

**COST-EFFECTIVENESS ANALYSIS OF TREATMENT OF TYPE 2 DIABETES:
COMPARISON BETWEEN A PRIVATE CLINIC AND
A PUBLIC HEALTH CENTER IN THE BANGKOK METROPOLITAN AREA**

Miss Hanan Wisitpattharanon



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By	Miss Hanan Wisitpattharanon
Field of Study	Health Economics and Health Care Management
Thesis Advisor	Assistant Professor Chantal Herberholz, Ph.D.
Thesis Co-Advisor	Pirus Pradithavanij, M.D.

Accepted by the Faculty of Economics, Chulalongkorn University in
Partial Fulfillment of the Requirements for the Master's Degree

..... Dean of the Faculty of Economics
(Professor Worawet Suwanrada, Ph.D.)

THESIS COMMITTEE

..... Chairman
(Associate Professor Paitoon Kraipornsak, Ph.D.)

..... Thesis Advisor
(Assistant Professor Chantal Herberholz, Ph.D.)

..... Thesis Co-Advisor
(Pirus Pradithavanij, M.D.)

..... External Examiner
(Chanvit Tharathep, M.D.)

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การศึกษานี้เป็นการศึกษาแบบย้อนหลัง เพื่อวิเคราะห์ต้นทุน - ประสิทธิภาพการรักษาผู้ป่วยเบาหวานชนิดที่ 2 ของคลินิกเอกชนและศูนย์บริการสาธารณสุข กรุงเทพมหานคร การคำนวณต้นทุนของการศึกษาในครั้งนี้ใช้วิธีการวิเคราะห์ต้นทุนกิจกรรม ข้อมูลทุติยภูมิของต้นทุนการรักษาผู้ป่วยเบาหวานชนิดที่ 2 ในปีงบประมาณ 2557 ของคลินิกพญาไทสิทธิเวช และศูนย์บริการสาธารณสุข 41 คลองเตย ซึ่งรวบรวมจากบัญชีค่าใช้จ่ายของสถานบริการทั้งสองแห่ง ประสิทธิภาพของการรักษาคนไขเบาหวานชนิดที่ 2 คือ สัดส่วนของคนไขเบาหวานชนิดที่ 2 ที่มีค่าน้ำตาลในเลือดสะสม (Hemoglobin A1c:HbA1c) น้อยกว่า 7% ต่อจำนวนคนไขเบาหวานชนิดที่ 2 ที่ได้รับการตรวจ HbA1c ต้นทุนของการรักษาคนไขเบาหวานชนิดที่ 2 ในปีงบประมาณ 2557 ของคลินิกพญาไทสิทธิเวช และศูนย์บริการสาธารณสุข ๓๗ คลองเตย เท่ากับ 583,602.28 บาท (3,224.32 บาทต่อคนต่อปี) และ 1,426,982.17 บาท (4,559.05 บาทต่อคนต่อปี) ตามลำดับ ประสิทธิภาพของการรักษาคนไขเบาหวานชนิดที่ 2 ของคลินิกพญาไทสิทธิเวช และศูนย์บริการสาธารณสุข 41 คลองเตย เท่ากับ 0.69 และ 0.28 ตามลำดับ ต้นทุนประสิทธิผลการรักษาคนไขเบาหวานชนิดที่ 2 ของคลินิกพญาไทสิทธิเวช และศูนย์บริการสาธารณสุข 41 คลองเตยเท่ากับ 4,672.93 และ 16,282.32 บาทต่อการควบคุมระดับน้ำตาลในเลือดได้ดีต่อปีตามลำดับ อย่างไรก็ตาม การสรุปผลการศึกษานี้ จะต้องตีความด้วยความระมัดระวัง เพราะอาจจะมีปัจจัยอื่น ๆ ที่เป็นตัวผลักดัน เช่น ความแตกต่างของสถานะทางสังคมและเศรษฐกิจ หรือความแตกต่างของการรักษาคนไขเบาหวานชนิดที่ 2 เป็นต้น ที่ส่งผลต่อประสิทธิภาพของการรักษาคนไขเบาหวานชนิดที่ 2

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HANAN WISITPATTHARANON: COST-EFFECTIVENESS ANALYSIS OF TREATMENT OF TYPE 2 DIABETES: COMPARISON BETWEEN A PRIVATE CLINIC AND A PUBLIC HEALTH CENTER IN THE BANGKOK METROPOLITAN AREA. ADVISOR: ASST. PROF. CHANTAL HERBERHOLZ, Ph.D., CO-ADVISOR: PIRUS PRADITHAVANIJ, M.D., 89 pp.

This retrospective study analyzes the cost-effectiveness of type 2 diabetes treatment in a private clinic and a public health center of Bangkok Metropolitan Administration. Activity-Based Costing (ABC) is used for calculating the cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei. The data were collected from financial records of fiscal year 2014. In this study, effectiveness is defined as the proportion of the number of patient visits with a Hemoglobin A1c (HbA1c) test result of less than 7% per total number of patient visits which tested for HbA1c. The total cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014 was 583,602.28 Baht (3,224.32 Baht per patient per year). The total cost of treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014 was 1,426,982.17 Baht (4,559.05 Baht per patient per year). The effectiveness of treatment of type 2 diabetes in fiscal year 2014 of Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei was 0.69 and 0.28, respectively. The cost-effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic was 4,672.93 Baht per one successful glycemic control per year and 16,282.32 Baht per one successful glycemic control per year at Public Health Center 41 Khlong Toei. However, these results have to be interpreted carefully as the results may be driven by factors such as differences in patients' socio-economic status or differences in type 2 diabetes treatment.

Field of Study: Health Economics and Student's Signature

Health Care Management Advisor's Signature

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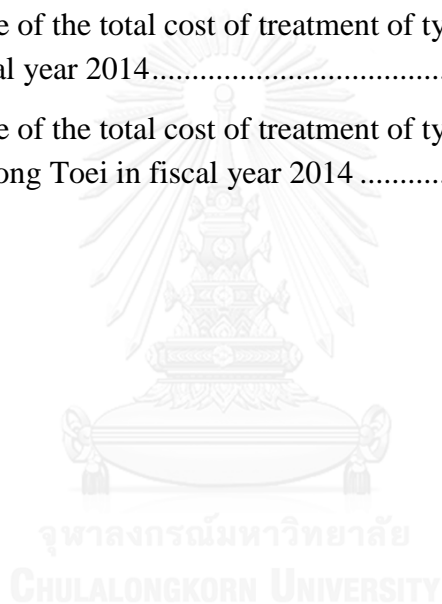
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LIST OF ABBREVIATIONS

ABC	ACTIVITY-BASED COSTING
CSMBS	CIVIL SERVANT MEDICAL BENEFIT SCHEME
FPG	FASTING PLASMA GLUCOSE
HbA1c	Hemoglobin A1c
IDF	INTERNATIONAL DIABETES FEDERATION
NDCs	NON-COMMUNICABLE DISEASES
NHSO	NATIONAL HEALTH SECURITY OFFICE
SSS	SOCIAL SECURITY SCHEME
UC	UNIVERSAL COVERAGE
WHO	WORLD HEALTH ORGANIZATION

CHAPTER I

INTRODUCTION

1.1 Problem and Significance

The World Health Organization (WHO) reported that 38 million (68%) death of 56 million deaths around the world in 2012 come from Non-Communicable Diseases (NCDs), of which 28 million NCDs death occurred in low- and middle-income countries (WHO, 2014). NCDs are not effect only to individual health status as disability but also effect to individual socioeconomic status as absence from work due to health condition which results to lose income and effect to society as productivity loss, loss an opportunity to provide other services to society due to use the budget for providing the healthcare services for treatment NCDs. The factors related with NCDs are tobacco use, physical inactivity, the harmful use of alcohol, unhealthy diet, rapidly growing of urbanization etc. For 82% of NCDs death come from Cardiovascular Diseases (17.5 million), cancer (8.2 million), respiratory diseases (4 million) and diabetes (1.5 million). NCDs are preventable and controllable with good management. The 1.5 million death of diabetes is the fourth leading cause of death in most high- income countries and there is substantial evidence that it is epidemic in many low- and middle- income countries (WHO, 2014).

Thailand, upper middle- income country since 2011, is also facing NCD (cardiovascular diseases, cancer, respiratory disease and diabetes) challenges. WHO report 71% of death in Thailand come from NCDs and 29% of NCDs death occurred in people under 60 years old. The fourth most cause of NCDs death are cardiovascular diseases (27%), cancer (12%), respiratory diseases (7%) and diabetes (6%). From the 4th Thai National Health Examination Survey in 2010-1011 found the prevalence of diabetes in people more than 15 years old is 9%. Prevalence of diabetes in Bangkok area is higher than other regions, both in male and female. One third of diabetes has not been diagnosed, 3.3%of diabetes has been diagnosed but do not access the treatment, two third of diabetes access the treatment and only 28.5% of all diabetes meet the treatment target (Fasting Plasma Glucose: FPG less than 126 mg/dl (Aekplakarn, 2011). There is 42.8% of diabetes patients in Bangkok area access the

treatment but do not meet target for glyceimic control, this number is higher than other regions in Thailand (Aekplakarn, 2011).

Early detection of diabetes can be reduced the severity of disease and prevented the complications. Patients who have been diagnosed to diabetes should be received the appropriate treatment for controlling blood glucose level. In Thailand, patients have to follow-up the treatment every 1-3 months depend on their blood glucose level for maintain the glyceimic control. Every visit patients have been measured for body weight, blood pressure and have been tested for blood glucose level (Dextrostix, Fasting Plasma Glucose). Health educations of nutrition, exercise, drug usage are also available for diabetic patients. Every year, diabetic patients are tested for Hemoglobin A1c (HbA1c), lipid profiles, ulbuminuria, eye care, dental care, foot care for evaluate the treatment and screening the complications, and cigarette cessation, alcohol consumption are included for evaluation of diabetes management. Early detection of complications can prevent the severity and delay the complications. For risk and severe complications, patients should be referred to higher level of healthcare services (Diabetes Association of Thailand, 2014).

Diabetes care is available in primary, secondary and tertiary healthcare facilities. In primary healthcare facility provide primary prevention for screening the risk people for early detection of diabetes, provide health education for pre-diabetic patient to change their lifestyle for prevent the diabetes and secondary prevention for diabetes care clinic as rehabilitation the symptom of diabetes, glyceimic control and prevent the complications (American Diabetes Association, 2016). Diabetic patients with severe conditions or complications are referred to higher level of healthcare facility for tertiary prevention and has been referred back to primary healthcare facility which patients registered for primary care unit.

Health care service can be provided by public and private providers. Public health care is usually provided by the government through national healthcare system. Private health care can be provided through “for profit” health care facility and “not for profit” non-government providers. In low- and middle- income countries use both type of health care provision even there is an argument in ideological that low- and middle- income countries should strengthen public versus private health care services

(Basu, 2012). The result of economic regression, International Monetary Fund (IMF) recommended that countries should increase the scope of private sector provision in health care as part of loan condition to reduce the government debt. However, critics of the private health sector believe that public healthcare provision is of most benefit to poor people and is the only way to achieve universal and equitable access to health care (Basu, 2012).

The public sector is the main service providers, including the private for profit and not for profit sector in a pluralistic health service system in Thailand. Public health facilities were rapidly expanded nationwide is the result of launching the first five-year National Economic and Social Development Plans (1961-1966) in 1961 (Sakunphanit, 2015). Private hospitals also play role in health services, mostly in Bangkok and urban area. There are also wide spread of private clinics and polyclinics in urban areas. Since 1994 (Sakunphanit, 2015).

Both public and private health care providers involve to provide health care services in Thailand. Insured person under Social Security Scheme (SSS) and Universal Coverage (UC) can select contracting public or private health care facilities for their primary care unit. In Bangkok Metropolis, there are 5 medical school hospitals, 29 general hospitals, 19 specialized hospitals/institutions, three 10-bed community hospitals (under Bangkok Metropolitan Administration or BMA), and 60 public health centers (with 83 branches, in all BMA districts) in the public sector. For the private sector, there are 103 private hospitals and 683 private clinics (Bureau of Policy and Strategy, Ministry of Public Health, 2016). There are 64.2% of all private hospitals and clinics involved in health security scheme, mostly in Bangkok (National Statistical Office, Ministry of Information and Communication Technology, 2013).

Delivery of diabetes care in primary health care facilities in Bangkok area are available in both public and private health care facilities which contracting with National Health Security Office (NHSO) and Social Security Office (SSO) for providing the health care services for insured person under UC and SSS, respectively. In this study, Phyathai Sithivej Clinic was selected for private health care facility and Public Health Center 41 Khlong Toei was selected for public health care facility. Phyathai Sithivej Clinic as a community clinic contracting with NHSO to provides the

health care services for UC. Phyathai Sithivej Clinic is located in Ratchathevi District where the characteristic of communities crowded with habitation and government office, then this health care facility was selected. Public Health Center 41 Khlong Toei is a public health care facility under BMA. In 2015, Public Health Center 41 Khlong Toei received the Good Management in Diabetes and Hypertension Award from Bureau of Public Health, BMA, thus Public Health Center 41 Klong Toei was selected for public health facility in this study.

1.2 Research Question

1.2.1 What is the cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei?

1.2.2 What is the effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei?

1.2.3 What is the most cost – effectiveness of treatment of type 2 diabetes between Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei?

1.3 Research Objective

1.3.1 To calculate the cost from provider perspective of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei.

1.3.2 To find the effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei.

1.3.3 To identify the most cost – effectiveness of treatment of type 2 diabetes between to receive the treatment at Phyathai Sithivej Clinic and Public Health Center 41 Khlog Toei.

1.4 Hypothesis

Phyathai Sithivej Clinic is more cost effectiveness of treatment of type 2 diabetes patient than Public Health Center 41 Khlong Toei.

1.5 Scope of the Study

This is a study about the Cost – Effectiveness Analysis of treatment of type 2 diabetes, comparison between a private clinic and a public health center. The private clinic of this study is Phyathai Sithivej Clinic and the public health center is Public Health Center 41 Khlong Toei. The cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in Fiscal Year 2014 (Oct 1st, 2013 – Sep 30th, 2014) from provider perspective are the primary which was collected by interview and secondary data which are collected from the account record, invoice on May, 2016 at both health facilities by using the record form of this study. Activity – Based Costing (ABC) is applied in this study for finding the cost of treatment of type 2 diabetes.



CHAPTER II

BACKGROUND

2.1 Non-Communicable Diseases

Non-communicable Diseases (NCDs) are the challenging in 21st Century in national and international level. World Health Organization (WHO) reported in 2008, there are 36 million NCDs deaths (63% of all deaths around the world) and 44% of NCDs death in people under 70 years old occurred in low- and middle- income countries (WHO, 2011). There are the collaborative of international authorities as WHO, United Nation, World Bank and the government of other countries to work together for chronic diseases surveillance to reduce the number of premature death to 25% in 2025 (WHO, 2013). The main chronic NCDs are cardiovascular disease, cancer, diabetes and chronic obstructive pulmonary disease. The cause of main chronic diseases are established as modifiable risk factors -unhealthy diet, physical inactivity, smoking, harmful use alcohol-, these cause are expressed through the intermediate risk factor of raised blood pressure, raised glucose level, abnormal blood lipid, overweight and obesity. There are non-modifiable risk factors as age, gender and heredity are the cause of chronic NCDs. Changing in demographic, increase the number of elderly and result in high number of NCDs. Globalization and rapidly growth of urbanization are the social determinants and driver which lead the increasing number of NCDs (WHO, 2005). The most of chronic NCDs take time to become fully established for this given long duration of establishment then there are many opportunities for prevention. Chronic NCDs require a long-term and systematic approach to treatment. Integrate the response to chronic NCDs with the response to acute, infection, communicable disease needed from the health service (WHO, 2005).

There are 71% chronic NCDs deaths of all deaths in Thailand (Aekplakarn, 2011), the most cause of NCDs death are come from cardiovascular diseases, diabetes, chronic obstructive pulmonary disease and cancer. From the 4th Thai National Health Examination Survey in 2010-2011 found the prevalence of diabetes

in people more than 15 years old was equal to 9%. Prevalence of diabetes in Bangkok area is higher than other regions both in male and female. One third of diabetes has not been diagnosed, 3.3% of diabetes has been diagnosed but do not access the treatment, two third of diabetes access the treatment and only 28.5% of all diabetes meet the treatment target (Fasting Plasma Glucose: FPG less than 126 mg/dl) (Aekplakarn, 2011). There are 42.8% of diabetic patients in Bangkok area access the treatment but do not meet target of glycemic control, this number is higher than other regions in Thailand (Aekplakarn, 2011).

Chronic NCDs are a world economic burden, it's not only about health expenditure but also including individuals income loss due to work absence, productivity loss, morbidity, early retirement, premature death and expenditure of care giver as family member. Health expenditure of chronic NCDs was 75% of all health expenditure and projected to increase in the future (Bloom, 2011).

