ECONOMIC IMPACT ASSESSMENT ON GOOD PHARMACY PRACTICE REGULATION IN COMMUNITY PHARMACY

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A Thesis Submitted in Partial Fulfillment of the Requirements
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การประเมินผลกระทบทางเศรษฐศาสตร์ของการออกกฎหมายเกี่ยวกับหลักเกณฑ์และวิธีปฏิบัติทางเภสัชกรรมในร้านขายยา

นางสาวธัชจุฑา วุฒิพานิช

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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Thesis Title	ECONOMIC IMPACT ASSESSMENT ON GOOD PHARMACY PRACTICE REGULATION IN COMMUNITY PHARMACY
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ธัชจุฑา วุฒิพานิช : การประเมินผลกระทบทางเศรษฐศาสตร์ของการออกกฎหมายเกี่ยวกับหลักเกณฑ์และวิธีปฏิบัติทางเภสัชกรรมในร้านขายยา (ECONOMIC IMPACT ASSESSMENT ON GOOD PHARMACY PRACTICE REGULATION IN COMMUNITY PHARMACY) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ภญ. ร.ต.อ. ดร.ฐณัฏฐา กิตติโสภี, 134 หน้า.

คณะกรรมการอาหารและยาได้ออกกฎกระทรวง การขออนุญาตและการออกใบอนุญาตขายยาแผนปัจจุบัน พ.ศ. 2556 ซึ่งระบุว่า ผู้รับอนุญาต และผู้มีหน้าที่ปฏิบัติการจะต้องจัดให้มีสถานที่ อุปกรณ์ และการปฏิบัติตาม “วิธีปฏิบัติทางเภสัชกรรมชุมชน” ภายในระยะเวลาที่กำหนด แต่ต้องไม่เกิน 8 ปี ดังนั้น งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาสถานการณ์ปัจจุบันของร้านขายยาแผนปัจจุบันในการปฏิบัติตามกฎกระทรวงฉบับนี้ และประเมินผลกระทบทางเศรษฐกิจที่อาจเกิดขึ้นของการออกกฎหมายเพื่อเป็นข้อมูลให้ภาครัฐใช้ประกอบการตัดสินใจอย่างมีประสิทธิภาพที่สุดในการออกประกาศกระทรวง โดยในการเก็บข้อมูล ผู้วิจัยเก็บข้อมูลจากการส่งแบบสอบถามให้กับผู้ประกอบการที่ไม่ใช่ร้านยาคุณภาพ 390 ร้าน โดยระยะเวลาในการเก็บข้อมูลตั้งแต่เดือนกรกฎาคม ถึง กันยายน พ.ศ. 2557 จากการทบทวนวรรณกรรมและความคิดเห็นจากผู้เชี่ยวชาญ ผลจากการศึกษาในด้านสถานการณ์ปัจจุบันและความพร้อมของร้านยาพบว่า ร้านยามีความพร้อมในการปฏิบัติตามมาตรฐานได้ 19 ข้อภายใน 1 ปี ซึ่งส่วนใหญ่อยู่ในมาตรฐานเรื่องสถานที่และอุปกรณ์ มีความพร้อมในการปฏิบัติตามได้ 10 ข้อภายใน 1-2 ปี อีก 9 ข้อภายใน 2-3 ปี และพบว่ามีเพียง 1 ข้อคือ การผลิตยาตามใบสั่งยาของผู้ประกอบวิชาชีพเวชกรรมสำหรับคนไข้เฉพาะราย ซึ่งร้านยาขอเวลาในการเตรียมพร้อมที่จะปฏิบัติตาม 3.5 ปี ส่วนผลการศึกษาในด้านผลตอบแทนลบต้นทุนพบว่า มูลค่าปัจจุบันสุทธิ(NPV)ของการบังคับใช้กฎหมายนี้ ในระยะเวลา 8 ปีมีค่า 2,087.79 ล้านดอลลาร์ (68,458.75 ล้านบาท) และอัตราส่วนผลตอบแทนต่อต้นทุน (B/C ratio) มีค่า 2.78 คิดเป็นต้นทุนรวมทั้งหมด 1,317.90 ล้านดอลลาร์ (48,639.61 ล้านบาท) ผลตอบแทนรวมทั้งหมด 3,672.34 ล้านดอลลาร์ (136,027.69 ล้านบาท) ซึ่งมาจากต้นทุนที่สามารถประหยัดได้จากการสุ่มตรวจร้านยา จากมูลค่ายาหมดอายุที่สูญเสียไป และจากปัญหาที่เกิดจากการใช้ยา เมื่อทำการวิเคราะห์ความไวพบว่า มูลค่าปัจจุบันสุทธิมีค่าอยู่ระหว่าง -856.14 ล้านดอลลาร์ ถึง 20,815.45 ล้านดอลลาร์ (-28,072.91 ล้านบาท ถึง 682,538.71 ล้านบาท) จำนวนการเกิดปัญหาที่เกิดขึ้นจากการใช้ยา และ ค่าใช้จ่ายที่ใช้ในการรักษาปัญหาที่เกิดขึ้นจากการใช้ยา นั้นเป็นตัวแปรที่มีผลมากที่สุดตามลำดับ ผลการศึกษานี้ช่วยสนับสนุนการตัดสินใจของภาครัฐว่าการบังคับกฎหมายฉบับนี้คุ้มค่ากับการลงทุน แต่หากรัฐบาลคำนึงถึงความพร้อมของร้านยาในการปฏิบัติตามนั้นผลการศึกษาชี้ให้เห็นว่าสามารถยืดเวลาให้กับร้านยาที่เปิดกิจการก่อนกฎหมายฉบับนี้ได้แต่ไม่ควรเกิน 3.5 ปี

