694.58**	**4,977.74**	**3,799.80**	**2,962.42**	**4,977.89**	**3,966.51**	**6,045.17**	**4,488.00**
DM	Number of patients	2,429	297	511	132	3,369	2,153	430	658	169	3,410
	%	76.14	61.36	75.59	63.16	73.90	71.69	61.78	72.55	62.83	69.95
	Expenditure/patient	**1,380.39**	**1,479.62**	**1,821.48**	**1,936.26**	**1,654.43**	**1,372.27**	**1,499.49**	**1,994.03**	**2,322.55**	**1,797.08**
Other	Number of patients	2,803	480	666	209	4,158	2,730	687	897	267	4,581
	%	87.87	99.17	98.52	100.00	91.20	90.91	98.71	98.90	99.26	93.97
	Expenditure/patient	**1,083.16**	**5,604.93**	**5,718.70**	**16,657.65**	**7,266.11**	**1,718.81**	**6,389.07**	**5,291.19**	**17,491.10**	**7,722.54**
Total	Number of patients	3,190	484	676	209	4,559	3,003	696	907	269	4,875
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/patient	**3,155.15**	**9,841.44**	**9,404.81**	**22,048.51**	**5,657.81**	**4,166.21**	**11,173.70**	**9,307.76**	**24,101.30**	**7,223.26**

Notes: DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications, CV = Cardiovascular drugs, DM = Antidiabetic drugs

2.2.2 Drug expenditure by health insurance coverage

2.2.2.1 Phrae Hospital

Diabetes patients under CSMBS had the highest average drug expenditure per patient per year (table 26). When comparing drug expenditure between the two years, the average drug expenditure per diabetes inpatients under CSMBS was decreased in 2003 but increased for the others.

Table 26 Drug expenditure of diabetes patients by health insurance coverage at Phrae Hospital, 2002-2003

		2002			2003		
		OP	IP	Total	OP	IP	Total
UC	Number of patients	1,609	296	1,814	1,703	781	2,260
	%	58.57	54.01	57.84	60.16	63.24	61.20
	Expenditure/patient	**1,427.89**	**3,389.86**	**1,819.67**	**1,636.66**	**3,658.81**	**2,497.68**
CSMBS	Number of patients	964	222	1,123	1,011	426	1,296
	%	35.09	40.51	35.81	35.71	34.49	35.09
	Expenditure/patient	**2,520.45**	**11,692.13**	**4,474.95**	**3,002.97**	**7,695.69**	**4,872.19**
Self-pay	Number of patients	137	29	162	70	20	88
	%	4.99	5.29	5.17	2.47	1.62	2.38
	Expenditure/patient	**255.55**	**1,437.52**	**473.44**	**349.44**	**1,580.15**	**637.09**
SSS	Number of patients	37	1	37	45	8	47
	%	1.35	0.18	1.18	1.59	0.65	1.27
	Expenditure/patient	**756.78**	**35.00**	**757.73**	**1,231.42**	**5,790.13**	**2,164.57**
NA	Number of patients	-	-	-	2	-	2
	%	-	-	-	0.07	-	0.05
	Expenditure/patient	**-**	**-**	**-**	**148.50**	**-**	**148.50**
Total	Number of patients	2,623	527	2,991	2,767	1,228	3,619
	%	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/patient	**1,826.23**	**6,908.49**	**2,818.78**	**2,133.50**	**5,060.11**	**3,348.22**

Notes: OP = Outpatients, IP = Inpatients, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme, NA = not available

2.2.2.2 Maharat Nakhon Ratchasima Hospital

Diabetes patients under CSMBS had the highest average drug expenditure per patient per year (table 27). When comparing drug expenditure between the two years, diabetes patients under CSMBS had increasing average drug expenditure per patient per year over the two-year periods but decreased for other groups.

Table 27 Drug expenditure of diabetes patients by health insurance coverage at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002			2003		
		OP	IP	Total	OP	IP	Total
UC	Number of patients	3,333	251	3,451	1,253	123	1,338
	%	43.79	34.01	43.56	22.52	11.32	22.12
	Expenditure/patient	**2,900.96**	**9,393.90**	**4,438.11**	**1,744.79**	**2,295.61**	**1,910.93**
CSMBS	Number of patients	3,787	429	3,933	4,182	903	4,522
	%	49.75	58.13	49.65	75.16	83.07	74.77
	Expenditure/patient	**6,180.24**	**11,041.00**	**8,213.42**	**9,735.63**	**11,755.72**	**12,118.83**
Self-pay	Number of patients	492	58	538	127	55	180
	%	6.46	7.86	6.79	2.28	5.06	2.98
	Expenditure/patient	**2,526.58**	**6,282.98**	**2,977.32**	**1,208.67**	**798.12**	**1,072.53**
NA	Number of patients	-	-	-	2	6	8
	%	-	-	-	0.04	0.55	0.13
	Expenditure/patient	-	-	-	**184.75**	**37.79**	**176.81**
Total	Number of patients	4,343	595	4,559	4,519	959	4,875
	%	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/patient	**4,789.40**	**8,392.61**	**5,657.81**	**6,170.86**	**7,640.59**	**7,223.26**

Notes: OP = Outpatients, IP = Inpatients, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, NA = not available

2.2.3 Drug expenditure by types of hospitals

The comparison of drug expenditure between the two hospitals was classified by two sections that were by diabetes complications and by health insurance coverage.

2.2.3.1 By diabetes complications

Diabetes patients at Maharat Nakhon Ratchasima Hospital had higher average drug expenditure per patient per year than Phrae Hospital for all diabetes groups for both years (table 28).

Table 28 Comparison of average drug expenditure per patient per year by diabetes complications between Phrae Hospital and Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002		2003	
		Phrae	Maharat	Phrae	Maharat
DM	Number of patients	1,606	3,190	1,001	3,003
	%	53.69	69.97	27.66	61.60
	Expenditure/patient	**1,540.97**	**3,155.15**	**1,823.48**	**4,166.21**
Macro	Number of patients	301	484	367	696
	%	10.06	10.62	10.14	14.28
	Expenditure/patient	**2,910.41**	**9,841.44**	**4,639.93**	**11,173.70**
Micro	Number of patients	881	676	1,863	907
	%	29.46	14.83	51.48	18.61
	Expenditure/patient	**4,216.04**	**9,404.81**	**3,290.67**	**9,307.76**
Multi	Number of patients	203	209	388	269
	%	6.79	4.58	10.72	5.52
	Expenditure/patient	**6,728.15**	**22,048.51**	**6,336.43**	**24,101.30**
Total	Number of patients	2,991	4,559	3,619	4,875
	%	100.00	100.00	100.00	100.00
	Expenditure/patient	**2,818.78**	**5,657.81**	**3,348.22**	**7,223.26**

Notes: Phrae = Phrae Hospital, Maharat = Maharat Nakhon Ratchasima Hospital, DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

2.2.3.2 By health insurance coverage

CSMBS had the highest average drug expenditure per patient per year for both hospitals for both years (table 29). When comparing drug expenditure between the two hospitals, average drug expenditure per patient per year at Maharat Nakhon Ratchasima Hospital was higher than at Phrae Hospital for most health insurance coverage except for UC in 2003. In addition, all of health insurance coverage at Phrae Hospital and only CSMBS at Maharat Nakhon Ratchasima Hospital were increased, while the rest was decreased over the two-year periods.

Table 29 Comparison of average drug expenditure per patient per year by health insurance coverage between Phrae Hospital and Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002		2003	
		Phrae	Maharat	Phrae	Maharat
UC	Number of patients	1,814	3,451	2,260	1,338
	%	57.84	43.56	61.20	22.12
	Expenditure/patient	**1,819.67**	**4,438.11**	**2,497.68**	**1,910.93**
CSMBS	Number of patients	1,123	3,933	1,296	4,522
	%	35.81	49.65	35.09	74.77
	Expenditure/patient	**4,474.95**	**8,213.42**	**4,872.19**	**12,118.83**
Self-pay	Number of patients	162	538	88	180
	%	5.17	6.79	2.38	2.98
	Expenditure/patient	**473.44**	**2,977.32**	**637.09**	**1,072.53**
SSS	Number of patients	37	-	47	-
	%	1.18	-	1.27	-
	Expenditure/patient	**757.73**	**-**	**2,164.57**	**-**
NA	Number of patients	-	-	2	8
	%	-	-	0.05	0.13
	Expenditure/patient	**-**	**-**	**148.50**	**176.81**
Total	Number of patients	2,991	4,559	3,619	4,875
	%	100.00	100.00	100.00	100.00
	Expenditure/patient	**2,818.78**	**5,657.81**	**3,348.22**	**7,223.26**

Notes: Phrae = Phrae Hospital, Maharat = Maharat Nakhon Ratchasima Hospital, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme, NA = not available

Section III. Clinical outcomes of drug use

1. Antidiabetic drugs

Clinical outcomes of antidiabetic drug use are fasting blood sugar (FBS; mg/dL) and hemoglobin A_{1C} (HbA_{1C}; %).