Office of The National Economic and Social Development Board (NESDB) reported Thailand spent 25,225 million Baht in 2008 of Universal Coverage Scheme (UC), Social Security Scheme (SSS) and Civil Servant Medical Benefit Scheme (CSMBS) for out-patient and inpatient services of diabetes, hypertension, cardiovascular disease and cancer, and increased to 335,359 million Baht in 2011 (47,956 million Baht spent for diabetes), this number account to 2.94% of Gross Domestic Product (GDP).

2.2 Diabetes and treatment

2.2.1 Diabetes and complications

Diabetes is a chronic condition that occurs when the body cannot produce enough insulin or cannot use insulin. Insulin is produced in the pancreas that use for transport glucose from the blood stream into the body's cell. Diabetes is diagnosed by observing raised level of glucose in the blood. The lack, or ineffectiveness, of insulin in a person with diabetes means that glucose remains circulating in the blood. Over time high level of glucose in the blood will cause damage to many tissues in the body

and leading the complications. There are three main type of diabetes (International Diabetes Federation; IDF, 2015).

Type 1 diabetes (insulin-dependent, juvenile or childhood-onset diabetes) is occurs by an autoimmune reaction, in which the body's defense system attacks the insulin – producing beta cell in the pancreas, leads deficiency insulin production, then the body can no longer produce the insulin it needs. Cause of type 1 diabetes is not known and it not preventable. The onset usually occurs in children or adolescent (young adults) even the disease can affect people of any age. Risk factors of type 1 diabetes are the complex of gene and environmental factors. People with this form of diabetes need insulin every day for regulation glucose in their blood. Without insulin, a person with type 1 diabetes cannot survive. The symptoms of type 1 diabetes are excessive urination, thirst, constant hunger, weight loss, vision change and fatigue (IDF, 2015).

Type 2 diabetes (non-insulin dependents or adult onset diabetes) is the most common type of diabetes, more than 90% of diabetes around the world or 95% of diabetes in Thailand (2014) is type 2 diabetes. It usually occurs in adults, but also occurs in children and adolescents. In type 2 diabetes, the body is able to produce insulin but becomes resistant so that the body ineffective use of insulin. Over time, insulin levels may subsequently become insufficient. Both the insulin resistance and deficiency lead to high blood glucose levels. The risk factor of type 2 diabetes is combination of genetic and metabolic factors, previous Gestational Diabetes combine with old-age, overweight and obesity, unhealthy diet, physical inactivity, tobacco use. The symptoms of type 2 diabetes (frequent urination, excessive thirst, weight loss, blurred vision) are similar to type 1 diabetes, but the symptoms less marked than in type 1 diabetes then many people with type 2 diabetes remain unaware of their condition for a long time and may take long time to be recognized. However, the diabetes hasn't been diagnosed but the body is already being damaged by excess blood glucose, it leads to have a complication condition, then the people with type 2 diabetes come to see doctor and has been diagnosed the diabetes with the complication. Daily insulin treatment do not require for type 2 diabetes to survive. The adoption of a healthy diet, increased physical activity and maintenance of a

normal body weight is the keys of treatment of type 2 diabetes. But there are the oral medications are prescript for controlling blood glucose. In case of blood glucose levels continue to rise people with type 2 diabetes may be prescribed insulin. Rapidly growing of people with type 2 diabetes worldwide is associated with ageing populations, economic development, increasing urbanization, less healthy diets and reduced physical activity (IDF, 2015).

Gestational Diabetes (GDM) occurs while pregnancy (temporary condition) and carries long-term risk of type 2 diabetes. GDM will lead the risk of complication during pregnancy and delivery and will effect to infant. Prenatal screening is the method that use to diagnosis. The risk factors of GDM include age, overweight or obesity, excessive weight gain during pregnancy, family history of diabetes, GDM in previous pregnancy. GDM will lead the risk of obesity and type 2 diabetes in the future after delivery (IDF, 2015)

Complications of diabetes

High blood glucose levels can lead to serious diseases affecting the heart and blood vessels, eyes, kidneys, nerves and also increase risk of developing infections. In high- income countries, diabetes is a leading cause of cardiovascular disease, blindness, kidney failure and lower-limb amputation. The increase in prevalence of type 2 diabetes in low- and middle- income countries present ineffective strategies to support better management of diabetes will create the large increases in the rates of complications. Maintaining blood glucose, blood pressure and cholesterol levels as close to normal as possible can be prevented or delayed diabetes complications. Screening complications in their early stages can prevent them becoming more serious (IDF, 2015).

Eye disease (retinopathy)

The main cause of retinopathy is constantly high levels of blood glucose, which damaged to network of blood vessels that supply the retina, then leading to permanent loss of vision. Retinopathy however, can become quite advanced before it affects vision, and it is therefore essential that people with diabetes have regular eye

screenings. Early detection and get the treatment can be prevent blindness. Keeping good control of blood glucose can reduces the risk of retinopathy (IDF, 2015).

Cardiovascular disease

Cardiovascular disease is the most common cause of death and disability among people with diabetes. The cardiovascular diseases that accompany diabetes include angina, myocardial infarction (heart attack), stroke, peripheral artery disease and congestive heart failure. High blood pressure, high cholesterol, high blood glucose and other risk factors contribute to the increased risk of cardiovascular complications (IDF, 2015).

Nerve damage (neuropathy)

Prolonged high blood glucose levels can lead nerve damage (neuropathy) and affect any nerve in the body. The most common type is peripheral neuropathy, which mainly affects the sensory nerves in the feet, lead to pain, tingling and loss of sensation. This is particularly significant because it can allow injuries to go unnoticed, leading to ulceration, serious infections and in some cases amputations. Neuropathy can lead to the problems with digestion, urination and a number of other functions (IDF, 2015)

Kidney disease (nephropathy)

People with diabetes have kidney disease (nephropathy) more than people without diabetes. Diabetes is one of the leading causes of chronic kidney disease. High blood glucose levels can damage to small blood vessels, which can cause the kidneys to be less efficient, or to fail altogether. Maintaining near-normal levels of blood glucose and blood pressure can reduce the risk of nephropathy (IDF, 2015)

Diabetic foot

Nerve damage leads poor circulation to the feet, cause increase the risk of ulceration, infection and amputation. 25 times of people with diabetes face a risk of amputation compare with people without diabetes. With good management however, a large proportion of amputations can be avoided. Even when a person undergoes amputation, the remaining leg – and the person's life – can be saved by good follow-

up care from a multidisciplinary foot team. It is important that people with diabetes have to examine their feet regularly for reduce the risk (IDF, 2015).

Oral health

Diabetes patient with poor glucose control can increase risk of inflammation of the tissue surrounding the tooth (periodontitis). Periodontitis is a major cause of tooth loss and is associated with an increased risk of cardiovascular disease. Management of periodontitis is very important in people with diabetes because optimal oral hygiene can prevent tooth loss (IDF, 2015).

2.2.2 Treatment of diabetes

The treatment of diabetes in health care facility applying the basis of providing the treatment from the Clinical Practice Guideline for Diabetes 2014 which is produced by the collaborative of Diabetes Association of Thailand under The Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn, The Endocrine Society of Thailand, Department of Medical Service, Ministry of Public Health and National Health Security Office. Using this guideline, health provider can be applied the basic practice depend on context of their capability, patient, environment and so on. The treatment of diabetes suggestions in the guideline are summarized below.

People who has been diagnosed diabetes should be received the appropriate treatment. The treatment of diabetes is available in primary health care facility. Early accessing the treatment will give more value to individual, families, societies and country.

The objectives of treatment of diabetes are:

- Rehabilitate the symptom related with high blood glucose level
- Prevent and rehabilitate the acute complication (hypoglycemia and hyperglycemia)
- Prevent or delay the chronic complications
- Quality of life of diabetic patient should be near as normal people

Target of treatment of diabetes needed for reaching the objectives of treatment. Initiative treatment of new diagnosed should be started immediately. The

target of treatment should be set for individual depend on the collaborative of patients and their care giver.

Glycemic control is a target of treatment of diabetes, in new adult diabetes diagnosed the target of glycemic control, HbA1c should be less than 6% (strongly stringent) but this number should not be set for ongoing treatment diabetes because strongly stringent will lead overweight and hypoglycemia. In general glycemic control target, HbA1c should be less than 7% (stringent). Diabetic patient who frequently has hypoglycemia condition or has complications or has comorbidity with other diseases the glycemic target should not be less than 7% (7-8% non-stringent) is shown in Table 2-1

Table 2- 1 Glycemic control target of adult diabetes

Glycemic control	Target		
	Strongly stringent control	Stringent control	Non – stringent control
Fasting blood sugar (FBS)	70 - <110 mg/dl	90 - <130 mg/dl	<150 mg/dl
Two-hours postprandial blood sugar	<140 mg/dl	-	-
Hemoglobin A1c (HbA1c)	<6.5 %	<7.0 %	7.0 – 8.0 %

Source: Clinical Practice Guideline for Diabetes 2014, Diabetes Association of Thailand under The Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn, 2014

For elder diabetic patient (> 65 years old) the HbA1c target can be separated into 3 groups depend on their health condition (i) elder diabetic patient without comorbidity HbA1c target should be less than 7% (stringent), (ii) elder diabetic patient who can functionally independent but has comorbidity HbA1c target should be 7.0 – 7.5% and (iii) elder diabetic patient who functionally dependent HbA1c target should not stringent (7.0 – 8.0%).

Target of treatment of diabetes not only glycemic control but also include controlling and reducing the risk factors of chronic complications as blood lipids, hypertension, Body Mass Index (BMI), tobacco cessation and exercise.

Follow-up the treatment of diabetes depend on individual glycemic level. Initiative treatment of new diabetes diagnosed, patient should be receive the treatment every 1-4 weeks, the treatment including health education for self-management, blood glucose monitoring and medicine adjustment, if patient can meet the target of treatment, the frequency of treatment will expand. For ongoing treatment of diabetes patient should be receive the follow-up treatment every 1-3 months depend on their blood glucose level. Every follow-up the treatment patients has been measured for weight, blood pressure and blood glucose level. Diabetic patient should be tested for HbA1c and lipid profiles at least once per year.

Glycemic control alone is not enough for treatment diabetes. There are other risk factor will lead to the complication of diabetes then the treatment of diabetes also including reducing the risk factor of complications and screening for complications as following activities:

- Intensive physical and foot examinations once per year
- Eye examination once per year
- Dental check at least once per year
- Urine albumin/ creatinine ratio once per year

Health education is the importance for people with diabetes. Appropriate knowledge of diabetes will lead patients have a good self-management. Patient collaborative in treatment will lead them meet the target of treatment, result the better health, reduce the acute and chronic complication condition and increase quality of life. Health care facility should provide health education for diabetes, the topic including;

- General information of diabetes
- Nutrition
- Exercise
- Medication
- Self-blood glucose monitoring and interpret

- Hypoglycemia and hyperglycemia condition
- Complication
- Foot care

Empowerment and patient centered should be the criteria of providing health education instead of description, this will lead diabetic patient to change their behavior or lifestyle, result the better health status/ condition.

2.3 Delivery of care

Thailand faced the burden of chronic NCDs as a national issues, the Thai Government plays an important role to solve this problem. In 2011, the Thai Government had a public health policy to improve health status for Thais in 4 years. One of the targets of the public health policy is to reduce the prevalence, death and effects related with chronic NCDs. There are others public health policy which were implemented for chronic NCDs management as The 11th National Health Development Plan under the National Economic Social Development Plan 2012 – 2016, Thailand Lifestyle Healthy Strategy Plan 2011 – 2020, Service Plan 2012 – 2016, 8 flagship Project, A Multi - Sectoral Network for Non-communicable Disease Control; NCD Network (Phosat, 2014).

There are 3 levels for delivery of diabetes care including (i) primary delivery: this level is screening the risk people, health promotion to prevent diabetes, (ii) secondary delivery: this level is passive treatment that provide health care service to rehabilitate diabetes patient especially medication treatment, screening the complication, and (iii) tertiary delivery: provide the treatment for complicate diabetic patient, rehabilitate the complications to reduce the morbidity rate (Phosat, 2014).

The delivering of diabetes needed multidisciplinary team to provide the services. There are primary, secondary and tertiary health care facilities provide the treatment of diabetes. Diabetes treatment should be continued, thus Primary health care facility plays an important role to provide the primary and secondary prevention of diabetes (Phosat, 2014).

Ministry of Public Health and National Health Security Office (NHSO) provide the screening program for diabetes and hypertension for people who are insured by Universal Coverage (UC), then people with diabetes can access to the health care service immediately, early treatment can prevent or delay the complications. The treatment of diabetes should be available at appropriate health care facility level. The treatment of uncomplicated diabetes at primary health care facility is the one of criteria for having a good management in chronic disease as an experience from England (Phosat, 2014). The delivery of diabetes is available in public and private health care facilities which contracting with NHSO for UC (Phosat, 2014). Health care facilities contracting with Social Security Office (SSO) receive 432 Baht/patient/year for risk case (diabetes included). There are public and private health care facilities which provide the diabetes care service for insured person under Social Security Scheme. There is only public health care facility available for diabetes care service for person under Civil Servant Medical Benefit Scheme (CSMBS).

2.4 Main Health Insurance Schemes in Thailand

There are three main health care insurances in Thailand including (i) Civil Servant Medical Benefit Scheme (CSMBS), (ii) the Social Security Scheme (SSS) and (iii) Universal Coverage (UC) (Bureau of Policy and Strategy, Ministry of Public Health, 2010).

CSMBS (1980) is a health care insurance that cover to public sector including civil servant of central government, pensioners and their dependants (parents, spouse and children) and permanent government employee. For state enterprises employee, local civil servant and public autonomous agency have their own employee health care benefit. The detail of health benefit packages similar detail in both health care benefits. The Comptroller General's Department (CGD), Ministry of Finance is the organization which responsible to manages this scheme by using the government budget as tax-based. CSMBS is the workplace's welfare health insurance system. The number of population who are insured by CSMBS is 5.4 million people (2011).

SSS was introduced in 1990, it is compulsory insurances in formal private sector which employ 1 employee or more and also include temporary government employee. The employee who has register in the SSS call "insured person". The

Social Security Office (SSO) is an organization which responsible for managing a Social Security Fund (SSF) under Ministry of Labor. This scheme is a tri-party of government, employer and insured person to pay contribution to SSF. The benefit of SSS comprises with (i) non-occupational injury or sickness, (ii) invalidity, (iii) death, (iv) antenatal, (v) child benefit, (vi) old-age benefit and (vii) unemployment benefit. For the (i) to (iv) benefit the Government, employer and insured person shall pay contributions equal rate and (v) to (vii) the Government, employer and insured person shall pay at the rate prescribe in the Ministerial Regulation.

Voluntary Insurance Article 40 of the Social Security Act B.E. 2533 (1990) has been implemented to extend social security coverage to informal workers or self-employed (SSO, 2016). Benefits for voluntary insurer including (i) injury or sickness, (ii) invalidity, (iii) death and (iv) old-age (Lump sum) (SSO, 2016).

The Royal Thai Government declared the Universal Coverage (UC) healthcare policy in 2001. And in 2002 the National Health Security Act B.E. 2545 (A.D. 2002) (NHS Act B.E. 2545) has been declared and established the National Health Security Office (NHSO). NHSO, an independent public agency by law is responsible for managing and operating the US (NHSO, 2012). The NHSO has duty to ensure the approximately 47 million (75%) Thai citizens uninsured by CSMBS (5.4 million) and SSS (9.29 million). The UC is the state welfare. This scheme is co-payment, patient shall pay 30 Baht per visit but it has been canceled in 2006. Goal of the UC: to equally entitle all Thai citizens to quality health care according to their needs, regardless of their socioeconomic status (NHSO, 2012).

The strategic objectives of the UC are (NHSO, 2012):

- To focus on health promotion and prevention as well as curative care
- To emphasize the role of primary health care and the rational use of effective and efficient integrated services
- To foster proper referrals to hospitals
- To ensure that subsidies on public health spending are pro-poor, at the same time ensuring that all citizens are protected against the financial risk of obtaining health care.

The principles and concept of the UC is accessibility in primary health care in community which provide promotion, prevention and curative cares, diagnosis,

rehabilitation, and Thai traditional and alternative medicine pursuant to Medical Registration Law. The UC scheme is a comprehensive package comprises with ambulatory care, hospitalization, disease prevention, health promotion and many expensive services such as radiotherapy and chemotherapy for cancer treatment, surgical operation and healthcare for accidents and emergency illness (MoPH, 2008). The population who are not insured by CSMBS and SSS has to register at primary care network for ensure the universal access in health care when needed. Insured person should get the health care services at primary health facility which has registered. In case of registered primary healthcare facility cannot provide appropriate treatment, patients are referred to higher-level healthcare facilities which the primary healthcare facilities has contracted such as provincial hospital, regional hospital and teaching hospital. In case of emergency the insured person can access the nearest health facility without referral system.