ภาควิชา เภสัชศาสตร์สังคมและบริหาร ลายมือชื่อนิสิต .....

สาขาวิชา เภสัชศาสตร์สังคมและบริหาร ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

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5576351733 : MAJOR SOCIAL AND ADMINISTRATIVE PHARMACY
KEYWORDS: COMMUNITY PHARMACY / DRUGSTORE / REGULATION / GOOD PHARMACY PRACTICE / THAILAND

THATJUTA WUTTIPANICH: ECONOMIC IMPACT ASSESSMENT ON GOOD PHARMACY PRACTICE REGULATION IN COMMUNITY PHARMACY. ADVISOR: ASST. PROF.TANATTHA KITTISOPEE, 134 pp.

Objectives of this study were to explore the current situation of community pharmacies in order to comply with the Good Pharmacy Practice (GPP) regulation and to evaluate the economic impact in terms of cost-benefit of the Ministerial Regulation on Application and Issuance of License to Modern Pharmacies from societal perspective. The data was obtained from self-administered questionnaires sent to Type I pharmacy owners during July–September, 2014, excluding the accredited pharmacies, and from the published literature and expert opinion. The result showed that pharmacy owners are ready to implement 19 standards of place and equipment within one year, ten standards within two years and other nine standards within three years. There are only one standard related to extemporaneous preparation, need 3.5 years to be ready. The result showed that the total 8-year cost was $1,317.90 million dollars (48,639.61 million baht) and total 8-year benefit was $3,672.34 million dollars (136,027.69 million baht). Net present value (NPV) and benefit to cost ratio were $ 2,087.79 million dollars (68,458.75 million baht) and 2.78 benefit:cost, respectively.The one-way best case and worse case sensitivity result presented that the net benefit ranged from -$856.14 million dollars to $20,815.45 million dollars (– 28,072.91 to 682,538.71 million baht). Cost per case of Drug-Related problem (DRP) and number of DRPs in community pharmacies were an important factor which might contribute to an impact on net benefit. The implementation of this regulation seems to have provided positive financial return on investment to Thai society. The results support the policy decision maker that immediately implement the GPP regulation was cost-beneficial. In addition, if the policy maker takes into account for the readiness of the pharmacy owners, implementing the regulation can be extended for the pharmacies that opened before the issuing of this regulation but should not be later than 3.5 years.