For FBS (table 30), 368 diabetes patients received antidiabetic drugs: 41 patients (11.14%) taking insulin only; 308 patients (83.70%) taking oral agents only, and 19 patients (5.16%) taking both agents. Patients taking oral agents only had the lowest mean of FBS and the highest percentage of patients whose FBS level lower than 130 mg/dL (37.99%).

For HbA_{1C} (table 30), there are only 119 diabetes patients who received HbA_{1C} test: 20 patients (16.81%) taking insulin only; 88 patients (73.95%) taking oral agents only, and 11 patients (9.24%) taking both agents. Patients taking both agents had the lowest mean of HbA_{1C} and the highest percentage of patients with good control (33.71%)

Table 30 Glycemic control of antidiabetic drug use

	Insulin only			Oral agents only			Insulin+Oral agents			Total		
	n	Mean ± S.D	**% good control**	n	Mean ± S.D	**% good control**	n	Mean ± S.D	**% good control**	n	Mean ± S.D	**% good control**
FBS[1]	41	194.88 ±118.28	**21.95**	308	147.56 ±50.41	**37.99**	19	159.32 ±49.29	**31.58**	368	153.44 ±63.18	**35.87**
HbA_{1c}[2]	20	9.88 ±2.78	**21.05**	88	7.66 ±1.93	**27.27**	11	7.33 ±1.77	**33.71**	119	8.00 ±2.23	**31.09**

[1]FBS goal = 90-130 mg/dL, [2]HbA_{1C} goal <7%
Reference: American Diabetes Association: Standards of medical care in diabetes. Diabetes care 2005; 38:S10.

2. Lipid lowering drugs

Clinical outcomes of lipid lowering drug use are triglyceride (TG; mg/dL), low-density lipoprotein (LDL; mg/dL), and high-density lipoprotein (HDL; mg/dL).

For TG (table 31), 61 diabetes patients received lipid lowering drugs: 40 patients (65.57%) taking Statin only; 18 patients (29.51%) taking non-Statin only, and 3 patients (4.92%) taking both agents. Patients taking non-Statin only had the lowest

mean of TG and the highest percentage of patients whose TG level lower than 150 mg/dL (66.67%).

For LDL (table 31), 39 diabetes patients received lipid lowering drugs: 30 patients (76.92%) taking Statin only; 6 patients (15.39%) taking non-Statin only, and 3 patients (7.69%) taking both agents. Patients taking Statin only had the lowest mean of LDL and the highest percentage of patients whose LDL level lower than 100 mg/dL (56.67%).

For HDL (table 31), 60 diabetes patients received lipid lowering drugs: 40 patients (66.67%) taking Statin only; 17 patients (28.33%) taking non-Statin only, and 3 patients (5.00%) taking both agents. Patients taking non-Statin only had the highest mean of HDL and the highest percentage of patients whose HDL level more than 40 mg/dL (75.00%).

Table 31 Lipid control of lipid lowering drug use

	Statin only			Non-Statin only			Statin+Non-Statin			Total		
	n	Mean ±S.D	**% good control**	n	Mean ±S.D	**% good control**	n	Mean ±S.D	**% good control**	n	Mean ±S.D	**% good control**
TG[1]	40	180.00 ±118.19	**57.50**	18	153.72 ±82.76	**66.67**	3	202.33 ±94.75	**33.33**	61	173.34 ±107.27	**59.02**
LDL[2]	30	96.53 ±34.84	**56.67**	6	127.50 ±32.33	**16.67**	3	102.00 ±28.05	**33.33**	39	101.72 ±35.09	**48.72**
HDL[3]	40	49.08 ±12.20	**70.59**	17	52.12 ±16.93	**75.00**	3	46.00 ±8.66	**66.67**	60	49.78 ±13.46	**73.33**

[1]TG goal <150 mg/dL, [2]LDL goal <100 mg/dL, [3]HDL goal >40 mg/dL
Reference: American Diabetes Association: Standards of medical care in diabetes. Diabetes care 2005; 38:S10.

3. Antihypertensive drugs

Clinical outcomes of antihypertensive drug use are systolic blood pressure (SBP; mm/Hg) and diastolic blood pressure (DBP; mm/Hg).

In table 32, 233 diabetes patients received antihypertensive drugs: 127 patients (54.51%) taking antihypertensive monotherapy and 106 patients (45.49%) taking antihypertensive combination therapy. Patients taking antihypertensive combination therapy had the lower mean of BP and the higher percentage of patients with BP under control (27.36%).

Table 32 Blood pressure control of antihypertensive drug use

	Monotherapy			Combination therapy			Total		
	n	Mean ±S.D	% good control	n	Mean ±S.D	% good control	n	Mean ±S.D	% good control
SBP[1]	127	134.23 ±18.24	**14.96**	106	133.25 ±9.72	**27.36**	233	133.78 ±19.04	**23.63**
DBP[2]		80.61 ±20.03			79.70 ±10.83			80.19 ±10.23	

[1]SBP goal 130 mmHg, [2]DBP goal <80 mmHg

Reference: American Diabetes Association: Standards of medical care in diabetes. Diabetes care 2005; 38:S10.

CHAPTER V

DISCUSSION

Electronic databases

1. Benefits of electronic databases

Advantages of hospital electronic databases are always available and information can be transferred. The practical benefits of electronic databases to patients and staff include:

•Represent a practitioner-based view of a patient's health history;

•Be a source of data for clinical, health services, and outcomes research;

•Serve as the legal document describing the healthcare services provided to the patients; and

•Document the specific services received by the patient for reimbursement.

2. Limitations of electronic databases

Hospital electronic databases may limit their usefulness for certain applications. These limitations are problems with data quality, excluded populations, and missing data elements. Among the most problems are inaccuracies and completeness that may occur for diagnosis and procedure codes. These problems may be due to errors in providers' understanding and lack in skill of diagnostic coding, which lead to miscoding and misclassification of diabetes with and without complications. For example, patients with more than one or many complications may be underreported.

For health insurance coverage, this study period was during the time period of health system transition to more UC. Thus, there was a lot of patients under UC and also increased over the two year periods. However, the majority of health insurance at Maharat Nakhon Ratchasima Hospital was CSMBS, and did not have patients under SSS. These might be explained that computers in pharmacy department were

used to charge patients only but they did not use for record information. Data are not used for reimbursement, hospitals may not pay attention to record keeping. For example, data for patients that did not pay money directly such as SSS may be not recorded.

Drug utilization from Phrae Hospital may be underestimated because these data were retrieved from hospital electronic databases only. Information of patients that were likely to receive their medication at other sites such as primary health care unit (PCU) might be loss.

Dataset of inpatient utilization at Maharat Nakhon Ratchasima Hospital were completed only 7 months in 2003, as in table 33. As a result, drug utilization and expenditure may be underestimated during 2002 and the first month of 2003.

Table 33 Number of admissions per month at Maharat Nakhon Ratchasima Hospital, 2002-2003

Month	Fiscal Year	
	2002	2003
October	1,063	1,862
November	1,133	1,807
December	1,232	1,753
January	1,244	1,834
February	1,347	1,992
March	1,409	4,352
April	1,458	4,642
May	1,545	4,763
June	1,667	4,992
July	1,424	5,147
August	1,372	5,287
September	1,453	5,061
Total	16,347	43,492

Drug utilization and expenditure

The percentage of diabetic patients who used antidiabetic drugs was about 70% in both hospitals. This might be explained that individuals with diabetes require a variety of glycemic control. Not only pharmacological intervention, but lifestyle modification such as healthy eating, active living, smoking avoidance/cessation, and stress management also form a necessary control of diabetes. In addition, patients may be received their glycemic medications from other site such as PCU.

For cardiovascular drugs, there are some diabetic patients with complications who did not receive cardiovascular drugs. This might be explained that they may be received these drugs from other site. On the other hand, diabetic patients without complication also used cardiovascular drugs. This finding probably results from the facts that the defining of diabetic patients with chronic complications was following as The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (12). This guideline is categorized hypertension and hyperlipidemia into comorbidity, not complications. As a result, all diabetes groups had diabetic patients with hypertension and hyperlipidemia diagnosis. Thus, diabetic patients without complication also had cardiovascular drugs such as antihypertensive and lipid lowering drugs.

Diabetic patients with complications had higher average drug expenditure per capita per year than those without complication. Moreover, diabetic patients with both complications had the highest average drug expenditure per capita per year. It could be due to the facts that this chronic disorder is associated with numerous serious and costly complications. Treatment of these complications required a lot of drugs and with high drug expenditure, particularly cardiovascular drugs, known as expensive drugs.

For health insurance coverage, CSMBS had the highest average drug expenditure per capita per year. This finding probably results from the facts that patients under FFS received more drugs and with higher expenditure than others. In addition, there is a good evidence that support this finding that CSMBS had the highest average drug items per capita per year over other health insurance for both

hospitals. Table 34 and 35 showed average drug items per outpatient per year at Phrae Hospital and Maharat Nakhon Ratchasima Hospital, respectively.

