COST EFFECTIVENESS ANALYSIS OF HYPERTENSION SCREENING CONDUCTED BY PUBLIC HEALTH OFFICERS VERSUS BY VILLAGE HEALTH VOLUNTEERS IN MAE FA LUANG DISTRICT, CHIANG RAI PROVINCE IN 2011-2012

Mr. Onn Laingoen

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Health Economics and Health Care Management
Faculty of Economics
Chulalongkorn University
Academic Year 2013

COST EFFECTIVENESS ANALYSIS OF HYPERTENSION SCREENING CONDUCTED BY PUBLIC HEALTH OFFICERS VERSUS BY VILLAGE HEALTH VOLUNTEERS IN MAE FA LUANG DISTRICT, CHIANG RAI PROVINCE IN 2011-2012

Mr. Onn Laingoen

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Health Economics and Health Care Management
Faculty of Economics
Chulalongkorn University
Academic Year 2013

การวิเคราะห์ต้นทุนประสิทธิผลของการตรวจวัดความดันโดยเจ้าพนักงานสาธารณสุขเปรียบเทียบกับการตรวจวัดความดันโดยอาสาสมัครสาธารณสุขประจำหมู่บ้านที่อำเภอแม่ฟ้าหลวง จังหวัดเชียงราย ในช่วงปี พ .ศ.2554-2555

นายอ่อน ลายเงิน

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาเศรษฐศาสตร์สาธารณสุขและการจัดการบริการสุขภาพ
คณะเศรษฐศาสตร์จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2556

Thesis Title	COST EFFECTIVENESS ANALYSIS OF HYPERTENSION SCREENING CONDUCTED BY PUBLIC HEALTH OFFICERS VERSUS BY VILLAGE HEALTH VOLUNTEERS IN MAE FA LUANG DISTRICT, CHIANG RAI PROVINCE IN 2011-2012
By	Mr.Onn Laingoen
Field of Study	Health Economics and Health Care Management
Thesis Advisor	Kannika Damrongplasit, Ph.D.
Thesis Co-advisor	Piya Hanvoravongchai, M.D.

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

……Dean of the Faculty of Economics
(Associate Professor Chayodom Sabhasri, Ph.D.)

THESIS COMMITTEE

……Chairman
(Associate Professor Siripen Supakankunti, Ph.D.)

……Thesis Advisor
(Kannika Damrongplasit, Ph.D.)

……Thesis Co-advisor
(Piya Hanvoravongchai , M.D.)

……Examiner
(Nopphol Witvorapong, Ph.D.)

……External Examiner
(Porntep Siriwanarangsun, M.D, Ph.D.)

อ่อน ลายเงิน: การวิเคราะห์ต้นทุนประสิทธิผลของการตรวจวัดความดันโดยเจ้าพนักงานสาธารณสุขเปรียบเทียบกับการตรวจวัดความดันโดยอาสาสมัครสาธารณสุขประจำหมู่บ้านที่อำเภอแม่ฟ้าหลวง จังหวัดเชียงราย ในช่วงปี พ.ศ.2554-2555 (COST- EFFECTIVENESS ANALYSIS OF HYPERTENSION SCREENING CONDUCTED BY PUBLIC HEALTH OFFICERS VERSUS BY VILLAGE HEALTH VOLUNTEERS IN MAE FA LUANG DISTRICT CHIANGRAI PROVINCE IN 2011-2012) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: อ.ดร. กรรณิการ์ ดำรงค์พลาสิทธิ์ อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: อ.นพ.ปิยะ หาญวรวงศ์ชัย, 83 หน้า

การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์และเปรียบเทียบต้นทุนและประสิทธิผลของการคัดกรองความดันโลหิตสูงซึ่งเปรียบเทียบระหว่างการคัดกรองความดันโลหิตโดยเจ้าพนักงานสาธารณสุขกับการคัดกรองความดันโลหิตโดยอาสาสมัครสาธารณสุขประจำหมู่บ้านในพื้นที่อำเภอแม่ฟ้าหลวง จังหวัดเชียงราย ในปี พ.ศ.2554-2555 จากมุมมองของผู้ให้บริการเพียงอย่างเดียวโดยใช้ต้นทุนฐานกิจกรรม (activity-based costing)ในการคำนวณหาต้นทุนของแต่ละโครงการ และวัดประสิทธิผลสองอย่าง คือจำนวนของผู้ที่ได้รับการตรวจคัดกรองทั้งหมดของแต่ละโครงการ และจำนวนคนที่ได้รับคัดกรองว่าเป็นหรือไม่เป็นโรคความดันโลหิตสูงอย่างถูกต้อง

ผลการศึกษาพบว่า ต้นทุนทั้งหมดของการตรวจวัดความดันโดยเจ้าพนักงานสาธารณสุขในปี 2554 รวมเป็นเงินทั้งสิ้น 63,988.90 บาท และสามารถตรวจคัดกรองเพื่อหาผู้ป่วยความดันโลหิตสูงได้ทั้งหมด 1,048 ราย ซึ่งคิดเป็นต้นทุนต่อการคัดกรอง 1 ราย เป็นเงิน 61.05 บาท จากจำนวนผู้ที่ถูกคัดกรองทั้งหมดนี้มี 891 คนที่ได้รับการวินิจฉัยได้อย่างถูกต้องว่าเป็นหรือไม่เป็นโรคความดันโลหิตสูง เมื่อประเมินออกมาเป็นมูลค่าเงินแล้วเท่ากับว่าต้องใช้เงินจำนวน 71.83 บาท ต่อการคัดกรองหาผู้ป่วยความดันโลหิตสูงได้อย่างถูกต้องหนึ่งรายโดยเจ้าพนักงานสาธารณสุข ส่วนต้นทุนทั้งหมดของการคัดกรองความดันโดยอาสาสมัครสาธารณสุขประจำหมู่บ้านในปี2555 นั้น รวมเป็นเงินทั้งสิ้น 89,852.70 บาท คัดกรองผู้ป่วยได้ทั้งหมด 1,106 ราย เมื่อคิดเป็นต้นทุนต่อการคัดกรอง 1 รายแล้วเท่ากับ 81.24 บาท สำหรับความแม่นยำในการคัดกรองนั้นพบว่า อาสาสมัครสาธารณสุขประจำหมู่บ้าน สามารถคัดกรองได้อย่างถูกต้อง 619 ราย เท่ากับว่า ต้องใช้ต้นทุนทั้งสิ้น 145.07 บาทต่อการคัดกรองผู้ป่วยได้อย่างถูกต้อง 1 ราย สุดท้ายแล้วการศึกษาครั้งนี้สามารถสรุปได้ว่า การคัดกรองความดันโดยเจ้าพนักงานสาธารณสุขนั้นคุ้มค่ากว่าการคัดกรองความดันโดยอาสาสมัครสาธารณสุขประจำหมู่บ้าน

สาขาวิชา: เศรษฐศาสตร์สาธารณสุขและการจัดการบริการสุขภาพ ลายมือชื่อนิสิต.....

ปีการศึกษา 2556 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

ลายมือชื่อ อ. ที่ปรึกษาวิทยานิพนธ์ร่วม.....

5585699629 MAJOR: HEALTH ECONOMICS AND HEALTH CARE MANAGMENT

KEYWORDS: COST EFFECTIVENESS ANALYSIS/ HYPERTENSION SCREEN/PUBLIC HEALTH OFFICERS/ VILLAGE VOLUNTEERS/MAE FA LUANG DISTRICT, CHIANG RAI PROVINCE

ONN LAINGOEN: COST EFFECTIVENESS ANALYSIS OF HYPERTENSION SCREENING CONDUCTED BY PUBLIC HEALTH OFFICERS VERSUS VILLAGE HEALTH VOLUNTEERS IN MAE FA LAUNG DISTRICT, CHIANG RAI PROVINCE IN 2011-2012OFFICERS. ADVISOR: KANNIKA DAMROMGPLASITT, Ph.D, CO-ADIVSOR: PIYA HANVORAVONGCHAI, M.D, 83 pp.

This study focuses on the cost and effectiveness analysis of hypertension screening conducted by public health officers versus by village heath volunteers in Mae Fah Luang District, Chiang Rai Province in 2011-2012. Only provider perspective has been included in this study. To obtain the cost of each program, activity-based costing method has been employed. However, we focus on two kinds of effectiveness measures including: (i) number of people screened and (ii) number of people with correct detection of hypertension. Delphi technique has been employed to estimate the probability of correct detection.

The total cost from provider perspective indicates that hypertension screening conducted by public health officers in 2011 was 63,988.90 Baht and the number of people who were screened is equal to 1,048. So the cost effectiveness ratio comes up to be 61.05 Baht / person. In addition, the number of people with correct detection of hypertension was equal to 891, which implies that the monetary cost is 71.83 Baht / one case detect correctly. However, the total cost of hypertension screening conducted by village health volunteers in 2012 was 89,852.70 Baht and 1,106 of people were screened. Thus, the cost effectiveness ratio is equal to 81.24 Bath/person in 2012. For the performance of village health volunteers on the correctly detecting hypertension, we estimate from Delphi technique that 619 people were correctly detected. Thus 145.07 Baht is needed in order to pay for one case to correct detection of hypertension in 2012. As a result, this study can conclude that hypertension screening conducted by public health officers is more cost effective than when it was conducted by village heath volunteers.

Field of Study: Health Economics and Health Care Management Student's Signature……

Academic Year: 2013 Advisor's Signature……

Co-advisor's Signature……

ACKNOWLEDGMENTS

I would like to express my heartfelt thanks to Kaninka Damrongplasit, Ph.D, my thesis advisor for her encouragement, hard work, and support in improving this thesis. Without her kindness this report would not have been finished. I sincerely acknowledge to Piya Hanvoravongchai, M.D., Co-advisor, Associate Professor Siripen Supakankunti Ph.D, Chairperson, Nopphol Witvorapong, Ph.D., committee member and Porntep Siriwanarangsun, M.D., external member of the committee for their valuable suggestions and comments on this study.

My grateful thanks must go to Doitung Primary Care Unit of The QUEEN SIRIKIT director, and all the staffs who fully helped me, by providing the information and materials for producing this thesis. I would also like to thank Mrs. Kingtong Gongonoin for her kind support as well.

I am very much thankful to Miss Marry Gerth, my best sister for her hard work in proof-reading my thesis.

I would like to express my deep appreciation to the staffs at Blessing Ministry Foundation (Bann Immanuel) for their financial support for my study in the master of health economics and health care management. I would like to take this opportunity to thank Mr. Ron Joseph Miller, Mr. Phitsanu Harichaikun and all staffs for their love and encouragement. Without their kindness, I could not successfully complete my education.

Finally, I give special thanks to my family, my father and mother for their love, understanding and encouragement in my life.

CONTENTS

Page

Page

Page

LIST OF TABLES

Page

Page

LIST OF FIGURES

Page

ABBREVIATIONS

ABC	Activity-Based Costing
BP	Blood Pressure
CSMBS	Civil Servant Medical Benefit Scheme
CEA	Cost Effectiveness Analysis
DBP	Diastolic Blood Pressure
DPCU	Doitung Primary Care Unit
HTN	Hypertension
ICER	Incremental Cost Effectiveness Ratio
MoPH	Ministry of Public Health
SBP	Systolic Blood Pressure
SSS	Social Security Scheme
THS	Thai Hypertension Society
UC	Universal Coverage
WHO	World Health Organization

CHAPTER I
INTRODUCTION

Problem and Significance

Hypertension (HTN) is a chronic medical condition in which the blood pressure in the arteries is elevated (Chobanian, Bakris, & Black, 2003; Steptoe, 2007). It requires the heart to work harder than normal to circulate blood through the blood vessels. Hypertension is a non-communicable disease which is a risk factor for many serious diseases such as stroke, myocardial infarction, heart failure, and chronic kidney disease as well as increasing blood pressure, all lead to shortening of life expectancy(Jonsson, Hansson, & Stalhammar, 2003). Hypertension has been called "the silent killer" because it can be deadly and often goes undiagnosed (Grandi et al., 1996; Meredith & Jarvis, 2011). The danger of hypertension is the extra load placed on the heart, leading to complications like thickening of the heart muscle, heart failure, and kidney damage. Worst of all, it does all this silently, often without warning.

According to World Health Organization, approximately 1,000 million people around the world suffer from hypertension. Furthermore it is found that one-fourth of males and females have high blood pressure globally, and 7.1 million of the world's populations pass away due to hypertension each year.

Hypertension affects one in three Thai adults and it is a major risk factor for coronary heart disease (CHD), stroke, and end-stage renal disease. In 2011 the prevalence of hypertension is the highest among all non-communicable diseases with the number of new cases being equal to 360,658 and the incidence rate of 566.17 per 100,000 populations. Furthermore the number of patients since 2008-2011 with hypertension is 1,725,719 while the prevalence rate is 2,709.06 per 100,000 populations. Among the new cases in 2011 the number of people who have complication is accounted for 2.68% and the number of people who do not have any complication is 351,009 which is equal to 97.31%. Among those with complications 5,213 of them or 54.03 % have multi-complication 2,034 of them or 21.08% have coronary complication, 2,006 of them or 20.79% have renal complication, 217 of them or 2.25% have paralysis complication, 179 of them or 1.86% have other

complications. For Thai adolescents, it is found that blood pressure has risen mainly because of diet and lifestyle(Thonghong A, 2011).

In Mae Fah Laung district, hypertension is one of top five diseases that threaten the health situation of the local population. The number of outpatients visit at Doitung Primary Care Unit of The QUEEN SIRIKIT (DPCU) relating to hypertension was 426 in 2010 and the number increased to 558 in 2011. However, the number dropped to 480 in 2012. While the prevalence rate of hypertension in Mea Fah Luang district in 2011 is equal to 2,920.67 per 100,000 populations and increase to 2,993.75 per 100,000 populations in 2012, which is higher than the average prevalence of hypertension in Thailand.

Table I-1: The number of populatoin whose death was caused by hypertension in Thailand

Years	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total cases	3213	3402	2491	2452	2363	2291	2463	2295	2478	3664
Ratio/100,000	5.1	5.4	4	3.9	3.8	3.6	3.9	3.6	3.9	5.7

After the government has provided active screening for blood pressure since 2003 with the campaign “Healthy Thailand”, which has been conducted by public health officers, the number of population whose death was caused by hypertension appear to decrease gradually. In 2011, after implementing the campaign “Thailand healthy lifestyle” the active screening of blood pressure has instead been conducted by health volunteers. Coincidentally, in 2011 the death rate due to hypertension has risen to 5.7 per 100,000 populations. The challenge for the Ministry of Public Health (MoPH) is to improve health status of Thai population and reduce the number of hypertension patients especially in the remote areas by conducting the most suitable program Therefore, it is important to compare cost and outcome of hypertension screening program by using cost-effectiveness analysis when it was conducted by public health officers relative to when it was conducted by village health volunteers in the context of Thailand health care system.

1.1.Research Question

- What is the most cost-effective hypertension screening program in Mae Fah Luang district?

1.2.Research Objectives

1.2.1. General objective

To identify the most cost-effective option between the two alternative interventions namely blood pressure screening conducted by public health officers versus the one done by village health volunteers.

1.2.2. Specific objective

- To assess and compare the cost-effectiveness ratio of both alternatives

1.3.Scope of the Study

This study has been carried out in Mae Fah Luang district of Thailand from February until March 2013. The evaluation period is in 2011 for hypertension screening conducted by public health officers and 2012 for hypertension screening conducted by village health volunteers. The study focuses on cost and effectiveness of the program among population aged 15 or older who are considered to have higher risk for getting hypertension. The focus of the study is on one particular primary care unit, which is Doitung Primary Care Unit of The QUEEN SIRIKIT' (DPCU), and uses secondary data which are available at Mae Fah Luang district public health office and in the DPCU database. The costing method used is activity based costing while the effectiveness measure is conducted by using Delphi technique.

1.4.Possible Benefit

This study's findings can assist policy makers in deciding whether hypertension screening should be conducted by public health officers or village health volunteers. If it is found that village health volunteers' involvement in the hypertension screening program is effective, then there is policy recommendation to further expand their involvement to other screening programs.

.

CHAPTER II
BACKGROUND

2.1.Thailand health care system

In Thailand, the government implements three main health insurance for the Thai population, including (i) the Universal Coverage (UC), (ii) the Social Security Scheme (SSS), (iii)and Civil Servant Medical Benefit Scheme (CSMBS).

By early 2002, Thailand achieved universal health coverage for the whole population by introducing a tax-funded health insurance scheme, the so-called ‘‘UC scheme’’, to cover approximately 47 million people who were not benefited carries of the Civil Servant Medical Benefit Scheme (CSMBS) or the Social Security Scheme (SSS). The Thai UC scheme comprises a comprehensive benefit package that includes ambulatory care, hospitalization, disease prevention, health promotion and many expensive medical services such as radiotherapy and chemotherapy for cancer treatments, surgical operations and healthcare for accidents and emergency illnesses(MoPH, 2008). The co-payment for services is 30 Baht as long as the patients visit designated health care facilities. UC benefit carriers are guaranteed universal access to health services by registering with a primary care network, from which they can obtain health services when needed. If the registered hospital cannot provide appropriate treatment, patients are transferred to a higher-level health facility such as a provincial or regional hospital, and sometimes a university hospital.