Department:	Social and Administrative Pharmacy	Student's Signature	.....
		Advisor's Signature	.....
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CHAPTER I

Introduction

1.1 Rational

The welfare and healthiness of people is one of the most important public health issues of concern. The obstacles to reaching a good health are poor accessibility to healthcare products or healthcare providers, high cost of health services, and insufficient healthcare staffs. Medicine is a necessary factor that is used for treatment or for prevention of many diseases in treatment plans. The clinical problems that come from use of medicines are improper selection of medicines, drug-drug interactions, food-drug interactions, adverse event effects, inappropriate administration, and low medication adherence. Besides clinical problems from medicines, there are other problems that are emerging and are dangerous for patients' health, such as substandard, contaminated, unlicensed, or counterfeit medications.[1] Therefore, it is necessary to have an ensuring system of medicine supply to guarantee the quality of medications before dispensing to patients.

Pharmacists are healthcare providers who play an important role to improve the accessibility of people to healthcare services because they help in managing the distribution of medical products to patients by focusing on efficacy and safety results. Thus, there is an International Pharmaceutical Federation or FIP which is the international union consisting of three million pharmacists and pharmaceutical scientists around the world. Their duty is to provide the directions for national pharmaceutical organizations that can motivate them to set their national standards. The important commitment of worldwide pharmacists is to promote the best practice for the benefits of patients.

" Good Pharmacy Practice in community and hospital pharmacy setting" was a standard for pharmacy services which was first developed by the International Pharmaceutical Federation (FIP) in 1992. The context of Good Pharmacy Practice was proposed to the WHO Expert Committee in 1994. After WHO Expert Committee gave the recommendations, then it was approved by FIP council in 1997. The joint

FIP/WHO guideline on Good Pharmacy Practice was issued in 1999.[1] The objective of FIP is to improve the standards of pharmacy services by using the FIP/WHO guidelines on GPP as a framework. The policy of FIP and WHO is to establish the guidelines for national pharmacy profession organizations. These organizations should develop their national good pharmacist guidelines according to FIP/WHO GPP guidance and the situation of using Good Pharmacy Practice will differ in each country.[1]

The current number of pharmacies has increased dramatically in Thailand. The total number of Type I pharmacies in 2008 was 10,063 and has increased to 13,088 in 2013.[2] Modern pharmacy in Thailand can be classified into two categories, Type I and Type II pharmacy. Type I pharmacy is the pharmacy that has at least one registered pharmacist working. All types of medicine (i.e. dangerous medicine, controlled substances and psychological medicine) are permitted to be sold in these types of pharmacy. There is no need to have registered pharmacist working in Type II pharmacy which can sell only non-dangerous, OTC (over the counter drugs).[3] However, it has also found that there are many major problems that need to be solved urgently. For example, selling drugs illegally or without permission, selling of prescription or controlled substances without a pharmacist who has responsibility for providing pharmaceutical care, and no pharmacist on duty at the operational time. These inappropriate dispensing practices may cause irrational use of medication and also affect to consumer safety.[3-6] Even though, there is the Drug Act, B.E.2510 (1967) in Thailand, it is a broad principle and there was no standard set of guidelines to comply with until 2003, when the Thai Food and Drug Administration collaborated with the Thai Pharmacy Council to start a, "Community Pharmacy Development and Accreditation" program (CPA). This is a voluntary program that promotes the pharmacies to improve themselves under Good Pharmacy Practice (GPP). The vision of this program was focusing on the safety and rational use of medicines by improving the quality in community pharmacy services.[7] Although the CPA program is a graceful and valuable program for patients, there are still small numbers of pharmacy accreditations.[8] The CPA program has been started since 2003 and 316 stores have been accredited by the Pharmacy Council and is being increased to 547 stores. Nine years have passed, and the qualification issue still exists because the

quality of the 20,000 pharmacies in the whole of Thailand are still below the standard.[9] There was a study that explored factors affecting the decision of pharmacy's owners to join in the CPA program and the result showed that the pharmacists in the CPA program saw the value of participating in CPA program, because they had an opportunity to provide a good quality of pharmaceutical care services to patients. On the other hand, pharmacists in non-accredited pharmacies thought that business benefits are the more important reason for them to join this program.[8]