Financial model of the UC is contracted model. NHSO buy health care services from contracted health care facilities which provide the health care services. Contracted public and private hospitals and requiring all contracting hospitals to establish one primary care unit (PCU) for every 10,000 – 15,000 registered population (NHSO, 2012)

There is difference payment mechanism in difference health insurance system, CSMBS is reimbursement model: fee for service, direct disbursement to public provider for out-patients (OPD) and conventional Diagnose Related Group (DRG) for in-patients (IPD) (NHSO, 2012). SSS is a contract model: inclusive capitation for OPD and IPD services. Social Security Office (SSO) pays the capitation to health care provider 1,446 Baht/one registered/year for out-patient (OPD) and in-patient service (IPD), pay extra 432 Baht/patient/year to health care facility which provide chronic disease treatment (diabetes treatment is included in this an extra) and pay an extra for Diagnose Related Group (DRG) both IPD and OPD. For the health promotion and prevention program, the government allocates the budget through NHSO to health care providers for insured person under SSS (SSO, 2013). UC is contract model: capitation for OPD and global budget plus DRG for IPD. NHSO pays the capitation for OPD 1,057 Baht/one registered/year and 1,027 Baht/one registered/year for IPD to health care facility for UC by number of registered (NHSO, 2014).

Accessing to service of each health care scheme: insured person under CSMBS have free choice of public providers, no registration require. SSS insurers have to register public and private competing contractors. Person under UC have to register for primary health care facility (NHSO, 2012). There are public and private health care facility contracting with NHSO for providing the health care services (NHSO, 2012).

Health promotion and prevention service is provided for all Thais under all health insurance system through the activity within promotion and prevention benefits under National Health Security System of NHSO. The objectives of this program are (i) to increase the accessibility of health promotion and prevention of each age group and (ii) to reduce risk factors, morbidity and mortality rate related with national health problem (NHSO, 2013).

There are the budget that use for control, prevent and treatment for chronic disease, diabetes and hypertension control, prevent and treatment are included in this budget. This is an extra payment from capitation that NHSO pays to health care facility which is under the contracting with. The objective of providing this budget are (i) to reduce or delay the progress of diabetes and hypertension in risk people (primary prevention), (ii) increase the accessibility of treatment of diabetes and hypertension, reduce or delay the complications in people with diabetes or hypertension (secondary prevention) and (iii) continuity improve the quality of service as standard. Promotion and support primary health care facility for providing chronic disease services should be have a good referral system for refer and refer back with main contractor.

2.5 Phyathai Sithivej Clinic

Phyathai Sithivej Clinic is a private community clinic which has a contracted with National Health Security Office to provide primary healthcare services for reducing the crowded in secondary and tertiary healthcare facilities. Phyathai Sithivej Clinic established in August, 2012. It is located at Phetchburi 7, Phetchburi Road, Thungphyathai, Rachathevi District, Bangkok. The patients who receive the treatment at Phyathai Sithivej Clinic have to register Universal Coverage at the clinic, for those who are not select Phyathai Sithivej Clinic as their primary healthcare facility shall

pay out-of-pocket to receive the treatment. There are two hospitals with contracted to refer patients as Phramongkutklo Hospital and Mahesak Hospital. The number of UC registered at Phyathai Sithivej Clinic in fiscal year 2014 is 8,300 person.

The personnel of Phyathai Sithivej Clinic include 2 medical doctors, 2 nurses, 2 nurses aid, 2 public health officers, 1 pharmacy and 1 manager. Phyathai Sithivej Clinic provides the promotion, prevention and curative care. The services include providing the treatment of diabetes, hypertension, providing the vaccination for infant and children, providing the antenatal care, providing family planning and providing the general treatment. The number of patient visited in fiscal year 2014 is 9,695 visits. The number of type 2 diabetes patients and number of patient visited for receiving type 2 diabetes treatment in fiscal year 2014 are 181 patients and 1,094 visits respectively.

2.6 Public Health Center 41 Khlong Toei

Public Health Center 41 Khlong Toei is one of 68 Public Health Center under the Bangkok Metropolitan Administration (BMA). Public Health Center 41 Khlong Toei is located at 139 Ardnarong Rd., Khlong Toei, Khong Toei District, Bangkok. Public Health Center 41 Khlong Toei provides the primary health care for people in Khlong Toei district include diabetes clinic, hypertension clinic, Tuberculosis clinic, psychiatric clinic, pediatrics clinic, drug addict clinic, pharmacy, X-ray, Pathology laboratory, physical therapy, eye clinic, dental care, school health education and community health education. The number of population in the area is 80,000 person, number of UC registered is 34,032 person.

There are 1 full-time medical doctor, 5 part-time medical doctors, 1 dentist, 3 dentist assistants, 4 social welfare worker, 18 full-time nurses, 2 part-time nurses, 16 general staffs, 1 health educator, 1 Health Staff, 1 full-time pharmacy, 1 pharmacist assistant, 2 physical therapist, 1 technician medical doctor, 3 public health staff, 1 disease control staff, 2 IT staffs, 2 finance and accounting staffs, 4 drivers, 5 security guards.

The number of patients visited in fiscal year 2014 is 52,076 visits. The number of patient receive the treatment of type 2 diabetes is 313 and number of patient visit for receiving the treatment of type 2 diabetes is 2,725 visits



CHAPTER III

LITERATURE REVIEW

3.1 Economic Evaluation

Limitation in resources leads policy maker not only to evaluate the cost-effective for using the resources in the intervention but also has to compare with other interventions as the condition to sacrifice other thing to get something (Drummond, 2005)

There are 4 type of economic evaluation

1. Cost – Minimization Analysis

Cost – Minimization Analysis (CMA) is the evaluation of cost of intervention without concerning the consequence or outcome. CMA concern only cost. The outcome of the study is equivalent. CMA identifies the lowest cost of different interventions.

2. Cost – Effectiveness Analysis

Cost – Effectiveness Analysis (CEA) is the evaluation of comparison of both cost and consequence of the difference interventions. Consequence or outcome should be the common outcome (single common effect). The result of CEA is the cost per unit of effect or effects per unit of cost

3. Cost – Benefit Analysis

Cost – Benefit Analysis (CBA) is the evaluation of comparison of cost and benefit of interventions. The benefit is the outcome or consequence present in monetary term. The challenge of this is to convert the outcome or consequence in to monetary term.

4. Cost – Utility Analysis

Cost – Utility Analysis (CUA) is the evaluation of comparison of both cost and outcome of interventions. Popularity outcome in CUA is Quality Adjusted of Life (QALYs).

3.2 Overview of costing

3.2.1 Traditional Costing System

All cost in traditional cost system can be classified to fixed and variable cost. Fixed cost is an unaffected by changes in activity level over a feasible range of operations for a given capacity or capability over a reasonable time period such as: insurance, rent, CEO salary (Martland, 2003). Variable cost is cost of producing the product with change when the units or volume of producing increased. Only the units or volume and other drivers as labor hour, machine hour which has highly correlated with unit or volume produced are importance. Production cost is based on unit or volume be produced. Using only unit- or volume- based activity as a driver to assign costs to cost objects is a traditional cost system (Hasan, 1997)

3.2.2 Overview of Activity-Based Costing

Using the driver tracing to cost objectives both volume- based activity and non- volume based activity (unrelated volume of product produced) will result the accuracy of cost assignment and relevance of cost information. A costing that uses both volume and non- volume based activity drivers to assign costs to cost objects is call Activity-Based Costing. The costs which are calculated by using contemporary cost management system will tell the producing cost information for variety of managerial purpose as the financial report and can be used for better planning, control and decision making (Hasan, 1997)

Activity-Based Costing (ABC) is a method that uses activities for calculate the cost of providing a service or producing a product. In healthcare, implementation of ABC can be used to calculate the cost of providing the healthcare services in all reimbursement mechanisms (capitation, diagnosis-related groups: DRGs, critical part analysis, patient acuity system, case management, utilization review, etc.). ABC is used for calculating the cost of providing services instead of using the conventional method which reported seriously distorted cost per patient when patient care is diverse in term of level of care or amount of care. ABC identified the activities performed, trace cost to these activities, and then uses various cost drivers to trace the cost of activities to the final products or services (Udpa, 1996).

The fundamental concentration on activities of the ABC approach makes it differ from the traditional approach. (Baker, 1998)

Even the ABC is useful approach for cost calculation but there is disadvantage of the ABC as shows in Table 3-1

Table 3- 1 Advantages and disadvantages of Activity-Based Costing

Advantages	Disadvantages
<ul style="list-style-type: none"> - Accuracy in the process of costing with regards to the product line, the end-users of the product, the stock-keeping units employed by the management and the channel and category which streamline the flow of the product from the producer to the end user. - Better assists in the process of understanding the concept of overhead costs i.e. the allocation of common business resources as they are used by specific product lines and their relation to specific cost driver. - Works exceptionally well will quality improvement and up gradation programs e.g. Six Sigma - Particularly helpful in identifying and ear-marking some of the matters business activities which are a burden or stress on the business i.e. wasteful or non-value adding services. - Mimics the actual business process as the appropriation of common pool resources takes place in the same way as common resources are used in the business. - Helpful in the process of benchmarking which is an integral part of the quality control system. 	<ul style="list-style-type: none"> - Data collection process for this system is very time consuming. - The capital expenditure on the activity based system and its subsequent running costs can be a road block for firms. - The system is very transparent which some managers would not approve of as they would like to keep some things out of the view of the owners of the company.

Source: Reprinted from Maingi J., 2011. Advantages & Disadvantages of activity based costing with reference to economic value addition. Muenchen: GRIN Verlag.

3.3 Financial (Accounting) versus Economic costs

“Accounting principles are not appropriate for decision making related to operating. There are other business costs relevant to decision making that may not be considered as costs from the perspective of accounting standards. For example, the owner/operator of a proprietorship invests time and effort in operating a business. These would typically not be treated as expenses on the proprietorship’s tax return but are certainly relevant to the owner in deciding how to manage his self-run business, is called economic cost” Stengel, 2011.

“Accounting costs are easily identified and calculated for companies during normal business operations. However, companies also experience economic costs that are not reported on accounting ledgers that can affect management decisions. Accounting costs are typically important for both internal and external company reports, while economic costs are only applicable to internal accounting reports for decision making” Marquis, 2013

“Economics and finance; both are important, and both have valid uses and applications. In many respects, economics is "big picture" (how a country/region/market is doing) and concerned about public policy, while finance is more company/industry-specific and concerned about how companies and investors evaluate and price risk and return. At some fundamental level, there will always be a separation, but both are likely to remain very important to the economy and financial markets for some time to come” Simson, 2016.

3.4 Previous study

Supasit Panarunothai and Manit Kongpan (1998) studied the cost - effectiveness of diabetes and hypertension management at urban medical center compare with Maharat Nakornratchasrima Hospital. The objective of this study (i) to analyze cost of urban medical center by Activity-Based Costing, (ii) To analyze the effectiveness of treatment of diabetes and hypertension: comparison between urban medical center and Maharat Nakornratchasrima Hospital and (iii) to analyze the cost-effectiveness of diabetes and hypertension management of urban medical center and Maharat Nakornratchasrima Hospital. Patients has been grouped to (i) patients receiving treatment with home visit by urban medical center, (ii) patients who live in social welfare worker,s responsibility's area and receiving treatment with home visit by Maharat Nakornratchasrima Hospital [Maharat Nakornratchasrima Hospital (in district)], and (iii) patients who live outside the social welfare worker's responsibility area [Maharat Nakornratchasrima Hospital (outside district)]. Provider and patient perspective were used in this study. Major finding cost of diabetes management on provider perspective of urban medical center, Maharat Nakornratchasrima Hostipal (in district) and Maharat Nakornratchasrima Hospital (outside district) were equal to 1,525.43 1,734.61 and 1,509.02 Baht per patient per year, respectively. 45.76% of total cost of urban medical center was labor cost, 43.30% material cost (32.95% of material cost was medical and non-medical supply) and 10.93% was capital cost. Cost at Maharat Nakornratchsrima Hospital is a unit cost without medical supply cost. Cost of diabetes management on patient perspective of urban medical center, Maharat Nakornratchasrima Hostipal (in district) and Maharat Nakornratchasrima Hospital (outside district) were equal to 2,325.25 4,576.27 and 4,669.76 Baht per patient per year, respectively. Even though the number of patient visit and number of home visit of urban medical center was higher than Maharat Nakornratchasrima Hospital, cost on provider perspective of diabetes management of Maharat Nakornratchasrima Hospital was higher than urban medical center, Lower cost of diabetes management of urban medical center presents the lower use of resources for providing primary health care. On patient perspective, cost of diabetes management of urban medical center lower than patient who received the treatment at Maharat Nakornratchasrima Hospital because the location of urban medical center is located in the community then patient

can save time and money for travelling cost, the opportunity cost of receiving the treatment lower and the medicine cost at urban medical center lower than Maharat Nakornratchasrima Hospital.

The effective in this study was defined as percentage of Fasting Blood Sugar (FBS) test result was equal to 80 – 140 mg/dl, the effectiveness of diabetes management at urban medical center, Maharat Nakornratchasrima Hospital (in district) and Maharat Nakornratchasrima Hospital (outside district) were equal to 50%, 49% and 33%, respectively. Result of effectiveness in this study show the successful glycemetic control in urban medical center was highest where the number of patient visit and home visit highest also, it shows correlation of glycemetic control and number of home visit, more home visit patients have a better glycemetic control. Effectiveness of glycemetic control of Maharat Nakornratchasrima Hospital (in district) was higher than Maharat Nakornratchasrima Hospital (outside district). This result can concluded that meet target of glycemetic control has a positive relationship with number of home visit.

Diabetes management on provider perspective at urban medical center was equal to 3,051 Baht per one successful control per year are most cost-effectiveness than Maharat Nakornratchasrima Hospital (in district) which was equal to 3,540 Baht per one successful control per year and Maharat Nakornratchasrima Hospital (outside district) 4,573 Baht per one successful control per year, respectively. Cost-effectiveness of diabetes management on patient perspective at urban medical center was equal to 4,651 Baht per one successful control per year are most cost-effectiveness than Maharat Nakornratchasrima Hospital (in district) which was equal to 9,339 Baht per one successful control per year and Maharat Nakornratchasrima Hospital (outside district) equal to 14,151 Baht per one successful control per year, respectively. Cost-effectiveness analysis in this study on both provider and patient perspectives show diabetes management at urban medical center most cost-effectiveness, than Maharat Nakornratchasrima Hospital (in district) and cost-effectiveness is Maharat Nakornratchasrima Hospital (outside district), respectively. Primary health care services with provide by urban medical center including home visit in some disease is more cost-effective.

Napassanun Limsantithum (2004) studied cost-effectiveness analysis of chronic disease management: comparison between King Chulalongkorn Memorial Hospital and Public Health Center 16 Lumpini during Oct 1st, 2003 – Sep 30th, 2004 on provider perspective. The aims of this study are (i) calculate the cost of chronic disease management, (ii) estimate the effectiveness of chronic disease and (iii) illustrate the chronic disease management at Public Health Center 16 Lumpini is most cost-effectiveness than the chronic disease management at King Chulalongkorn Memorial Hospital. Cost of Public Health Center 16 Lumpini including labor cost, material cost and capital cost of three cost centers as Non-Revenue Producing Cost Center (NRPCC), Revenue Producing Cost Center (RPCC) and Patient Service (PS), cost was allocated by using simultaneous equation method, then unit cost of diabetes was calculated by the proportion of visited in OPD. 78% of total cost at Public Health Center 16 Lumpini was labor cost, 19% was material cost and 3% was capital cost. The total cost of management of diabetes with non-complicated patients at King Chulalongkorn Memorial Hospital and Public Health Center 16 Lumpini was 1,170,917.21 and 738,679.67 Baht/year, respectively. The unit cost of management of diabetes with non-complicated patients at King Chulalongkorn Memorial Hospital and Public Health Center 16 Lumpini was 1,885.53 and 370 Baht per visit, respectively. The effective is defined as percentage of Fasting Plasma Glucose (FPG) result between 90 – 130 mg % as disease controllable. The effectiveness of glycemic control of diabetes with non-complicated patients at King Chulalongkorn Memorial Hospital and Public Health Center 16 Lumpini was 34.79% and 22.58%, respectively. The cost-effectiveness of diabetes management at King Chulalongkorn Memorial Hospital and Public Health Center 16 Lumpini was 20,522.39 and 10,655.99 Baht/case disease controllability, respectively. As the result, Public Health Center is considered to be an efficient health care facility in case of chronic disease management than teaching hospital. Primary care unit at Public Health Center should be more appropriate than having primary care unit at teaching hospital or tertiary hospital.