Another scheme, which the government provided, is Social Security Scheme that was introduced in 1990 with the objectives of reducing inequity in access to health care of different population groups, and providing financial security to formal sector private employees. The SSS is a compulsory scheme and receives contributions from employers, employees, and the government, each paying a fixed percent of the employee’s wages. Illness benefits consist of general and specialized services, outpatient services, hospital care, prescriptions, ambulance and transportation services, and ancillary services. The Social Security Office (SSO) collects funds and purchases health services from both public and private hospitals at a capitation rate to cover all services to which SSS beneficiaries are entitled under the scheme. The

capitation payment is a fixed payment per worker per year regardless of service utilization.

The government also provides health insurance for civil servants of the country through Civil Servant Medical Benefit Scheme (CSMBS). This scheme covers government officers, pensioners, and their dependants, which account for 5.4 million people. Civil Servant Medical Benefit Scheme (CSMBS) receives budget from the government from a tax- based system and functions as fringe benefits for the beneficiaries. Benefits consist of general and specialized services. Comprehensive package includes outpatient services, hospital care, prescriptions, ambulance and transportation services, and ancillary services as well as private ward in public hospital.

2.2.Blood pressure screening and treatment program in Thailand

2.2.1. Healthy Thailand strategy

In 2003, the government has come up with the policy of "*Healthy Thailand*," aimed at mobilizing the forces of the nation to build a healthy country, set the strategy for health promotion as a national agenda, as proposed by the Ministry of Public Health to reduce behavioral health risk and major health problems in Thailand(MoPH, 2006). One of the strategies is screening blood pressure for the population to detect hypertension. This strategy attempts to detect hypertension patients at an early stage and reduce the number of chronic patients who have high blood pressure. The intervention has been adapted from a passive screening approach or a health care facility based program in which individuals visit health care facility on their own due to some illnesses or some symptoms of hypertension. Blood pressure screening is usually conducted at a clinician's office by using an arm cuff and a calibrated sphygmomanometer (blood pressure meter). If health care workers detect unusually high levels of blood pressure which identify patients as having hypertension, drug treatments are provided. However, with the new policy of passive screening combined with active screening, the screening is not only conducted at the healthcare facility. Health care workers also go to visit each community to (i) educate people to change their lifestyle, in order to help averting hypertension, (ii) measure blood pressure of people who are 15 years old and over who are considered to be in a risk group, and

(iii) provide treatment for those with high level of blood pressure who possibly have hypertension.

2.2.2. Thailand healthy lifestyle strategy

Since 2012 the campaign " *Thailand healthy lifestyle*" have been implemented with the aim to achieve a risk-free and healthy living, create enabling factors conductive to influencing people to practice healthy consumption habits, generate social immunity and well-being, and reduce disease burden and threats(MoPH, 2012). The development of Thailand healthy lifestyle strategy is part of Health development Plan and the National Economic and Social Development Plan, which has been developed on the basis of concerns on healthiness of physical, mental, social and intellectual/ spiritual well – being that are the basic rights of human beings. The strategy of Thailand healthy lifestyle focuses on five main non-communicable diseases include diabetes mellitus, heart disease, cerebrovascular disease, cancer, and hypertension. The strategy on hypertension attempts to create confidence and participation of community to be involved in the Thai health care system by using health volunteers in each village to conducted the screening and detect hypertension for people in their own village instead using public health officers.

2.3.General information about Mae Fah Luang district

Mae Fah Luang district is located in the northern part of Thailand in Chiang rai province. It is one of the most remote and underdeveloped with the majority of its geography consists of mountains. Its border line with Myanmar stretches for 109 km. Mae Fah Luang consists of various ethnic groups with the population of 68,944. In this area, people of older generations usually have low education. Most of them work in agricultural sector. Many of them do not understand Thai language, which is an official language in Thailand. In term of healthcare accessibility, there are still problems among patients and health workers to travel to healthcare facilities mainly due to geographic barriers. People cannot afford to buy vehicle due to poor economic status, making it difficult for them to commute to receive care. To maintain good health status for the population in this area can be very challenging for health care workers especially how to treat and prevent infectious diseases and to manage chronic diseases in mountainous community.

2.3.1. Doitung Primary Care Unit of The QUEEN SIRIKIT

Doitung Primary Care Unit of The QUEEN SIRIKIT (DPCU) is the primary health care facility (health promotion hospital) located in Mae Fah Luang district. This hospital's coverage area includes ten villages and three schools which accounts for 573 households and a total population of 3,866 people in 2012. The number of twelve staffs has worked at this DPUC including one health promotion hospital director, one nurse, two public health officers, one dentist, one dentist technical officer, two dentist assistant, one Thai medicine officer, one Thai medicine assistant , one patient's assistant, and one driver. The Primary Care Unit is located 35 kilometers (km.) from Mae Chan hospital, a community hospital and main contractor, and 60 km. from Chiangrai Prachanukroh Hospital, a general hospital. Travel time take approximately 1 hour and 30 minutes to transfer patients from Doitung Primary Care Unit of The QUEEN SIRIKIT to general hospital. The geography is mostly mountainous with many barriers between the mountains of Laos, Thailand and Myanmar. About 1,000 meters above sea level, the village are scattered throughout the slopes. In each village the number of households range from 33 to 94 households and the houses are either built with grass or permanent materials. The distance between the villages and Doitung Primary Care Unit ranges from 0.5 to 20 kilometers. Most people use motorcycle or hire a car to commute to health care facility but for the poor they usually come by walking because there is neither public transportation nor bus from each village to DPCU. However the number of people who came to visit DPCU accounts for 11,125 in 2010 then increase to 11,630 in 2011, and grow to 11,866 in 2012.

Table II-1: The top 5 diseases that receive treatment at DPCU during 2010-2012

Disease	**Year 2010**	**Year 2011**	**Year 2012**
	Number	number	Number
Respiratory system disease	3,892	4,029	3,757
Digestive system disease	8,872	2,914	2,275
Musculoskeletal system disease	257	926	867
Blood circulatory system disease	684	558	480
Skin and subcutaneous tissue disease	837	396	534

Data from: The annual report of DPCU, 2012

For the common diseases that made people come for treatment (show in Table II-2) at DPCU during 2010-2012, respiratory system disease is the highest among all the diseases with the number of outpatients visit equal to 3,298 in 2010, 4029 in 2011 and 3,757 in 2012. The main reason for this phenomenon is because every year Mae Fah Luang district is threatened by smog problem, which affects the respiratory system of the people in this district on. However, blood circulatory system disease is one of the top five diseases in DPCU. Thus, it is important to investigate how well people in Mae Fah Luang district have been protected from hypertension, which is one of the major blood circulatory system diseases.

CHAPTER III
LITERATURE REVIEW

3.1.Blood pressure measurement

Blood pressure is a measure of the force that the circulating blood exerts on the walls of the main arteries when heart beating and pumping the blood through the body (WHO, 2013). There are two stages to measure blood pressure, measure maximum pressure (systolic) and the minimum pressure (diastolic)

The systolic blood pressure (SBP) is the maximum pressure in an artery at the moment when the heart is beating and pumping blood through the body (American Heart Association, 2012). A normal systolic blood pressure is 120 or below. A systolic blood pressure of 120-139 means blood pressure that is higher than ideal or borderline high blood pressure. Even people with this level are at a greater risk of developing heart disease. A systolic blood pressure number of 140 or higher is considered to be hypertension, or high blood pressure(Chobanian et al., 2003).

The diastolic blood pressure (DBP) is the lowest pressure in an artery in the moments between beats when the heart is resting(American Heart Association, 2012). A normal diastolic blood pressure number is 80 or less. A diastolic blood pressure between 80 and 89 is normal but higher than ideal. A diastolic blood pressure number of 90 or higher is considered to be hypertension or high blood pressure(Chobanian et al., 2003).

In Thailand's health care system, 2 types of blood pressure measurement devices are typically used including

- Automatic blood pressure monitoring device
- Mercury sphygmomanometer

For both automatic blood pressure monitoring device and mercury sphygmomanometer, the quality of both measurement devices is needs to be checked regularly. In addition, the arm cuff needs to be suitable for the patient where the bladder should cover 80% of the patient's arm. Size of bladder for normal people usually use is 12 cm. × 22 cm. (Thai Hypertension Society, 2012)

According to the Thai Hypertension Society, the guideline for blood pressure classification is provided in the following Table III-1.

Table III-1:Blood pressure classification

Categories	SBP (mmHg)	DBP (mmHg)
Optimal	< 120	< 80
Normal	120-129	80-84
High normal	130-139	85-89
Grade 1 hypertension (Mild)	140-159	90-99
Grade 2 hypertension (Moderate)	160-179	100-109
Grade 3 hypertension (Severe)	≥180	≥110
Isolated systolic hypertension	≥140	< 90

Data from: Thai Guidelines on The Treatment of Hypertension Update 2012

3.2.Economic evaluation

The efficiency in the healthcare sector requires priority to be given to those treatments which provide the greatest benefit per unit of cost (Stephen P, 1999). Alternative interventions usually need to be compared to determine whether a change in the mix of interventions would increase efficiency. Therefore, economic evaluations have to be used to identify that efficiency. There are different types of criteria for efficiency that are commonly used including:

Cost-minimization analysis (CMA) measures and compares input costs, and assumes outcomes to be equivalent (Drummond, Iglesias, & Cooper, 2008). Thus, the types of interventions that can be evaluated with this method are limited. The strength of each CMA lies in the acceptability by the readers or evaluators that outcomes are indeed equivalent.

Cost benefit analysis (CBA) involves measuring costs and benefits in commensurate terms, usually monetary. Welfare economics shows that under certain conditions any net excess of monetary benefits over costs represents the gain in welfare by society.

Cost utility analysis (CUA) measures an intervention's effect on both the quantitative and qualitative aspects of health (morbidity and mortality) using a utility based

measure such as quality adjusted life years (QALYs) and disability adjusted life years (DALYs).

Cost effectiveness analysis (CEA) is one form of full economic evaluation where both the cost and consequences of health programmes or treatments are examined (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005).CEA is most suitable in situation where a decision need to be made while operating within a given budget. The major source of effectiveness data come from the existing medical literature. A major limitation of cost effectiveness analysis is its inability to compare interventions with different natural effects (Jonsson et al., 2005). For example, interventions aimed at increasing life years gained cannot be directly compared with those which aim to improve physical functioning. Cost effectiveness analysis therefore cannot directly address allocative efficiency.

In this study, we attempt to use cost-effectiveness analysis to compare cost and outcome of hypertension screening programs when it was conducted by public health officers and after when it was conducted by village health volunteers in the context of Thailand health care system.

3.3.Activity-Based Costing review

We will employ activity-based costing method to calculate cost of hypertension screening in our study. Activity-Based Costing (ABC) is developed in the United State during 1970-1980 in an effort to improve efficiency and control cost. Peter B. B. Turney (1996) defined ABC as a method of measuring the cost and performance of activities and cost objects. Assigns cost to activities based on their use of resources and assigns cost to cost objects based on their use of activities. ABC recognizes the causal relationship of cost drivers to activities. ABC can be defined by the following equation:

C/A = HD + M + E + S

Where C/A = Estimated cost per activity

H = Number of labor hours required to perform the activity one time

D = Wages per labor hour

M = Material costs required to perform the activity one time

E = Equipment costs to perform the activity one time

S = Subcontracting costs to perform the activity one time

The total cost for performing the activity will be based on the number of times the activity is performed during a specific time frame. An activity based costing system first traces costs to activities and then to products and other cost objects. Moreover, Baker J. (1998) suggests that when we employ the activity based costing method. The most important activities need to be picked up, but not each and every activity needs to be detailed, especially when those activities do not have a major impact on cost.

After reviewing study that use both cost-effectiveness analysis and using activity-based costing method for calculating costs, we only find one paper has reported by Yang H.(2012) studies on the topic of cost-effectiveness of intensity-modulated radiotherapy in prostate cancer. The study uses activity-based costing method to estimate cost of the modulated radiotherapy (IMRT) and three-dimensional conformal radiotherapy (3DCRT).They allocate costs to six major activities associated with the planning, preparation and delivery of radiotherapy. The number of cases per year was estimated for cost driver of IMRT and 3DCRT.

3.4.Cost determining components

According to Creese and Parker (1997), cost in health care intervention can be classified by input as below:

Table III-2:Input and cost determinant component

Inputs	Components that determine the cost
Vehicle	Distance traveled/ time used
Equipment	Time used
Building space	Time used/space used
Personnel	Time used
Supplies	Volume
Vehicle: operation and maintenance	Distance traveled/ time used
Building: operation and maintenance	Time used/space
Other inputs	Miscellaneous

According to the Table III-2 of input and cost determinant component shown that many of the inputs have similar components in determining their costs such as equipment, building space, and personnel have cost determinant being time used. However, for some inputs like vehicle, its cost is determined based on distance traveled or time used while the cost of office supplies are determined by the volume used. Besides, other inputs may be determined based on miscellaneous factors. Likewise, the studies by Ghimir S. (2007) on the topic of "cost-effectiveness of public and metropolitan dots centers in Nepal", classifies staffs' cost by time used, and materials such as stationary and drugs by their volume used.

3.5.Delphi technique

Delphi technique was used in this study to obtain the performance of public health officers and village health volunteers for detected hypertension. The Delphi technique was developed in the 1950's by the Rand Corporation, Santa Monica, California, in operations research. The Delphi method is based on structural surveys and makes use of the intuitive available information of the participants, who are mainly experts (Hasson, Keeney, & McKenna, 2000). This method makes a better use of group interaction (Fernández-Llamazares et al., 2013) through the questionnaires' approach in order to gain feedback consensus from the experts (Hanafin S, 2005). Since this method was conducted in two rounds, so the participants were able to improve their assessments in the second round (Eto, 2003).

3.6.Health Outcome

Disease burden is an indicator of health outcome. Disease burden can be expressed in many ways, such as the number of cases (incidence and prevalence), deaths or disability-adjusted life years lost (DALYs) associated with a given condition. Health outcome, a denominator of cost-effectiveness ratio, can be reported as intermediate outcomes or long-term outcomes such as life saved, life years gained, or quality adjusted life years gained (QALYs). (Drummond, Aguiar-Ibanez, & Nixon, 2006)

The study by Subhash P.(Subhash, 1999) measures outcome or effectiveness of early detection for visceral leishmaniasis in Nepal by using two levels of outcome including case detection and number of deaths averted then the study tries to compare the effectiveness between outreach case detection and health facility-based program.

Primkeaw W.(2001) studies leprosy case detection by comparing active and passive screening versus passive alone screening in Thailand. The study uses numbers of newly detected leprosy cases as its effectiveness measure. In a study of short course anti-tuberculosis treatment program compared with a standard regimen in Thailand, Pirom (Kamolratanakul P., 1996) defines measure of effectiveness by using a simple formula. In particular, the effectiveness in this study is equal to

[(number of patients admitted minus number of patients dropped out minus sputum non-conversation rate minus sputum relapse) / number of patients admitted] He then compares cost per effectiveness of two regimens. However, many of the recent studies use QALYs as effectiveness measure such as study by Y. Claire Wang (2011) investigates cost-effectiveness of Blood Pressure Screening in Adolescents in the United States. This study compares the long-term effectiveness and cost-effectiveness of 3 approaches to managing elevated blood pressure (BP) among adolescents in the United States namely, no intervention, ‘‘screen-and-treat,’’ and population-wide strategies to lower the entire BP distribution. The effectiveness measure in this study is defined to be QALYs.

3.7.Economic evaluation of hypertension screening: a review of past study

Kate Lovibond(Lovibond et al., 2011)studies about cost-effectiveness of options for the diagnosis of high blood pressure in primary care using Markov model-based probabilistic cost-effectiveness analysis. In this study quality-adjusted life years (QALYs) were used to measure the effectiveness. They found that ambulatory monitoring was the most cost-effective strategy for the diagnosis of hypertension for men and women of all ages. It was cost-saving for all groups (from $56 [95% CI –105 to –10] in men aged 75 years old to $323 [–389 to –222] in women aged 40 years old) and resulted in more quality-adjusted life years for men and women older than 50 years (from 0.006 [0.000 to 0.015] for women aged 60 years to 0.022 [0.012 to 0.035] for men aged 70 years).

Geisler (Geisler et al., 2012) studies cost-effectiveness and clinical effectiveness of catheter-rased renal denervation for resistant hypertension by using a state-transition (Markov) model to project the impact of treatment and outcome were reported by quality-adjusted life years (QALYs). They found that the discounted lifetime incremental cost-effectiveness ratio was $3,071 per quality-adjusted life-year.

Findings were relatively insensitive to variations in input parameters except for systolic blood pressure reduction, baseline systolic blood pressure, and effect duration. The 95% credible interval for incremental cost-effectiveness ratio was cost-saving to $31,460 per quality-adjusted life-year.