Recently, the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy was revised by the Thai FDA because it was obsolete and not suited to the current situation. Eventually, it was approved by the Royal Gazette on 27th December, 2013 and became effective on 26th June,2014. The main context in this regulation is requiring all new community pharmacies to pass Good Pharmacy Practice (GPP) standard before renewing their pharmacy license. In contrast, there is time for the old community pharmacies which opened before this new regulation to adapt and they must pass GPP standard within eight years.[10] The purpose of revising this regulation was to improve the standard of pharmacies in terms of place and equipment, personal, effective drug management and pharmacy service regarding safety and efficacy to customer. Besides improving the standard of pharmacies, the benefit from this regulation is that it is a positive approach, to increase opportunities for competition, and prepare the system of pharmacies in Thailand in order to have a potential to become part of ASEAN Economic Community (AEC).

As such, the voluntary change of community pharmacy to follow GPP guideline will occur due to the market competitive pressure because people are more likely to concern about the quality issue. In addition, The Association of Southeast Asian Nations had set the goal of regional economic integration by 2015 called ASEAN Economic Community (AEC). The AEC will put another pressure on the old pharmacies. Since the new comers from Asian community will invest in community pharmacy in Thailand, the FDA needs to legislate based on the principle of Good Regulatory Practice (GRP), by using Regulatory Impact Analysis (RIA) method in order to implement the regulation.[11]

There are many studies which have examined the compliance to standard for accredited pharmacies.[12, 13] There is only one study of the Thai-FDA officer which has examined the possibility to comply to the GPP standard for community pharmacies under the Ministry of Public Health notification.[14] However, the Thai-FDA study was conducted by using two standards of the GPP regulation and the population in this study was the pharmacies who willing to participate in an accredited pharmacy program. Therefore, the ability and readiness of pharmacies to comply with four standards of the GPP regulation was still in question. In addition, there is no study which has examined the economic impact of this regulation which would be an important and useful information to support the decision of policy maker. Regarding the economic impact assessment, the cost-benefit analysis was used in this study. It is an economic evaluation technique which calculates and compares the benefits and costs of an intervention or program in monetary terms. Therefore, the first objective of this study was to explore the current and readiness of pharmacy in order to comply with the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy. The second objective was to evaluate the economic impact of Good Pharmacy Practice regulation from societal perspective by using cost-benefit analysis

1.2 Objectives:

1) To explore the current situation and readiness regarding the extent to which pharmacy stores in Thailand can comply with the Good Pharmacy Practice issued under the Ministerial Regulation on Application and Issuance of License to Modern Pharmacies

2) To evaluate the economic impact of Good Pharmacy Practice regulation from societal perspective by using cost-benefit analysis

1.3 Expected benefits

1) The information of the current situation helped to identify problems and potential for law compliance in order to adjust the regulation as necessary.

2) The impact assessment result of Good Pharmacy Practice regulation could support the Thai FDA in implementing the regulation.

3) The result from this study can help the Thai FDA find the supportive intervention for pharmacy stores' owners who need assistance.

1.4 Perspective of Analysis of the Study

This study analyzed the cost and benefit of implementing Good Pharmacy Practice regulation in community pharmacy from societal perspective.

1.5 Scope of the study

This study was conducted in type I pharmacies in Thailand during July 1st, 2014 to September 30th,2014

1.6 Budget of the study

The estimated budget of this study was approximately 50,000 baht.