Orasa Tungsayan, Penpuk Utid, Sukontha Kongsil and Sukum Jiemton (2013) studied about Cost-Effectiveness Analysis of Successfully Controlling Blood Glucose in Diabetic Patients in Fiscal Year 2010, Medical Service Department, Bangkok Metropolitan Administration. The aim of this study is to analyze the cost-effectiveness of successfully controlling blood glucose in diabetic patients who has been treated at Out-Patient Department (OPD) of Ladkrabung Bangkok Hospital. This study concern both provider and patient perspective. The study found total cost of diabetes who has been tested by FBS is 3,976.42 Baht per patient and total cost of diabetes patient who has been tested by HbA1c is 4,731.10 Baht per patient. The component of total cost of both using FBS test and HbA1c test included cost in terms of provider perspective and patient perspective. Cost of provider perspective both FBS test and HbA1c test is equal 1,683.85 Baht/Patient (Labor Cost 90.84 : Non-Labor Cost 5.87 : Capital Cost 3.65). Cost of patient perspective is separated into two groups. First group is the patient who has been tested by FBS, the cost of this group is 2,292.57 Baht per patient. The second group is patient who has been tested by HbA1c, the cost of this group is 3,047.25 Baht per patient. (Medical Cost > Indirect Cost > Non-Medical Cost). The effectiveness of this study is the ratio of no. of patients who has the result of FBS test equal 70 – 110 mg/dl two times (15 patients) per no. of patient who has been test by FBS (225 patients) equal 0.07. In case of HbA1c test the effectiveness is the ratio of no. of the result of HbA1c test less than 7% two times (22 patient) per no. of patients who has been tested by HbA1c two times (79 patients) equal 0.28. The Cost-Effectiveness of successfully controlling blood glucose in case of using FBS is the indicator of success equal 56,806.00 Baht per effectiveness. But in case of using HbA1c is the indicator of success equal 16,896.79 Baht per effectiveness. The Cost-Effectiveness of successfully controlling blood glucose in diabetic patients that has been tested by FBS is higher than has been tested by HbA1c 3.36 time. The result of this study found 1% of successfully controlling of effectiveness the hospital has to pay 56,806 Bath (FBS indicator) and 16,896.79 Bath (HbA1c indicator).

From the previous study, most of cost of treatment of diabetes is labor cost. The cost-effectiveness of treatment of diabetes at uncomplicated management health care facility more cost effectiveness than complicated management health care

facility. For ongoing treatment of chronic disease as diabetes, providing treatment by primary health care facility more cost effective than providing by secondary and tertiary health care facilities.



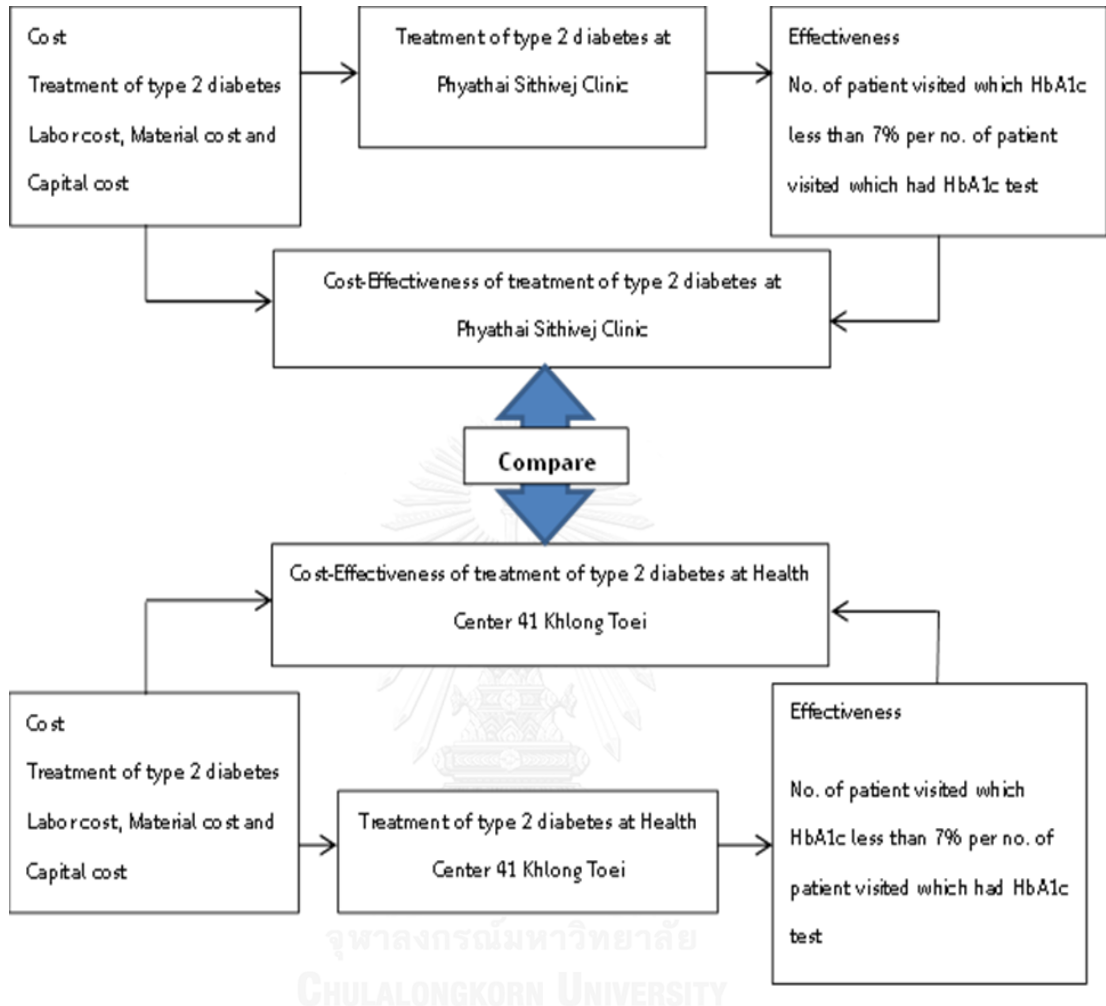
CHAPTER IV

RESEARCH METHODOLOGY

4.1 Conceptual Framework

Health Economic Evaluation concept is used in this study to compare cost-effectiveness of two health care facilities of treatment of type 2 diabetes patients (Phyathai Sithivej Clinic and Health Center 41 Khlong Toei). Cost of treatment of type 2 diabetes in this study is cost of provider perspective. All cost related with providing a treatment of type 2 diabetes patient will be considered and calculated by Activity-Based Costing Method. The outcome or effectiveness in this study is the proportion of the number of patient visits with a Hemoglobin A1c (HbA1c) test result of less than 7% per total number of patient visits which tested for HbA1c. The reason of HbA1c result less than 7% in this study because ongoing treatment of diabetes should not stringent than compare with a new case. A new diagnosed diabetes HbA1c result should be less than 6.5% (strongly stringent) but for ongoing treatment of diabetes HbA1c result should be less than 7% (stringent) because strongly stringent in ongoing treatment diabetic patient will lead hypoglycemia and weigh gain. For elder diabetic patient (> 65 years old) the HbA1c result can be separated into 3 groups depend on their health condition (i) elder diabetic patient without comorbidity HbA1c result should be less than 7% (stringent), (ii) elder diabetic patient who can functionally independent but has comorbidity HbA1c result should be 7.0 – 7.5% and (iii) elder diabetic patient who functionally dependent HbA1c should not stringent (7.0 – 8.0%). (Diabetes Association of Thailand, 2014) Then the appropriate HbA1c result in this study should be less than 7% because the sample in this study is ongoing treatment of type 2 diabetes whose has been diagnosed more than 1 year.

Figure 4- 1 Conceptual Framework



4.2 Data collection

Provider perspective is a point of view in this study. Cost of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei are both primary and secondary data. Primary data were collected by interview the staff who involved to perform the activity of treatment of type 2 diabetes. Secondary data were collected from account record and invoice. Cost was collected by using the gathering data form which was developed for this study (see appendix). The effectiveness is collected from the medical record card. To compute the cost-effectiveness of treatment of type 2 diabetes of both health care facilities by using the Cost-Effectiveness Analysis principal. Then compare the Cost-Effectiveness of treatment of type 2 diabetes patients of Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei.

4.3 Study population

Population in this study is diabetic patients who are diagnosed before October 2012 and received ongoing treatment more than one year at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei.

Inclusion criteria are type 2 diabetic patients at all age group with or without comorbidity (hypertension) whose has been diagnosed and accessed the treatment more than one year.

Exclusion criteria are diabetic patients whose has complications condition as Cardiovascular Disease, retinopathy, nephropathy, neuropathy. Diabetic patients whose are treated with insulin injection. Diabetic patient with tuberculosis, functional dependence, and pregnancy.

4.4 Cost data

Cost in this study is classified to operating or recurrent cost and capital cost. Operating cost or recurrent cost or running cost is the cost of nonrenewable resources such as labor cost, material cost, maintenance cost, electricity, water supply, short-term training course etc. (Singchanchai, 2014) Capital cost is annual depreciation of

building, medical equipment and office equipment which invested in one time but the length of use is more than one year, vehicle etc (Srirattanaban, 2002).

In this study researcher assumed office material, maintenance cost of computer and air-conditioner, electricity, water supply, telephone, manager salary, supportive staff salary, cleaning cost are the cost of supportive unit which indirectly related with providing the treatment, then these cost are overhead cost which is allocated to each activity of providing the treatment by using volume and non-volume related drivers (Drummond, 2005). The rent of building is included in capital cost instead of depreciation of building (Drummond, 2005). Depreciation of building is annual cost of the building in that year but private clinic in this study does not own the building then rent of building in that year can be annual depreciation cost of the building.

4.5 Activity-Based Costing

Activity-Based Costing (ABC) is the method uses to identify the resources which use in each activity for providing health care services. (Singchanchai, 2014) Developing activity model is the starting process of ABC (Baker, 1998) Figure 4-2, 4-3 are the activity model which shows the activities of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in fiscal year 2014, respectively.

Figure 4- 2 List of activities for type 2 diabetes treatment at Phyathai Sithivej Clinic (2014)

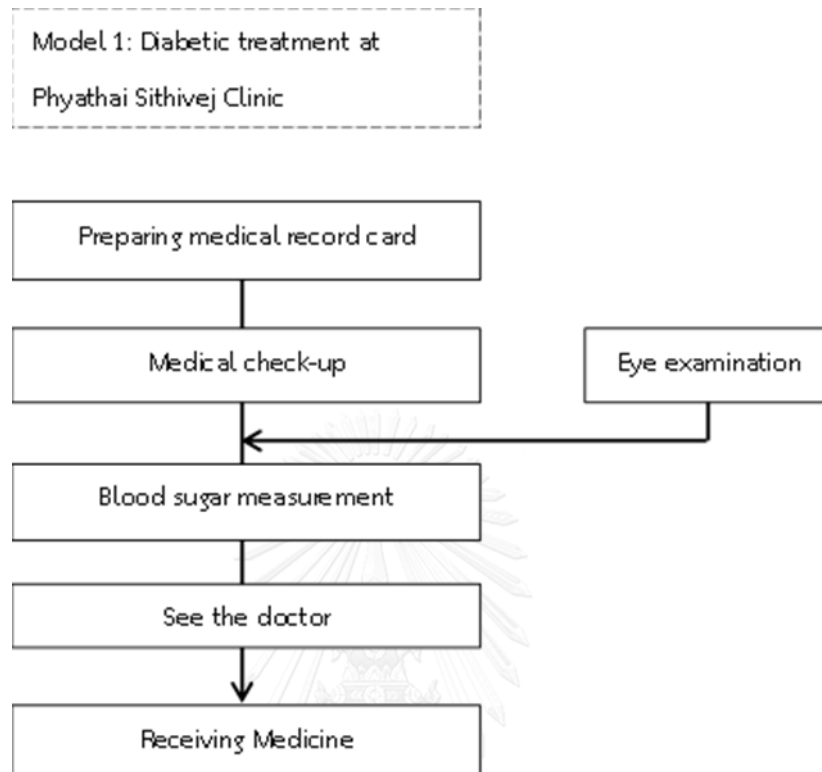
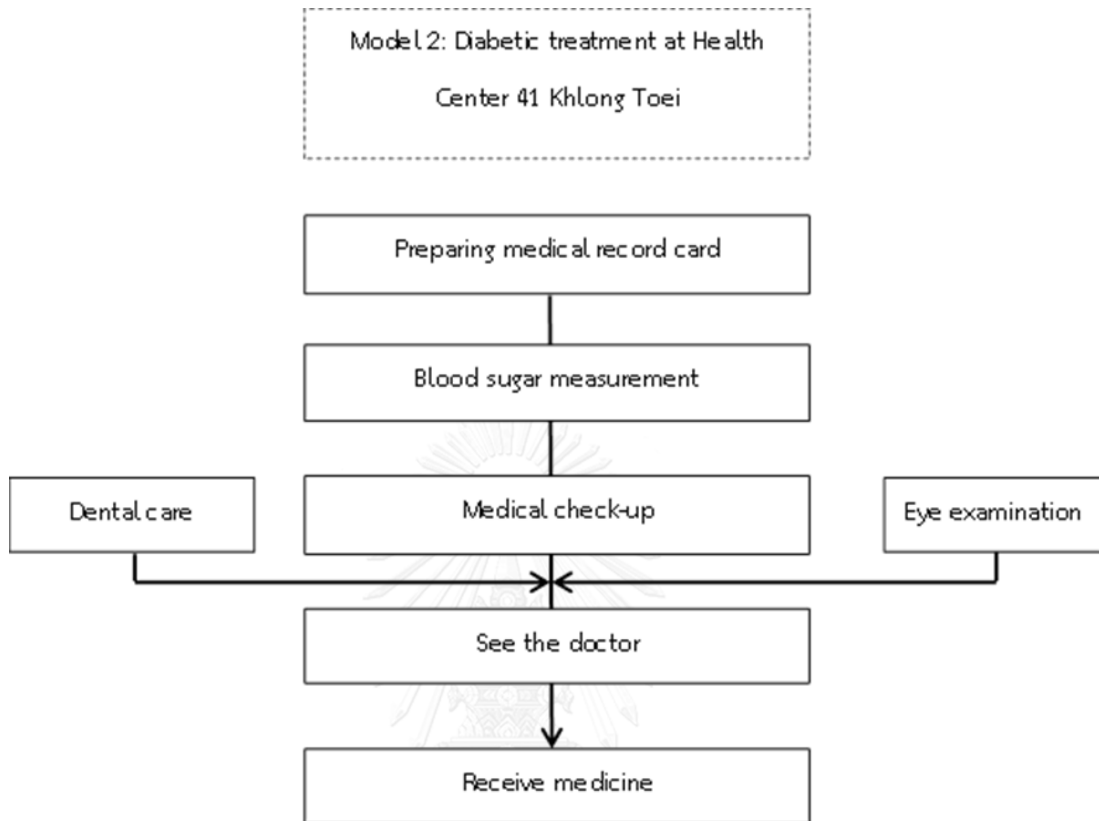


Figure 4- 3 List of activities for diabetic treatment at Public Health Center 41 Khlong Toei (2014)



4.5.1 Identify activities related cost

Model 1 in Figure 4-2 identified the list of activities of treatment of diabetes at Phyathai Sithivej Clinic in Fiscal year 2014, each activity that provide for diabetic treatment cause cost. The incurred cost of each activity is the following:

(i) Cost of preparing medical record card: Ongoing treatment of diabetes, patient always have an appointment for the next time of treatment and when the day patient visit the clinic, the staff will prepare medical record card in advance or even for the new patient there also have to register in this section but in this study the population is the patient who has been treated at Phyathai Sithivej Clinic more than one year before this study, it means patients should be received the treatment since October 2012 of before that. The cost of preparing the medical record card including staff's cost (nurse aid and public health officer), cost of using computer for search the patient information, cost of cabinet which use for store the medical record card, cost of furniture which were put in that area, cost of space used for providing the service.

(ii) Cost of providing medical check-up: Every visit patient has been measured for weigh and blood pressure. Health personnel give health education to diabetes patient individual or group. The topics of health education for diabetic patient following the standard which is recommended by Diabetes Association of Thailand including nutrition (diet), exercise, medication, foot care and self-management, hypoglycemia and hyperglycemia. Diabetic patient should be received health education at least 3 topics per year. Health personnel give health education to patient by using the media as leaflet and poster which separate the topics of treatment of diabetes. Providing medical check-up, there is the equipment has been used as weighing machine, blood pressure gauge, cost of material use for giving health education, cost of staff who providing the service (nurse, nurses aid and public health officer), cost of furniture in the area that patient receive the services and cost of space used for providing the service.

(iii) Cost of blood glucose measuring: Every visit of follow-up the treatment, diabetic patient has been measured for capillary blood glucose level which is interpreted by glucometer. Annually, diabetic patient has been test for HbA1c at least once per year for measuring cumulative blood glucose level in 2-3 months ago; blood sample which is collected from patients venous will be sent to laboratory. The cost of

providing including staff's cost (nurse, nurse aid and public health officer), medical supply cost, medical equipment cost and also include the cost that clinic pay to outsource laboratory for analysis the sample (blood and urine), furniture cost which is put in the area of providing the service and cost of space used for providing the service.