Y. Claire Wang (Wang et al., 2011) studies about effectiveness and cost-effectiveness of blood pressure screening in adolescents in the United States. The study compares the long-term effectiveness and cost-effectiveness of 3 approaches in managing elevated blood pressure (BP) in adolescents in the United States namely no intervention, ‘‘screen-and-treat,’’ and population-wide strategies to lower the entire BP distribution. In the study, they use a simulation model to combine several data sources to project the lifetime costs and cardiovascular outcomes for a cohort of 15-year-old U.S. adolescents under different BP approaches and conducted cost-effectiveness analysis. Moreover, they use quality-adjusted life years (QALYs) to measure their effectiveness. The result of the study find that among screen-and-treat strategies, finding and treating the adolescents at highest risk (eg, left ventricular hypertrophy) was the most cost-effective ($18 000/QALY [boys] and $47 000/QALY [girls]). However, screen-and-treat strategies were dominated by population-wide strategies such as salt reduction (cost-saving $700/QALY [boys] and $650/ QALY [girls]) and increasing physical education ($11000/QALY [boys] and $35 000/QALY [girls]).Therefore they conclude that routine adolescents BP screening is moderately effective, but population-based BP interventions with broader reach could potentially be less costly and more effective for early cardiovascular disease prevention and should be implemented in parallel.

A study by Fukunaga H,(Fukunaga et al., 2008) on the topic of cost-effectiveness of the introduction of home blood pressure measurement in patients with office hypertension estimates the cost savings from the perspective of the Japanese healthcare system. They constructed a simulation model using data from the Ohasama study and the number of 1000 subjects per 5 years was used to measure the effectiveness in their study. They found that the introduction of home blood pressure (HBP) measurement for the treatment of hypertension is very useful for reducing medical costs. When HBP measurement is not incorporated into the diagnostic process, the medical cost is estimated at US$10.89 million per 1000 subjects per 5 years. When HBP measurement is incorporated, the medical cost is estimated at

US$9.33 million per 1000 subjects per 5 years. The reductions in medical costs vary from US$674,000 to US$2.51 million per 1000 subjects per 5 years for treatment of hypertension, when sensitivity analysis is performed.

"Cost-Effectiveness of Screening and Optimal Management for Diabetes, Hypertension, and Chronic Kidney Disease: A Modeled Analysis" by Kirsten Howard (Howard et al., 2010) using a Markov model to compare (1) intensive management versus usual care for patients with sub-optimally managed diabetes and hypertension, and (2) screening for and intensive treatment of diabetes, hypertension, and proteinuria versus usual care. Intervention effectiveness was based on published meta-analyses and randomized controlled trial data; costs were measured from a central health-care funder perspective in 2008 Australian dollars ($Aus), and outcomes were reported in quality-adjusted life-years (QALYs).They conclude that strategies combining primary care screening of 50- to 69-years-old for proteinuria, diabetes, and hypertension followed by the routine use of ACE inhibitors, and optimal treatment of diabetes and hypertension, respectively, have the potential to reduce death and end-stage kidney disease and are likely to represent good value for money.

The study in Thailand on the topic of economic analysis of the diabetes and hypertension screening in collaboration between community pharmacies and a Thai government primary care unit study by Phayom Sookaneknun (Sookaneknun et al., 2010) attempts to evaluate models for collaboration between community pharmacies and a government primary care unit (PCU) in carrying out a screening program for diabetes and hypertension. Study sites consist of two community pharmacies for Model 1 and seven communities for Model 2 under supervision of PCU in the city of Maha Sarakham Province, Thailand. The Combined Model consisted of Models 1 and 2. Those who are eligible must be aged 40 years old and over and not known to have diabetes or hypertension. Activity-based costing of three models was analyzed from the provider perspective and the outcome was measured by the number of confirmed new diagnosed diabetes or hypertension. They conclude that pharmacy-based screening was more costly, but the success rate for referral was higher when comparing with community-based service. Thus, more effort is needed to ensure referred patients attend the government primary care unit since it is more cost effective.

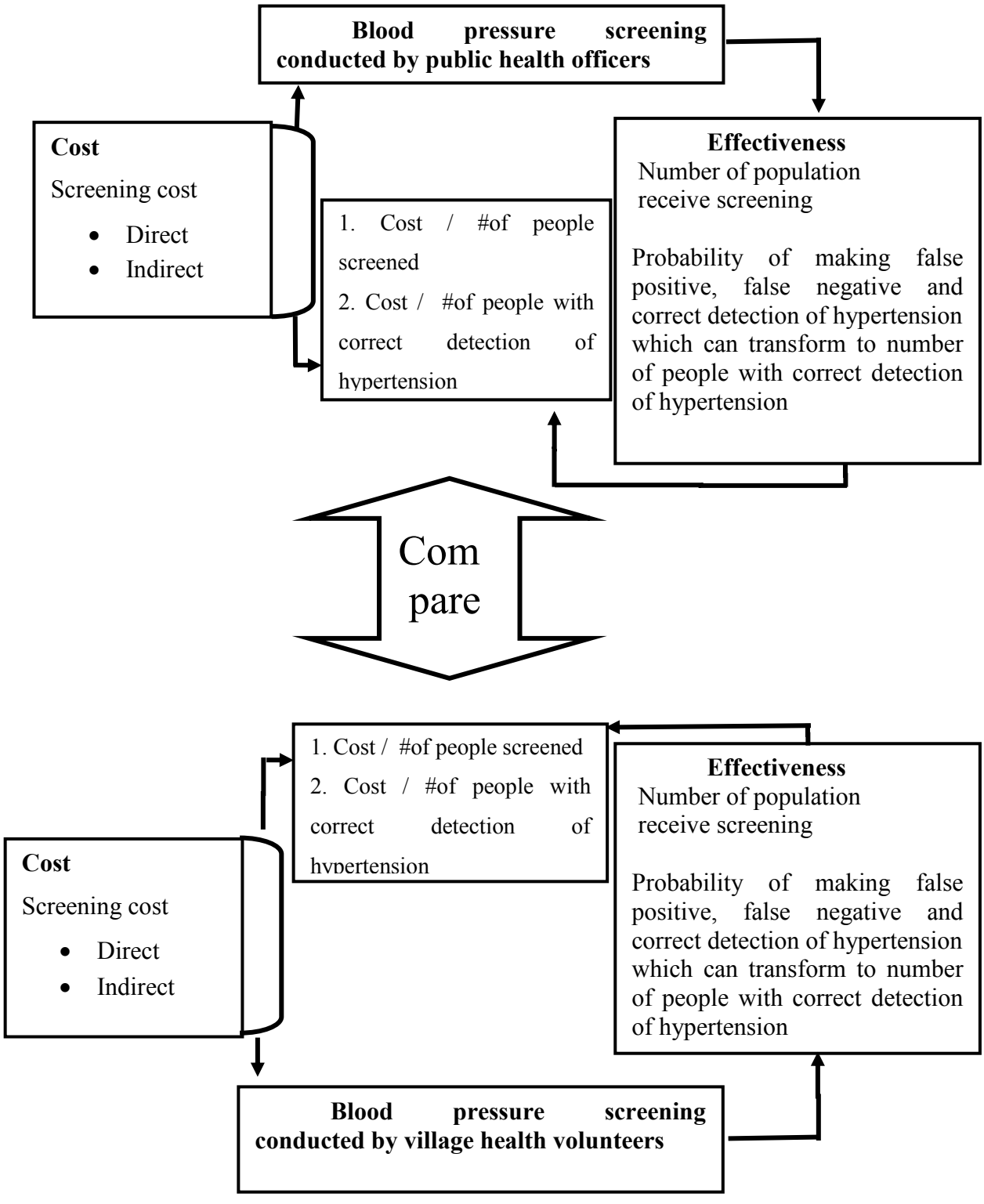
CHAPTER IV
RESEARCHMETHODOLOGY

4.1.Conceptual Framework

In this study, cost and effectiveness of two interventions of blood pressure screening programs (hypertension screening conducted by public health officer compare with village health volunteers) are analyzed by using health economics evaluation concept. Cost in this study is evaluated from provider perspective. All cost that associated with hypertension screening will be considered. Particularly, cost data in 2011 are used for hypertension screening conducted by public health officer and the cost data in 2012 are employed for screening of hypertension conducted by village health volunteers, both will be calculated in this study by using activity-based costing.

For the part of effectiveness, there are two types of outcome that we will consider in this study. The first outcome is the number of risk population (people aged 15 or older) that receive hypertension screening by each program. The second outcome is the probability of making false positive, false negative, and correct detection of hypertension conducted by public health officers and village health volunteers. These three probability measures can be used to estimate the number of people with correct detection of hypertension.

Figure 1:Concetual Framework



4.2.Study Design

This study is a retrospective study, focusing on the analysis of the cost and outcome for hypertension screening conducted by village health volunteers as compared with public health officers. It employs secondary data from Doitung Primary Care Unit of The QUEEN SIRIKIT and then uses cost-effectiveness analysis (CEA) to evaluate two different interventions and to compute "cost per effectiveness" associated with each screening program.

4.3.Study population

In this study, one health promotion hospital (Doitung Primary Care Unit of The QUEEN SIRIKIT) with the coverage of 10 villages that is located in Mae Fah Luang district is considered as a provider of hypertension screening. The hypertension screening had been conducted by public health officers in 2011 and by village health volunteers in 2012, were conducted through this particular health promotion hospital. Therefore, data of cost for screening of hypertension for both years from provider perspective will be analyzed together with the clinical data of hypertension patients. These data are obtained from this as particular hospital.

4.4.Study Instrument

Cost data from provider perspective are collected from the accounts record, and interview public health officers who work at Doitung Primary Care Unit of The Queen Sirikit (DPCU). Clinical data are collected from database of DPCU. Staffs' salary data are obtained from district public health office database. In addition, Delphi technique is then used to obtain the probability of false positive, false negative and true detection of hypertension from the screening conducted by public health officers and village health volunteers.

Table IV-1: Data requirement and source of data

Data requirement	Study instrument	source
1. Cost of hypertension screening	Accounts record	secondary data
2. Clinical data Number of people screened	DPCU database	secondary data
3. Probability of screening probability of making false positive, false negative and true detection of hypertension from the screening	Delphi technique	primary data

Data have been collected following the Table IV-1 and the analysis of the data has been performed by using Microsoft Excel 2007 software.

4.5.Cost data

Table IV-2: Identification, measurement and valuation of cost

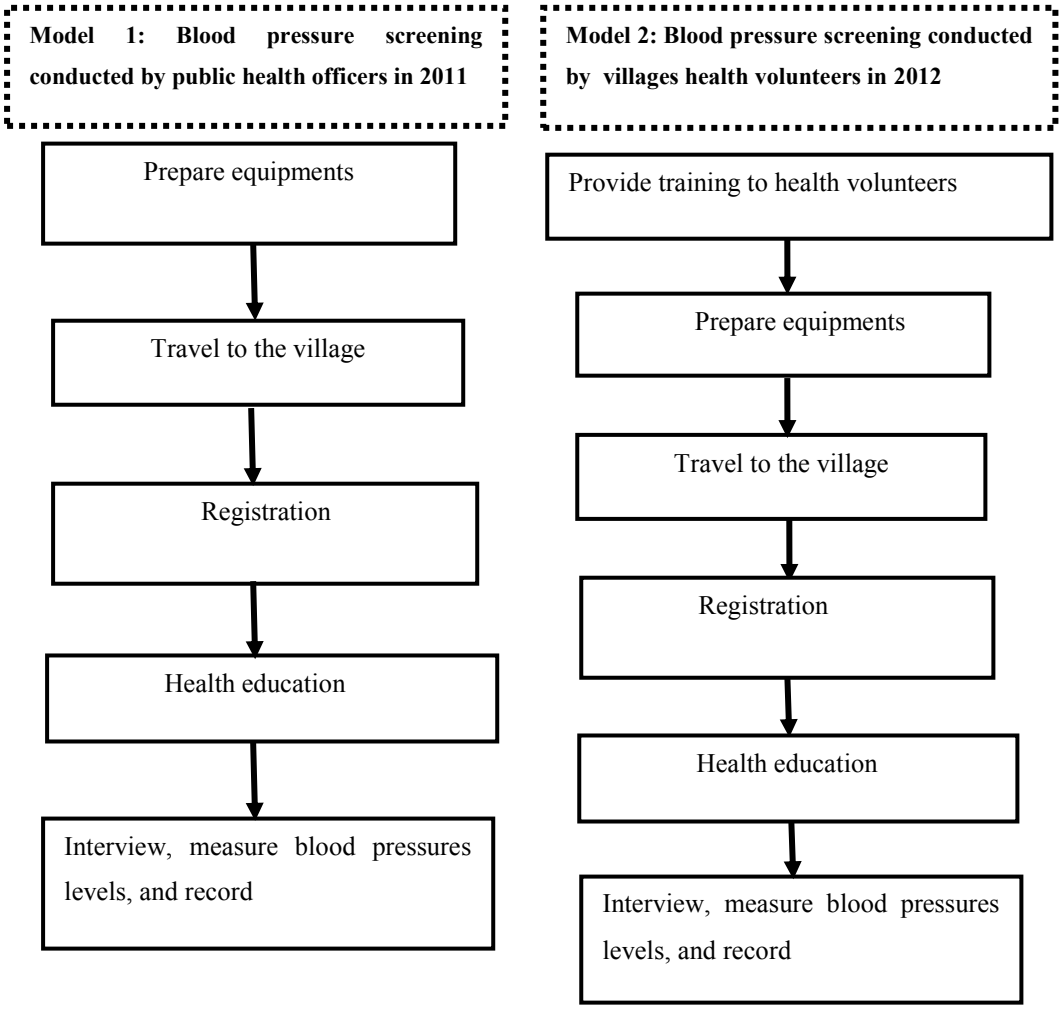
Resource use	How to measure	Basis of valuation
Health providers cost		
Staff (indirect)	Time(minutes)	Salary/Wage rate
Material (direct)	Units/amounts consumed	Market prices
Overheads (allocated)	Units/amounts consumed Time (minutes)	Market prices

According to Table IV-2 on identification measurement, and valuation of cost, it demonstrates how we can identify the value of each resource used. For example, the valuation of cost for staffs is based on their salary and the amount of time worked while materials are based on their market prices.

The cost data for hypertension screening programs will be collected from secondary source which is available at Mae Fah Luang district public health office. All costs that are related to hypertension screening program will be calculated in this study by using activity-based costing.

4.6.Activity based costing

Figure 2:List of activities involved for hypertension screening conducted by public health officers(Model 1) and by village health volunteers(model 2)



The activity-based costing process starts by developing the activity model (Baker, 1998), which outlines the sequence of activities that are involved in the hypertension screening program. Figure 2 is the activity models, which shows a list of activities involved for hypertension screening by public health officers in 2011 and by village health officers in 2012.

Next, an activity analysis is performed to identify the resources used for each activity.

4.6.1. Identify activities related cost

Model 1

Model 1 in Figure 2 identifies the list of activities involved for hypertension screening by public health officers in 2011, and each activity can incur cost. The incurred cost on each activity is the following: (I) Cost of preparing equipments : Before the implementation of blood pressure screening program for population in the village, each staff needs to prepare all related equipments and materials such as mercury sphygmomanometer, monitor, projector, computer, postcard, paper, and microphone. Therefore, the cost will start to accumulate once the staffs have spent time to prepare these equipments and materials.

(II) Cost of traveling to the villages cost: In this activity, cost includes staffs' cost for spending time traveling to the villages, vehicle cost, and fuel cost. However, total amount of this cost will depend on the travel distance between the villages and DPCU.

(III) Registration cost: Once the staffs arrive at the village, they need to set up the place for registration process. Then they will prepare all equipments and materials to be ready for blood pressure screening program. This activity's cost includes space, furniture, stationary, water, electricity and staffs' cost that are used in this particular task. In order to calculate staff's cost, we need to know how many clients were registered by each staff then transfer it into minutes used by each staff in the registration process. On average, 2 minutes per client is needed.

(IV) Health education cost: After clients were registered, staffs will educate them to change their lifestyle, especially consumption behaviors, in order to help averting hypertension as well as how to protect themselves from harms of other communicable and non-communicable disease. Therefore, the cost in this activity includes 2 parts, which are staffs' cost and the cost of all equipments and materials that have been used during health education session cost such as monitor, projector, computer, postcard, paper, microphone, and loudspeaker.

(V) Cost of interviewing, measuring, and recording blood pressure level cost: In this process, staffs will interview clients about their historical health and diseases. Then, staffs will measure and record each client's blood pressure. So, all the cost will come from time spent of staffs in duty and equipments and materials that were used at work such as mercury sphygmomanometer**,** automatic blood pressure monitoring device**,** plastic box, record form, and writing devices.

Model 2

According to Figure 2, we identify a list of activities involved for hypertension screening by village health volunteers in 2012, which can incur cost. To begin with, Provide training cost**:** In this activity, 50 representatives from 10 villages will be trained by DPCU staffs at DPUC. The program training includes the procedure to measure blood pressure, teach them about basic health care knowledge, health counseling, and the way to protect their families from all kinds of disease as well as train them to be able to educate people in their villages. Hence, the cost in this activity will separate into two major parts, which are (1) capital cost including the cost of building, operation and maintenance such as electricity, water, fan, air conditioner, fuel, telephone, cleaning and the cost of materials such as monitor, postcard, paper, writing devices, document, microphone, loudspeaker and (2) staffs' or trainer' cost who have spent time in this activity.