1.7 Operational definition

1) Good Pharmacy Practice (GPP) regulation is defined as the regulation that was revised by the Thai FDA and would be effective within 180 days (26th June,2014) after approved by the Royal Gazette on 27th December,2013. The context in GPP regulation focused on place and equipment, personnel, effective drug management and pharmacy service. All new community pharmacies have to pass Good Pharmacy Practice (GPP) standard before renewing their pharmacy license, whereas old pharmacies which open before this new regulation will have a time period to improve and must pass GPP standard within eight years.

2) Economic impact analysis of the GPP regulation is defined as the evaluation of the benefits and costs of implementing the GPP regulation in community pharmacies from societal perspective by using cost benefit analysis (CBA).

3) Cost of implementing the GPP is defined as all costs (direct, indirect,) that occur when the GPP regulation is implemented from societal perspective. In this study, there are three stakeholders relating to this GPP regulation, so the cost of implementing GPP should come from government (FDA) perspective, pharmacies' owners' perspective and patients' perspective.

Cost of implementing the GPP from the government (FDA) perspective is defined as all costs that government (FDA) has to spend when implementing the GPP regulation. The costs that are considered in government perspective are cost of issuing law and regulation, cost of GPP training course for the authorities (FDA officers and outsourced authorities who are responsible for renewing pharmacies assessment), cost of GPP information distribution and cost of GPP handbook for FDA officers (76 provinces).

Cost of implementing the GPP from pharmacies' owners' perspective is defined as all costs that pharmacies' owners have to spend when implementing the GPP regulation. The costs that are considered in pharmacies' owners' perspective are cost for renovating place and equipment, cost for adapting stock management, other variable costs after GPP implementation, cost of GPP handbook for pharmacies, cost of full time pharmacist fee, opportunity cost of pharmacy closing when renovating the store, cost of pharmacies' close down and assessment cost for renewing pharmacy license.

Cost of implementing GPP from patients' perspective is defined as all costs that patients have to spend when implementing the GPP regulation. There is no cost for patients' perspective.

4) Benefits of implementing the GPP is defined as all benefits (direct, indirect, and intangible) which occur when implementing the GPP regulation from societal perspective. In this study, there are three stakeholder relating to this GPP regulation, so the benefit of implementing GPP should be come from government (FDA) perspective, pharmacies' owners' perspective and patients' perspective. All benefits have been transferred to monetary value.

Benefit of implementing the GPP from the government (FDA) perspective is defined as all benefits that the government (FDA) receives after implementation of the GPP regulation. The benefit, which is considered in the government perspective, is cost saving from reducing of surveillance cost.

Benefit of implementing the GPP from pharmacies' owners' perspective is defined as all benefits that pharmacies' owners receive after they have implemented the GPP regulation. The benefit that is considered in pharmacies' owners' perspective is cost saving from reducing waste of expired drug.