(iv) Cost of giving an advice: After patient is measured the blood sugar level and had medical check-up, the next step is counseling with doctor. The doctor will give some information about patient individual health status related with the result of blood glucose level; adjust the medicine, giving an advice and prescript medicine. Cost including cost of medical doctor who are providing the service, cost of furniture in the area of providing the services and cost of space which use for providing the service.

(v) Cost of providing medicine: The last step of treatment diabetes in each time is receiving the medicine at pharmaceutical corner. The activities of this part are preparing medicine following as medical doctor's prescription, giving an advice for medicine usage which is provided by pharmacy and public health officer. The cost including cost of staffs, cost of medicine, cost of sticker, medicine envelop or bag, plastic bag, cost of durable equipment which is used in this part and space cost which used for providing the service.

(vi) Eye examination's cost: Patients with type 2 diabetes are recommended to have eye examination at least once per year. Phyathai Sithivej Clinic employed the ophthalmology team to perform eye examination at Clinic two times per year. Patient has been appoint to have eye examination at the clinic, the number of patients who are involve in this part approximately 80% of number of diabetic patient according to the medical doctor recommendation. The cost including staff's cost (nurse, nurse aid and public health officer), cost of providing the service which Phyathai Sithivej Clinic shall pay for outsource ophthalmology team and cost of space which used for providing the service.

Model 2 in Figure 4-3 identified the list of activities of treatment of diabetes at Public Health Center 41 Khlong Toei in Fiscal year 2014, each activity that provide for diabetic treatment cause cost. The cost of each activity is the following

(i) Cost of preparing medical record: For patient who have an appointment the staff will prepare the medical record card in advance, the cost in this activity is staff's cost, cost of using computer for search patient information, cost of cabinet which store the medical record card, cost of furniture in that area and cost of space which use for providing the service.

(ii) Providing blood glucose level measurement: Patient with diabetes should have the capillary blood glucose level measurement for every visit which is provided by health personnel and venous cumulative blood glucose level annually. Cost of providing blood glucose level measurement including staff's cost (medical laboratory scientist), cost of medical supply, cost of medical equipment as strip, syringe etc. and cost for annual check (blood and urine) which the health facility pays to outsource laboratory, cost of furniture in the laboratory room and cost of space used for providing the service.

(iii) Medical check-up: The activities of medical check-up are measuring weigh, blood pressure and giving health education. For giving health education, health personnel provide the service to patient individual and group. The topics of health education for diabetic patient following the standard which is recommended by Diabetes Association of Thailand including nutrition (diet), exercise, medication, foot care and self-management, hypoglycemia and hyperglycemia. Diabetic patient should be received health education at least 3 topics per year. Health personnel give health education to patient by using the media as leaflet and poster which separate the topics of treatment of diabetes. For group health education the health personnel just narrate the health education by topics to all patients who are received the treatment. The cost including staff's cost (nurse, public health officer), cost of equipment as weighing machine, blood pressure gauge, cost of material which use for giving health education, cost of furniture and space used for providing the service.

(iv) Cost of giving an advice: After patients had blood glucose check and medical check-up, patients have to see doctor. The doctor will giving information of treatment, giving an advice, adjusts medicine, prescript medicine. The cost of this activity including staff's cost whose are proving service (1 full time general practitioner and 3 part time general practitioners), cost of furniture and space used for providing the service.

(v) Cost of preparing the medicine: Cost of pharmaceutical department including staff's cost (pharmacy, pharmacy assistant, staff), sticker, medicine envelop (bag), plastic bag, medicine, cost of durable equipment which is use in this department and cost of space used for providing the service.

(vi) Eye examination: Eye examination is provided by Ophthalmology team of Public Health Center 41 Khlong Toei. Patient with type 2 diabetes is recommended to have eye examination at least once per year (Clinical Practice Guideline for Diabetes 2014, 2014). The cost of eye examination at Public Health Center 41 Khlong Toei including staff's cost (ophthalmologist, nurse and staff), computer, fundus camera, furniture and space cost at the area of providing the service.

(vii) Dental care: Dental care is provided for diabetic patient once per year. Cost of dental care including cost of staffs (dentist, dentist assistant, and staff), cost of medical supply, cost of dental master unit, cost of furniture and space in the area of providing the service.

There are the differences of services provided for treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei as following:

(i) Providing eye examination service: Phyathai Sithivej Clinic does not available for providing eye examination services but this health facility hired the ophthalmology team for providing eye examination service at the clinic twice a year. The number of patient who received eye examination service is 80% of number of type 2 diabetes. Public Health Center 41 Khlong Toei has ophthalmology department, then they can provide eye examination service by their ophthalmology team. The number of patient who received eye examination service is 80% of number of type 2 diabetes.

(ii) Providing dental care: Phyathai Sithivej Clinic does not provide the dental care for diabetic patients but Public Health Center 41 Khlong Toei did. There is a dental department at Public Health Center 41 Khlong Toei, then type 2 diabetic patients has been checked for dental care at least one per year. The number of type 2 diabetes who received the dental care was 80% of number of type 2 diabetes.

Both health care facilities in this study also provide the health care services in community that health personnel going to community and giving health care services and health education. Phyathai Sithivej Clinic has only two communities in their

responsibility as Phetchburi 7 community and Ban Krua community. Normally health personnel going to community to provide the health care services to patient who are not able to going received the treatment in healthcare facility regularly as call bed ridden, and the case of diabetes is also like mention before but patient who has other health condition is excluded from this study, then providing health care services in community is does not matter to put cost in this study.

There are 31 communities in responsibility of Public Health Center 41 Klong Toei, there are variety in size and ability of each community. Empowerment is needed for the efficient operation of public health in communities. Empowerment leads the strength to community for sustainable community self-management in public health. There are health care volunteers provide the health care services in community. The diabetic case which health care personnel providing the service in community is case of bed ridden patient that is excluded from this study, then there is no cost of providing the treatment of type 2 diabetes in community in this study.

Phyathai Sithivej Clinic is located in Thungphyathai Sub-district, Ratchathevi District where in the middle of Bangkok. There are many commercial area around this community. There are crowded of habitation and government office (Ratchathevi District Office, 2016). There are variety in occupation of people in this area (Ratchathevi District Office, 2016).

Public Health Center 41 Khlong Toei is located in Khlong Toei district where well known as the biggest crowded community in Thailand (Kwannet, 2010). The communities in this area face many problem such as drug abuse, prostitution etc. There are variety in occupation of people in communities.

Even there is an evidence from the study about diabetes and the rise of the socioeconomic health gradient that found education has become more important in both the detection and successful management of diabetes (Smith, 2007), but in this study the individual socioeconomic information of diabetic patients were not collected.

4.5.2 Cost category

After identified cost of resources used in each activity, then assign resources used into cost category. This study categorized cost into operational cost (labor cost:

salary, wage, overtime, position allowance – the allowance that some position get extra from salary depends on their position like a managerial position that medical doctor have to perform, hospitalization fees – the fringe benefit as health care utilization for themselves and their dependants, child benefit allowance, non-private practice incentive and non-labor cost or material cost: medical supply, medical material, non-medical material, stationary, electricity, water supply, telephone, maintenance etc.) and capital cost (annual depreciation of furniture, durable equipment, building and rent of building), the annual depreciation cost in this study calculated by using straight-line method. Operational cost and capital cost are divided to direct and indirect cost, where direct cost refers to cost that could be allocated directly to cost center, indirect cost refers to the cost that could not be allocated directly to cost center and were calculated using cost driver. (Javid M., 2016)

Calculation of annual capital cost we use the straight-line method. The straight-line method equal the purchase price of the asset minus residual value and divided by useful life time, in practical if the residual value is not substantial there is no need to put it for calculating the depreciation as the residual of office material, decoration material so on. In contrast the residual of vehicle, machine, building are matter to use it for calculating annual depreciation (Williams, 2007). The rent of building can put instead of annual depreciation of building if the organization does not own the building themselves (Drummond, 2005).

$$\text{Annual depreciation} = \frac{(\text{Purchase price} - \text{residual value})}{\text{Useful life}}$$

There are the resources that serve in many difference programmes or department such as general hospital administration, central laundry, cleaning, electricity, water supply, telephone and so on, is called ‘shared cost or overhead cost’. If individual program are to be costed, these shared cost may need to be attributed to programmes. These overhead cost need to be allocated to programmes or department by the basis of some measure, called an allocation basis such as square feet of floor used, number of health personnel in each department, number of patient visit, number of time spent, distance and so on. (Michael F. Drummond, 2005) In this study all overhead costs are summarized to the whole overhead cost of health care

facility in fiscal year 2014 and then allocated to diabetes treatment at the first round by the basis of number of patient visit in fiscal year 2014, then allocated to each activity on basis of the proportion of number of time spent in each activity divided by number of time spent in providing the treatment of type 2 diabetes in whole fiscal year 2014 as a second round of allocation.

Cost category which is assigned in this step can help for estimate the cost of activities.

Cost category of each resource used in each activity of providing the treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei are shown in Table 4-1

Table 4- 1 Cost category

Component Activity	Category	
1.Preparing Medical Record Card		
- Staff	LC	Indirect cost
- Ink (for printer)	MC	Indirect cost
- Printer	CC	Indirect cost
- Computer	CC	Indirect cost
- Medical record cabinet	CC	Indirect cost
- Furniture	CC	Indirect cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost
2.Providing Medical Check-up		
- Staff	LC	Indirect cost
- Concentrated artificial flavored syrup	MC	Indirect cost
- Leaflet, poster	MC	Direct cost
- Blood pressure gauge	CC	Indirect cost
- Weighing machine	CC	Indirect cost
- Health education material	CC	Indirect cost
- Furniture	CC	Indirect cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost
3.Providing Laboratory test		
- Staff	LC	Indirect cost
- Medical supply	MC	Direct cost
- Strip	MC	Direct cost
- Glucometer	CC	Direct cost
- Annual laboratory test	MC	Direct cost

Component Activity	Category	
- Furniture	CC	Indirect cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost
4.Giving an advice		
- Staff	LC	Indirect cost
- Computer	CC	Indirect cost
- Furniture	CC	Indirect cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost
5.Preparing medicine		
- Staff	LC	Indirect cost
- Label sticker	MC	Direct cost
- medicine bag	MC	Direct cost
- plastic bag	MC	Direct cost
- Medicine	MC	Direct cost
- Printer	CC	Indirect cost
- Computer	CC	Indirect cost
- Cabinet	CC	Indirect cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost
6.Eye examination		
- Staff	LC	Indirect cost
- Medical supply	MC	Direct cost
- Fundus camera	CC	Direct cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost
7.Dental care		
- Staff	LC	Indirect cost
- Medical supply	MC	Direct cost
- Medical material	MC	Direct cost
- Dental Unit (Dental Bed)	CC	Indirect cost
- Overhead	LC,MC,CC	Indirect cost
- Space	CC	Indirect cost

Note: LC refers to Labor Cost, MC refers to Material Cost and CC refers to Capital Cost

4.5.3 Cost driver1

After identified the cost which assigned in each activity, then calculate the cost driver rate that use for assigning activity costs to services. Cost driver or allocation base in Activity-Based Costing approach can be used both volume related and non- volume related allocation base (Baker, 1998). In this study used annual time

spent in each activity divided by number of time use to perform the services in whole year as a cost driver rate of each cost. Cost driver rate in this study means cost per one minute used to perform the activity (Laingoen, 2013). For direct cost which is related directly with the activity to perform the treatment, it used number of volume as a basis of allocation.



$$\text{Cost allocation rate} = \frac{\text{Annual cost of resource}}{\text{Annual quantity of cost driver}}$$

4.5.4 Total cost of activity

Final step of calculating cost of each activity of treatment of diabetes is multiplying the actual quantity of allocation (time spent or volume) by the cost allocation rate of each resource for treatment of diabetes activity.

4.5.5 Cost of treatment of type 2 Diabetes

Total cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in fiscal year 2014 is summation of total cost of each activity which is provided for treatment type 2 diabetes.

In this study the cost of treatment of type 2 Diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei should be the average cost of treatment of type 2 diabetes per one patient per year. The cost of treatment of type 2 diabetes per one patient per year equal total cost of treatment of type 2 diabetes patient of each health facility divided by number of patient who are received the treatment in that health facility in Fiscal Year 2014.

$$\begin{aligned} &\text{Cost of treatment of type 2 diabetes per one patient per year} \\ &= \frac{\text{Total cost of treatment of type 2 diabetes}}{\text{no. of patient who recieved the treatment}} \end{aligned}$$

4.6 Outcome/ Effectiveness

For ongoing of treatment of diabetes, patients have been appoint to follow-up the treatment every 1-3 months. Follow-up the treatment including physical examination (measuring weight, blood pressure level), health education (self or group), measuring blood sugar level, see the doctor etc. The main point of follow-up the treatment is for assessment the glycemc control of each patient. For assessment the glycemc control, HbA1c is recommended indicator for measuring glycemc

control. Patient with diabetes have been collected blood for HbA1c test at least once per year (Diabetes Association of Thailand, 2014).

The outcome or effectiveness in this study concern about glycemic control of diabetic patients, As the HbA1c is the reliable result of glycemic control than Fasting Blood Sugar (FBS). In this study HbA1c result is selected to evaluate the outcome or effectiveness. The outcome or effectiveness in this study is the proportion of the number of patient visits with a HbA1c test result of less than 7% (recommended for ongoing treatment by Diabetes Association of Thailand) per total number of patient visits which tested for HbA1c.

$$\text{effectiveness} = \frac{\text{no. of patient visit with a HbA1c} < 7\%}{\text{total no. of patient vissit which tested for HbA1c}}$$

4.7 Cost – Effectiveness Analysis

The Cost-Effectiveness is a comparison of cost of treatment of type 2 diabetes divided by the effectiveness. The result of Cost-Effectiveness in this study shows the cost of one success glycemic control per one patient per year in each health facility. Then compare the result of both health facilities, which health facility that cost per effectiveness is lower.

CHAPTER V

ANALYSIS AND RESULT

This study analyses and compares the cost and effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in Fiscal Year 2014. Activity-Based Costing approach was applied for calculation cost of treatment of type 2 diabetes.

5.1 The cost of treatment of type 2 diabetes patient at Phyathai Sithivej Clinic

The cost of treatment of type 2 diabetes patient at Phyathai Sithivej Clinic in Fiscal Year 2014 include the cost of the activities incurred for providing the treatment in Fiscal Year 2014. It can be separated into four main parts consist with staff cost for those who are involved for treatment of type 2 diabetes, material cost that are used in the activity, the overhead cost (shared cost) which is the cost of management of health facility and capital cost of the capital asset which invested for providing the service of health facility. The cost was calculated by using Activity-Based Costing Method (ABC).

To calculate cost of providing the treatment of type 2 diabetes at Phyathai Sithivej Clinic in this study we used the total number of time spent in each activity for allocating the cost of each activity.

Total number of time spent in each activity come from average time spent per one patient per one visit in each activity multiplying with number of patient visit in fiscal year 2014. Average and total time spent in each activity of providing the treatment of type 2 diabetes at Phyathai Sithivej in fiscal year 2014 is shown in Table 5-1.

Table 5- 1 Time spent in each activity of treatment of Phyathai Sithivej Clinic in Fiscal Year 2014

1	2	3	4
Activity	No. of patient visit in fiscal year 2014 (visits)	Average time spent per visit (minutes)	Total time spent in one year (minutes)
1.Preparing Medical Record Card	1,094	3	3,282
2.Providing physical Examination	1,094	7	7,658
3.Providing Blood glucose measurement	1,094* 142**	3 10	4,702
4.Giving an advice	1,094	5	5,470
5.Preparing medicine	1,094	4	4,376
6.Providing eye examination	144	10	1,440
Total			<u>26,928</u>

Note1: * Number of patient visit in whole year that has been tested for capillary blood glucose level, ** Number of patient visit in whole year that has been tested for HbA1c

From Table 5-1 average time spent per visit in column 3 is the number of time spent in each activity per visit which comes from the interview of personnel who involved to perform the activity of treatment of type 2 diabetes in this study. Total time spent in column 4 come from the average time spent per visit in column 3 multiplying with number of patient visit in fiscal year 2014 in column 2. For providing blood glucose measurement, total time spent in one year come from total time spent in measuring capillary blood glucose which has been test for every visit and total time spent in one year of measuring venous hemoglobin which has been test at least once per year. Eye examination the number of patient visit (144) in fiscal year come from 80% of number of type 2 diabetes in fiscal year 2014 (181 patients), even the Diabetes Association of Thailand suggested diabetic patient should be tested for eye at least once per year but in practice health care facility cannot provide this services to all diabetic patient but they have set the target of diabetic patients who received eye examination 80% of number of diabetes and patients were selected by the general practitioner's recommendation for those who are risk group.