When comparing drug expenditure between the two hospitals, diabetic patients at Maharat Nakhon Ratchasima Hospital (regional hospital) had higher average drug expenditure per capita per year than Phrae Hospital (general hospital) for all diabetes groups. This finding probably reflects the facts that patients who were referred to regional hospital typically have diabetic illness that is more difficult to control. In addition, diabetes management in regional hospital may be offered by trained specialists or specialty teams. As a result, patients in regional hospital may receive more drugs and with high expenditure, particularly NED, than general hospital. There is a good evidence that support this finding that patients at Maharat Nakhon Ratchasima Hospital had more average drug items per capita per year than Phrae Hospital, as in table 36.

Table 34 Comparison of average drug items per outpatient per year by health insurance coverage at Phrae Hospital, 2002-2003

		2002	2003
UC	Number of outpatients	1,609	1,703
	Items/outpatient	**19.76**	**20.39**
	Expenditure/outpatient	1,427.89	1,636.66
CSMBS	Number of outpatients	964	1,011
	Items/outpatient	**21.26**	**22.02**
	Expenditure/outpatient	2,520.45	3,002.97
Self-pay	Number of outpatients	137	70
	Items/outpatient	**4.02**	**5.00**
	Expenditure/outpatient	255.55	349.44
SSS	Number of outpatients	37	45
	Items/outpatient	**15.97**	**19.20**
	Expenditure/outpatient	756.78	1,231.42
NA	Number of outpatients	-	2
	Items/outpatient	**-**	**4.00**
	Expenditure/outpatient	-	148.50
Total	Number of outpatients	2,623	2,767
	Items/outpatient	**20.37**	**21.04**
	Expenditure/outpatient	1,826.23	2,133.50

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme, NA = not available

Table 35 Comparison of average drug items per outpatient per year by health insurance coverage at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002	2003
UC	Number of outpatients	3,333	1,253
	Items/outpatient	**11.88**	**8.07**
	Expenditure/outpatient	2,900.96	1,744.79
CSMBS	Number of outpatients	3,787	4,182
	Items/outpatient	**18.68**	**26.25**
	Expenditure/outpatient	6,180.24	9,735.63
Self-pay	Number of outpatients	492	127
	Items/outpatient	**5.49**	**4.88**
	Expenditure/outpatient	2,526.58	1,208.67
NA	Number of outpatients	-	2
	Items/outpatient	**-**	**5.00**
	Expenditure/outpatient	-	184.75
Total	Number of outpatients	4,343	4,519
	Items/outpatient	**14.85**	**21.66**
	Expenditure/outpatient	4,789.40	6,170.86

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, NA = not available

Table 36 Comparison of average drug items per outpatient per year by diabetes complications between Phrae Hospital and Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002		2003	
		Phrae	Maharat	Phrae	Maharat
DM	Number of outpatients	1,454	3,099	627	2,834
	Items/outpatient	**15.99**	**21.85**	**10.18**	**21.23**
	Expenditure/outpatient	1,310.72	3,154.22	824.27	3,883.57
Macro	Number of outpatients	225	405	155	573
	Items/outpatient	**24.86**	**34.17**	**17.14**	**33.06**
	Expenditure/outpatient	2,021.15	8,857.45	1,632.73	9,658.83
Micro	Number of outpatients	780	643	1,698	860
	Items/outpatient	**23.30**	**34.52**	**22.68**	**34.70**
	Expenditure/outpatient	2,285.35	7,635.44	2,258.71	8,018.92
Multi	Number of outpatients	164	196	287	252
	Items/outpatient	**39.10**	**47.27**	**37.19**	**45.98**
	Expenditure/outpatient	3,945.65	12,900.96	4,523.40	17,655.90
Total	Number of outpatients	2,623	4,343	2,767	4,519
	Items/outpatient	**20.37**	**34.45**	**21.04**	**33.74**
	Expenditure/outpatient	1,826.23	4,789.40	2,133.50	6,170.86

Notes: Phrae = Phrae Hospital, Maharat = Maharat Nakhon Ratchasima Hospital, DM = Diabetes mellitus without complication, macro = Diabetes mellitus with macrovascular complications, micro = Diabetes mellitus with microvascular complications, multi = Diabetes mellitus with macrovascular and microvascular complications

Clinical outcomes of drug use

Number of patients that received HbA_{1C} and lipid test was low. Particularly, there were only 119 patients that tested for HbA_{1C}, compared with 368 patients that received FBS test. Although, HbA_{1C} is strongly representing glycemic control, but FBS is easier to do, more acceptable to patients, and lower cost, so it is the preferred test.

For clinical outcomes of drug use, the results showed that the percentage of good control for glycemic and blood pressure was low. These were reflected that most of diabetic patients did not have good control of the diseases. However, other factors that affected clinical outcomes such as life style changes, weight management, drug interaction, or medication adherence were not studied.

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

Characteristics of diabetic patients

The prevalence of diabetes is increasing over two-year periods. There are 4.65% and 5.58% of total number of patients at Phrae Hospital, while 3.23% and 3.47% of total number of patients were diagnosed with diabetes at Maharat Nakhon Ratchasima Hospital in 2002 and 2003 respectively. Among these, there are 53.69% and 27.66% without complication at Phrae Hospital in 2002 and 2003, whereas diabetic patients without complication at Maharat Nakhon Ratchasima Hospital were 69.97% and 61.60% respectively.

About 90% of total number of patients diagnosed with diabetes were older than 40 years of age with an average of more than 60 years and with about two-thirds were female. Majority of health insurance at Phrae Hospital and Maharat Nakhon Ratchasima Hospital were UC program and CSMBS respectively.

Drug utilization

Diabetic patients had higher average prescriptions per patient per year than non-diabetes patients. Moreover, diabetic patients with complications had higher average prescriptions per patient per year than those without complication. In 2003, number of prescriptions per outpatient per year for diabetic outpatients with macrovascular, microvascular, and both complications at Phrae Hospital were 4.14, 6.97, and 8.20 respectively, while those without complication had only 3.57

Drug expenditure

Factors affecting drug expenditure were diabetes complications, types of drug use, health insurance coverage, and types of hospital. First, the effect of diabetes complications would result that diabetic patients increased expenditure of drug use. Average drug expenditure per diabetes patient without complication at Phrae Hospital was 1,541 baht and 1,823 baht in 2002 and 2003 respectively. The presence of macrovascular complications would lead to 2,910 baht and 4,640 baht in 2002 and 2003 respectively. Moreover, average drug expenditure per diabetes patient with microvascular complications was 4,216 baht and 3,291 baht in 2002 and 2003 respectively. These patients with both complications increased drug expenditure to 6,720 baht and 6,336 baht in 2002 and 2003 respectively.

The second factor which should be concerned for drug expenditure was types of drug use. Types of drug use, particularly cardiovascular drugs affect expenditure of both diabetic patients with and without complications. The average drug expenditure per patient per year for these drugs were 1,382 baht and 1,003 baht for macrovascular, 1,300 baht and 1,007 baht for microvascular, and 2,158 baht and 2,841 baht for both complications at Phrae Hospital in 2002 and 2003 respectively, while those without complication had only 696 baht and 436 baht in 2002 and 2003 respectively.

Third, the expenditure of drug use among various types of health insurance was different. This study found that CSMBS had the highest average drug expenditure per patient per year with 4,872 baht at Phrae Hospital in 2003, while other types of health insurance were lower average drug expenditure per patient per year than CSMBS (2,498, 2,165, and 638 baht for UC, SSS, and self-pay respectively).

Finally, types of hospital were affecting drug expenditure. Diabetic patients at Maharat Nakhon Ratchasima Hospital (a regional hospital) had higher average drug expenditure per patient per year than Phrae Hospital (a general hospital). In 2003, average drug expenditure per patient per year at Maharat Nakhon Ratchasima Hospital and Phrae Hospital was 7,223 and 3,348 baht respectively.

Clinical outcomes of drug use

The percentage of good control for glycemic and blood pressure was low with 35.87%, 31.09%, and 23.63% for FBS, HbA_{1C}, and BP respectively, slightly high for lipid control with 59.02%, 48.72%, and 73.33% for TG, LDL, and HDL respectively.

Recommendations

1. Hospitals should set strategy such as screening for complications at an early stage of the diseases. It could be an effective measure to prevent disease progression and save costs.

2. The impact of long-term medications on health care financing requiring careful evaluation to assess their effectiveness.

3. To set strategy to economize utilization of drugs in Thailand is the systematic approach. Starting from policy maker should perform drug utilization in all levels of health care facilities in order to gain pattern of drug use, and use this data to promote rational use of drugs.

Suggestions for future studies

1. In this study, drug utilization was studied in transition duration Universal Coverage. Therefore, the study of drug utilization under different health insurance should be continued after transition of this system in order to obtain more accurate data.