In the second model, equipment's preparation cost, village traveling cost, providing health education cost, and interviews, measure, and record blood pressure level cost, will be similar to the first model for the activities and method of identified the cost.

In addition, Table IV-3 lists differences in activities between hypertension screening done by public health officers in 2011 and by village health volunteers in 2012. The differences in activities consist of health education process, registration process, and interview, measure, and record blood pressure process. In 2011, all of these activities were performed by public health officers and director of DPCU was also involved in all of these activities including commuting to each village to conduct hypertension screening like other staffs of DPCU. But in 2012, village health volunteers were the ones who conducted health education, registered villagers, and interviewed, measured, and recorded blood pressure under supervision of public health officers. Moreover, for hypertension screening program in 2012, public health officers provided training for village health volunteers to make them able to measure blood pressure accurately. The training was conducted only once for all village health volunteers from all villages at the same time at DPCU. All of DPCU staffs including the director were responsible for this activity.

Table IV-3: Different activities of hypertension screening done by public health officers and village health volunteers

Hypertension screening conducted by public health officers in 2011	**Hypertension screening conducted by village health volunteers in 2012**
Health education - Health education is provided by public health officers Registration process - Registration process is done by public health officers Interview, measure, and record blood pressure - Interview, measure, and record blood pressure in 2011 are done by public health officers	Provide training - Village health volunteers were provided training by public health officers Registration process - Registration process is done by public health officers Health education - Health education is provided by village health officers under supervision of public health officers Interview, measure, and record blood pressure - Interview, measure, and record blood pressure in 2011 are done by village health volunteers under supervision of public health officers

4.6.2. Cost category

After cost of resources used in each activity was identified, we must then assign each resource used into a cost category which is either direct or indirect cost category. Direct cost implies that the component can be only used once and directly related to the hypertension screening program, in other words, it is a single allocated component such as fuel, stationary, and record form. For the indirect cost, it is the component which can be reused or allocated into many activities or even many programs. On the other hand, we can say it is a multiple allocated components such as staffs' cost, furniture, monitor, projector, computer, microphone, and weighing machine.

The cost category of each resource used is shown in Table IV-4 below.

Table IV-4:Cost category

Component activity	Category
Provide training	
Staff	Indirect cost
Space	Indirect cost
Equipment	Indirect cost
Materials	Direct cost
Preparing equipment	
Staff	Indirect cost
Travel to the village	
Staff	Indirect cost
Vehicle	Indirect cost
Fuel	Direct cost
Registration Unit	
Staff	Indirect cost
Space	Indirect cost
Furniture	Indirect cost
Stationary and others	Direct cost
Electricity/water	Direct cost
Health education	
Staff	Indirect cost
Stationary and others	Direct cost
Projector	Indirect cost
Monitor	Indirect cost
Microphone	Indirect cost
Computer	Indirect cost
Plastic box	Indirect cost
Interview, measure and record blood pressure	
Staff	Indirect cost
Weighing machine	Indirect cost
Sphygmomanometer	Indirect cost
Record form	Indirect cost
Pen	Indirect cost

4.6.3. Cost driver

Next the cost drivers for each resource and the number of resources utilized need to be determined. A cost driver is the causal factor that influences the cost of the activity. The annual quantity of the cost driver is estimated according to the nature

usage of cost driver. For example, staffs' cost driver and equipment costs depend on their time used, material costs are identified as volume used and fuel cost depends on the distance traveled. All cost drivers in this study are shown in Table IV-5.

Table IV-5:Cost driver

Component activity	**Category**	**Cost driver**
Provide training		
Staff	Indirect cost	Time used
Space	Indirect cost	Time used
Equipment	Indirect cost	Time used
Materials	Direct cost	Volume used
Preparing equipment		
Staff	Indirect cost	Time used
Travel to the village		
Staff	Indirect cost	Time used
Vehicle	Indirect cost	Time used
Fuel	Direct cost	Distance traveled
Registration Unit		
Staff	Indirect cost	Time used
Space	Indirect cost	Time used
Furniture	Indirect cost	Time used
Stationary and others	Direct cost	Volume
Electricity/water	Direct cost	Volume
Health education		
Staff	Indirect cost	Time used
Stationary and others	Direct cost	Volume
Projector	Indirect cost	Time used
Monitor	Indirect cost	Time used
Microphone	Indirect cost	Time used
Computer	Indirect cost	Time used
Plastic box	Indirect cost	Time used
Interview, measure and record blood pressure		
Staff	Indirect cost	Time used
Weighing machine	Indirect cost	Time used
Sphygmomanometer	Indirect cost	Time used
Record form	Indirect cost	Volume
Pen	Indirect cost	Time used

Once the cost drivers have been identified, the next step is to calculate the cost allocation rate which is the ratio of annual cost of the resources and number of times the resources were used in a whole year (annual quantity of cost driver).

To calculate the annual cost of the capitals and equipment which were considered to be indirect cost for the hypertension screening programs, the following approaches as proposed by Crees and Parker (1994) will be used:

$$\text{Current Price of the asset: } Ct = Co\,(1+r)^{t}$$

Where Ct = current price of the asset, Co = purchase price, r = discount rate, t = years since purchase.

After that, annualization factor of each capitals and materials will be obtained by using the following equation:

$$\text{Annualization factor: } a(r,n) = [r(1 + r)^{n}] / [(1+r)^{n} - 1]$$

where r = discount rate ,and n = usable life of capital asset.

Then we will get the annualization cost by dividing the current price of each asset by its annualization factor.

$$\text{Annual cost} = \frac{\text{Current price}}{\text{Annualization factor}}$$

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

Total cost of program = cost allocation rate × actual quantity of allocation

Finally, we can find the annual hypertension screening program cost by multiplying the actual quantity of allocation by the cost allocation rate of each resource for that hypertension screening activity (Michel J., 2011).

4.7.Outcome measurement and valuation

1. The effectiveness is measured by counting the number of people screened in each program.
2. The probability of making false positive, false negative and true detection of hypertension from screening conducted by public health offices and village health volunteers are obtained by using Delphi technique. This technique involves asking three directors of district public health officers, one director of health promotion hospital, one nurse and three public health officers about

their opinions on these statistics. Then, we can calculate the following statistics:

	(+) Hypertension	(-) Hypertension	Total
(+) Screening	A	B	A+B
(-) Screening	C	D	C+D
Total	A+C	B+D	A+B+C+D

False positive rate = B / B+D

False negative rate = C / A+C

True detection rate = 1- (B / B+D) – (C / A+C)

where positive screening is the result of screening referring to clients who have got hypertension reported by public health officers or village health volunteers;

negative screening is the result of screening referring to clients who have not got hypertension reported by public health officers or village health volunteers;

positive hypertension indicates confirmation of clients who have actually got hypertension diagnosed by the medical doctor; and

negative hypertension indicates confirmation of clients who have not got hypertension diagnosed by medical doctor.

False positive rate is the rate of occurrence of positive screening results in people known to be free from hypertension disease. Oppositely, the false negative rate is the rate of occurrence of negative screening results in people who have actually got hypertension disease.

Once the probability of false positive rate, false negative rate and true detection of hypertension has been estimated, the next step is to transform these rates to actual number of screened people who incur false positive, false negative and true detection of hypertension. As a result, the performance of both public health officers and village health volunteers can be assessed.

4.8.Cost –effectiveness analysis

Cost –effectiveness analysis ratio = C / E

where C is the cost of hypertension screening and E stands for the outcome of hypertension screening. Therefore, cost-effectiveness is a comparison of the cost of different programs for blood pressure screening to achieve an outcome (i.e. effectiveness) ,which is the cost of each program divided by its effectiveness. As the result, costs per unit of outcome are obtained.

If cost per its effectiveness is lower, then that particular alternative becomes the most cost-effective option because it uses less cost to provide one unit of outcome.

Sensitivity analysis

In this study, we calculated the cost of staffs of the hypertension screening programs from the provider perspective. Moreover, we also want to estimate the full staffs cost of the hypertension screening programs so we will employ the sensitivity analysis by adding the overhead cost of staffs to the programs.

CHAPTER V
RESULT AND DISCUSSION

This chapter presents the empirical results of the study. This study analyses and compares cost and effectiveness of hypertension screening conducted by both public health officers and village health volunteers. The structure of the results is shown as follows:

1. The cost of hypertension screening conducted by public health officers
2. The cost of hypertension screening conducted by village health volunteers
3. The effectiveness of hypertension screening conducted by public health officer
4. The effectiveness of hypertension screening conducted by village health volunteers
5. The cost-effectiveness of hypertension screening conducted by public health officers and village health volunteers.

5.1.The cost of hypertension screening conducted by public health officers

The cost of hypertension screening conducted by public health officers in 2011 consist of cost data from ten villages, which are Chalor , Liche, Phakloy1, Phakloy2, Phaka, Laba, Sounpha, Khayang, Phabue, and Selung. For this part, the cost includes, cost of the activities that incur while hypertension screening was conducted in 2011. It can be separated into two main parts consisting of staffs cost for those who are involved for hypertension screening program and materials cost that are used in the activities. The cost was calculated by using activity-based costing method. The costs of material have both direct and indirect cost. For materials that are considered to be direct cost towards the activities, we add them directly to the hypertension screening program cost but for materials that are considered to have indirect effect on the activities, we allocate the use of these materials for the activities on the basis of time spent to perform those activities related hypertension screening program .The staffs cost is based on the salary of Doitung Primary Care Unit (DPCU) staffs who are involved in the hypertension screening program. Staff cost is considered as indirect cost towards the activities. Again, in case of indirect cost, we allocate the cost according to the time that staffs spent on that particular activity.

Calculation of staffs' cost in this study used data on monthly gross salary of staffs which was obtained from salary database and then multiplied by twelve to convert monthly gross salaries to annual cost which were incurred by the DPCU. After that, we divide annual cost of staffs by annual quantity of cost driver which is the total amount of time that staffs usually work in a year in term of minutes. This comes from 60 minutes ×8 hours per day × 22 days per month × 12 months = 126720 minutes. The reason to using 22 days is because staffs have a total of 8 days off in a month during the weekend. This ratio provides the cost allocation rate of staffs that is simply cost per minute of working for Doitung Primary Care Unit. Furthermore, we can calculate the allocated activity cost for hypertension screening program by multiplying the cost allocation rate by the actual quantity of allocation based (i.e. time spent in each activity of hypertension screening program). In Table V-1 we use Chalor village as an example in calculating the staffs' cost for hypertension screening program. For the rest of the villages the step of the calculation for staffs' cost is the same as Chalor. The time used in each activity was estimated based on different basis including:

Staffs spent 45 minutes to prepare equipments as estimated in activity 1. Activity 2 refers to traveling to the village. It depended on the distance of travel multiplying by time used for traveling. This study is conducted at Mae Fah Luang district which is mostly mountainous with many barriers between the mountains of Laos, Thailand and Myanmar. Therefore, two minutes per kilometer of traveling was estimated for Chalor village where it is located 40 km. away from DPCU. Thus, a total of 80 minutes is used for traveling. For activity 3 which refers to registration process, the estimate of time use depended on the number of people who registered and the amount of time it takes to register each person. Thirty seconds per person was estimated for registration process. For activity 4 which is the step of health education, usually staffs spent 60 minutes for this process. In addition, staffs would interview clients about their historical health and diseases. Then, staffs would measure and record clients' blood pressure. Therefore, the time used in this process was estimated by the number of people whose blood pressure was measured multiplying by minutes used per person. In this study, we assume two minutes per case were used for measuring and recording blood pressure.

Table V-1:Calculation of staff cost for hypertension screening programm (Chalor Village, 2011)

Category	Salary	Annual cost	Annual quantity cost driver	Allocation rate	activity 1	activity 2	activity 3	activity 4	activity 5	Total
					45 min	80 min	57 min	60 min	228 min	
Director	31,880	382560	126720	3.019	135.8	241.5	172.08	181.14	688.3	1418.90
Nurse	24,940	299280	126720	2.362	106.2	188.9	134.62	141.70	538.4	1110.02
Dentist	15,000	180000	126720	1.420	63.9	113.6	80.97	85.23	323.8	667.61
Public health officer	17,330	207960	126720	1.641	73.8	131.2	93.54	98.47	374.1	771.32
Public health officer	12,000	144000	126720	1.136	51.1	90.9	64.77	68.18	259.0	534.09
Thai medicine officer	11,570	138840	126720	1.096	49.3	87.6	62.45	65.74	249.8	514.95
Dentist Technical officer	9,890	118680	126720	0.937	42.1	74.9	53.38	56.19	213.5	440.18
Thai medicine assistant	10,760	129120	126720	1.019	45.8	81.5	58.08	61.14	232.3	478.90
Dentist assistant	7,702	92424	126720	0.729	32.8	58.3	41.57	43.76	166.2	342.80
Dentist assistant	5,000	60000	126720	0.473	21.3	37.8	26.99	28.41	107.9	222.54
Patient's assistant	8,243	98916	126720	0.781	35.1	62.4	44.49	46.84	177.9	366.88
Driver	6,490	77880	126720	0.615	27.6	49.1	35.03	36.88	140.1	288.85
Total staff cost	160,805	1929660			685.2	1218.2	867.98	913.66	3471.9	**7157.04**

Notes: Activity 1 refers to Prepare equipments

Activity 2 refers to Travel to the villages

Activity 3 refers to Registration

Activity 4 refers to Provide health education

Activity 5 refers to Interview, measure, and record blood pressure level

Capital and material costs in this program were calculated based on their usage in each activity. The purchase price and year of purchase for some capitals and materials are difficult to find or even have no records available. If so, interviewing the director of DPCU who has worked at DPCU for more than 20 years was used to estimate the cost and year of purchase of these capitals and materials. Space or building in this study is the hall or room in each village that is used to provide the service of this program to people in each village. The space was estimated to have a

useful life of 30 years and other materials' useful life were estimated to be between 1-20 years. In this study, the interest rate of 3 percent (i.e. the interest rate of Thailand in 2011) was used to find the current price of capitals and materials. The current price of capitals and materials were annualized depending on the discount rate and its useful life. Finally, the annual costs were obtained as an example of calculation for Chalor village is shown in Table V-2. The rest of the villages use similar calculation. To calculate the cost allocation rate of each resource, we need to divide the annual cost of capitals and materials by numbers of minutes that capitals and materials were used in the whole year of 2011 or annual quantity of cost driver.

In addition, we estimate the annual quantity of cost driver for capital and materials (i.e. numbers of minutes that capitals and materials are used in 1 year) by interviewing DPCU director who has worked at DPCU more than 20 years and other staffs at DPCU. Three criterias were considered in this study including: (i) 60 minutes ×24 hours per day × 30 day per month × 12 months = 518400 minutes for resources which were used all the time such as space and vehicle, (ii) 60 minutes ×8 hours per day × 30 day per month × 12 months = 172800 minutes for components that were employed in office time such as computer, weighing machine, mercury sphygmomanometer**,** automatic blood pressure monitoring and patient historical record form, and (iii) 60 minutes ×3 hours per day × 4 day per month × 12 months = 8640 minutes for the materials and equipments which were used only when DPCH staffs outreach services to people in the villages on every Friday afternoon.

Finally, the capital and material cost were allocated to hypertension screening program by multiplying the cost allocation rate of each resource with its annual quantity of cost driver. Again, the calculation example of Chalor village is shown in Table V-3. For other villages, the calculation can be found in the appendices.

Table V-2:Calculation of annual capital and materials cost for hypertension screening program (Chalor village, 2011, 3% of discount rate)

Activity	Purchase price	Amount	Year of purchase	Useful life	Total purchase	* Current price	**Annualization	Annual cost
Preparing equipment								
Staff								
Travel to village								
Staff								
Fuel	240				240	240.0		240.00
Vehicle	900000	1	2001	30	900000	1209524.7	19.6	61710.45
Registration unit								
Staff								
Space	35000	1	1990	30	35000	65110.3	19.6	3321.95
furniture total	25000		1990	15	25000	46507.4	11.938	3895.74
water/electricity	100							100.00
stationery and others	1000							1000.00
Health education								
Staff								
stationery and others	1200	1	2011	2	1200	1200.0	4.329	277.20
Projector	8500	1	2005	15	8500	10149.4	11.938	850.18
Monitor	2500	1	2005	10	2500	2985.1	8.53	349.96
Microphone	2500	1	2009	15	2500	2652.3	11.938	222.17
plastic box	650	3	2010	5	1950	2008.5	5.58	359.95
Computer	19000	1	2010	10	19000	19570.0	8.53	2294.26
Interview and measure								
Staff								
weighing machine	1300	1	2009	10	1300	1379.2	8.53	161.68
sphygmomanometer	9400	2	2005	20	18800	22448.2	14.877	1508.92
automatic BP measure device	2500	1	2009	10	2500	2652.3	8.53	310.93
record form	25	114	2011	3	2850	2850.0	2.829	1007.42
Pen	5	25	2011	1	125	125.0	0.971	128.73
Total cost					**1021465**	**1389402**		**77739.54**

*Calculated using; $Ct = Co\ (1+r)^t$ where Ct = current price of the asset,

Co = purchase price, r = interest rate, t = years since purchase

**Calculate using; Annualization factor: $a(r,n) = [r(1 + r)^n] / [(1+r)^n - 1]$

where r = interest rate , n = usable life of capital asset.