Table 5- 2 Calculation staffs' cost for providing the treatment of type 2 diabetes patient at Phyathai Sithivej Clinic in 2014

(1)	(2)	(3)	(4)	(5)	(6)
Category	Annual salary (Baht)	Annual quantity cost driver (min)	Allocation rate (Baht/min)	Activity 1 (Baht)	Activity 2 (Baht)
			(2) / (3)	3,282 min*(4)	7,658 min*(4)
Doctor	660,000	72,000	9.167		
Nurse	309,000	120,000	2.575		19,719.35
Nurse	309,000	120,000	2.575		19,719.35
Nurse aid	113,400	120,000	0.945	3,101.49	7,236.81
Nurse aid	113,400	120,000	0.945	3,101.49	7,236.81
Public Health Officer	189,000	120,000	1.575	5,169.15	12,061.35
Public Health Officer	189,000	120,000	1.575	5,169.15	12,061.35
Pharmacy	429,000	120,000	3.575		
Total staffs' cost	2,311,800			16,541.28	78,035.02

Notes: Activity 1 refers to preparing medical record card, Activity 2 refers to providing physical examination, min refers to minute

Table 5-2 Calculation staffs' cost for providing the treatment of type 2 diabetes patient at Phyathai Sithivej Clinic in 2014 (Cont.)

(1)	(7)	(8)	(9)	(10)	(11)
Category	Activity 3 (Baht)	Activity 4 (Baht)	Activity 5 (Baht)	Activity 6 (Baht)	Total (Baht)
	4,702 min*(4)	5,470 min*(4)	4,376 min*(4)	1,440 min*(4)	Summation of (5) – (10)
Doctor		50,141.67			50,141.67
Nurse	12,107.65			3,708.00	35,535.00
Nurse	12,107.65			3,708.00	35,535.00
Nurse aid	4,443.39			1,360.80	16,142.49
Nurse aid	4,443.39			1,360.80	16,142.49
Public Health Officer	7,405.65		6,892.20	2,268.00	33,796.35
Public Health Officer	7,405.65		6,892.20	2,268.00	33,796.35
Pharmacy			15,644.20		15,644.20
Total staffs' cost	47,913.38	50,141.67	29,428.60	14,673.60	<u>236,733.55</u>

Notes: Activity 3 refers to providing blood sugar measurement, Activity 4 refers to giving an advice, Activity 5 refers to preparing medicine, Activity 6 refers to providing eye examination, min refers to minute

From Table 5-2 annual quantity cost driver in column 3 is number of working time in one year. For medical doctor who provided the treatment of diabetes, the working time is 60 minutes x 8 hours per day x 3 days per week x 50 weeks = 72,000 minutes per year. For others personnel working time per year is 60 minutes x 8 hours per day x 5 days per week x 50 weeks = 120,000 minutes. Service schedule is used for calculation the working time. The reason of using 50 weeks because the clinic closes every Thai Public Holiday, it's approximately 13 days per year this study assume 2 weeks, then the working time is 50 weeks per year. The allocation rate in column 4 shows the labor cost per one minute of each personnel. The total in column 11 shows the total labor cost of each personnel who involved to perform the treatment of type 2 diabetes in fiscal year 2014. The last row of column 5 -10 show the labor cost of each activity which perform the treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014. The total staffs' cost of providing the treatment of type 2 diabetes at Phyatha Sithivej Clinic in fiscal year was equal to 236,733.55 Baht.

Table 5- 3 Calculation of material cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014

	1	2	3	4
	Cost component	Amount	Price per one unit (Baht)	Total cost (Baht) (column 2 * column 3)
1	1.Preparing medical record card			
2	ink (for printer)	3	450.00	1,350.00
3	Total			1,350.00
4	2. Providing physical examination			
5	Leaflet, Poster			1,000.00
6	Concentrated artificial flavored syrup	3	50.00	150.00
7	Total			1,150.00
8	3.Providing blood glucose measurement			
9	Medical supply			6,000.00
10	Medical equipment			3,000.00
11	Strip	1,200	7.00	8,400.00
12	Laboratory test	142	280.00	39,760.00
13	Total			57,160.00
14	4.Giving an advice by doctor			
15	ink (for printer)	2	450.00	900.00
16	Total			900.00
17	5.Preparing medicine			
18	Label sticker	3,000	0.30	900.00
19	medicine bag	3,000	0.30	900.00
20	plastic bag	1,500	0.70	1,050.00
21	Medicine		97,744.00	97,744.00
22	Total			100,594.00
23	6.Providing eye examination			
24	Laboratory test	144	50.00	7,200.00
25	Total			7,200.00
26	Total material cost			<u>168,354.00</u>

From Table 5-3, the material cost of each activity of providing the treatment of type 2 diabetic patients in fiscal year 2014 used volume basis for allocated the cost to activities. The amount of laboratory test in column 2, row 12 of providing blood glucose measurement is the number of patients who has been tested for HbA1c. Total amount of medicine cost (97,744 Baht) in column 3 and row 21 is a medicine cost which is collected from the invoice. The material cost of each activity is shown in column 4 rows 3, 7, 13, 16, 22 and 25 respectively. The total material cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014 was 168,354 Baht.



Table 5- 4 Calculation of capital cost of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic in fiscal year 2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Am oun t	Purchase price per one unit (Baht)	Useful life (years)	Residual value per one unit (Baht)	Annual cost or annual depreciation per one unit (Baht) {(3)– (5)}/(4)}	Total annual cost or annual depreciation (Baht) [(6)*(2)]
1	1.Preparing Medical record card						
2	Computer	1	20,000.00	5	2,000.00	3,600.00	3,600.00
3	Printer	1	3,500.00	5	350.00	630.00	630.00
4	Cabinet	3	5,000.00	15	500.00	300.00	900.00
5	Furniture		5,000.00	15	500.00	300.00	300.00
6	Space						117,078.00
7	Total						
8	2.Medical check-up						
9	Blood pressure gauge	2	4,500.00	10		450.00	900.00
10	Weighing machine	1	4,500.00	10		450.00	450.00
11	Furniture		15,000.00	15	1,500.00	900.00	900.00
12	Space						117,078.00
13	Total						
14	3.Provide the blood sugar test						
15	Glucometer	2	3,000.00	5		600.00	1,200.00
16	Furniture		20,000.00	15	2,000.00	1,200.00	1,200.00
17	Space						117,078.00
18	Total						
19	4.Giving an advice by doctor						
20	Computer	1	20,000.00	5	2,000.00	3,600.00	3,600.00
21	Furniture		10,000.00	15	1,000.00	600.00	600.00
22	Space						117,078.00
23	Total						
24	5.Preparing medicine						
25	Printer	1	8,500.00	5	850.00	1,530.00	1,530.00
26	Computer	1	20,000.00	5	2,000.00	3,600.00	3,600.00
27	Cabinet	3	5,000.00	10	500.00	450.00	1,350.00
28	Furniture		5,000.00	15	500.00	300.00	300.00
29	Space						117,078.00
30	Total						
31	6.Eye check						
32	Space						117,078.00
33	Total						
34	Total capital cost						

Table 5-4 Calculation of capital cost of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic in fiscal year 2014 (Cont.)

(1)	(8)	(9)	(10)	(11)	(12)
	Cost driver	Annual Quantity of cost driver (minutes)	Cost allocation rate [(7)/(9)]	Actual quantity of allocation based (minutes)	Allocation activity cost (Baht) [(10)*(12)]
1.Preparing Medical record card					
Computer	minute used	138,000	0.0261	3,282	85.62
Printer	minute used	138,000	0.0046	3,282	14.98
Cabinet	minute used	138,000	0.0065	3,282	21.40
Furniture	minute used	138,000	0.0022	3,282	7.13
Space	minute used	26,928	4.3478	3,282	14,269.53
Total					14,398.67
2.Medical check-up					
Blood pressure gauge	minute used	138,000	0.0065	7,658	49.94
Weighing machine	minute used	138,000	0.0033	7,658	24.97
Furniture	minute used	138,000	0.0065	7,658	49.94
Space	minute used	26,928	4.3478	7,658	33,295.58
Total					33,420.44
3.Provide the blood glucose test					
Glucometer	minute used	26,928	0.0446	4,702	209.54
Furniture	minute used	138,000	0.0087	4,702	40.89
Space	minute used	26,928	4.3478	4,702	20,443.43
Total					20,693.86
4.Giving an advice by doctor					
Computer	minute used	138,000	0.0261	5,470	142.70
Furniture	minute used	138,000	0.0043	5,470	23.78
Space	minute used	26,928	4.3478	5,470	23,782.56
Total					23,949.03
5.Preparing medicine					
Printer	minute used	138,000	0.0111	4,376	48.52
Computer	minute used	138,000	0.0261	4,376	114.16
Cabinet	minute used	138,000	0.0098	4,376	42.81
Furniture	minute used	138,000	0.0022	4,376	9.51
Space	minute used	26,928	4.3478	4,376	19,026.04
Total					19,241.04
6.Eye check					
Space	minute used	26,928	4.3478	1,440	6,260.86
Total					6,260.86
Total capital cost					<u>117,963.89</u>

From Table 5-4 the annual quantity of cost driver in column 9 is the number of operating time of Phyathai Sithivej Clinic in fiscal year 2014 (60 minutes x 46 hours per week x 50 weeks per year = 138,000 minutes per year). For the space cost or the cost of building, Phyathai Sithivej Clinic rent the building to provide the services, annual cost of space in column 7 rows 6, 12, 17, 22, 29 and 32 were allocated from the whole annual space cost to the annual cost of space of providing the treatment of type 2 diabetes by allocation rate of time spent for providing the treatment of type 2 diabetes divided by the whole year of providing the service of Phyathai Sithivej Clinic, the calculations of space cost is shown in Table 5-5

Table 5- 5 Calculation of space cost of Phyathai Sithivej Clinic in fiscal year 2014

(1)	(2)	(3)	(4)	(5)
Annual Rent (Baht)	Operation time (minutes)	Allocation rate [(1) * (2)]	Time used for providing the treatment of type 2 diabetes (minutes)	Annual rent cost of providing the treatment of type 2 diabetes (Baht) [(3) *(4)]
600,000	138,000	4.3478	26,928	<u>117,078.26</u>

From Table 5-5 is the first round of allocation the space cost or annual rent cost of building to annual rent cost of providing the treatment of type 2 diabetes in fiscal year 2014, the annual rent of building for providing the treatment of type 2 diabetes was 117,078.26 Baht. Annual rent of building of treatment of type 2 diabetes was allocated to each activity, the allocation rate (column 10 Of Table 5-4) for the second round is annual rent of treatment of type 2 diabetes (from column 5 in Table 5-5) divided time spent for providing the treatment of type 2 diabetes in fiscal year 2014 (from Table 5-1), then multiply the allocation rate with time spent in each activity of providing the services.

Overhead cost of Phyathai Sithivej Clinic in this study including manager salary, electricity, water supply, telephone, office material and air conditioner are shown in Table 5-6

Table 5- 6 Overhead cost of Phyathai Sithivej Clinic in fiscal year 2014

Cost component	Annual cost (Baht)
Manager salary	420,000
Water supply	38,400
Electricity	60,000
Office material	5,000
Depreciation of air conditioner	13,200*
Total	<u>536,600</u>

Note: * calculation of depreciation of air conditioner used straight-line method

Overhead cost of Phyathai Sithivej Clinic in fiscal year 2014 was 536,600 Baht. The overhead cost is supportive cost for providing the services. The overhead cost should be allocated to the treatment of type 2, allocation rate is number of type 2 diabetes visit in fiscal year divided by number of patient visit in whole year as shown in Table 5-7

Table 5- 7 Calculation overhead cost to cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014

1	2	3	4	5
Overhead cost in whole year (Baht)	No. of patient visit in whole year (visits)	Overhead per visit (Baht)	No. of diabetes visit in whole year (visits)	Overhead cost of treatment of type 2 diabetes (Baht) [column 3 * column 4]
536,600	9,695	55.35	1,094	<u>60,550.84</u>

From Table 5-7 the overhead cost which is allocated to the cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014 was 60,550.84 Baht. Overhead cost of treatment of type 2 diabetes should be allocated to each activity of providing the treatment, the allocation rate is total time spent in each activity divided by total time spent for providing the treatment of type 2 diabetes in fiscal year 2014, the overhead cost of each activity is shown in Table 5-8

Table 5- 8 Calculation of overhead cost of treatment of type 2 diabetes to each activity

	1	2	3	4	5
1	Activity	Total time spent in one year (minutes)	Allocation rate [column 2 / (row 8 of column 2)]	Overhead cost of treatment of type 2 diabetes (Baht)	Overhead cost (Baht) [column 3 * column 4]
2	1.Preparing Medical Record Card	3,282	0.1219	60,550.84	7,379.97
3	2.Providing Physical Examination	7,658	0.2844	60,550.84	17,219.93
4	3.Providing Blood sugar measurement	4,702	0.1746	60,550.84	10,573.01
5	4.Giving an advice	5,470	0.2031	60,550.84	12,299.95
6	5.Preparing medicine	4,376	0.1625	60,550.84	9,839.96
7	6. Providing eye examination	1,440	0.0535	60,550.84	3,238.01
8	Total	26,928			<u>60,550.84</u>

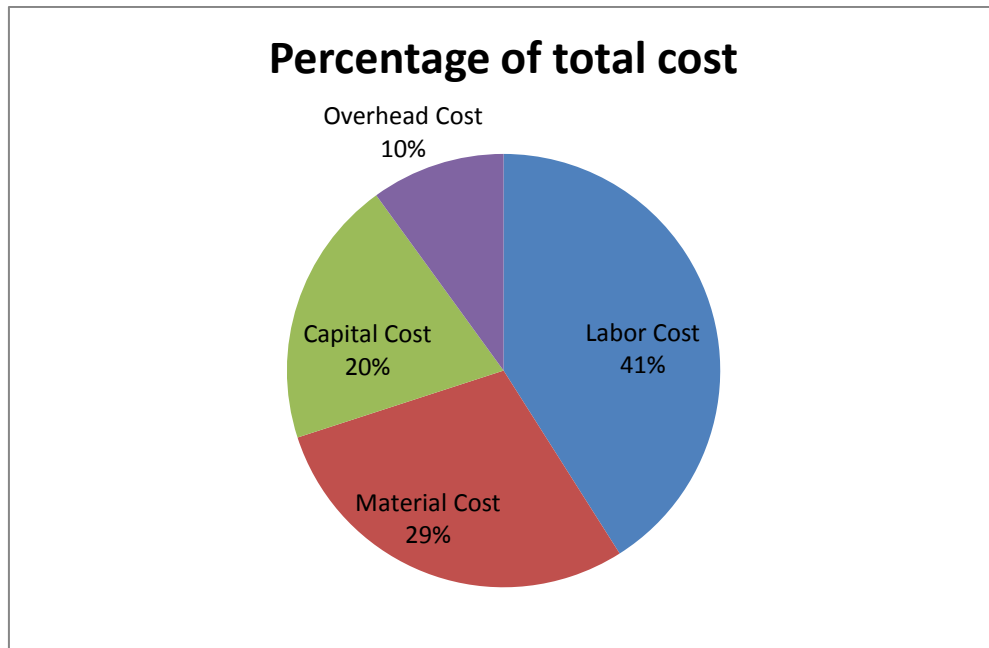
After we got all cost related with the treatment of type 2 diabetes, we have to summarize all cost to find the cost of treatment of type 2 diabetes in whole year. The cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic is shown in Table 5-9

Table 5- 9 Calculation of cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014

	(1)	(2)	(3)	(4)	(5)	(6)
	Activity	Labor Cost (LC) (Baht) [From Table 5-2]	Material Cost (MC) (Baht) [From Table 5-3]	Capital Cost (CC) (Baht) [From Table 5-4]	Overhead Cost (Baht) [From Table 5-8]	Total (Baht) [(2) + (3) + (4) + (5)]
1	1.Preparing Medical Record Card	16,541.28	1,350.00	14,398.67	7,379.97	39,669.92
2	2.Providing Physical Examination	78,035.02	1,150.00	33,420.44	17,219.93	129,825.39
3	3.Providing Blood sugar measurement	47,913.38	57,160.00	20,693.86	10,573.01	136,340.25
4	4.Giving an advice	50,141.67	900.00	23,949.03	12,299.95	87,290.65
5	5.Preparing medicine	29,428.60	100,594.00	19,241.04	9,839.96	159,103.60
6	6. Providing eye examination	14,673.60	7,200.00	6,260.86	3,238.01	31,372.47
7	Total	236,733.55	168,354.00	117,963.90	60,550.83	<u>583,602.28</u>

Table 5-9 provides total cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014, was equal to 583,602.28 Baht.

Figure 5- 1 Percentage of the total cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic in fiscal year 2014



From Figure 5-1, the most expenditure at Phyathai Sithivej Clinic was the labor cost. There are 41%, 29% for the material cost, 20% for the capital cost and 10% for overhead cost.