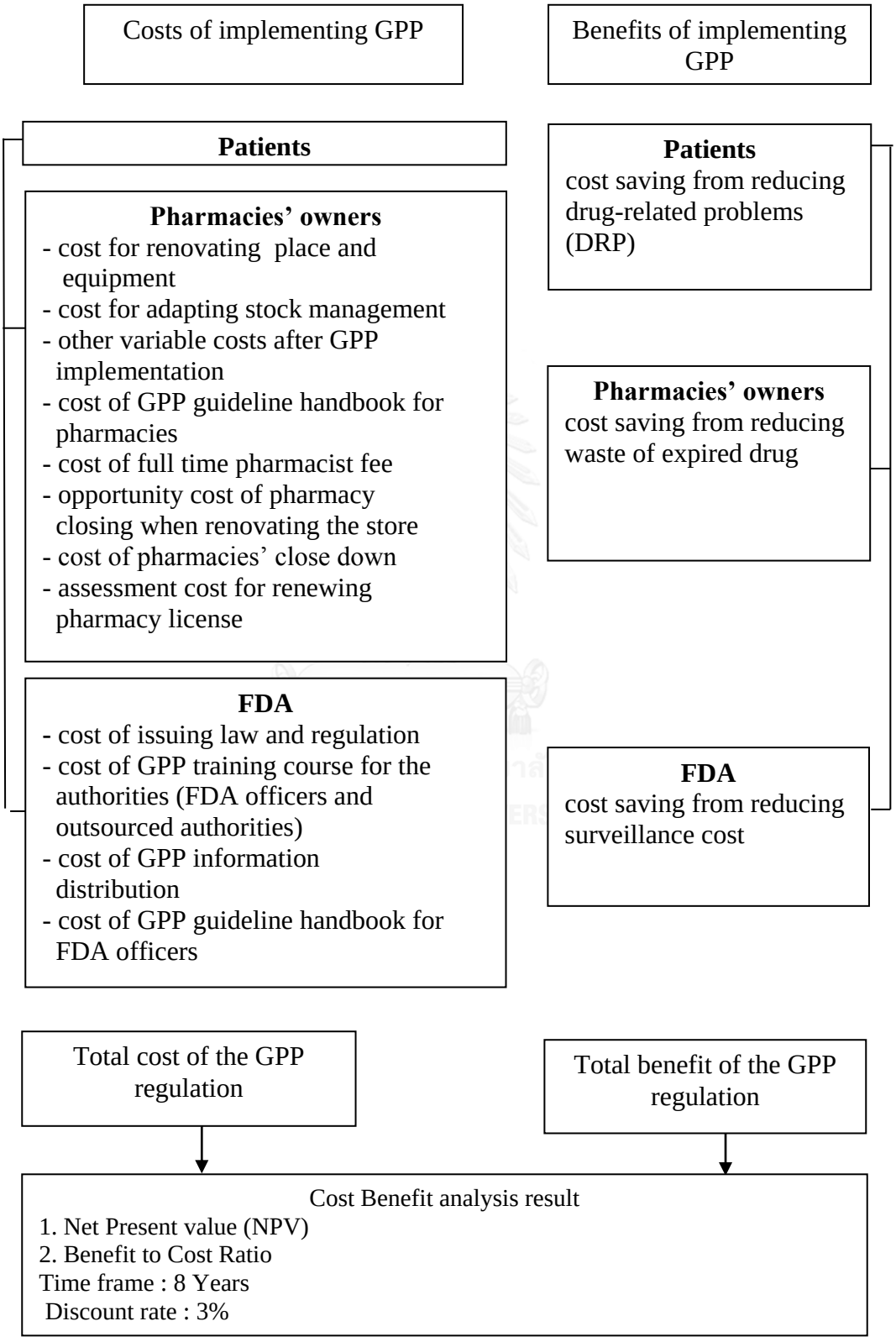
Benefit of implementing the GPP from patients' perspective is defined as all benefits that patients receive after the GPP regulation has been implemented. The benefit that is considered in patients' perspective is cost saving from reducing drug-related problems (DRP).

5) Net present value (NPV) can be calculated from net benefit (the difference between costs and benefits) by time with discount factor $1/(1+r)^t$ to adjust cost and benefit to one point of time, because the cash flow from different points of time were not equal. The discount rate that was used in this study was 3%.[15]

6) Benefit to cost ratio can be calculated from the sum of total benefits divided by total costs. The policy maker should select the program that is cost effective, or when the result showed benefit-to-cost ratio > 1.

1.8 **Conceptual framework**

Figure 1 Conceptual framework of cost-benefit analysis of GPP implementation



CHAPTER II

Review Literature

This chapter consists of four main parts. The first part is value of pharmacist. The second part is about Good Pharmacy Practice. The third part is about impact assessment by using cost-benefit analysis. The fourth part is about the related research.