Table V-3:Calculation of cost for hypertension screening program (Chalor village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	minutes used	126720	15.23	45	685.25
Travel to village							
Staff	Indirect cost	1929660	minutes used	126720	15.23	80	1218.22
Fuel	Direct cost	240	volume				240.00
Vehicle	Indirect cost	61710	minutes used	518400	0.12	80	9.52
Registration unit							
Staff	Indirect cost	1929660	minutes used	126720	15.23	57	867.98
Space	Indirect cost	3322	minutes used	518400	0.01	57	0.37
furniture total	Indirect cost	3896	minutes used	518400	0.01	57	0.43
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1929660	minutes used	126720	15.23	60	913.66
stationery and others	Indirect cost	277	minutes used	8640	0.03	60	1.93
Projector	Indirect cost	850	minutes used	8640	0.10	60	5.90
Monitor	Indirect cost	350	minutes used	8640	0.04	60	2.43
Microphone	Indirect cost	222	minutes used	8640	0.03	60	1.54
plastic box	Indirect cost	360	minutes used	8640	0.04	60	2.50
Computer	Indirect cost	2294	minutes used	172800	0.01	60	0.80
Interview and measure							
Staff	Indirect cost	1929660	minutes used	126720	15.23	228	3471.93
weighing machine	Indirect cost	162	minutes used	172800	0.0009	228	0.21
sphygmomanometer	Indirect cost	1509	minutes used	172800	0.01	228	1.99
automatic BP measure device	Indirect cost	311	minutes used	172800	0.008	228	0.41
record form	Indirect cost	1007	minutes used	172800	0.01	228	1.33
Pen	Indirect cost	129	minutes used	172800	0.0007	228	0.17
Total cost		9726040					**7626.57**

Table V-4:Total cost to hypertension screening program conducted by public health officer in 2011

Activity	Chalor	Liche	Phakloy	Phakloy2	Phakha	Laba	Sounpha	Khayang	Phabue	Selang	Total cost
Preparing equipment											
Staff	685.25	685.25	685.25	685.25	685.25	685.25	685.25	685.25	685.25	685.25	6852.49
Travel to village											
Staff	1218.2	913.66	426.38	365.47	730.93	304.55	304.55	243.64	121.82	30.46	4659.69
Fuel	240.00	130.00	18.00	6.00	44.00	60.00	104.00	36.00	52.00	44.00	734.00
Vehicle	9.52	7.14	3.33	2.86	5.71	2.38	2.38	1.90	0.95	0.24	36.43
Registration unit											
Staff	867.98	746.16	852.75	593.88	837.53	0.00	860.37	966.96	609.11	723.32	7058.06
Space	0.37	0.31	0.36	0.22	0.29	0.32	0.35	0.35	0.22	0.23	3.02
Furniture total	0.43	0.37	0.42	0.25	0.39	0.30	0.24	0.27	0.17	0.29	3.13
Water/electricity	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1000.00
Stationery and others	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1000.00
Health education											
Staff	913.66	913.66	913.66	913.66	913.66	913.66	913.66	913.66	913.66	913.66	9136.65
stationery and others	1.93	1.93	0.10	1.93	1.93	1.93	1.93	1.93	1.93	1.93	17.42
Projector	5.90	5.90	0.30	5.90	5.90	5.90	5.90	5.90	5.90	5.90	53.43
Monitor	2.43	2.43	0.12	2.43	2.43	2.43	2.43	2.43	2.43	2.43	21.99
Microphone	1.54	1.54	0.08	1.54	1.54	1.54	1.54	1.54	1.54	1.54	13.96
plastic box	2.50	2.50	0.12	2.50	2.50	2.50	2.50	2.50	2.50	2.50	22.62
Computer	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	7.97
Interview and measure											
Staff	3471.93	2984.64	3411.02	2375.53	3350.10	3685.11	3411.02	3867.85	2436.44	2893.27	31886.90
weighing machine	0.21	0.18	0.21	0.15	0.21	0.23	0.21	0.24	0.15	0.18	1.96
sphygmomanometer	1.99	1.71	1.96	1.36	1.92	2.11	1.96	2.22	1.40	1.66	18.29
automatic BP device	0.41	0.35	0.40	0.28	0.40	0.44	0.40	0.46	0.29	0.34	3.77
record form	1.33	0.98	1.28	0.62	1.24	1.39	1.50	1.65	0.65	0.92	11.57
Pen	0.17	0.15	0.17	0.12	0.16	0.18	0.17	0.19	0.12	0.14	1.56
Total cost	**7626.5**	**6709.6**	**6516.7**	**5394.7**	**6982.8**	**6051.0**	**6637.1**	**7139.7**	**5225.3**	**5705.0**	**63,988.9**

TableV-4 provides total cost of the hypertension screening program conducted by public health officers when considering all the ten villages that DPCU serves.

The total cost of the hypertension screening program in 2011 which is the screening of hypertension conducted by public health officers was equal to 63,988.9

Baht. When we look deeply at each village, the proportion of costs was different among them. To begin with Chalor village, the total cost was 7626.57 Baht. It was the highest among ten villages because the number of village members was higher than other villages and the distance between DPCU and Chalor village was farthest when comparing to others. Therefore, more time is needed to travel. After calculating the staff cost for traveling, we found it to be equal to 1218.22 Bath and it was the highest among all the villages.

The total cost for Liche village was 6709.67 Baht. The majority of the cost in Liche village was the staff cost, accounting for 93.05 % following by material cost accounting for 6.95 %. This village had high cost when comparing to other villages except Chalor and Laba villages because the distance between DPCU and Liche village is further than others.

As for Phakloy1 or Akha Phakloy, the total cost of hypertension screening program running by public health officers in 2011 was 6516.70 Baht. As other villages, the major proportion of cost was incurred in staff cost accounting for 96.5% following by material cost of 3.5%.

Phakloy2 or Lahu Phakloy is also the village that DPCU is responsible for conducting of hypertension screening. The total cost of hypertension screening program running by public health officers in 2011 was 5394.7 Baht. As other villages, the major proportion of cost was incurred in staff cost accounting for 91.45% following by materials cost 8.54%. In comparison to other villages, Phakloy2 incurred the lowest cost among the ten villages because the distance between DPCU and phakloy2 is nearest when comparing to others and also the number of village members is less than other villages, so staffs can save time for traveling and doing other activities in this village.

For other villages, Phaka, Laba Sounpha Khayang Phabue and Selang, the feature of their cost are quite similar to the villages that we already mentioned. The highest proportion of cost of hypertension screening program in all villages incurred in the process of interview, measure and record the level of blood pressure. The proportion of cost for this activity is equal to 49.89% of the total cost that was employed in hypertension screening program or equivalent to 31,924.24 Baht.

5.2. The cost of hypertension screening conducted by village health volunteers

Table V-5:Total cost to hypertension screening program conducted by village health volunteers

Activity	Chalor	Liche	Phaklouy	Phaklouy2	Phakha	Laba	Sounpha	Khayang	Phabue	Selang	Total cost
Training cost											
Staff											7309.318182
Capital cost											249.847048
Direct cost											13250
Preparing equipment											
Staff	705.81	705.81	705.81	705.81	705.81	705.81	705.81	705.81	705.81	705.81	7058.05
Travel to village											
Staff	1254.77	941.07	439.17	376.43	752.86	313.69	313.69	250.95	125.48	31.37	4799.48
Fuel	240.00	130.00	18.00	6.00	44.00	60.00	104.00	36.00	52.00	44.00	734.00
Vehicle	9.81	7.36	3.43	2.94	5.89	2.45	2.45	1.96	0.98	0.25	37.52
Registration unit											
Staff	948.92	784.23	956.76	658.75	941.07	972.44	901.86	1019.50	705.81	784.23	8673.56
Space	0.40	0.33	0.40	0.24	0.32	0.34	0.37	0.37	0.26	0.25	3.28
Furniture total	0.47	0.39	0.47	0.28	0.44	0.31	0.25	0.29	0.20	0.31	3.41
Water/electricity	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1000.00
Stationery and others	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1000.00
Health education											
Staff	941.07	941.07	941.07	941.07	941.07	941.07	941.07	941.07	941.07	941.07	9410.74
stationery and others	1.98	1.98	0.10	1.98	1.98	1.98	1.98	1.98	1.98	1.98	17.94
Projector	6.08	6.08	0.30	6.08	6.08	6.08	6.08	6.08	6.08	6.08	55.03
Monitor	2.50	2.50	0.13	2.50	2.50	2.50	2.50	2.50	2.50	2.50	22.65
Microphone	1.59	1.59	0.08	1.59	1.59	1.59	1.59	1.59	1.59	1.59	14.38
plastic box	2.57	2.57	0.13	2.57	2.57	2.57	2.57	2.57	2.57	2.57	23.30
Computer	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	8.21
Interview and measure											
Staff	3795.66	3136.91	3827.03	2635.0	3764.3	3889.7	3607.45	4077.99	2823.2	3136.9	34694.26
weighing machine	0.23	0.19	0.24	0.16	0.23	0.24	0.22	0.25	0.17	0.19	2.13
sphygmomanometer	2.18	1.80	2.19	1.51	2.16	2.23	2.07	2.34	1.62	1.80	19.90
automatic BP device	0.90	0.74	0.90	0.31	0.44	0.92	0.85	0.96	0.67	0.74	7.44
record form	1.45	1.03	1.44	0.69	1.39	1.46	1.59	1.74	0.76	1.00	12.55
Pen	0.19	0.15	0.19	0.13	0.18	0.19	0.18	0.20	0.14	0.15	1.70
Total cost	**8117.40**	**6976.64**	**7098.67**	**5778.8**	**7571.7**	**7286.49**	**6933.41**	**7458.98**	**5761.7**	**6059.6**	**89,852.7**

Table V-5 illustrates the cost of hypertension screening program conducted by village health volunteers in 2012. In this year, all of activities related to blood pressure screening are still the same as the processes like in 2011 but now village health volunteers were the ones who conduct the blood pressure screening instead of public health officers. Therefore, the methods of calculating were the same as 2011 when hypertension screening program was conducted by public health officers. The total cost for running the hypertension screening program in 2012 was 89,852.70 Baht.

Because it was the first year that the program collaborated with ten villages by providing training to health volunteers so that they could be able to educate their people and measure level of blood pressure for screening hypertension, the cost of training was the additional cost that needs to be include for calculated in this year. Moreover, the cost for training was separated into two main parts, which are cost of staffs and capitals and materials, such as buildings, monitors, postcards, pieces of paper, writing devices, and microphones. Costs were allocated into different categories, including direct and indirect costs. For materials that were considered to have direct cost towards the activities, we added them directly to the training activity cost. On the other hand, for the material and staff cost that were considered to have an indirect effect on the activities, we allocated the use of these resources for the training activities for health volunteers on the basis of time spent (i.e. actual quantity of minutes used) to perform the activities.

Speaking of the calculation of staff cost for training activities, the same process of staff cost calculation in 2011is applied here. The calculation started by multiplying monthly gross salary of staffs obtained from salary database by twelve to convert monthly gross salaries to annual cost which was incurred by the DPCU. After that, we divided annual cost of staffs by annual quantity of cost driver which come from 60 minutes ×8 hours per day × 22 days per month × 12 months = 126720 minutes. This ratio gives us the cost allocation rate of staffs per minute of working at Doitung Primary Care Unit. Then, we calculated the allocated activity cost by multiplying the cost allocation rate by the actual quantity of allocation based (i.e. time spent in the training activity for health volunteers). In the training activity, 480 minutes were estimated for the actual quantity of allocation based because DPCU staffs spent 8 hours for training activity. The calculation is shown in Table V-6.

Table V-6:Staffs cost calculatio of training for village health volunteers

Category	Salary	Annual cost	Annual quantity of cost driver	Allocation rate	Time spent for training	Allocated activity cost
Director	31,880	382560	126720	3.019	480.00	1449.09
Nurse	24,940	299280	126720	2.362	480.00	1133.64
Dentist	15,000	180000	126720	1.420	480.00	681.82
Public health officer	17,330	207960	126720	1.641	480.00	787.73
Public health officer	12,000	144000	126720	1.136	480.00	545.45
Thai medicine officer	11,570	138840	126720	1.096	480.00	525.91
Dentist Technical officer	9,890	118680	126720	0.937	480.00	449.55
Thai medicine assistant	10,760	129120	126720	1.019	480.00	489.09
Dentist assistant	7,702	92424	126720	0.729	480.00	350.09
Dentist assistant	5,000	60000	126720	0.473	480.00	227.27
Patient's assistant	8,243	98916	126720	0.781	480.00	374.68
Driver	6,490	77880	126720	0.615	480.00	295.00
Total staff cost	160,805	1929660				**7309.32**

The indirect capital' and materials' cost for this activity calculated on the basis of proportion used in the training activity for village health volunteers. Space was estimated to have a useful life of 30 years and other materials' useful life was estimated to be between 8-20 years. In this study, the discount rate of 3 percent in 2011 was used to find the current price of capitals and materials because the training activity for village health volunteers was prepared in 2011. Once the current price was identified, we must then calculate the annual cost of capitals and materials by annualizing each resource depending on the discount rate and its useful life as shown in Table V-7. After that, the cost allocation rate can be calculated by dividing annual cost of the resources by annual quantity of cost driver. The result is shown in Table V-8.

Table V-7:The calculation of annual capital and materrial cost for training activities

Resources	Amount	Purchase price	Total purchase price	Year of purchase	Useful life	Current price	Annualization factor	Annual Cost
Space		500000	500000	1998	30	989965.8	15.37	64400.59
Sphygmomanometer	4	9400	37600	2005	20	52907.0	12.46	4245.46
Projector	1	8500	8500	2008	20	10331.8	12.46	829.06
Computer	1	19000	19000	2010	15	20947.5	10.38	2018.06
Microphone	1	2500	2500	2009	15	2894.1	10.38	278.81
Light	1	2000	2000	2006	10	2680.2	7.72	347.09
Weighing machine	1	1300	1300	2009	10	1504.9	7.72	194.89
Fan	2	1700	1700	2009	12	1968.0	8.86	222.04
Chair	50	250	12500	2011	10	13125.0	7.72	1699.69
Table	5	500	2500	2011	10	2625.0	7.72	339.94
Telephone	1	2000	2000	2005	8	2814.2	6.46	435.43
Total cost			**589600**			**1101763**		**75011.06**

Table V-8:Calculation of indirect cost of training for villlage health volunteer activitiy

Activity	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Time Used in training	Cost for Training program
Provide training for health volunteers						
Staff	1929660	Minutes used	126720	15.2277	480	7309.32
Space	64401	Minutes used	172800	0.3727	480	178.89
sphygmomanometer	4245	Minutes used	126720	0.0335	60	2.01
Projector	829	Minutes used	8640	0.0960	60	5.76
Computer	2018	Minutes used	172800	0.0117	480	5.61
Microphone	279	Minutes used	8640	0.0323	360	11.62
Light	347	Minutes used	172800	0.0020	380	0.76
weighing machine	195	Minutes used	126720	0.0015	60	0.09
Fan	222	Minutes used	43200	0.0051	480	2.47
Chair	1700	Minutes used	23040	0.0738	480	35.41
Table	340	Minutes used	23040	0.0148	480	7.08
Telephone	435	Minutes used	172800	0.0025	60	0.15
Total cost	75011.0					**7559.17**

Direct cost of training activity includes food, coffee and snack during coffee break and materials such as pieces of paper, pens, training manuals and evaluation forms. Travel cost was categorized under the direct cost because DPCU was required to pay a fixed travel cost of 100 Baht for each village health volunteer. This cost is shown in Table V-9.

Table V-9:Direct cost calculation of training for village health volunteers

Input	**Cost**	**Amount**	**total cost**
Food	80	50	4000
Coffee and snack during coffee break	25	50	1250
Travel	100	50	5000
Material			
Paper	1500	1	1500
Pen	5	50	250
evaluation form	5	50	250
training manual	20	50	1000
Total cost	1,735		**13,250**

Total cost for training was 20,809.17 Baht (7559.17 + 13,250 =20,809.17). The major proportion cost was the direct material cost which is shown in Table 17. It is equal to 63.67% of all the cost and is followed by the cost of staffs or supervisor which is accounting for 7,559.16 Baht (36.32%). Other 1.2% is the cost of capitals and indirect materials.

When looking at the total cost in 2012, we find that it increases from 2011 by 40.42%. However, if we deeply look at only the cost of staffs and materials without training cost for village health volunteers, it is equal to 69,043.54 Bath which increases by only 7.45% from 2011. Therefore, it means that the main factor that leads to the increase in the cost of hypertension screening program in 2012 is the training activity for village health volunteers.