2. The result from this study could not be representative of overall hospitals in Thailand. However, this preliminary research can be the basis for drug utilization study in other health care facilities.

3. For calculating expenditure of drug use, charge data was used because actual cost data were not available. Therefore, further research should study cost for hospital treatment in order to obtain accurate data.

4. To calculate utilization of diabetic patients, it should be separated treatment of other disease from treatment of diabetes and its complications in order to know the factor to increased utilization of diabetes.

5. Other factors that affected clinical outcomes such as life style changes, weight management, or medication adherence were not studied. The further research should be concerned of these factors.

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APPENDIX

APPENDIX A

ICD-10 codes used to identify diabetes complications

1. Macrovascular complications

Coronary disease	
I20	Angina pectoris
I200	Unstable angina
I201	Angina pectoris with documented spasm
I208	Other forms of angina pectoris
I209	Angina pectoris, unspecified
I21	Acute myocardial infarction
I210	Acute transmural myocardial infarction of anterior wall
I211	Acute transmural myocardial infarction of inferior wall
I212	Acute transmural myocardial infarction of other sites
I213	Acute transmural myocardial infarction of unspecified site
I214	Acute subendocardial myocardial infarction
I219	Acute myocardial infarction, unspecified
I22	Subsequent myocardial infarction
I220	Subsequent myocardial infarction of anterior wall
I221	Subsequent myocardial infarction of inferior wall
I228	Subsequent myocardial infarction of other sites
I229	Subsequent myocardial infarction of unspecified site
I23	Certain current complications following acute myocardial infarction
I230	Haemopericardium as current complication following acute myocardial infarction
I231	Atrial septal defect as current complication following acute myocardial
I232	Ventricular septal defect as current complication following acute myocardial
I233	Rupture of cardiac wall without haemopericardium as current complication
I234	Rupture of chordae tendineae as current complication following acute myocardial
I235	Rupture of papillary muscle as current complication following acute myocardial
I236	Thrombosis of atrium, auricular appendage, and ventricle as current
I238	Other current complications following acute myocardial infarction
I24	Other acute ischaemic heart diseases
I240	Coronary thrombosis not resulting in myocardial infarction
I241	Dressler's syndrome
I248	Other forms of acute ischaemic heart disease
I249	Acute ischaemic heart disease, unspecified
I25	Chronic ischaemic heart disease
I250	Atherosclerotic cardiovascular disease, so described
I251	Atherosclerotic heart disease
I252	Old myocardial infarction
I253	Aneurysm of heart
I254	Coronary artery aneurysm
I255	Ischaemic cardiomyopathy
I256	Silent myocardial ischaemia
I258	Other forms of chronic ischaemic heart disease
I259	Chronic ischaemic heart disease, unspecified
I50	Heart failure
I500	Congestive heart failure
I501	Left ventricular failure

I509	Heart failure, unspecified
Cerebrovascular disease (CVD)	
I60	Subarachnoid haemorrhage
I600	Subarachnoid haemorrhage from carotid siphon and bifurcation
I601	Subarachnoid haemorrhage from middle cerebral artery
I602	Subarachnoid haemorrhage from anterior communicating artery
I603	Subarachnoid haemorrhage from posterior communicating artery
I604	Subarachnoid haemorrhage from basilar artery
I605	Subarachnoid haemorrhage from vertebral artery
I606	Subarachnoid haemorrhage from other intracranial arteries
I607	Subarachnoid haemorrhage from intracranial artery, unspecified
I608	Other subarachnoid haemorrhage
I609	Subarachnoid haemorrhage, unspecified
I61	Intracerebral haemorrhage
I610	Intracerebral haemorrhage in hemisphere, subcortical
I611	Intracerebral haemorrhage in hemisphere, cortical
I612	Intracerebral haemorrhage in hemisphere, unspecified
I613	Intracerebral haemorrhage in brain stem
I614	Intracerebral haemorrhage in cerebellum
I615	Intracerebral haemorrhage, intraventricular
I616	Intracerebral haemorrhage, multiple localized
I618	Other intracerebral haemorrhage
I619	Intracerebral haemorrhage, unspecified
I62	Other nontraumatic intracranial haemorrhage
I620	Subdural haemorrhage (acute)(nontraumatic)
I621	Nontraumatic extradural haemorrhage
I629	Intracranial haemorrhage (nontraumatic), unspecified
I63	Cerebral infarction
I630	Cerebral infarction due to thrombosis of precerebral arteries
I631	Cerebral infarction due to embolism of precerebral arteries
I632	Cerebral infarction due to unspecified occlusion or stenosis of precerebral
I633	Cerebral infarction due to thrombosis of cerebral arteries
I634	Cerebral infarction due to embolism of cerebral arteries
I635	Cerebral infarction due to unspecified occlusion or stenosis of cerebral
I636	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
I638	Other cerebral infarction
I639	Cerebral infarction, unspecified
I64	Stroke, not specified as haemorrhage or infarction
I649	Old CVA
I65	Occlusion and stenosis of precerebral arteries, not resulting in cerebral infarction
I650	Occlusion and stenosis of vertebral artery
I651	Occlusion and stenosis of basilar artery
I652	Occlusion and stenosis of carotid artery
I653	Occlusion and stenosis of multiple and bilateral precerebral arteries
I658	Occlusion and stenosis of other precerebral artery
I659	Occlusion and stenosis of unspecified precerebral artery
I66	Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction
I660	Occlusion and stenosis of middle cerebral artery
I661	Occlusion and stenosis of anterior cerebral artery
I662	Occlusion and stenosis of posterior cerebral artery

I663	Occlusion and stenosis of cerebellar arteries
I664	Occlusion and stenosis of multiple and bilateral cerebral arteries
I668	Occlusion and stenosis of other cerebral artery
I669	Occlusion and stenosis of unspecified cerebral artery
I67	Other cerebrovascular diseases
I670	Dissection of cerebral arteries, nonruptured
I671	Cerebral aneurysm, nonruptured
I672	Cerebral atherosclerosis
I673	Progressive vascular leukoencephalopathy
I674	Hypertensive encephalopathy
I675	Moyamoya disease
I676	Nonpyogenic thrombosis of intracranial venous system
I677	Cerebral arteritis, not elsewhere classified
I678	Other specified cerebrovascular diseases
I679	Cerebrovascular disease, unspecified
I68	Cerebrovascular disorders in diseases classified elsewhere
I680	Cerebral amyloid angiopathy (E85.-+)
I681	Cerebral arteritis in infectious and parasitic diseases
I682	Cerebral arteritis in other diseases classified elsewhere
I688	Other cerebrovascular disorders in diseases classified elsewhere
I69	Sequelae of cerebrovascular disease
I690	Sequelae of subarachnoid haemorrhage
I691	Sequelae of intracerebral haemorrhage
I692	Sequelae of other nontraumatic intracranial haemorrhage
I693	Sequelae of cerebral infarction
I694	Sequelae of stroke, not specified as haemorrhage or infarction
I698	Sequelae of other and unspecified cerebrovascular diseases
Peripheral vascular disease	
E105	Diabetic gangrene
E115	Diabetic gangrene
E125	Diabetic gangrene
E135	Diabetic gangrene
E145	Diabetic gangrene
I70	Atherosclerosis
I700	Atherosclerosis of aorta
I701	Atherosclerosis of renal artery
I702	Atherosclerosis of arteries of the extremities
I708	Atherosclerosis of other arteries
I709	Generalized and unspecified atherosclerosis
I71	Aortic aneurysm and dissection
I710	Dissection of aorta [any part]
I711	Thoracic aortic aneurysm, ruptured
I712	Thoracic aortic aneurysm, without mention of rupture
I713	Abdominal aortic aneurysm, ruptured
I714	Abdominal aortic aneurysm, without mention of rupture
I715	Thoracoabdominal aortic aneurysm, ruptured
I716	Thoracoabdominal aortic aneurysm, without mention of rupture
I718	Aortic aneurysm of unspecified site, ruptured
I719	Aortic aneurysm of unspecified site, without mention of rupture
I72	Other aneurysm