5.2 The cost of treatment of type 2 diabetic patient at Public Health Center 41 Khlong Toei

The cost of treatment of type 2 diabetes patient at Public Health Center 41 Khlong Toei in fiscal year 2014 including cost of staffs who performed the service for treatment of type 2 diabetes, material cost that used for treatment capital cost, and overhead cost. Before calculate related cost of treatment we have to know time spent in each activity of providing the services. Time spent in each activity of providing the treatment of type 2 diabetes in fiscal year 2014 are presented in Table 5-10

Table 5- 10 Time spent in each activity of providing the treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014

(1) Activity	(2) Average time spent per one visit (minutes)	(3) No. of patients visit in one year (visits)	(4) Total time spent in one year (minutes) [(2) * (3)]
1.Preparing medical record card	3	2,725	8,175
2.Providing blood glucose measurement	3 ¹	2,725	11,165
	10 ²	299	
3.Providing physical examination	7	2,725	19,075
4.Giving an advice	5	2,725	13,625
5.Preparing medicine	4	2,725	10,900
6.Providing eye examination	15	250	3,750
7.Providing dental care	15	250	3,750
Total			<u>70,440</u>

Notes: ¹Refers to average time spent per one visit for providing capillary blood sugar measurement for every visit, ²Refers to average time spent per one visit for providing blood collection for HbA1c test

From Table 5-10 average time spent in each activity is come from the interview of staffs who provided the services for treatment of type 2 diabetes at Public Health Center 41 Khlong Toei. The number of patient visit of providing eye examination and dental care is 80% of number of patient who received the treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014 (313 patients). Even the Diabetes Association of Thailand suggested that every diabetic patient should be checked for eye and dental care once a year but in practice the health care facility could not provide the services to all patients. The Department of Public Health, Bangkok Metropolitan Administration (BMA), the organization which has responsibility to control the public health center had set the target of treatment of type 2 diabetes and the number of diabetic patient for eye examination and dental care should not less than 80%, then Public Health Center 41 Khlong Toei meet the target in fiscal year 2014.

First step to calculate the cost of treatment of type 2 diabetes at Public Health Center 41 Khlong Toei is the calculation of staffs' cost.

Table 5- 11 Calculation of staffs' cost of treatment of type 2 diabetic patients at Public Health Center 41 Khlong Toei in fiscal year 2014

(1)	(2)	(3)	(4)	(5)	(6)
Category	Annual salary (Baht)	Annual quantity of cost driver (minutes)	Allocation rate (Baht/minute) [(2) / (3)]	Activity 1 (Baht) [8,175min * (4)]	Activity 2 (Baht) [11,165min*(4)]
Doctor	608,210	120,000	5.0684		
Doctor	492,000	52,000	9.4615		
Doctor	492,000	52,000	9.4615		
Doctor	492,000	52,000	9.4615		
Nurse	225,410	120,000	1.8784		
Nurse	192,000	120,000	1.6000		
Staff	201,400	120,000	1.6783	13,720.38	
Staff	149,800	120,000	1.2483	10,205.13	
Staff	169,480	120,000	1.4123	11,545.83	
Staff	172,200	120,000	1.4350		
Staff	115,620	120,000	0.9635		
Staff	198,000	120,000	1.6500		18,422.25
Pharmacy	680,330	120,000	5.6694		
Pharmacy assistant	208,610	120,000	1.7384		
Staff	142,680	120,000	1.1890		
Staff	172,200	120,000	1.4350		
Dentist	658,370	120,000	5.4864		
Dentist assistant	180,000	120,000	1.5000		
Staff	115,620	120,000	0.9635		
Staff	144,000	120,000	1.2000		
Ophthalmologists	857,470	120,000	7.1456		
Nurse	120,000	36,000	3.3333		
Staff	201,400	120,000	1.6783		
Total	6,988,800			35,471.33	18,422.25

Notes: Activity 1 refers to preparing medical record card, Activity 2 refers to providing blood glucose level measurement, min refers to minute

Table 5-11 Calculation of staffs' cost of treatment of type 2 diabetic patients at Public Health Center 41 Khlong Toei in fiscal year 2014 (Cont.)

(1)	(7)	(8)	(9)	(10)	(11)	(12)
Category	Activity 3 (Baht) [19,075min * (4)]	Activity 4 (Baht) [3406min * (4)]	Activity 5 (Baht) [10,900min * (4)]	Activity 6 (Baht) [3,750min * (4)]	Activity 7 (Baht) [3,750min * 4]	Total (Baht) (summati on of (5)- (11))
Doctor		17,264.29				17,264.29
Doctor		32,228.37				32,228.37
Doctor		32,228.37				32,228.37
Doctor		32,228.37				32,228.37
Nurse	35,830.80					35,830.80
Nurse	30,520.00					30,520.00
Staff						13,720.38
Staff						10,205.13
Staff						11,545.83
Staff	27,372.63					27,372.63
Staff	18,378.76					18,378.76
Staff						18,422.25
Pharmacy			61,796.64			61,796.64
Pharmacy assistant			18,948.74			18,948.74
Staff			12,960.10			12,960.10
Staff			15,641.50			15,641.50
Dentist					20,574.06	20,574.06
Dentist assistant					5,625.00	5,625.00
Staff					3,613.13	3,613.13
Staff					4,500.00	4,500.00
Ophthalmologists				26,795.94		26,795.94
Nurse				12,500.00		12,500.00
Staff				6,293.75		6,293.75
Total	112,102.19	113,949.39	109,346.98	45,589.69	34,312.19	<u>469,194.01</u>

Note: Activity 3 refers to providing physical examination, Activity 4 refers to giving an advice, Activity 5 refers to preparing medicine, Activity 6 refers to providing eye examination, Activity 7 refers to providing dental care, min refers to minute

From Table 5-11 the annual quantity of cost driver in column 3 is a working time (minutes) at Public Health Center 41 Khlong Toei in fiscal year 2014 of each health personnel, some of them are full time staff and some of them are part-time staff. There is one fulltime general practitioner and three part time general practitioners, full time general practitioner worked 120,000 min per year (120,000 minute come from 60 minutes x 8 hours per day x 5 days per week x 50 weeks per year) and 3 of part time general practitioners worked 52 hours per week (60 minutes x 52 hours per week x 50 weeks equal to 156,000 minutes in whole year, then divided working time in whole years by number of part time general practitioner, thus working time of each general practitioner equal to 52,000 minutes in whole year). General practitioners spent approximately 5 minutes per one patient visit for giving an advice about the treatment, adjust medicine in some case, prescript the medicine and so on. In this study the number of patient visited for treatment type 2 diabetes is 2725 visits. We separate the number of visited for each general practitioner equally at 682 visited. Then each general practitioner spent 3406 minutes per year (682 visits x 5 min per visit) for providing the treatment of type 2 diabetes. Allocation rate in column 4 is the cost of each personnel per one minute. Total cost in column 12 is the total cost of each personnel who provided the treatment of type 2 diabetes. Last rows of column 5 – 11 are the staffs' cost in each activity of providing the treatment of type 2 diabetes. Total staffs' cost of providing the treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014 was equal to 469,194.01 Baht.

Table 5- 12 Calculation of material cost of treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014

(1)	(2)	(3)	(4)
Cost component	Amount	Price per one unit (Baht)	Total cost (Baht) [(2)*(3)]
1.Preparing Medical record card			
Stationary		200.00	200
ink	5	500.00	2,500
Total			2,700
2.Providing blood glucose measurement			
Stationary		200.00	300
Medical material		3,000.00	3,000
Medical supply		25,000.00	25,000
Strip	3,000	8.00	24,000
Annual laboratory test	299	120.00	35,880
Total			88,180
3.Providing physical examination			
Stationary		400.00	400
Leaflet, Poster		5,000.00	5,000
Concentrated artificial flavored syrup	24	45.00	1,080
Total			6,480
4.Giving an advice			
Stationary		400.00	400
Ink	4	500.00	2,000
Total			2,400
5.Preparing Medicine			
Label sticker	7,500	0.30	2,250
medicine bag	7,500	0.70	5,250
plastic bag	3,500	0.80	2,800
Medicine		280,000.00	280,000
Ink	5	600.00	3,000
Total			293,300
6.Eye examination			
Non-medical material		2,000.00	2,000
Medical supply		10,000.00	10,000
Total			12,000
7.Dental care			
Medical supply		10,000.00	10,000
Total			10,000
Total material cost			415,060

From the table 5-12, medicine cost was equal to 280,000 Baht come from the number of medicine that patients have been described multiplying by purchase price. Material cost of providing the treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014 was equal 415,060 Baht.

Next we have to calculate the capital cost of providing the treatment of type 2 diabetic patient at Public Health Center 41 Khlong Toei in fiscal year 2014.



Table 5- 13 Calculation of Capital Cost of treatment of type 2 diabetic patient at Public Health Center 41 Khlong Toei in fiscal year 2014

(1)	(2)	(3)	(4)	(5)	(6)
	Amount	Purchase price (Baht)	Useful life (years)	Residual (Baht)	Annual depreciation (Baht) [(3) – (5)/ (4)]
1.Preparing Medical record card					
Printer	2	4,800	5	960	768
Computer	3	25,000	5	5,000	4,000
Cabinet	1	150,000	10	30,000	12,000
Furniture	1	10,000	15	2,000	533
Space	1	20,000,000	25	4,000,000	640,000
Total					
2.Measuring blood sugar					
Printer	1	4,800	5	960	768
Computer	1	25,000	5	5,000	4,000
Furniture	1	80,000	15	16,000	4,267
Space	1	20,000,000	25	4,000,000	640,000
Total					
3.Physical examination					
Printer	1	4,800	5	960	768
Computer	1	25,000	5	5,000	4,000
Blood pressure gauge	2	5,500	10	1,100	440
Weighing machine	2	4,500	10	900	360
Furniture	1	10,000	15	2,000	533
Space	1	20,000,000	25	4,000,000	640,000
Total					
4.Giving an advice					
Printer	4	4,800	5	960	768
Computer	4	25,000	5	5,000	4,000
Furniture	4	25,000	15	5,000	1,333
Space	1	20,000,000	25	4,000,000	640,000
Total					
5.Preparing Medicine					
Printer	3	8,500	5	1,700	1,360
Computer	3	25,000	5	5,000	4,000
Cabinet	1	100,000	10	20,000	8,000
Furniture	1	20,000	15	4,000	1,067

(1)	(2)	(3)	(4)	(5)	(6)
	Amount	Purchase price (Baht)	Useful life (years)	Residual (Baht)	Annual depreciation (Baht) [(3) – (5)/ (4)]
Space	1	20,000,000	25	4,000,000	640,000
Total					
6.Eye examination					
Printer	1	4,800	5	960	768
Computer	1	25,000	5	5,000	4,000
Fundus camera	1	1,200,000	15	240,000	64,000
Furniture	1	5,000	15	1,000	267
Space	1	20,000,000	25	4,000,000	640,000
Total					
7.Dental care					
Printer	1	4,800	5	960	768
Computer	1	25,000	5	5,000	4,000
Dental Unit	3	480,000	15	96,000	25,600
Furniture	1	20,000	15	4,000	1,067
Space	1	20,000,000	25	4,000,000	640,000
Total					
Total capital cost					

Table 5-13 Calculation of Capital Cost of treatment of type 2 diabetic patient at Public Health Center 41 Khlong Toei in fiscal year 2014 (Cont.)

(1)	(7)	(8)	(9)	(10)	(11)
	Total annual cost or annual depreciation (Baht) [(6) * (2)]	Annual Quantity of cost driver (minutes)	Cost allocation rate (Baht/minute) [(6) / (8)]	Actual quantity of allocation based (minutes)	Allocation activity cost (Baht) [(9) * (10)]
1.Preparing Medical record card					
Printer	1,536	138,000	0.0111	8,175	90.99
Computer	12,000	138,000	0.0870	8,175	710.87
Cabinet	12,000	138,000	0.0870	8,175	710.87
Furniture	533	138,000	0.0039	8,175	31.59
Space	640,000	138,000	4.6377	8,175	37,913.04
Total					39,457.37
2.Measuring blood sugar					
Printer	768	138,000	0.0056	11,165	62.14
Computer	4,000	138,000	0.0290	11,165	323.62
Furniture	4,267	138,000	0.0309	11,165	345.20
Space	640,000	138,000	4.6377	11,165	51,779.71
Total					52,510.67
3.Physical examination					
Printer	768	138,000	0.0056	19,075	106.16
Computer	4,000	138,000	0.0290	19,075	552.90
Blood pressure gauge	880	138,000	0.0064	19,075	121.64
Weighing machine	720	138,000	0.0052	19,075	99.52
Furniture	533	138,000	0.0039	19,075	73.72
Space	640,000	138,000	4.6377	19,075	88,463.77
Total					89,417.70
4.Giving an advice					
Printer	3,072	138,000	0.0223	13,625	303.30
Computer	16,000	138,000	0.1159	13,625	1,579.71
Furniture	5,333	138,000	0.0386	13,625	526.57
Space	640,000	138,000	4.6377	13,625	63,188.41
Total					65,597.99
5.Preparing Medicine					

(1)	(7)	(8)	(9)	(10)	(11)
	Total annual cost or annual depreciation (Baht) [(6) * (2)]	Annual Quantity of cost driver (minutes)	Cost allocation rate (Baht/minute) [(6) / (8)]	Actual quantity of allocation based (minutes)	Allocation activity cost (Baht) [(9) * (10)]
Printer	4,080	138,000	0.0296	10,900	322.26
Computer	12,000	138,000	0.0870	10,900	947.83
Cabinet	8,000	138,000	0.0580	10,900	631.88
Furniture	1,067	138,000	0.0077	10,900	84.25
Space	640,000	138,000	4.6377	10,900	50,550.72
Total					52,536.95
6.Eye examination					
Printer	768	27,000	0.0284	3,750	106.67
Computer	4,000	27,000	0.1481	3,750	555.56
Fundus camera	64,000	27,000	2.3704	3,750	8,888.89
Furniture	267	27,000	0.0099	3,750	37.04
Space	640,000	138,000	4.6377	3,750	17,391.30
Total					26,979.45
7.Dental care					
Printer	768	138,000	0.0056	3,750	20.87
Computer	4,000	138,000	0.0290	3,750	108.70
Dental Unit	76,800	138,000	0.5565	3,750	2,086.96
Furniture	1,067	138,000	0.0077	3,750	28.99
Space	640,000	138,000	4.6377	3,750	17,391.30
Total					19,636.81
Total capital cost					<u>346,136.94</u>

From Table 5-13 cost driver which is used for calculation the capital cost is minute used in each asset to performed the treatment of type 2 diabetes in fiscal year 2014. Annual quantity of cost driver in column 8 is the operating time of providing the service of Public Health Center 41 Khlong Toei in fiscal year 2014, but it difference in operating time of providing eye service. Operating time of ophthalmology department was only 27,000 minutes in fiscal year 2014 because this department provide the service only 3 hours per day, 3 days in a week, 50 weeks per year.