Table V-10: Comparison of costs of hypertension screening activities in 2011 and 2012

Activity	Cost in 2011	Cost in 2012	Cost difference between 2011 and 2012
Provide training			
Staff		7309.318182	7309.318182
Capital cost		249.847048	249.847048
Direct cost		13250	13250
Total		**20809.16523**	**20809.16523**
Preparing equipment			
Staff	**6852.485795**	**7058.053977**	**205.5681818**
Travel to village			
Staff	4659.690341	4799.476705	139.7863636
Fuel	734	734	0
Vehicle	36.42630492	37.51909407	1.092789148
Total	**6874.116646**	**7014.995799**	**140.8791528**
Registration unit			
Staff	7058.060369	8673.56411	1615.503741
Space	3.01506092	3.276115386	0.261054466
Furniture total	3.131874788	3.412405929	0.280531141
Water/electricity	1000	1000	0
Stationary and others	1000	1000	0
Total	**9064.207305**	**10680.25263**	**1616.045326**
Health education			
Staff	9136.647727	9410.738636	274.0909091
stationary and others	17.42126742	17.94390544	0.522638023
Projector	53.43142865	55.03437151	1.602942859
Monitor	21.99380716	22.65362137	0.659814215
Microphone	13.96268597	14.38156655	0.418880579
plastic box	22.62162112	23.30026975	0.678648634
Computer	7.966165169	8.205150124	0.238984955
Total	**9274.044703**	**9552.257521**	**278.2128184**
Interview and measure			
Staff	31886.90057	34694.25644	2807.355871
weighing machine	1.95930348	2.131804525	0.172501046
sphygmomanometer	18.28516037	19.89502291	1.609862543
automatic BP device	3.767891307	7.443078812	3.675187505
record form	11.56855092	12.55476002	0.986209096
Pen	1.559996853	1.697342135	0.137345282
Total	**31924.04147**	**34737.97845**	**2813.936977**
Total cost	**63988.89592**	**89852.70361**	**25863.80769**

Table V-10 shows the comparison of the costs of hypertension screening in 2011 and 2012 and the difference in the cost between 2012 and 2011. In 2011, there was no training cost because all the hypertension screening activities were done by public health officers. The cost for providing training to village health volunteers in 2012 is 20809.17 Baht. Thus, the difference in training cost between 2012 and 2011 is the entire amount. Total staff costs were 6852.49 Baht in 2011 and 7058.05 Baht in 2012. Staff cost increase by 2.05 % in 2012 comparing to 2011. The total travelling cost to village was 6874.12 Baht in 2011 and it increased by 2.04 % in 2012. The total cost of registration unit also increased by 17% in 2012. In 2011, the hypertension screening program spent 9274.04 Baht on health education and the spending went up to 9552.25 Baht in 2012, leading to cost increased of 2.99% in 2012. The total cost for interview and measure also increased in 2012. This amount increased from 31924.04 Baht to 34737.97 Baht during these two years. Thus, the cost for interview and measure blood pressure is increased by 8.81% in 2012. The total cost of hypertension screening was 63988.89 Baht in 2011 and it increased to 89852.70 Baht in 2012. Among all cost items, training cost accounts for the largest difference in cost between the two years.

5.3. The effectiveness of hypertension screening conducted by public health officers

The effectiveness of hypertension screening conducted by public health officers was measured in two categories, which are (i) the number of people screened by public health officers, and (ii) probability of making false positive, false negative and true detection of hypertension.

Table V-11: Total number of people screened blood pressure in 2011

Year	Numbers of people screened by public health officers,
2011	1048

The effectiveness in part (i) was measured by counting the number of people screened. The total number of people who were screened by public health officers in 2011 was 1048 persons consisting of 114 people in Chalor, 98 people in Liche, 112

people in Phakloy(1), 78 people in Phakloy(2), 110 people in Phaka, 121 people in Laba, 113 people in Sounpha, 127 people in Khayang, 80 people in Phabue, and 95 people in Selung. In comparison among all ten villages, Chalor village had the highest number of people screened in 2011. In contrary, Phaklouy2 had the lowest number of people screened.

However, according to the effectiveness measure in part (ii) we obtained it through Delphi technique by asking three directors of district public health offices, including the director of Mae Chan district public health office, director of Mae Lao district public health office and, director of Muang Chiang Rai district public health office. Moreover, in this study we also asked one director of the health promotion hospital who has worked at DPCU for many years, one vice director of Mae Fah Luang district public health office, one nurse who has been working at DPCU and also has the experience of working with village health volunteers for more than five years. In addition, two public health officers who used to work with village health volunteers, but currently work at Mae Fah Luang district public health office were also asked. Thus, a total of 8 people were interviewed. In the first step, we used a matrix shown in section 4.7 to ask the eight experts about their opinions on the probability of false positive, false negative and true detection of hypertension. The result from the first round is shown in Table V-12. However, in this step, the director of Chiang Rai district public health office (i.e. person 7) did not answer the question about the probability of false positive and false negative for public health officers' performance but he answered in the part of village health volunteers' performance. "No evidence has been recorded and it will become biased if he has to evaluate himself" was his reason for why he could not provide the answer for public health officers' performance of the detection of hypertension.

Table V-12:Result of asking probability of public health officers performance for detection of hypertension (first round)

	person 1	person 2	person 3	person 4	person 5	person 6	person 7	person 8	Min	Max	Mean
False positive rate	0.8	0.1	0.1	0.04	0.03	0.04		0.06	0.03	0.80	**0.17**
False negative rate	0.07	0.1	0.1	0.05	0.09	0.03		0.06	0.03	0.10	**0.07**

Table V-13: Result of asking probability of public health officers performance for detection of hypertension (second round)

	person 1	person 2	person 3	person 4	person 5	person 6	person 7	person 8	Min	Max	Mean
False positive rate	0.1	0.1	0.1	0.04	0.03	0.04		0.06	0.03	0.10	**0.07**
False negative rate	0.1	0.1	0.1	0.05	0.09	0.03		0.06	0.03	0.10	**0.08**

Notes: Person1 refers to the director of health promotion hospital (DPCU)

Person2 refers to the nurse who has been working at DPCU

Person3 refers to the public health officer

Person4 refers to the public health officer

Person5 refers to the director Mae Chan district public health office.

Person6 refers to the director of Mae Lao district public health office.

Person7 refers to the director of Chiang Rai district public health office.

Person8 refers to the vice director of Mae Fah Luang district public health office.

From the first round of the Delphi technique, the director of health promotion hospital (DPCU) (i.e. person 1) gives the highest false positive rate of 0.8. The highest false negative rate was found to equal to 0.1. However, the mean probability of making false positive in the first round was equal to 0.17 while the mean probability of making false negative was equal to 0.07.

In the second step, we went back to ask these eight experts again with the same question and showed them the answers that we obtained from the first round. Only the director of the health promotion hospital (DPCU) changed her answer, other

participants still maintained their answers that they gave in the first round (shown in Table V-13). Therefore, we used that the result from the second round as the final probability of the public health officers' performance for screening the blood pressure and detection of hypertension.

Table V-14: Result of asking probability of public health officers performance for detection of hypertension (second round)

	Min	max	Mean
Sensitivity	0.9	0.96	0.92
Specificity	0.2	0.97	0.93
False positive rate	0.03	0.10	**0.07**
False negative rate	0.03	0.10	**0.08**
Test positive rate	0.03	0.51	0.43
Predictive value for positive screening test	0.77	0.96	0.93
Predictive value for negative screening test	0.5	0.96	0.93

Data that shows in the Table V-14 is the feedback from the second round. Because the director of health promotion hospital (DPCU) modified her answer, the result of the second round was changed; the mean of making false positive rate reduced from 0.17 to 0.07, whereas the mean of making false negative increased from 0.07 to 0.08.

5.4. The effectiveness of hypertension screening conducted by village health volunteers

The effectiveness of hypertension screening conducted by the village health volunteers was also measured with the same method as when it was conducted by public health officers, including (i) the number of people who were screened by the village health volunteers, and (ii) probability of making false positive, false negative and true detection of hypertension.

Table V-15:Total number of people screened blood pressure in 2012

Year	Numbers of people screened by village health volunteers involved
2012	1106

The total number of people who were screened by village health volunteers in 2012 was 1106 persons. When deeply looking at each village, we found that, Chalor has 121people, Liche has 100 people, Phakloy(1) has 122 people, Phakloy(2) has 84 people, Phaka has 120 people, Laba has 124 people, Sounpha has 115 people, Khayang has 130 people, Phabue has 90 people, and Selung has 100 people. In comparison to the total number of people screened in 2011, it increased by 5.5%. Among ten villages, the number of people screened has increased the highest in Phabue village by 12.5% followed by Phaka village that has increased by 9.09%. In contrast, the number of people screened has increased the least by only 1.76% in Sounpha village.

The second set of effectiveness measure of the blood pressure screening conducted by village health volunteers in 2012 came from the Delphi technique in similar fashion as in 2011. Three directors of district public health office, one vice director of district public health office , one director of the health promotion hospital, one nurse, and two public health officers were asked about the performance of blood pressure screening conducted by village health volunteers. In this part, all the experts gave their opinion. The outcome of the first round of the Delphi technique is shown in the TableV-16.

Table V-16:Result of asking probability of village health volunteers performance for detection of hypertension (first round)

	person 1	person 2	person 3	person 4	person 5	person 6	person 7	person 8	Min	max	Mean
False positive rate	0.57	0.14	0.33	0.1	0.13	0.17	0.19	0.27	0.1	0.57	**0.24**
False negative rate	0.23	0.23	0.27	0.1	0.2	0.25	0.15	0.22	0.1	0.27	**0.21**

Table V-17: Result of asking probability of village health volunteers performance for detection of hypertension (second round)

	person 1	person 2	person 3	person 4	person 5	person 6	person 7	person 8	Min	max	Mean
False positive rate	0.57	0.14	0.33	0.14	0.13	0.17	0.19	0.27	0.13	0.57	**0.24**
False negative rate	0.23	0.23	0.27	0.23	0.2	0.25	0.15	0.22	0.15	0.27	**0.22**

Notes: Person1 refers to the director of health promotion hospital (DPCU)

Person2 refers to the nurse who has been working at DPCU

Person3 refers to the public health officer

Person4 refers to the public health officer

Person5 refers to the director Mae Chan district public health office.

Person6 refers to the director of Mae Lao district public health office.

Person7 refers to the director of Chiang Rai district public health office.

Person8 refers to the vice director of Mae Fah Luang district public health office.

Table V-18: Performance of blood presure screening conducted by village health volunteers

	Min	Max	Mean
Sensitivity	0.73	0.84	0.77625
Specificity	0.43	0.87	0.75625
False positive rate	0.13	0.57	**0.2425**
False negative rate	0.15	0.27	**0.2225**
Test positive rate	0.4	0.65	0.52875
Predictive value for positive screening test	0.7	0.9	0.78625
Predictive value for negative screening test	0.5	0.87	0.7325

For the second round, one of public health officers who has worked at Mae Fah Luang district adjusted his answer. He changed the probability of making false positive rate from 0.1 in the first round to 0.14 in the second round and changed the probability of making false negative from 0.1 to 0.23 (see Table V-17). Finally, the mean probability of village health volunteers' performance for screening the blood pressure and detection of hypertension was equal to 0.024 for the false positive rate and 0.022 for the false negative rate as shown on Table V-18. The average false positive rate and false negative rate made by village health volunteers were 3.6 and 2.93 times that of the average false positive rate and false negative rate made by public health officers consecutively.

5.5. The cost-effectiveness of hypertension screening conducted by public health officers and village health volunteers.

The cost – effectiveness ratio in this study was obtained by dividing the cost of hypertension screening program in each year by the outcome (i.e. the number of people who were screened in each intervention). After calculating the cost of hypertension screening, we found that the total cost of the program has increased from 63,988.90 Baht in 2011 when hypertension screening was conducted by public health officers to 89,852.70 in 2012 when hypertension screening was conducted by village health volunteers. The cost in 2012 has increased by 40.42%. When looking at the outcome or effectiveness part, we found that the total number of people who were screened in 2011 was 1,048 and it has increased by 5.5% to 1,106 people in 2012.

Table V-19: The result of cost effectiveness ratio (cost/number of people screened)

Years	2011	2012
Total number of people screened	1,048	1,106
Cost of the program (Baht)	63,988.90	89,852.70
Cost / 1 person screened	61.05	81.24

When considering in term of cost per unit of outcome (cost per person screened), we found that it was equal to 61.05 Baht per one case screening in 2011 when hypertension screening was conducted by public health officers. And in 2012, the cost per outcome was 81.24 Baht. This can indicate that hypertension screening conducted by public health officers was 33.06 % [((81.24 – 61.05) /61.05)×100] more cost effective than conducted by village health volunteers.

Table V-20: The result of cost effectiveness ratio (cost/number of people with correct detection)

	Performance of public health officers in 2011	Performance of village health volunteers in 2012
False positive rate	73	266
False negative rate	84	243
True detection	891	619
Cost / True detection	71.83	145.07

Here the focus was on the performance of blood pressure screening by observing the probability of making false positive rate, false negative rate and correct detection of hypertension. We then transformed the probability which has been obtained by using the Delphi technique to the real number of people who were screened with false positive, false negative and correct detection (see Table V-20). The estimated number of people with correct detection of hypertension screening by public health officers was 891 persons (85.78%), while the number of people with correct detection of hypertension screening conducted by village health volunteers was equal to 619 persons (53.52%). Therefore, when calculating in term of cost-effectiveness ratio which is cost / number of true detection, we found that cost of hypertension screening program in 2012(145.07 Baht / 1 correct detection) was 2.02 time more costly when comparing to hypertension screening program in 2011(71.83Baht / 1 correct detection).

5.6.Sensitivity analysis by dropping outliers response from Delphi technique and calculating median probability of performance.

Table V-21: The median of probability of performance for hypertension screening by public health officers and village health volunteers

Performance of blood pressure screening	**Public health officers**		**Village health volunteers**	
	Rate	Number of people	Rate	Number of people
False positive rate	0.05	52.4	0.3	331.8
False negative rate	0.075	78.6	0.225	248.85
True detection rate	0.875	917	0.475	525.35
Cost / 1 person with correct detection of hypertension	69.78		171.03	

Table V-21 summarizes the median probability of the false positive, false negative and true detection of the hypertension screening done by public health officers and village health volunteers after we drop outlier response. That is after we drop the largest and smallest false positive and false negative rate reported by interviews from Delphi technique. In the previous section, the mean of the probability is calculated from the results of interviewing eight experts who are familiar with hypertension screening program. However, in this section we compute the median probability of performance done by public health officers and village health volunteers as a sensitivity analysis to check whether our results are robust after dropping outliers. The median probability of false positive rate, false negative rate, and true detection rate when hypertension screening is conducted by public health officers in 2011 are 0.05, 0.075, and 0.875 respectively. When these rates are transformed into numbers of people with false positive, false negative, and correct detection the figures become 52, 78 and 917, respectively. And the cost per one person with correct detection of hypertension is equal to 69.78 Baht for the screening program in 2011.

In 2012, the median rate of false positive detection is higher than 2011. In particular, when hypertension screening was conducted by village health volunteers, the median false positive rate is 0.3. Similarly, the median false negative detection is also higher than that of hypertension screening conducted by public health officers

and the rate is 0.225. Therefore, the median true detection rate of hypertension screening done by village health volunteers is lower than that by public health officers and the rate is 0.475. When we transform these rates into numbers of people screened, the number of people with false positive is about 331 and with false negative is about 248 and the number of people with correct detection of hypertension is about 525. The cost per one person with correct detection of hypertension is equal to 171.03 Baht/one correct detection.

From this sensitivity analysis, we find that the cost effectiveness ratio when hypertension screening is conducted by village health volunteers is still higher than that done by public health officers (i.e. 171.03 Baht/one correct detection versus 69.78 Baht /one correct detection). Specifically, the program in 2012 is 2.45 times more than the program in 2011. By dropping outlier response from Delphi technique and using median probability, our main result still holds. That is, we find that hypertension screening conducted by public health officers is more cost effective than village health volunteers. Furthermore, the extent of cost effectiveness is even greater when outlier response is dropped and median probability is used.

5.7.Sensitivity analysis when dentist and dentist assistants' costs are excluded

Table V-22: The result of hypertension screening program when drop dentist and Dentist assistants costs

Years	2011	2012
Total number of people screened	1,048	1,106
Cost of the program (Baht)	45,688.66	75,197.20
Cost / 1 person screened	43.59	67.09
Cost / 1 person with correct detection of hypertension	51.28	119.80

In this study, we include the staff cost of all health personnel who work at DPCU in our cost calculation because they all work together in every activity relating to hypertension screening programs. It is usually difficult to isolate who is more involved in each activity than others. Nonetheless, it is possible that dentist and dentist assistants may do not be as technically involved in hypertension screening when comparing to others. Therefore, in this section we conduct sensitivity analysis

by dropping the staff cost for dentist and dentist assistants when calculating the overall cost. The total cost of the program becomes 45688.66 Baht in 2011 and 75197.20 Baht in 2012 respectively, after the exclusion of dentist and dentist assistants. The cost per one person screened is 43.59 Baht in 2011 when hypertension screening conducted by public health officers is equal to 67.09 Baht per person screened in 2012 when hypertension screening is conducted by village health volunteers. The cost per one person with correct detection of hypertension is 51.28 Baht in 2011 and it increased up to 119.80 Baht in 2012.