I720	Aneurysm of carotid artery
I721	Aneurysm of artery of upper extremity
I722	Aneurysm of renal artery
I723	Aneurysm of iliac artery
I724	Aneurysm of artery of lower extremity
I728	Aneurysm of other specified arteries
I729	Aneurysm of unspecified site
I73	Other peripheral vascular diseases
I730	Raynaud's syndrome
I731	Thromboangiitis obliterans [Buerger]
I738	Other specified peripheral vascular diseases
I739	Peripheral vascular disease, unspecified
I74	Arterial embolism and thrombosis
I740	Embolism and thrombosis of abdominal aorta
I741	Embolism and thrombosis of other and unspecified parts of aorta
I742	Embolism and thrombosis of arteries of the upper extremities
I743	Embolism and thrombosis of arteries of the lower extremities
I744	Embolism and thrombosis of arteries of extremities, unspecified
I745	Embolism and thrombosis of iliac artery
I748	Embolism and thrombosis of other arteries
I749	Embolism and thrombosis of unspecified artery
I77	Other disorders of arteries and arterioles
I770	Arteriovenous fistula, acquired
I771	Stricture of artery
I772	Rupture of artery
I773	Arterial fibromuscular dysplasia
I774	Coeliac artery compression syndrome
I775	Necrosis of artery
I776	Arteritis, unspecified
I778	Other specified disorders of arteries and arterioles
I779	Disorder of arteries and arterioles, unspecified
I78	Disease of capillaries
I780	Hereditary haemorrhagic telangiectasia
I781	Naevus, non-neoplastic
I788	Other diseases of capillaries
I789	Disease of capillaries, unspecified
I79	Disorders of arteries, arterioles and capillaries in diseases classified elsewhere
I790	Aneurysm of aorta in diseases classified elsewhere
I791	Aortitis in diseases classified elsewhere
I792	Peripheral angiopathy in diseases classified elsewhere
I798	Other disorders of arteries, arterioles and capillaries in diseases classified
R02	Gangrene, not elsewhere classified

2. Macrovascular complications

Retinopathy	
E103	Diabetic cataract
E113	Diabetic cataract
E123	Diabetic cataract
E133	Diabetic cataract
E143	Diabetic cataract
H25	Senile cataract
H250	Senile incipient cataract
H251	Senile nuclear cataract
H252	Senile cataract, morgagnian type
H258	Other senile cataract
H259	Senile cataract, unspecified
H27	Other disorders of lens
H270	Aphakia
H271	Dislocation of lens
H277	Len dislocation
H278	Other specified disorders of lens
H279	Disorder of lens, unspecified
H28	Cataract and other disorders of lens in diseases classified elsewhere
H280	Diabetic cataract (E10-E14+ with common fourth character .3)
H281	Cataract in other endocrine, nutritional and metabolic diseases classified
H282	Cataract in other diseases classified elsewhere
H283	Diabetic cataract
H288	Other disorders of lens in diseases classified elsewhere
H34	Retinal vascular occlusions
H340	Transient retinal artery occlusion
H341	Central retinal artery occlusion
H342	Other retinal artery occlusions
H348	Other retinal vascular occlusions
H349	Retinal vascular occlusion, unspecified
H35	Other retinal disorders
H350	Background retinopathy and retinal vascular changes
H351	Retinopathy of prematurity
H352	Other proliferative retinopathy
H353	Degeneration of macula and posterior pole
H354	Peripheral retinal degeneration
H355	Hereditary retinal dystrophy
H356	Retinal haemorrhage
H357	Separation of retinal layers
H358	Other specified retinal disorders
H359	Retinal disorder, unspecified
H36	Retinal disorders in diseases classified elsewhere
H360	Diabetic retinopathy (E10-E14+ with common fourth character .3)
H368	Other retinal disorders in diseases classified elsewhere
H40	Glaucoma
H400	Glaucoma suspect
H401	Primary open-angle glaucoma
H402	Primary angle-closure glaucoma
H403	Glaucoma secondary to eye trauma

H404	Glaucoma secondary to eye inflammation
H405	Glaucoma secondary to other eye disorders
H406	Glaucoma secondary to drugs
H408	Other glaucoma
H409	Glaucoma, unspecified
H42	Glaucoma in diseases classified elsewhere
H420	Glaucoma in endocrine, nutritional and metabolic diseases classified elsewhere
H428	Glaucoma in other diseases classified elsewhere
H46	Optic neuritis
H47	Other disorders of optic [2nd] nerve and visual pathways
H470	Disorders of optic nerve, not elsewhere classified
H471	Papilloedema, unspecified
H472	Optic atrophy
H473	Other disorders of optic disc
H474	Disorders of optic chiasm
H475	Disorders of other visual pathways
H476	Disorders of visual cortex
H477	Disorder of visual pathways, unspecified
H48	Disorders of optic [2nd] nerve and visual pathways in diseases classified elsewhere
H480	Optic atrophy in diseases classified elsewhere
H481	Retrobulbar neuritis in diseases classified elsewhere
H488	Other disorders of optic nerve and visual pathways in diseases classified
H540	Blindness, both eyes
H541	Blindness, one eye, low vision other eye
H542	Low vision, both eyes
H543	Unqualified visual loss, both eyes
H544	Blindness, one eye
H545	Low vision, one eye
H546	Unqualified visual loss, one eye
H547	Unspecified visual loss
Neuropathy	
E104	Diabetic neuropathy
E114	Diabetic neuropathy
E124	Diabetic neuropathy
E134	Diabetic neuropathy
E144	Diabetic neuropathy
G59	Mononeuropathy in diseases classified elsewhere
G590	Diabetic mononeuropathy (E10-E14+ with common fourth character .4)
G60	Hereditary and idiopathic neuropathy
G600	Hereditary motor and sensory neuropathy
G601	Refsum's disease
G602	Neuropathy in association with hereditary ataxia
G603	Idiopathic progressive neuropathy
G608	Other hereditary and idiopathic neuropathies
G609	Hereditary and idiopathic neuropathy, unspecified
G61	Inflammatory polyneuropathy
G610	Guillain-Barr, syndrome
G611	Serum neuropathy
G618	Other inflammatory polyneuropathies
G619	Inflammatory polyneuropathy, unspecified

G62	Other polyneuropathies
G620	Drug-induced polyneuropathy
G621	Alcoholic polyneuropathy
G622	Polyneuropathy due to other toxic agents
G628	Other specified polyneuropathies
G629	Polyneuropathy, unspecified
G63	Polyneuropathy in diseases classified elsewhere
G630	Polyneuropathy in infectious and parasitic diseases classified elsewhere
G631	Polyneuropathy in neoplastic disease (C00-D48+)
G632	Diabetic polyneuropathy (E10-E14+ with common fourth character .4)
G633	Polyneuropathy in other endocrine and metabolic diseases
G634	Polyneuropathy in nutritional deficiency (E40-E64+)
G635	Polyneuropathy in systemic connective tissue disorders
G636	Polyneuropathy in other musculoskeletal disorders
G638	Polyneuropathy in other diseases classified elsewhere
G64	Other disorders of peripheral nervous system
G990	Autonomic neuropathy in endocrine and metabolic diseases
L00	Staphylococcal scalded skin syndrome
L01	Impetigo
L010	Impetigo [any organism][any site]
L011	Impetiginization of other dermatoses
L02	Cutaneous abscess, furuncle and carbuncle
L020	Cutaneous abscess, furuncle and carbuncle of face
L021	Cutaneous abscess, furuncle and carbuncle of neck
L022	Cutaneous abscess, furuncle and carbuncle of trunk
L023	Cutaneous abscess, furuncle and carbuncle of buttock
L024	Cutaneous abscess, furuncle and carbuncle of limb
L028	Cutaneous abscess, furuncle and carbuncle of other sites
L029	Cutaneous abscess, furuncle and carbuncle, unspecified
L03	Cellulitis excludes: mouth
L030	Cellulitis of finger and toe
L031	Cellulitis of other parts of limb
L032	Cellulitis of face
L033	Cellulitis of trunk
L038	Cellulitis of other sites
L038X	Cellulitis
L039	Cellulitis, unspecified
L04	Acute lymphadenitis includes: abscess (acute)
L040	Acute lymphadenitis of face, head and neck
L041	Acute lymphadenitis of trunk
L042	Acute lymphadenitis of upper limb
L043	Acute lymphadenitis of lower limb
L048	Acute lymphadenitis of other sites
L049	Acute lymphadenitis, unspecified
L05	Pilonidal cyst
L050	Pilonidal cyst with abscess
L059	Pilonidal cyst without abscess
L08	Other local infection of the skin and subcutaneous tissue
L080	Pyoderma
L080X	Pyostomatits vegetans

L081	Erythrasma
L088	Other specified local infection of the skin and subcutaneous tissue
L089	Local infection of the skin and subcutaneous tissue, unspecified
Nephropathy	
E102	DM nephropathy
E112	DM nephropathy
E122	DM nephropathy
E132	DM nephropathy
E142	DM nephropathy
N083	Glomerular disorders in diabetes mellitus (E10-E14+ with common fourth)
N18	Chronic renal failure
N180	End-stage renal disease
N188	Other chronic renal failure
N189	Chronic renal failure, unspecified
N19	Unspecified renal failure

APPENDIX B

Data structure of hospital databases

1. Databases from medical record department

1.1 Outpatient department

- HN (Hospital number)
- VN (Visit number)
- OPD_DATE (Date of visit)
- TITLE (Title of patient)
- NAME (Name of patient)
- BIRTHDATE (Date of birthday)
- SEX (male or female)
- PTNTYPE (Patient's type of health insurance coverage)
- MARRIAGE (Marriage status)
- ADDRESS (Patient's hometown)
- DIAG (both principle and other diagnosis)