The cost of providing the treatment of type 2 diabetes is not only Labor cost, material cost and capital cost but also has overhead cost which is the cost of supportive department. The overhead cost of Public Health Center 41 Khlong Toei (shown in Table 5-14) including staffs of supportive department (administrative department, cleanning, security), electricity, water supply, telephone, building maintenance. We sum all overhead cost in fiscal year 2014 and divided by number of patient visit in the whole year (overhead cost per one patient visit). We multiplied the overhead cost per one patient visit with the number of type 2 diabetic patient visit which was equal to 2,725 visits(shown in Table 5-14), then we allocated the overhead cost to each activity by the proportion of time spent in each activity (shown in Table 5-15)

Table 5- 14 Calculation of overhead cost to overhead of providing the treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014

1	2	3	4	6
Overhead cost in 2014 (Baht)	No. of patient visit in 2014 (visits)	Overhead per one patient visit (Baht) [column 1 / column 2]	No. of type 2 diabetic visit in 2014(visits)	Overhead cost of type 2 diabetes in 2014 (Baht) [column3*column4]
3,753,702	52,031	72.14356826	2,725	<u>196,591.22</u>

Table 5- 15 Calculation of overhead cost to each activity of providing the treatment of type 2 diabetes at Public Health Center 42 Khlong Toei in 2014

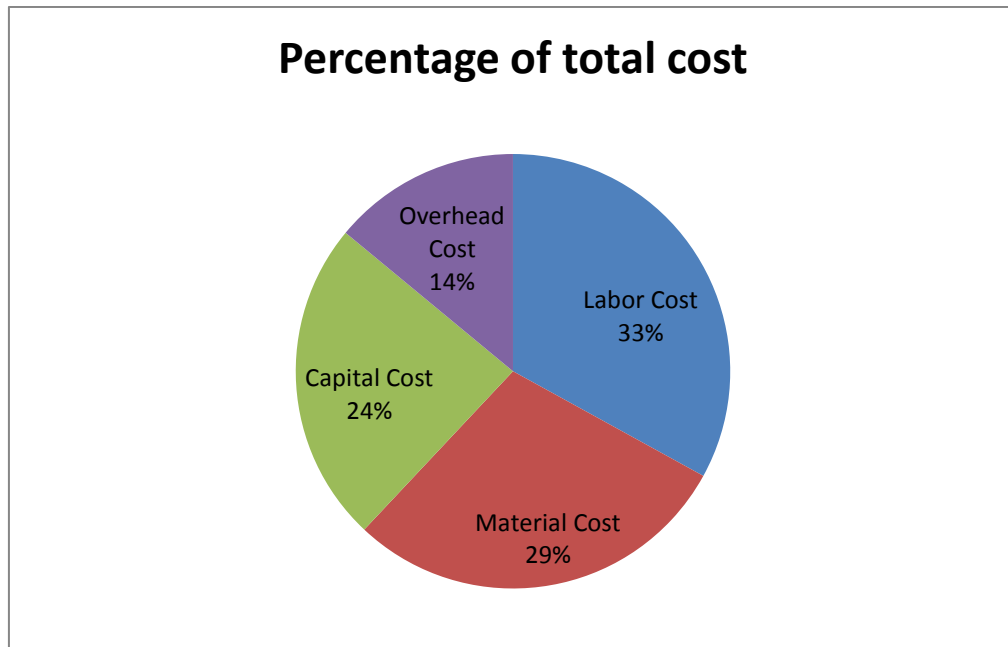
(1) Activity	(2) Time spent per year (minutes)	(3) Allocation rate (Baht/min) [(2)/70,440 min]	(4) Overhead of providing the treatment of type 2 diabetes in 2014 (Baht) [From (6) of Table 5-14]	(5) Total overhead cost in each activity (Baht) [(3) * (4)]
1.Preparing medical record card	8,175	0.1161	196,591.22	22,815.63
2.Providing blood glucose measurement	11,165	0.1585	196,591.22	31,160.43
3.Providing physical examination	19,075	0.2708	196,591.22	53,236.48
4.Giving an advice	13,625	0.1934	196,591.22	38,026.06
5.Preparing medicine	10,900	0.1547	196,591.22	30,420.85
6.Providing eye examination	3,750	0.0532	196,591.22	10,465.89
7.Providing dental care	3,750	0.0532	196,591.22	10,465.89
Total	70,440			<u>196,591.22</u>

Table 5- 16 Calculation of total cost of treatment of type 2 diabetic patients at Public Health Center 41 Khlong Toei in fiscal year 2014

1	2	3	4	5	6
Activity	Labor Cost (Baht) (from Table 5-11)	Material Cost (Baht) (from Table 5-12)	Capital Cost (Baht) (from Table 5-13)	Overhead Cost (Baht) (from Table 5-15)	Total Cost (Baht) [column2+column 3+ column4+column 5]
1. Preparing medical record card	35,471.33	2,700.00	39,457.37	22,815.63	100,444.33
2.Measuring blood glucose level	18,422.25	88,180.00	52,510.67	31,160.43	190,273.35
3.Providing physical examination	112,102.19	6,480.00	89,417.70	53,236.48	261,236.37
4.Giving an advice	113,949.39	2,400.00	65,597.99	38,026.06	219,973.44
5.Preparing medicine	109,346.98	293,300.00	52,536.95	30,420.85	485,604.78
6.Providing eye examination	34,312.19	12,000.00	26,979.45	10,465.89	83,757.53
7.Providing dental care	45,589.69	10,000.00	19,636.81	10,465.89	85,692.39
Total	469,194.01	415,060.00	346,136.94	196,591.22	<u>1,426,982.17</u>

From Table 5-16 total cost of treatment of type 2 diabetic patient at Public Health Center 41 Khlong Toei was equal to 1,426,982.17 Baht.

Figure 5- 2 Percentage of the total cost of treatment of type 2 diabetes at Public Health Center 41 Klong Toei in fiscal year 2014



From Figure 5-2, the most expenditure of providing the treatment of type 2 diabetes at Public Health Center 41 Klong Toei in fiscal year 2014 was the labor cost. There are 33%, 29% for the material cost, 24% for capital cost and 14% of overhead cost.

5.3 The effectiveness of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic

Effectiveness is defined as the proportion of the number of patient visits with a Hemoglobin A1c (HbA1c) test result of less than 7% per total number of patient visits which tested for HbA1c

There are 181 of type 2 diabetic patients who are received the treatment at Phyathai Sithivej Clinic in fiscal year 2014. There is 142 patient visits which tested for HbA1c and there are 98 HbA1c test result of less than 7%.

The effectiveness of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic in fiscal year 2014 was equal to 0.69 (98/142).

5.4 The effectiveness of treatment of type 2 diabetic patients at Public Health Center 41 Khlong Toei

There are 313 of type 2 diabetes patient who are received the treatment at Public Health Center 41 Khlong Toei in fiscal year 2014, there is 299 patient visits which tested for HbA1c and there are 85 HbA1c test result less than 7%.

The effectiveness of treatment of type 2 diabetic patients at Public Health Center 41 Khlong Toei in fiscal year 2014 was equal to 0.28 (85/299).

5.5 The Cost-Effectiveness of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in Fiscal year 2014

The cost of treatment of type 2 diabetic patients at Phyathai Sithivej Clinic was equal to 583,602.28 Baht (from Table 5-9). There are 181 patients who received the treatment, the cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic was equal to 3,224.32 Baht per patient per year (583,602.28/181).

The cost-effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic in Fiscal Year 2014 was equal to 4,672.93 Baht per one successful glycemic control per year (3,224.32/0.69).

The cost of treatment of type 2 diabetes at Public Health Center 41 Khlong Toei in fiscal year 2014 was equal to 1,426,982.17 Baht (from Table 5-16). There are 313 patients who received the treatment, the cost of treatment of type 2 diabetes at

Public Health Center 41 Khlong Toei in Fiscal year 2014 was equal to 4,559.05 Baht per patient per year (1,426,982.17/313)

The cost-effectiveness of treatment of type 2 diabetes at Public Health Center 41 Khlong Toei was equal to 16,282.32 Baht per one successful glycemetic control per year (4,559.05/0.28)

From the result the cost-effectiveness analysis of treatment of type 2 diabetes at Phyathai Sithivej Clinic was more cost-effectiveness than Public Health Center 41 Khlong Toei.



5.6 Sensitivity analysis.

5.6.1 Sensitivity analysis when the cost of providing dental care at Public Health Center 41 Khlong Toei are excluded

In this study, providing dental care for type 2 diabetes at Public Health Center was included to calculate the cost of treatment. Even there is an evidence recommend that diabetes patient should be checked for dental care at least once per year but in practice the Phyathai Sithivej Clinic does not provide this service to diabetes, Then there is a difference activity which is provided by Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei for treatment of type 2 diabetes. If dental care service of Public Health Center 41 Khlong Toei was excluded the cost of treatment of type 2 diabetes at Public Health Center 41 Khlong Toei per decrease from 1,426,982.17 Baht to 1,341,289.79 Baht and the cost of treatment per one patient per year decreased from 4,559.05 Baht to 4,285.27 Baht. Decreasing in cost per one patient per year leads cost-effectiveness per one successful glycemic control per year decrease from 16,282.32 Baht to 15,304.54 Baht (Table 5-17).

Table 5- 17 Calculation of cost-effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in fiscal year 2014 when drop dental care service

(1)	(2)	(3)	(4)	(5)	(6)
Health facility	Total cost in 2014 (Baht)	No. of patient visit (visits)	Cost per one patient per year (Baht) [(2)/(3)]	Effectiveness	Cost/Effectiveness (Baht/ per one successful glycemic control per year) [(4)/(5)]
Phyathai Sithivej Clinic	583,602.28	181	3,224.32	0.69	4,672.93
Public Health Center 41 Khlong Toei	1,341,289.79	313	4,285.27	0.28	15,304.54

The result of excluding the dental care cost of Public Health Center 41 Khlong Toei, we find providing the treatment of type 2 diabetes by Phyathai Sithivej Clinic is still more cost effective than provided by Public Health Center 41 Khlong Toei.

5.6.2 Sensitivity analysis when exclude cost of providing eye examination and dental care

Table 5- 18 Calculation of cost-effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in fiscal year 2014 when drop eye examination and dental care services

(1)	(2)	(3)	(4)	(5)	(6)
Health facility	Total cost in 2014 (Baht)	No. of patient visit (visits)	Cost per one patient per year (Baht) [(2)/(3)]	Effectiveness	Cost/Effectiveness (Baht per one successful glycemetic control per year) [(4) / (5)]
Phyathai Sithivej Clinic	552,229.81	181	3,050.99	0.69	4,421.73
Public Health Center 41 Khlong Toei	1,257,532.26	313	4,017.67	0.28	14,348.84

Effectiveness is defined as the proportion of the number of patient visits with a HbA1c test result of less than 7% per total number of patient visits which tested for HbA1c, HbA1c is one indicator that was used for setting the target of glycemetic control of treatment of diabetes. Then we tried to exclude cost of providing eye examination and dental care services which are provided for diabetes. As a result in Table 5-18, after sensitivity analysis by excluding eye examination and dental care cost was done, providing the treatment of type 2 diabetes at Phyathai Sithivej Clinic is still more cost effective than provided by Public Health Center 41 Khlong Toei.

5.6.3 Sensitivity analysis when excluded overhead cost

The total amount of overhead cost in this study is summation of supportive service for providing the treatment which included manager salary, stationary or office material, depreciation of air conditioner and so on. The allocation basis for allocate overhead cost to each department are variety, its depend on the category of cost such as manager salary (labor cost) the allocation basis as number of personnel in each department, cleaning cost the allocation basis as area of used and so on (Singchanchai, 2014). In this study, overhead cost is a total amount of all supportive service which was allocates to cost of treatment of type 2 diabetes by number of patient visit and allocated to each activity of providing the treatment of type 2 diabetes by ratio of time spent in each activity and total time spent to providing the treatment of type 2 diabetes. The allocation basis for allocating the overhead cost of each activity may related with the cost category than using the total amount, thus overhead cost was excluded for calculation of cost – effectiveness analysis of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in fiscal year 2014.

Table 5- 19 Calculation of cost-effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei in fiscal year 2014 when drop overhead cost

(1)	(2)	(3)	(4)	(5)	(6)
Health facility	Total cost in 2014 (Baht)	No. of patient visit (visits)	Cost per one patient per year (Baht) [(2) / (3)]	Effectiveness	Cost/Effectiveness (Baht per one successful glyceemic control per year) [(4) / (5)]
Phyathai Sithivej Clinic	523,051.45	181.00	2,889.79	0.69	4,188.10
Public Health Center 41 Khlong Toei	1,230,390.95	313.00	3,930.96	0.28	14,039.15

From 5-19 cost-effectiveness of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei when excluded overhead cost were equal to 4,188.10 Baht per one successful glycemc control per year and 14,039.15 Baht per one successful glycemc control per year, respectively. As a result, providing the treatment of type 2 diabetes at Phyathai Sithivej Clinic is still more cost effectiveness than provided by Public Health Center 41 Khlong Toei.



CHAPTER VI

CONCLUSION

6.1 Conclusion

Cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic and Public Health Center 41 Khlong Toei was calculated by using the Activity-Based Costing (ABC) approach. The effectiveness of treatment of diabetes is the proportion of HbA1c result was less than 7% per number of patient visits which has been tested for HbA1c. The cost-effectiveness of treatment of type 2 diabetes was calculated at both health care facilities.

Calculation of the cost of treatment of type 2 diabetes based on activity of treatment, in this study, the labor cost was highest than material cost, capital cost and overhead cost of all activities at both healthcare facilities. The total cost of treatment of type 2 diabetes in fiscal year 2014 at Public Health Center 41 Khlong Toei (1,206,054.61 Baht) was higher than the total cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic (509,498.76 Baht). Even the Diabetes Association of Thailand recommend that diabetes patient should be had an annual dental check for reduce the risk of complication (Periodontitis), Phyathai Sithivej Clinic does not provide this kind of service for diabetic patients because the patients under UC have registered at another dental clinic but Public Health Center 41 Khlong Toei did, this is one of the reasons why the total cost of treatment of type 2 diabetes patients at Public Health Center 41 Khlong Toei higher than total cost of treatment of type 2 diabetes at Phyathai Sithivej Clinic even with out dental check-up, the cost-effectiveness of Public Health Center 41 Khlong Toei is 15,305 compared with 4,673 of Phyathai Sithivej Clinic. For providing eye examination, Phyathai Sithivej Clinic hired the outsource ophthalmologist team for providing the service then. But Public Health Center 41 Khlong Toei had provided this activity by their staff with their equipment, the recurrent cost and capital cost quit difference form Phyathai Sithivej Clinic. Moreover the cost of treatment at Public Health Center 41 Khlong Toei was higher than Phyathai Sithivej Clinic because of size of healthcare facility, difference in activities of providing the healthcare services. Health education is the important point

of treatment of type 2 diabetes, this is related with the cost of treatment because the personnel spent time to provide this kind of service, then time spent in this part of service cause cost of treatment of type 2 diabetes.

We used HbA1c be indicator of the effectiveness in this study, as healthcare personnel is suggested to provide the HbA1c test for ongoing treatment of type 2 diabetes patient at least once per year. HbA1c can tell that patient can meet the target of blood glucose level control in 3-6 months ago or not. In this study the proportion of controllable of type 2 diabetes who are received the treatment at Phyathai Sithivej Clinic is higher than patient who are received the treatment at Public Health Center 41 Klong Toei, this result may related with the socioeconomics of the individual patient. But in this study, the individual socioeconomic hasn't been collected to analyze the factor related with the target of the treatment.

However, the cost – effectiveness shows that Phyathai Sithivej Clinic is more cost effectiveness than Public Health Center 41 Klong Toei. The results of this study can compare with the cost – effectiveness of diabetes management at urban medical center compared with Maharat Nakornratchasrima Hospital (Punnarunothai, 1998) and cost – effectiveness analysis of chronic disease management: comparison between King Chulalongkorn Memorial Hospital and Public Health Center 16 Lumpini (Limsantithum, 2004) found the cost – effectiveness at primary health care facility had more cost – effectiveness than secondary and tertiary health care facilities. Even the study from Punnarunothai S. and Limsantithum N. compare the primary health care facility with higher level of health care facility, the results show more complicated management will leads low cost – effectiveness compare with less complicated management of health care facilities. This study, cost – effectiveness were compared within primary health care facilities but there are difference in size, and managerial activity, thus higher size and more complicated management of Public Health Center 41 Klong Toei less cost effectiveness than smaller size and less complicated management as the results of previous study by Punnarunothai S. and Limsantithum N..

The cost – effectiveness at Phyathai Sithivej Clinic is more than Public Health Center 41 Klong Toei does in treatment of type 2 diabetes patients. The cost – effectiveness of treatment of type 2 diabetes patient at Private Clinic which had

contracted with NHSO is more than the Public Health Center of BMA in case of treatment of type 2 diabetes patients because from this study the cost at Public Health Center of BMA is higher than the cost at Phyathai Sithivej Clinic does at the same time at the effectiveness in term of controllable of disease are similar.

6.2 Recommendation

Private clinic which had contracted with NHSO is efficient for providing the treatment of type 2 diabetes more than the Public Health Center of BMA in term of small size, uncomplicated management and so on.. Thus, having the private clinic for providing the primary care unit to reduce the crowded at secondary and tertiary healthcare facilities is be considered for health policy-maker.

6.3 Limitation of this study

This is a retrospective study which some data were missed, underestimated, poorly recorded or unrecorded. And this study only analyzed on provider perspective meanwhile the cost of treatment of type 2 diabetes incurred by the patient, payer and society perspective but have not been included in this study. Lack of individual socioeconomic information of diabetic patients to analyze the factor related with the treatment of diabetes. Inclusion criteria in this study set as diabetic patients who have been diagnosed and received the treatment more than one year but the length of treatment of diabetes are differ from longer treatment, then diabetes patient should be group in difference in length of the treatment.

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APPENDIX



จุฬาลงกรณ์มหาวิทยาลัย
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Data gathering form 4: Recording form of Material Cost, Fiscal Year 2014

Category	Amount	Purchase Price
Medical material		
.....		
Non-medical material		
.....		
Medical supply		
.....		
Non-medical supply		
.....		
Other		
.....		
Total		

Data gathering form 5: Recording form of Capital Cost, Fiscal Year 2014

Category	Amount	Purchase Price
Medical equipment		
.....		
Non-medical equipment		
.....		
Rent/ Building		
.....		
Other		
.....		
Total		

VITA

Hanan Wisitpattharanon was born in Pattani, Thailand in May 12, 1989. She graduated secondary school from Benjamarachutit Pattani. She received a Bachelor of Biomedical Science and Business Administration with first class honor from Naresuan University in 2011. She enrolled in a Master's degree majoring in Health Economics and Health Care Management at Chulalongkorn University in May 2012. She works at Fiscal Policy Office, Ministry of Finance since August 2015.