As a result, after we did the sensitivity analysis by excluding the staff cost for dentist and dentist assistants, we find that hypertension screening conducted by public health officers in 2011 is still more cost effective than when it conducted by village health volunteers in 2012.

5.8.Sensitivity analysis of full staffs' cost

In this study, we calculated the cost only from provider perspective. Therefore, a sensitivity analysis as a full staffs' cost should be considered and estimated by adding the overhead cost of staffs to the program. Overhead costs such as position allowance, tuition for children, medical treatment fee and so on, were the welfare provided by government. The study of Piya Hanvoravongchai (2012), "Consultancy Report to the Office of Civil Service Commission on Health Workforce Planning and Management," reports that the overhead cost of public health staffs in Thailand was 32% of their salary. So, in this study we included the overhead cost of 20 %, 30%, and 40% in our sensitivity analysis when computing the total cost of hypertension screening. The cost-effectiveness ratio is shown in Table V-23.

Table V-23:Sensitivity analysis of full staffs cost, added overhead cost of staffs (Cost / 1 people screened)

Percent of overhead cost	**Cost / 1 people screened (Bath)**	
	Year 2011	**Year 2012**
20 percent	72.43	94.25
30 percent	78.11	100.76
40 percent	83.80	107.26

After calculating the staffs cost by adding the overhead cost with their salary based, we found that the cost effectiveness ratio of hypertension screening conducted by public health officers in 2011 is equal to 72.43 Baht / 1 person screened when 20 percent of their regular salary based was added as overhead cost. It increased by 18% when comparing to the figure without the overhead cost. The cost increased by 27.93% per person screened when we assumed the overhead cost of staffs was 30 percent of their salary, and 37.25% was the cost increase for 40 percent overhead cost added. Moreover, the cost effectiveness ratios of hypertension screening conducted by village health volunteers in 2012 were equal to 94.25 Baht / 1 person screened, 100.76 Baht / person screened and 107.26 Baht / person screened with 20, 30 and 40 percent of the overhead cost added consecutively. In addition, the cost- effectiveness ratio as measured by cost per one person with correct detection of hypertension screening after adding full staffs cost is shown in Table V-24.

Table V-24:Sensitivity analysis of full staffs cost, added overhead cost of staffs (Cost / 1 people with correct detection)

Percent of overhead cost	**Cost / 1 correct detection (Bath)**	
	Year 2011	**Year 2012**
20 percent	85.21	168.30
30 percent	91.90	179.92
40 percent	98.59	191.53

The cost effectiveness ratio is consistently higher for the hypertension screening program in 2012 as compared to 2011, regardless of the level of the overhead cost included. This implies that the hypertension screening program conducted by village health volunteers in 2012 appears to be less cost effective than the screening done by public health officers in 2011.

5.9.Discussion

Based on the finding of this study, hypertension screening program provided by public health officers appears to be more cost effective than the hypertension conducted by village health volunteers. However, in this study, we are looking at the cost of hypertension screening program only in term of monetary value. However, if

we consider the benefit of having village health volunteers involved in the remote areas whether limited number of public health officers available, the involvement of village health volunteers can have a crucial role in supporting the work of public health officers. In other words, with limited resources of public health personnels in the district relative to the population size and the workload that they have, the involvement of village health volunteers in conducting hypertension screening can substantially free up the time of public health officers so that health personels can spend more time in providing other health services that require more advanced medical skills. Moreover, if public health officers still continue to conduct the screening by outreach into each village without help from village health volunteers, the DPCU will need to be closed on the day that public health staffs outreach screening takes place, which will incur opportunity cost of closing hospital. For example, people with serious illness will not be able to seek care during the hospital closed. As in the study by Melville B. (1995) about the role of community health volunteers, he finds that the participation of community health volunteers can be very useful for health care system especially for primary care in developing country.

Since 2012 is the first year that village health volunteers conduct screening in order to detect hypertension for people in their villages, the program cost in 2012 must take into account the setup cost in preparing them to be able to screen blood pressure. In addition to the training cost, the supervision cost must also be added. This is because public health officers need to supervise village health volunteers in all hypertension screening activities during the first year of the program. By this, it led to very high supervision cost for the program conducted by village health volunteers in 2012. However, in subsequent years, it is anticipated that these setup costs may reduce overtime since the supervision and training cost may not be required as much once village health volunteers gain more experience and become specialists in hypertension screening.

Another factor that made public health officers more effective than village health volunteers is the low performance of village health volunteers for screening and detecting hypertension. Because village health volunteers have low skills and no experience in the detection of hypertension, as the result, the study finds that the false positive rate and false negative rate of village health volunteers are higher than public health officers, leading to lower true detection rate for the former. Therefore, cost per

one person with correct detection of hypertension conducted by village health volunteers in 2012 is inevitably higher when compared with such conducted by public health officers in 2011. This is because the denominator for cost effectiveness ratio is lower in the case of hypertension screening by village health volunteers, making the overall C / E ratio to be higher. However, in the future, when village health volunteers have more experience and improve their skills in measuring blood pressure, the probability of making false positive and false negative will decline while the probability of making true detection will rise. As a result, the cost effectiveness ratio should improve overtime for the hypertension screening done by village health volunteers. Our conjecture is in accord with the study by Fillippo C. (1995) on the topic of improving skills and utilization of community health volunteers in Nepal. He finds that, after community health volunteers were trained by the Ministry of Health at the end of two years' implementation community health volunteers can improve their ability to detect and treat a range of common diseases such as diarrhea, malnutrition and acute respiratory infraction. Moreover, he also suggests that, inclusion of health service activities to community health volunteers responsibilities seems to be a key factor to increase motivation of volunteers and their acceptance within the community.

Finally, the involvement of village health volunteers on Thailand's healthcare system can possibly have some positive spillover effect in the community. By having active participation at the local level in the screening program, village health volunteers can disseminate their knowledge and make other people in their community become more aware of health related matters. Village health volunteers can empower people in the community to be more health conscious and possibly lead a more healthy lifestyle. This positive spillover effect can benefit Thailand's health care system as a whole.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1.Conclusion

The result of this study shows that the hypertension screening conducted by public health officers in 2011 was a more cost effective approach. The total cost of the hypertension screening in 2011 was 63,988.90 Baht with number of 1,048 people was screened for detected hypertension. So cost-effectiveness ratio was 61.05 Baht / outcome. The total cost of the hypertension screening in 2012 conducted by village health volunteers was 89,852.70 Baht, and 1,106 of people were screened. The cost-effectiveness ratio was 81.24 Baht/outcome. The hypertension screening conducted by public health officers was 33.06 percent more cost effective than conducted by village health volunteers. The number of people with correct detection of hypertension from the screening by public health officers is 891 persons (85.78% of the total number of screened persons), while the number of people with correct detection of hypertension screened by village health volunteers is equal to 619 persons (53.52% of the total number of screened persons). Therefore, when we calculate the cost-effectiveness ratio (cost / number of true detection), we find that the cost of hypertension screening program in 2012 (145.07 Baht/ 1 correct detection) was 2.02 time more costly when comparing to hypertension screening program in 2011 (71.83Baht/1 correct detection).

The majority of the cost for hypertension screening program was staffs cost. It was accounted for 93.13% for hypertension screening conducted by public health officers in 2011 and 80.17 % in 2012.

Based on the finding of this study, hypertension screening program should be provided by public health officers because it appears to be more cost effective.

6.2.Policy implication

The study concludes that when we focus only on monetary cost and outcome, the hypertension screening program should be run by public health officers because it was 33.06% more cost effective than the screening program conducted by village health volunteers. However, other reasons such as awareness of people on their health, and participation of villagers in taking care of their health, should also be considered. In other words, the involvement of village health volunteers on Thailand's healthcare system can possibly have some positive spillover effect for the community, which may not be easily assessed in term of monetary value. Thus, policy makers should not use cost effectiveness ratio alone in choosing which policy option to implement rather other possible benefits from having village health volunteers involved in the screening program should also be considered when making such decision.

6.3.Limitation of the study

In this study, we have to estimate some capital and material costs by asking public health officers due to not enough information records. Thus, recall bias of the information may be occurred. Another limitation of this study is that the information provided by village health volunteers is available only for one year (2012), therefore we are not able to collect further information from other years. Because of the lack of information in subsequent year, we are not able to quantify the improvement in cost effectiveness overtime of the hypertension screening done by village health volunteers.

REFERENCES

American Heart Association, AHA. (2012) Understanding Blood Pressure Readings. [Online]. Available from: http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/AboutHighBloodPressure/Understanding-Blood-Pressure-Readings_UCM_301764_Article.jsp [2013,January 12]

Baker, Judith J. (1998). Activity-base costing and activity-based management for health care.

Chobanian, A. V., Bakris, G. L., & Black, H. R. (2003). The seventh report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure. The JNC 7 report. *ACC Current Journal Review, 12*(4), 31-32. [Online]. Available from: http://dx.doi.org/10.1016/S1062-1458(03)00270-8 [2013,January 15]

Drummond, M. F., Aguiar-Ibanez, R., & Nixon, J. (2006). Economic evaluation. *Singapore Med J, 47*(6), 456-461; quiz 462.

Drummond, M. F., Iglesias, C. P., & Cooper, N. J. (2008). Systematic reviews and economic evaluations conducted for the National Institute for Health and Clinical Excellence in the United Kingdom: a game of two halves? *Int J Technol Assess Health Care, 24*(2), 146-150. doi: 10.1017/S0266462308080203

Drummond, M. F., Sculpher, M. J., Torrance, G. W., O'Brien, B. J., & Stoddart, G. L. (2005). Methods for the Economic Evaluation of Health Care Programmes.

Fernández-Llamazares, Cecilia M., Hernández-Gago, Yolanda, Pozas, Maite, Cabañas, M. Josep, Feal, Begoña, Villaronga, Miquel, . . . Valverde, Esteban. (2013). Two-round Delphi technique for the consensual design of a paediatric pharmaceutical care model. *Pharmacological Research, 68*(1), 31-37. doi: http://dx.doi.org/10.1016/j.phrs.2012.11.001

Fukunaga, H., Ohkubo, T., Kobayashi, M., Tamaki, Y., Kikuya, M., Obara, T., . . . Imai, Y. (2008). Cost-effectiveness of the introduction of home blood pressure measurement in patients with office hypertension. *J Hypertens, 26*(4), 685-690. doi: 10.1097/HJH.0b013e3282f42285

Geisler, Benjamin P., Egan, Brent M., Cohen, Joshua T., Garner, Abigail M., Akehurst, Ronald L., Esler, Murray D., & Pietzsch, Jan B. (2012). Cost-Effectiveness and Clinical Effectiveness of Catheter-Based Renal Denervation for Resistant Hypertension. *Journal of the American College of Cardiology, 60*(14), 1271-1277. [Online]. Available from: http://dx.doi.org/10.1016/j.jacc.2012.07.029

Grandi, Anna M., Gaudio, Giovanni, Fachinetti, Anna, Bianchi, Lorenzo, Nardo, Barbara, Zanzi, Paolo, . . . Venco, Achille. (1996). Hyperinsulinemia, family history of hypertension, and essential hypertension. *American Journal of Hypertension, 9*(8), 732-738. doi: http://dx.doi.org/10.1016/0895-7061(96)00095-7

Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *J Adv Nurs, 32*(4), 1008-1015.

Howard, Kirsten, White, Sarah, Salkeld, Glenn, McDonald, Stephen, Craig, Jonathan C., Chadban, Steven, & Cass, Alan. (2010). Cost-Effectiveness of Screening and Optimal Management for Diabetes, Hypertension, and Chronic Kidney Disease: A Modeled Analysis. *Value in Health, 13*(2), 196-208. [Online]. Available from: http://dx.doi.org/10.1111/j.1524-4733.2009.00668.x

Jonsson, B., Carides, G. W., Burke, T. A., Dasbach, E. J., Lindholm, L. H., Dahlof, B., & Group, Life Study. (2005). Cost effectiveness of losartan in patients with hypertension and LVH: an economic evaluation for Sweden of the LIFE trial. *J Hypertens, 23*(7), 1425-1431.

Jonsson, B., Hansson, L., & Stalhammar, N. O. (2003). Health economics in the Hypertension Optimal Treatment (HOT) study: costs and cost-effectiveness of intensive blood pressure lowering and low-dose aspirin in patients with hypertension. *J Intern Med, 253*(4), 472-480.

Kamolratanakul P., Chunhaswasdikul B and Dhanamun B. (1996). Cost-effectiveness analysis of three short course anti-tuberculosis programs compared with standard regimen in Thailand. *Journal of clinical epidemiology*.

Lovibond, Kate, Jowett, Sue, Barton, Pelham, Caulfield, Mark, Heneghan, Carl, Hobbs, F. D. Richard, . . . McManus, Richard J. (2011). Cost-effectiveness of options for the diagnosis of high blood pressure in primary care: a modelling study. *The Lancet, 378*(9798), 1219-1230. [Online]. Available from: http://dx.doi.org/10.1016/S0140-6736(11)61184-7

Meredith, P. A., & Jarvis, S. C. (2011). Comments on systematic review of clinical- and cost-effectiveness of candesartan and losartan in hypertension and heart failure. *Int J Clin Pract, 65*(8), 911; author reply 912. doi: 10.1111/j.1742-1241.2011.02700.x

MoPH. (2006). Health Policy in Thailand *Bureau of Policy and Strategy, Ministry of Public health, Nonthaburi*. [Online]. Available from: http://bps.ops.moph.go.th/HealthPolicy6.pdf

MoPH. (2008). Thailand Health Profile 2005-2007. *Bureau of Policy and Strategy, Ministry of Public health, Nonthaburi*.

MoPH. (2012). Thailand healthy lifestyle Strategic Plan B.E. 2554 - 2563 (2011 - 2020). *Bureau of Policy and Strategy, Ministry of Public health, Nonthaburi*. [Online]. Available from: http://bps.moph.go.th/content/thailand-healthy-lifestyle-strategic-plan-be-2554-2563-2011-2020

Sookaneknun, Phayom, Saramunee, Kritsanee, Rattarom, Ruchilak, Kongsri, Suratchada, Senanok, Ratana, Pinitkit, Pongpan, . . . Deesin, Bhudtharat. (2010). Economic analysis of the diabetes and hypertension screening collaboration between community pharmacies and a Thai government

primary care unit. *Primary Care Diabetes, 4*(3), 155-164. [Online]. Available from: http://dx.doi.org/10.1016/j.pcd.2010.05.003

Steptoe, A. (2007). Hypertension. In M. Editor-in-Chief: George FinkAssociate Editors:Bruce, E. R. d. Kloet, R. Robert, C. George, S. Andrew, R. Noel, C. Ian & E. R. d. K. R. R. G. C. A. S. N. R. I. C. G. F. Giora FeuersteinA2 - Editor-in-Chief: George FinkAssociate Editors:Bruce McEwen (Eds.), *Encyclopedia of Stress (Second Edition)* (pp. 376-381). New York: Academic Press.

Subhash, P. (1999). cost effectiveness of early case detection for visceral leishmaniasis in Napal. *health economic*.

Thai Hypertension Society, THS. (2012). Thai Guidelines on The Treatment of Hypertension Update 2012. [Online]. Available from: http://www.thaihypertension.org/files/216_1.Hypertension_Guideline_2012.pdf

Thonghong A, Tepsittha K, Jongpiriyaanan P, Gappbirom T. (2011). Chronic Diseases Surveillance Report. *Weekly Epidemiological Surveillance Report 2012, 43*, 257-264

Wang, Y. Claire, Cheung, Angela M., Bibbins-Domingo, Kirsten, Prosser, Lisa A., Cook, Nancy R., Goldman, Lee, & Gillman, Matthew W. (2011). Effectiveness and Cost-Effectiveness of Blood Pressure Screening in Adolescents in the United States. *The Journal of pediatrics, 158*(2), 257-264.e257.