1.2 inpatient department

- HN (Hospital number)
- AN (Admission number)
- DATEADM (Date of admission)
- DATEDSC (Date of discharge)
- LOS (length of stay)
- TITLE (Title of patient)
- NAME (Name of patient)
- DOB (Date of birthday)
- SEX (male or female)
- PTNTYPE (Patient's type of health insurance coverage)
- MARRIAGE (Marriage status)
- OCCUPA (Patient's occupation)
- ADDRESS (Patient's hometown)
- DIAG (Principle or other diagnosis)

2. Databases from pharmacy department.

2.1 Phrae Hospital

2.1.1 Outpatient department

- HN (Hospital number)
- VN (Visit number)
- PRSC_FREQ (Frequency of prescription)
- RX_DATE (Date of prescription)
- RCVPAID (Receive or paid drug)
- DRUGCODE (Drug code)
- SRVCCODE (Service code)
- SALEUPRICE (Unit price)
- QUANT (Quantity of service)
- PTNTYPE (Patient's type of health insurance coverage)

2.1.2 Inpatient department

- SYS_PRSC or PRESC_ID (Prescription number)
- HN (Hospital number)
- AN (Admission number)
- RX_DATE or PRESC_DATE (Date of prescription)
- TITLE (Title of patient)
- NAME (Name of patient)
- RCVPAID (Receive or paid drug)
- DRUGCODE (Drug code)
- SRVCCODE (Service code)
- SALEUPRICE (Unit price)
- SALEUNIT (Sale unit)

- QUANT (Quantity of service)
- DRUGMTHD (Method of drug use)
- DOSE (Dose)
- USEUNIT (Use unit)
- DRUGFREQ (Drug frequency)
- PTNTYPE (Patient's type of health insurance coverage)

2.2 Maharat Nakhon Ratchasima Hospital

2.2.1 PRSCRIPT databases

- SYS_PRSC (Prescription number)
- HN (Hospital number)
- DATE (Date of prescription)
- TITLE (Title of patient)
- PTNNAME (Name of patient)
- PTNLNAME (Last name of patient)
- AGE (Age of patient)
- PTNTYPE (Patient's type of health insurance coverage)
- PD_TYPE (1 = outpatient, 2 = inpatient, 3 = discharged patient)
- DISPDEPT (Dispensing department)

2.2.2 PRSCLIST databases

- SYS_PRSC (Prescription number)
- HN (Hospital number)
- DATE (Date of prescription)
- RCVPAID (Receive or paid drug)
- DRUGCODE (Drug code)
- DRUGNAME (Drug name)
- SRVCCODE (Service code)

- UPRICE (Unit Price)
- TPRICE (Total price)
- QUANT (Quantity of service)
- DOSE (Dose)
- SALEUNIT (Sale unit)
- DRUGFREQ (Drug frequency)

APPENDIX C

Table C.1 Gender, age group, and health insurance coverage of diabetes and non-diabetes outpatients at Phrae Hospital, 2002-2003

	2002						2003					
	DM	%	NON-DM	%	Total	%	DM	%	NON-DM	%	Total	%
Gender												
Male	865	33.0	21,977	44.8	22,842	44.2	974	35.2	23,103	46.2	24,077	45.6
Female	1,758	67.0	26,541	54.1	28,299	54.8	1,793	64.8	26,890	53.8	28,683	54.4
NA	-	-	540	1.1	540	1.0	-	-	-	-	-	-
Total	2,623	100.0	49,058	100.0	51,681	100.0	2,767	100.0	49,993	100.0	52,760	100.0
% Total	5.08		94.92		100.00		5.24		94.76		100.00	
Age group (years)												
0-10	20	0.8	5,801	11.8	5,821	11.3	23	0.8	5,261	10.5	5,284	10.0
11-20	18	0.7	5,102	10.4	5,120	9.9	16	0.6	4,281	8.6	4,297	8.1
21-30	5	0.2	7,100	14.5	7,105	13.7	10	0.4	7,180	14.4	7,190	13.6
31-40	89	3.4	7,634	15.6	7,723	14.9	95	3.4	8,410	16.8	8,505	16.1
41-50	420	16.0	7,179	14.6	7,599	14.7	461	16.7	8,321	16.6	8,782	16.6
51-60	936	35.7	6,845	14.0	7,781	15.1	949	34.3	7,181	14.4	8,130	15.4
61-70	765	29.2	5,214	10.6	5,979	11.6	811	29.3	5,526	11.1	6,337	12.0
>70	367	14.0	3,643	7.4	4,010	7.8	402	14.5	3,833	7.7	4,235	8.0
NA	-	-	543	1.1	543	1.1	-	-	-	-	-	-
Total	2,623	100.0	49,058	100.0	51,681	100.0	2,767	100.0	49,993	100.0	52,760	100.0
Average	59.43		43.96		46.11		59.32		44.51		46.65	
Health insurance coverage												
UC	1,609	56.9	29,899	59.0	31,483	59.0	1,703	60.2	30,568	59.8	32,271	59.8
CSMBS	964	34.1	12,231	24.1	13,195	24.7	1,011	35.7	12,483	24.4	13,494	25.0
Self-pay	137	4.8	5,697	11.2	4,432	8.3	70	2.5	4,589	9.0	4,659	8.6
SSS	37	1.3	2,773	5.5	2,810	5.3	45	1.6	3,430	6.7	3,475	6.4
NA	-	-	-	-	-	-	2	0.1	56	0.1	58	0.1
Total	2,826	100.0	50,650	100.0	53,399	100.0	2,831	100.0	51,126	100.0	53,957	100.0
Duplicate	203	7.2	1,592	3.1	1,718	3.2	64	2.3	1,133	2.2	1,197	2.2

Notes: DM = Diabetes mellitus, NA = not available, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme

Table C.2 Gender, age group, and health insurance coverage of diabetes and non-diabetes inpatients at Phrae Hospital, 2002-2003

	2002						2003					
	DM	%	NON-DM	%	Total	%	DM	%	NON-DM	%	Total	%
Gender												
Male	189	35.9	8,622	41.9	8,811	41.7	435	35.4	10,386	48.5	10,821	47.8
Female	336	63.8	9,220	44.8	9,556	45.2	793	64.6	10,805	50.4	11,598	51.2
NA	2	0.4	2,758	13.4	2,760	13.1	-	-	236	1.1	236	1.0
Total	527	100.0	20,600	100.0	21,127	100.0	1,228	100.0	21,427	100.0	22,655	100.0
% Total	2.49		97.51		100.00		5.42		94.58		100.00	
Age group (years)												
0-10	11	2.1	1,381	6.7	1,392	6.6	19	1.5	1,601	7.5	1,620	7.2
11-20	8	1.5	1,273	6.2	1,281	6.1	12	1.0	1,581	7.4	1,593	7.0
21-30	3	0.6	2,819	13.7	2,822	13.4	8	0.7	3,039	14.2	3,047	13.4
31-40	15	2.8	2,934	14.2	2,949	14.0	42	3.4	3,540	16.5	3,582	15.8
41-50	42	8.0	2,779	13.5	2,821	13.4	104	8.5	3,401	15.9	3,505	15.5
51-60	144	27.3	2,219	10.8	2,363	11.2	381	31.0	2,622	12.2	3,003	13.3
61-70	194	36.8	2,259	11.0	2,453	11.6	400	32.6	2,713	12.7	3,113	13.7
>70	108	20.5	2,156	10.5	2,264	10.7	262	21.3	2,689	12.5	2,951	13.0
NA	2	0.4	2,780	13.5	2,782	13.2	-	-	241	1.1	241	1.1
Total	527	100.0	20,600	100.0	21,127	100.0	1,228	100.0	21,427	100.0	22,655	100.0
Average	61.82		47.86		48.69		61.32		47.26		48.77	
Health insurance coverage												
UC	222	40.5	13,211	61.4	13,330	60.5	781	63.2	14,531	66.6	15,312	66.5
CSMBS	178	32.5	4,265	19.8	4,487	20.4	426	34.5	4,186	19.2	4,612	20.0
Self-pay	119	21.7	3,386	15.7	3,415	15.5	20	1.6	2,285	10.5	2,305	10.0
SSS	29	5.3	637	3.0	815	3.7	8	0.6	781	3.6	789	3.4
NA	-	-	-	-	-	-	-	-	24	0.1	24	0.1
Total	548	100.0	21,499	100.0	22,047	100.0	1,235	100.0	21,807	100.0	23,042	100.0
Duplicate	21	3.8	899	4.2	920	4.2	7	0.6	380	1.7	387	1.7

Notes: DM = Diabetes mellitus, NA = not available, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme

Table C.3 Gender, age group, and health insurance coverage of diabetes and non-diabetes outpatients at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002						2003					
	DM	%	NON-DM	%	Total	%	DM	%	NON-DM	%	Total	%
Gender												
Male	1,362	31.4	48,069	36.3	49,431	36.2	1,537	34.0	50,412	41.2	51,949	41.0
Female	2,981	68.6	66,071	49.9	69,052	50.5	2,982	66.0	67,047	54.9	70,029	55.2
NA	-	-	18,249	13.8	18,249	13.3	-	-	4,774	3.9	4,774	3.8
Total	4,343	100.0	132,389	100.0	136,732	100.0	4,519	100.0	122,233	100.0	126,752	100.0
% Total	3.18		96.82		100.00		3.31		89.40		100.00	
Age group (years)												
0-10	11	0.3	12,981	9.8	12,992	9.5	19	0.4	13,971	11.4	13,990	11.0
11-20	8	0.2	10,725	8.1	10,733	7.8	12	0.3	12,064	9.9	12,076	9.5
21-30	3	0.1	20,819	15.7	20,822	15.2	8	0.2	20,882	17.1	20,890	16.5
31-40	187	4.3	18,926	14.3	19,113	14.0	182	4.0	19,854	16.2	20,036	15.8
41-50	898	20.7	18,579	14.0	19,477	14.2	937	20.7	16,986	13.9	17,923	14.1
51-60	1,166	26.8	12,521	9.5	13,687	10.0	1,242	27.5	13,395	11.0	14,637	11.5
61-70	1,370	31.5	11,101	8.4	12,471	9.1	1,352	29.9	11,555	9.5	12,907	10.2
>70	700	16.1	8,488	6.4	9,188	6.7	767	17.0	8,752	7.2	9,519	7.5
NA	-	-	18,249	13.8	18,249	13.3	-	-	4,774	3.9	4,774	3.8
Total	4,343	100.0	132,389	100.0	136,732	100.0	4,519	100.0	122,233	100.0	126,752	100.0
Average	61.22		36.95		49.09		61.09		37.45		49.27	
Health insurance coverage												
UC	3,333	43.8	65,718	39.5	69,051	39.7	1,253	22.5	44,322	32.7	45,575	32.3
CSMBS	3,787	49.8	95,223	57.3	99,010	56.9	4,182	75.2	89,526	66.1	93,708	66.5
Self-pay	492	6.5	5,370	3.2	5,862	3.4	127	2.3	1,486	1.1	1,613	1.1
NA	-	-	-	-	-	-	2	0.0	41	0.0	43	0.0
Total	7,612	100.0	166,311	100.0	173,923	100.0	5,564	100.0	135,375	100.0	140,939	100.0
Duplicate	3,269	42.9	33,922	20.4	37,191	21.4	1,045	18.8	13,142	9.7	14,187	10.1

Notes: DM = Diabetes mellitus, NA = not available, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme

Table C.4 Gender, age group, and health insurance coverage of diabetes and non-diabetes inpatients at Maharat Nakhon Ratchasima Hospital, 2002-2003

	2002						2003					
	DM	%	NON-DM	%	Total	%	DM	%	NON-DM	%	Total	%
Gender												
Male	197	33.1	6,556	50.9	6,753	50.1	282	29.4	13,739	45.0	14,021	44.5
Female	398	66.9	6,158	47.8	6,556	48.7	677	70.6	16,665	54.5	17,342	55.0
NA	-	-	166	1.3	166	1.2	-	-	151	0.5	151	0.5
Total	595	100.0	12,880	100.0	13,475	100.0	959	100.0	30,555	100.0	31,514	100.0
% Total	4.42		95.58		100.00		3.04		96.96		100.00	
Age group (years)												
0-10	5	0.8	1,760	13.7	1,765	13.1	10	1.0	3,285	10.8	3,295	10.5
11-20	3	0.5	1,581	12.3	1,584	11.8	8	0.8	3,486	11.4	3,494	11.1
21-30	2	0.3	1,851	14.4	1,853	13.8	8	0.8	5,001	16.4	5,009	15.9
31-40	15	2.5	1,718	13.3	1,733	12.9	20	2.1	4,974	16.3	4,994	15.8
41-50	75	12.6	1,476	11.5	1,551	11.5	122	12.7	4,807	15.7	4,929	15.6
51-60	145	24.4	1,397	10.8	1,542	11.4	234	24.4	2,914	9.5	3,148	10.0
61-70	202	33.9	1,522	11.8	1,724	12.8	335	34.9	2,902	9.5	3,237	10.3
>70	148	24.9	1,409	10.9	1,557	11.6	222	23.1	3,035	9.9	3,257	10.3
NA	-	-	166	1.3	166	1.2	-	-	151	0.5	151	0.5
Total	595	100.0	12,880	100.0	13,475	100.0	959	100.0	30,555	100.0	31,514	100.0
Average	62.46		40.36		51.41		62.14		37.40		49.77	
Health insurance coverage												
UC	251	34.0	4,331	31.2	4,582	31.3	123	11.3	8,905	25.5	9,028	25.1
CSMBS	429	58.1	9,011	64.9	9,440	64.5	903	83.1	24,421	69.9	25,324	70.3
Self-pay	58	7.9	552	4.0	610	4.2	55	5.1	1,310	3.7	1,365	3.8
NA	-	-	-	-	-	-	6	0.6	302	0.9	308	0.9
Total	738	100.0	13,894	100.0	14,632	100.0	1,087	100.0	34,938	100.0	36,025	100.0
Duplicate	143	19.4	1,014	7.3	1,157	7.9	128	11.8	4,383	12.5	4,511	12.5

Notes: DM = Diabetes mellitus, NA = not available, UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme

APPENDIX D

Table D.1 Drug expenditure of diabetes outpatients by health insurance coverage at Phrae Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
UC	Number of outpatients	929	143	457	80	1,609	418	100	1,023	162	1,703
	%	61.04	60.34	55.73	47.62	58.57	65.31	62.50	58.79	55.67	60.16
	Items/outpatient	15.86	24.27	22.54	41.13	19.76	9.89	16.01	22.49	36.93	20.39
	Expenditure/outpatient	1,069.91	1,613.22	1,830.65	2,953.04	1,427.89	605.91	1,120.98	1,832.93	3,375.09	1,636.66
CSMBS	Number of outpatients	484	80	316	84	964	188	53	649	121	1,011
	%	31.80	33.76	38.54	50.00	35.09	29.38	33.13	37.30	41.58	35.71
	Items/outpatient	16.21	25.80	23.70	36.83	21.26	10.43	17.77	22.71	38.22	22.02
	Expenditure/outpatient	1,803.67	2,743.49	2,939.96	4,859.93	2,520.45	1,296.90	2,505.34	2,949.17	6,160.24	3,002.97
Self-pay	Number of outpatients	80	14	39	4	137	22	4	38	6	70
	%	5.26	5.91	4.76	2.38	4.99	3.44	2.50	2.18	2.06	2.47
	Items/outpatient	3.74	4.29	4.18	7.25	4.02	4.68	4.50	5.00	6.50	5.00
	Expenditure/outpatient	232.29	327.86	236.59	652.50	255.55	308.05	359.00	289.11	877.00	349.44
SSS	Number of outpatients	29	-	8	-	37	12	1	30	2	45
	%	1.91	-	0.98	-	1.35	1.88	0.63	1.72	0.69	1.59
	Items/outpatient	12.69	-	27.88	-	15.97	15.33	88.00	18.87	13.00	19.20
	Expenditure/outpatient	699.48	-	964.50	-	756.78	1,079.67	6,459.00	1,173.27	400.50	1,231.42
NA	Number of outpatients	-	-	-	-	-	-	2	-	-	2
	%	-	-	-	-	-	-	1.25	-	-	0.07
	Items/outpatient	-	-	-	-	-	-	4.00	-	-	4.00
	Expenditure/outpatient	-	-	-	-	-	-	148.50	-	-	148.50
Total	Number of outpatients	1,454	225	780	164	2,623	627	155	1,698	287	2,767
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Items/outpatient	15.99	24.86	23.30	39.10	20.37	10.18	17.14	22.68	37.19	21.04
	Expenditure/outpatient	1,310.72	2,021.15	2,285.35	3,945.65	1,826.23	824.27	1,632.73	2,258.71	4,523.40	2,133.50