WHO. (2013). A Global Brief on Hypertension. *World Health Day 2013*. doi: http://apps.who.int/iris/bitstream/10665/79059/1/WHO_DCO_WHD_2013.2_eng.pdf

Yong, J. H. E., Beca, J., McGowan, T., Bremner, K. E., Warde, P., & Hoch, J. S. (2012). Cost-effectiveness of Intensity-modulated Radiotherapy in Prostate Cancer. *Clinical Oncology, 24*(7), 521-531. [Online]. Available from: http://dx.doi.org/10.1016/j.clon.2012.05.004

APPENDICES

Calculation of cost for hypertension screening programm (Liche Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45.00	685.25
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60.00	913.66
Fuel	Direct cost	130	volume				130.00
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	60.00	7.14
Registration unit							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	49.00	746.16
Space	Indirect cost	3322	Minutes used	518400	0.0064	49.00	0.31
furniture total	Indirect cost	3896	Minutes used	518400	0.0075	49.00	0.37
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60.00	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60.00	1.93
projector	Indirect cost	850	Minutes used	8640	0.0984	60.00	5.90
Monitor	Indirect cost	350	Minutes used	8640	0.0405	60.00	2.43
microphone	Indirect cost	222	Minutes used	8640	0.0257	60.00	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60.00	2.50
computer	Indirect cost	2294	Minutes used	172800	0.0133	60.00	0.80
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	196.00	2984.64
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	196.00	0.18
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	196.00	1.71
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	196.00	0.35
record form	Indirect cost	866	Minutes used	172800	0.0050	196.00	0.98
Pen	Indirect cost	129	Minutes used	172800	0.0007	196.00	0.15
Total cost							**6709.7**

Calculation of cost for hypertension screening programm (Phaklouy1 Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	28	426.38
Fuel	Direct cost	18	volume			28	18.00
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	28	3.33
Registration unit							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	56	852.75
Space	Indirect cost	3322	Minutes used	518400	0.0064	56	0.36
furniture total	Indirect cost	3896	Minutes used	518400	0.0075	56	0.42
water/electricity	Direct cost	100	Volume				100.00
stationery and others	Direct cost	1000	Volume				100.00
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	172800	0.0016	60	0.10
Projector	Indirect cost	850	Minutes used	172800	0.0049	60	0.30
Monitor	Indirect cost	350	Minutes used	172800	0.0020	60	0.12
Microphone	Indirect cost	222	Minutes used	172800	0.0013	60	0.08
plastic box	Indirect cost	360	Minutes used	172800	0.0021	60	0.12
Computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	224	3411.02
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	224	0.21
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	224	1.96
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	224	0.40
record form	Indirect cost	990	Minutes used	172800	0.0057	224	1.28
Pen	Indirect cost	129	Minutes used	172800	0.0007	224	0.17
Total cost							**6516.7**

Calculation of cost for hypertension screening programm (Phaklouy2 Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	24	365.47
fuel	Direct cost	6	volume				6.00
vehicle	Indirect cost	61710	Minutes used	518400	0.1190	24	2.86
Registration unit							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	39	593.88
space	Indirect cost	2866	Minutes used	518400	0.0055	39	0.22
furniture total	Indirect cost	3361	Minutes used	518400	0.0065	39	0.25
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.93
projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.90
monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.43
microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	156	2375.53
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	156	0.15
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	156	1.36
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	156	0.28
record form	Indirect cost	689	Minutes used	172800	0.0040	156	0.62
pen	Indirect cost	129	Minutes used	172800	0.0007	156	0.12
Total cost							**5394.7**

Calculation of cost for hypertension screening programm (Phaka Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	48	730.93
Fuel	Direct cost	44	volume				44.00
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	48	5.71
Registration unit							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	55	837.53
Space	Indirect cost	2701	Minutes used	518400	0.0052	55	0.29
furniture total	Indirect cost	3710	Minutes used	518400	0.0072	55	0.39
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.93
Projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.90
Monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.43
Microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	220	3350.10
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	220	0.21
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	220	1.92
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	220	0.40
record form	Indirect cost	972	Minutes used	172800	0.0056	220	1.24
Pen	Indirect cost	129	Minutes used	172800	0.0007	220	0.16
Total cost							**6982.9**

Calculation of cost for hypertension screening programm (Laba Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.249
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	20	304.555
Fuel	Direct cost	60	volume				60.000
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	20	2.381
Registration unit		1929660					
Staff	Indirect cost		Minutes used	126720	0.0000	60.5	0.000
Space	Indirect cost	2782	Minutes used	518400	0.0054	60.5	0.325
furniture total	Indirect cost	2551	Minutes used	518400	0.0049	60.5	0.298
water/electricity	Direct cost	100	volume				100.000
stationery and others	Direct cost	1000	volume				100.000
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.665
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.925
Projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.904
Monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.430
Microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.543
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.500
Computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.797
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	242	3685.115
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	242	0.226
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	242	2.113
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	242	0.435
record form	Indirect cost	990	Minutes used	172800	0.0057	242	1.386
Pen	Indirect cost	129	Minutes used	172800	0.0007	242	0.180
Total cost							**6051.03**

Calculation of cost for hypertension screening programm (Sounpha Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	20	304.55
Fuel	Direct cost	104	volume				104.00
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	20	2.38
Registration unit							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	56.5	860.37
Space	Indirect cost	3225	Minutes used	518400	0.0062	56.5	0.35
furniture total	Indirect cost	2214	Minutes used	518400	0.0043	56.5	0.24
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.93
Projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.90
Monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.43
Microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	224	3411.02
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	224	0.21
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	224	1.96
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	224	0.40
record form	Indirect cost	1158	Minutes used	172800	0.0067	224	1.50
Pen	Indirect cost	129	Minutes used	172800	0.0007	224	0.17
Total cost							**6637.2**

Calculation of cost for hypertension screening programm (Khayang Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	16	243.64
Fuel	Direct cost	36	volume				36.00
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	16	1.90
Registration unit							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	63.5	966.96
Space	Indirect cost	2866	Minutes used	518400	0.0055	63.5	0.35
furniture total	Indirect cost	2214	Minutes used	518400	0.0043	63.5	0.27
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.93
Projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.90
Monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.43
Microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	254	3867.85
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	254	0.24
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	254	2.22
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	254	0.46
record form	Indirect cost	1122	Minutes used	172800	0.0065	254	1.65
Pen	Indirect cost	129	Minutes used	172800	0.0007	254	0.19
Total cost							**7139.74**

Calculation of cost for hypertension screening programm (Phabue Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	8	121.82
fuel	Direct cost	52	volume				52.00
vehicle	Indirect cost	61710	Minutes used	518400	0.1190	8	0.95
Registration unit							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	40	609.11
space	Indirect cost	2866	Minutes used	518400	0.0055	40	0.22
furniture total	Indirect cost	2214	Minutes used	518400	0.0043	40	0.17
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.93
projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.90
monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.43
microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
staff	Indirect cost	1929660	Minutes used	126720	15.2277	160	2436.44
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	160	0.15
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	160	1.40
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	160	0.29
record form	Indirect cost	707	Minutes used	172800	0.0041	160	0.65
pen	Indirect cost	129	Minutes used	172800	0.0007	160	0.12
Total cost							**5225.34**

Calculation of cost for hypertension screening programm (Selang Village, 2011)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	45	685.25
Travel to village							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	2	30.46
Fuel	Direct cost	44	volume				44.00
Vehicle	Indirect cost	61710	Minutes used	518400	0.1190	2	0.24
Registration unit							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	47.5	723.32
Space	Indirect cost	2472	Minutes used	518400	0.0048	47.5	0.23
furniture total	Indirect cost	3131	Minutes used	518400	0.0060	47.5	0.29
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	60	913.66
stationery and others	Indirect cost	277	Minutes used	8640	0.0321	60	1.93
Projector	Indirect cost	850	Minutes used	8640	0.0984	60	5.90
Monitor	Indirect cost	350	Minutes used	8640	0.0405	60	2.43
Microphone	Indirect cost	222	Minutes used	8640	0.0257	60	1.54
plastic box	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Computer	Indirect cost	2294	Minutes used	172800	0.0133	60	0.80
Interview and measure							
Staff	Indirect cost	1929660	Minutes used	126720	15.2277	190	2893.27
weighing machine	Indirect cost	162	Minutes used	172800	0.0009	190	0.18
sphygmomanometer	Indirect cost	1509	Minutes used	172800	0.0087	190	1.66
automatic BP measure device	Indirect cost	311	Minutes used	172800	0.0018	190	0.34
record form	Indirect cost	840	Minutes used	172800	0.0049	190	0.92
Pen	Indirect cost	129	Minutes used	172800	0.0007	190	0.14
Total cost							**5705.05**

Calculation of cost for hypertension screening programm (Chalor Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
staff	Indirect cost	1987548	Minutes used	126720	15.6846	80	1254.77
fuel	Direct cost	240	volume				240.00
vehicle	Indirect cost	63562	Minutes used	518400	0.1226	80	9.81
Registration unit							
staff	Indirect cost	1987548	Minutes used	126720	15.6846	60.5	948.92
space	Indirect cost	3422	Minutes used	518400	0.0066	60.5	0.40
furniture total	Indirect cost	4013	Minutes used	518400	0.0077	60.5	0.47
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
staff	Indirect cost	1987548	Minutes used	126720	15.6846	242	3795.66
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	242	0.23
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	242	2.18
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	242	0.90
record form	Indirect cost	1038	Minutes used	172800	0.0060	242	1.45
pen	Indirect cost	133	Minutes used	172800	0.0008	242	0.19
Total cost							**8117.40**

Calculation of cost for hypertension screening programm (Liche Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
staff	Indirect cost	1987548	Minutes used	126720	15.685	45	705.81
Travel to village							
staff	Indirect cost	1987548	Minutes used	126720	15.685	60	941.07
fuel	Direct cost	130	volume				130.00
vehicle	Indirect cost	63562	Minutes used	518400	0.123	60	7.36
Registration unit							
staff	Indirect cost	1987548	Minutes used	126720	15.685	50	784.23
space	Indirect cost	3422	Minutes used	518400	0.007	50	0.33
furniture total	Indirect cost	4013	Minutes used	518400	0.008	50	0.39
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
staff	Indirect cost	1987548	Minutes used	126720	15.685	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.033	60	1.98
projector	Indirect cost	876	Minutes used	8640	0.101	60	6.08
monitor	Indirect cost	360	Minutes used	8640	0.042	60	2.50
microphone	Indirect cost	229	Minutes used	8640	0.026	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.043	60	2.57
computer	Indirect cost	2363	Minutes used	172800	0.014	60	0.82
Interview and measure							
staff	Indirect cost	1987548	Minutes used	126720	15.685	200	3136.91
weighing machine	Indirect cost	167	Minutes used	172800	0.001	200	0.19
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.009	200	1.80
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.004	200	0.74
record form	Indirect cost	892	Minutes used	172800	0.005	200	1.03
pen	Indirect cost	133	Minutes used	172800	0.001	200	0.15
Total cost							**6976.64**

Calculation of cost for hypertension screening programm (Phaklouy1 Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	28	439.17
Fuel	Direct cost	18	volume			28	18.00
Vehicle	Indirect cost	63562	Minutes used	518400	0.1226	28	3.43
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	61	956.76
Space	Indirect cost	3422	Minutes used	518400	0.0066	61	0.40
furniture total	Indirect cost	4013	Minutes used	518400	0.0077	61	0.47
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	172800	0.0017	60	0.10
Projector	Indirect cost	876	Minutes used	172800	0.0051	60	0.30
Monitor	Indirect cost	360	Minutes used	172800	0.0021	60	0.13
Microphone	Indirect cost	229	Minutes used	172800	0.0013	60	0.08
plastic box	Indirect cost	371	Minutes used	172800	0.0021	60	0.13
Computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	244	3827.03
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	244	0.24
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	244	2.19
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	244	0.90
record form	Indirect cost	1019	Minutes used	172800	0.0059	244	1.44
Pen	Indirect cost	133	Minutes used	172800	0.0008	244	0.19
Total cost							**7098.67**

Calculation of cost for hypertension screening programm (Phaklouy2 Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	24	376.43
Fuel	Direct cost	6	volume				6.00
Vehicle	Indirect cost	63562	Minutes used	518400	0.1226	24	2.94
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	42	658.75
Space	Indirect cost	2952	Minutes used	518400	0.0057	42	0.24
furniture total	Indirect cost	3461	Minutes used	518400	0.0067	42	0.28
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
Projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
Monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
Computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	168	2635.01
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	168	0.16
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	168	1.51
automatic BP measure device	Indirect cost	320	Minutes used	172800	0.0019	168	0.31
record form	Indirect cost	710	Minutes used	172800	0.0041	168	0.69
Pen	Indirect cost	133	Minutes used	172800	0.0008	168	0.13
Total cost							**5778.88**

Calculation of cost for hypertension screening programm (Phaka Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	48	752.86
Fuel	Direct cost	44	volume				44.00
Vehicle	Indirect cost	63562	Minutes used	518400	0.1226	48	5.89
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
Space	Indirect cost	2782	Minutes used	518400	0.0054	60	0.32
furniture total	Indirect cost	3822	Minutes used	518400	0.0074	60	0.44
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
Projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
Monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
Computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	240	3764.30
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	240	0.23
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	240	2.16
automatic BP measure device	Indirect cost	320	Minutes used	172800	0.0019	240	0.44
record form	Indirect cost	1001	Minutes used	172800	0.0058	240	1.39
Pen	Indirect cost	133	Minutes used	172800	0.0008	240	0.18
Total cost							**7571.72**

Calculation of cost for hypertension screening programm (Laba Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	20	313.69
Fuel	Direct cost	60	volume				60.00
Vehicle	Indirect cost	63562	Minutes used	518400	0.1226	20	2.45
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	62	972.44
Space	Indirect cost	2866	Minutes used	518400	0.0055	62	0.34
furniture total	Indirect cost	2627	Minutes used	518400	0.0051	62	0.31
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
Projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
Monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
Computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	248	3889.77
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	248	0.24
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	248	2.23
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	248	0.92
record form	Indirect cost	1019	Minutes used	172800	0.0059	248	1.46
Pen	Indirect cost	133	Minutes used	172800	0.0008	248	0.19
Total cost							**7286.49**

Calculation of cost for hypertension screening programm (Sounpha Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	20	313.69
Fuel	Direct cost	104	volume				104.00
Vehicle	Indirect cost	63562	Minutes used	518400	0.1226	20	2.45
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	57.5	901.86
Space	Indirect cost	3322	Minutes used	518400	0.0064	57.5	0.37
furniture total	Indirect cost	2281	Minutes used	518400	0.0044	57.5	0.25
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
Projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
Monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
Computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	230	3607.45
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	230	0.22
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	230	2.07
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	230	0.85
record form	Indirect cost	1192	Minutes used	172800	0.0069	230	1.59
Pen	Indirect cost	133	Minutes used	172800	0.0008	230	0.18
Total cost							**6933.41**

Calculation of cost for hypertension screening programm (Khayang Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6845	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	16	250.95
Fuel	Direct cost	36	volume				36.00
Vehicle	Indirect cost	63562	Minutes used	518400	0.1226	16	1.96
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	65	1019.50
Space	Indirect cost	2952	Minutes used	518400	0.0057	65	0.37
furniture total	Indirect cost	2281	Minutes used	518400	0.0044	65	0.29
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
Projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
Monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
Microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
Computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	260	4077.99
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	260	0.25
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	260	2.34
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	260	0.96
record form	Indirect cost	1156	Minutes used	172800	0.0067	260	1.74
Pen	Indirect cost	133	Minutes used	172800	0.0008	260	0.20
Total cost							**7458.98**

Calculation of cost for hypertension screening programm (Phabue Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocated activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	8	125.48
Fuel	Direct cost	52	volume				52.00
vehicle	Indirect cost	63562	Minutes used	518400	0.1226	8	0.98
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Space	Indirect cost	2952	Minutes used	518400	0.0057	45	0.26
furniture total	Indirect cost	2281	Minutes used	518400	0.0044	45	0.20
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	180	2823.22
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	180	0.17
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	180	1.62
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	180	0.67
record form	Indirect cost	728	Minutes used	172800	0.0042	180	0.76
Pen	Indirect cost	133	Minutes used	172800	0.0008	180	0.14
Total cost							**5761.73**

Calculation of cost for hypertension screening programm (Selang Village, 2012)

Activity	Category	Annual cost	Cost driver	Annual quantity of cost driver	Cost allocation rate	Actual quantity of allocation based	Allocation activity cost
Preparing equipment							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	45	705.81
Travel to village							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	2	31.37
Fuel	Direct cost	44	volume				44.00
vehicle	Indirect cost	63562	Minutes used	518400	0.1226	2	0.25
Registration unit							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	50	784.23
Space	Indirect cost	2546	Minutes used	518400	0.0049	50	0.25
furniture total	Indirect cost	3225	Minutes used	518400	0.0062	50	0.31
water/electricity	Direct cost	100	volume				100.00
stationery and others	Direct cost	1000	volume				100.00
Health education							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	60	941.07
stationery and others	Indirect cost	286	Minutes used	8640	0.0330	60	1.98
projector	Indirect cost	876	Minutes used	8640	0.1014	60	6.08
monitor	Indirect cost	360	Minutes used	8640	0.0417	60	2.50
microphone	Indirect cost	229	Minutes used	8640	0.0265	60	1.59
plastic box	Indirect cost	371	Minutes used	8640	0.0429	60	2.57
computer	Indirect cost	2363	Minutes used	172800	0.0137	60	0.82
Interview and measure							
Staff	Indirect cost	1987548	Minutes used	126720	15.6846	200	3136.91
weighing machine	Indirect cost	167	Minutes used	172800	0.0010	200	0.19
sphygmomanometer	Indirect cost	1554	Minutes used	172800	0.0090	200	1.80
automatic BP measure device	Indirect cost	641	Minutes used	172800	0.0037	200	0.74
record form	Indirect cost	865	Minutes used	172800	0.0050	200	1.00
Pen	Indirect cost	133	Minutes used	172800	0.0008	200	0.15
Total cost							**6059.63**

BIOGRAPHY

Name:	Mr. Onn Laingoen
Date of Birth:	December, 27, 1987
Place of Birth:	ChiangRai Thailand
Citizenship:	Thailand
Address;	664 Rimkok district, Muang ChiangRai, ChiangRai Province, Thailand 57100
E-mail Address	onn_neo99@hotmail.com
Education:	Bachelor of Public health Mae Fah Luang University 2011