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme, NA = not available

Table D.2 Drug expenditure of diabetes inpatients by health insurance coverage at Phrae Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
UC	Number of inpatients	119	61	90	26	296	323	185	184	89	781
	%	54.59	59.22	52.33	47.27	54.01	69.46	67.77	55.59	53.61	63.24
	Expenditure/inpatient	1,834.87	3,567.57	4,368.86	6,701.23	3,389.86	2,716.73	4,856.06	3,337.01	5,254.42	3,658.81
CSMBS	Number of inpatients	86	36	75	25	222	125	84	142	75	426
	%	39.45	34.95	43.60	45.45	40.51	26.88	30.77	42.90	45.18	34.49
	Expenditure/inpatient	3,997.55	5,387.39	20,186.56	21,757.00	11,692.13	3,075.79	6,471.90	11,757.89	9,075.04	7,695.69
Self-pay	Number of inpatients	12	6	7	4	29	12	4	2	2	20
	%	5.50	5.83	4.07	7.27	5.29	2.58	1.47	0.60	1.20	1.62
	Expenditure/inpatient	570.00	1,617.67	3,510.29	142.50	1,437.52	940.42	1,942.75	249.50	6,024.00	1,580.15
SSS	Number of inpatients	1	-	-	-	1	5	-	3	-	8
	%	0.46	-	-	-	0.18	1.08	-	0.91	-	0.65
	Expenditure/inpatient	35.00	-	-	-	35.00	7,044.40	-	3,699.67	-	5,790.13
Total	Number of inpatients	210	100	166	51	527	461	273	330	164	1,228
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/inpatient	2,709.59	4,212.74	11,637.11	14,092.69	6,908.49	2,838.36	5,310.56	6,955.24	7,075.12	5,060.11

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme

Table D.3 Drug expenditure of diabetes patients by health insurance coverage at Phrae Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
UC	Number of patients	1,012	190	512	100	1,814	675	243	1,118	224	2,260
	(%)	60.17	60.13	55.23	47.39	57.84	66.24	65.32	58.66	56.57	61.20
	Expenditure/patient	1,197.92	2,359.54	2,401.96	4,104.75	1,819.67	1,675.22	4,158.31	2,226.39	4,528.61	2,497.68
CSMBS	Number of patients	549	108	363	103	1,123	298	118	718	162	1,296
	(%)	32.64	34.18	39.16	48.82	35.81	29.24	31.72	37.67	40.91	35.09
	Expenditure/patient	2,216.33	3,828.01	6,730.08	9,244.26	4,474.95	2,108.36	5,732.40	4,991.13	8,802.57	4,872.19
Self-pay	Number of patients	92	18	44	8	162	33	8	39	8	88
	(%)	5.47	5.70	4.75	3.79	5.17	3.24	2.15	2.05	2.02	2.38
	Expenditure/patient	276.34	794.22	768.16	397.50	473.44	547.33	1,150.88	294.49	2,163.75	637.09
SSS	Number of patients	29	-	8	-	37	13	1	31	2	47
	(%)	1.72	-	0.86	-	1.18	1.28	0.27	1.63	0.51	1.27
	Expenditure/patient	700.69	-	964.50	-	757.73	3,706.00	6,459.00	1,493.45	400.50	2,164.57
NA	Number of patients	-	-	-	-	-	-	2	-	-	2
	(%)	-	-	-	-	-	-	0.54	-	-	0.05
	Expenditure/patient	-	-	-	-	-	-	148.50	-	-	148.50
Total	Number of patients	1,606	301	881	203	2,991	1,001	367	1,863	388	3,619
	(%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/patient	1,540.97	2,910.41	4,216.04	6,728.15	2,818.78	1,823.48	4,639.93	3,290.67	6,336.43	3,348.22

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, SSS = Social Security Scheme, NA = not available

Table D.4 Drug expenditure of diabetes outpatients by health insurance coverage at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
UC	Number of outpatients	2,378	289	509	157	3,333	811	141	227	74	1,253
	%	44.35	41.29	42.77	43.61	43.79	23.49	20.32	20.88	22.42	22.52
	Items/outpatient	10.17	16.19	14.94	19.85	11.88	7.30	10.18	9.19	9.07	8.07
	Expenditure/outpatient	1,331.00	3,001.69	2,871.09	4,400.08	2,900.96	1,012.48	2,164.48	1,617.39	2,184.82	1,744.79
CSMBS	Number of outpatients	2,649	361	601	176	3,787	2,569	540	829	244	4,182
	%	49.40	51.57	50.50	48.89	49.75	74.40	77.81	76.26	73.94	75.16
	Items/outpatient	15.81	24.58	23.32	33.82	18.68	20.99	32.21	33.33	44.50	26.25
	Expenditure/outpatient	2,406.90	7,438.96	5,516.10	9,359.01	6,180.24	3,939.63	9,630.80	7,853.13	17,518.98	9,735.63
Self-pay	Number of outpatients	335	50	80	27	492	72	13	31	11	127
	%	6.25	7.14	6.72	7.50	6.46	2.09	1.87	2.85	3.33	2.28
	Items/outpatient	4.90	5.78	7.20	7.22	5.49	4.56	8.77	4.06	4.73	4.88
	Expenditure/outpatient	698.29	686.36	1,662.88	7,058.85	2,526.58	885.83	2,206.46	609.10	1,133.27	1,208.67
NA	Number of outpatients	-	-	-	-	-	1	-	-	1	2
	%	-	-	-	-	-	0.03	-	-	0.30	0.04
	Items/outpatient	-	-	-	-	-	3.00	-	-	7.00	5.00
	Expenditure/outpatient	-	-	-	-	-	226.00	-	-	513.00	184.75
Total	Number of outpatients	3,099	405	643	196	4,343	2,834	573	860	252	4,519
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Items/outpatient	21.85	34.17	34.52	47.27	34.45	21.23	33.06	34.70	45.98	33.74
	Expenditure/outpatient	3,154.22	8,857.45	7,635.44	12,900.96	4,789.40	3,883.57	9,658.83	8,018.92	17,655.90	6,170.86

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, NA = not available

Table D.5 Drug expenditure of diabetes inpatients by health insurance coverage at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
UC	Number of inpatients	78	83	52	38	251	58	39	20	6	123
	%	27.66	36.09	39.39	40.43	34.01	11.58	12.07	11.90	6.32	11.32
	Expenditure/inpatient	724.92	3,342.16	10,917.04	22,591.50	9,393.90	555.76	3,152.08	2,666.45	2,808.17	2,295.61
CSMBS	Number of inpatients	185	127	72	45	429	415	271	136	81	903
	%	65.60	55.22	54.55	47.87	58.13	82.83	83.90	80.95	85.26	83.07
	Expenditure/inpatient	1,209.41	6,830.69	17,998.88	25,896.31	11,041.00	3,523.56	7,766.16	10,945.50	24,787.68	11,755.72
Self-pa	Number of inpatients	19	20	8	11	58	25	12	10	8	55
	%	6.74	8.70	6.06	11.70	7.86	4.99	3.72	5.95	8.42	5.06
	Expenditure/inpatient	511.21	1,554.65	10,227.58	5,067.18	6,282.98	417.52	1,235.50	375.70	1,163.75	798.12
NA	Number of inpatients	-	-	-	-	-	3	1	2	-	6
	%	-	-	-	-	-	0.60	0.31	1.19	-	0.55
	Expenditure/inpatient	-	-	-	-	-	53.67	1.00	96.50	-	37.79
Total	Number of inpatients	252	185	96	62	595	442	286	148	83	959
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/inpatient	1,150.79	6,356.70	15,083.99	33,541.13	8,392.61	3,405.22	7,840.52	10,445.05	24,505.55	7,640.59

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, NA = not available

Table D.6 Drug expenditure diabetes patients by health insurance coverage at Maharat Nakhon Ratchasima Hospital, 2002-2003

		2002					2003				
		DM	Macro	Micro	Multi	Total	DM	Macro	Micro	Multi	Total
UC	Number of patients	2,417	333	532	169	3,451	853	171	239	75	1,338
	%	44.09	41.06	42.87	43.56	43.56	23.16	19.98	20.75	21.01	22.12
	Expenditure/patient	1,332.92	3,438.10	3,814.04	9,167.40	4,438.11	1,000.42	2,503.64	1,759.31	2,380.35	1,910.93
CSMBS	Number of patients	2,715	412	622	184	3,933	2,729	660	871	262	4,522
	%	49.53	50.80	50.12	47.42	49.65	74.10	77.10	75.61	73.39	74.77
	Expenditure/patient	2,430.80	8,623.69	6,513.77	15,285.43	8,213.42	4,244.48	11,068.58	9,183.50	23,978.76	12,118.83
Self-pay	Number of patients	350	66	87	35	538	97	24	40	19	180
	%	6.38	8.14	7.01	9.02	6.79	2.63	2.80	3.47	5.32	2.98
	Expenditure/patient	696.12	991.08	3,184.15	7,037.94	2,977.32	765.13	1,812.92	565.98	1,146.11	1,072.53
NA	Number of patients	-	-	-	-	-	4	1	2	1	8
	%	-	-	-	-	-	0.11	0.12	0.17	0.28	0.13
	Expenditure/patient	-	-	-	-	-	96.75	1.00	96.50	513.00	176.81
Total	Number of patients	3,190	484	676	209	4,559	3,003	696	907	269	4,875
	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Expenditure/patient	3,155.15	9,841.44	9,404.81	22,048.51	5,657.81	4,166.21	11,173.70	9,307.76	24,101.30	7,223.26

Notes: UC = Universal Health Care Coverage, CSMBS = Civil Servants Medical Benefits Scheme, NA = not available

BIOGRAPHY

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