2.1 Value of pharmacist

There is a report which collected the literature reviews and researches from Australian and international evidence published from 1990 to 2002 regarding pharmacist services in community setting and evaluated the services by concerning about cost-saving and quality of care. The findings showed that the professional services, provided by pharmacists, can be summarized into nineteen services, which are pharmaceutical care services, continuity of care services, pharmacist clinic services, pre-admission clinics, medication review for repeat prescriptions, medication review in aged care facilities, medication review in the outpatient setting, pharmacist services providing education to patients, education services for health care professionals, drug information services, pharmacist participation in therapeutic decision making, pharmacist involvement in non-prescription medication use, smoking cessation services, pharmacist advocacy for immunization services, pharmacist administration of vaccines, hospital in home, interventions, screening, and monitoring. The definition of “pharmacist service” in this study was the activities provided by pharmacists in order to improve quality of drug use and increase patient outcomes. The outcomes evaluated were clinical outcomes (mortality, morbidity, ADE), intermediate outcomes (laboratory result), other outcomes that related to interested clinical outcomes (patient adherence), quality of medicine use, and economic outcome.[16] There were four pharmacist interventions which related to the context of pharmacists who work in pharmacies in Thailand.

Pharmaceutical care service

The definition of pharmaceutical care in this study was "…*the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life. These outcomes are (i) cure of a disease; (ii) elimination or reduction of a patient's symptomatology; (iii) arresting or slowing of a disease process; or (iv) preventing a disease or symptomatology*".[16] The procedure of patient care in this service comprised the following activities; pharmacist should establish treatment, assess drug-related problem, develop the treatment plan, evaluate and continue to follow-up. The result show that providing pharmaceutical care can improve patient outcomes, reduce adverse drug events (ADE), improve appropriate use of medicines, reduce drug-related problems, improve intermediate outcomes (ie. Blood pressure) and reduce drug costs.[16]

Education and Counseling Services for patients provided by pharmacist

This service comprises the activities of pharmacists that provide education or counseling to their patients through verbal communication or written knowledge material together with giving advice to their patients. This service commonly happens via face-to-face interaction between pharmacists and patients, but can also occur via telephone. The findings presented are for single session counseling when dispensing medicine with limited therapy period from one study which showed improvement of gastrointestinal quality of life in a patient with dyspepsia.[16, 17] For single session counseling for long-term therapy, the results showed that it can improve metered dose inhaler technique in asthma patients and can improve compliance and medication knowledge in elderly patients.[16, 18, 19] For multiple session education, the evidence showed that this service can improve compliance in patients with the following conditions; hypertension, elderly, lipid-lowering, chronic heart failure, anti-retroviral and renal transplant. In addition, multiple session education in cooperation with active self-monitoring can reduce hospitalization, increase quality of life and improve adherence in heart failure patients.

Drug Information Service

This service is for providing drug information and answering both general and specific questions about medications and their use. No randomized controlled trial design studies have evaluated the impact of drug information service. However, uncontrolled studies recommend that this service may provide the improvement of patient outcome.

Pharmacist involvement in non-prescription medicine use

In many countries, pharmacists have a responsibility to provide counseling, assist and recommend non-prescription medication use. Some medications are controlled by allowing only to sell by pharmacist or in pharmacy in some countries because of the perception patients who believe that pharmacist can improve their use of medication. There was one randomized controlled trial study that evaluated the effect of pharmacist counseling in a dyspepsia patient and the result showed that this service can improve quality of life.[16, 17] Moreover, other uncontrolled studies also showed the positive result of pharmacist providing advice in non-prescription medicine use. Scalar et al, conducted a study in pharmacies in Washington, USA and the result presented that 43% of patients change their decision of medicine purchasing, 4.2 % of patients were referred to doctor and 7.3% of patients could be prevented from ADE as a result of counseling service providing by interns pharmacists.[16, 20] Another study found that 63% of patients reported that their symptom improved, while 85% stated that it was not essential to see the physicians when they have minor health problem as a result of having pharmacist for over-the-counter (OTC) drug therapy.[16, 21, 22]

For this reason, it is necessary to provide pharmaceutical care by pharmacist, so it is important issue to have a Good Pharmacy Practice regulation in Thailand.

2.2 Good pharmacy practice (GPP)

"Good Pharmacy Practice in community and hospital pharmacy setting" was standards for pharmacy services and first developed by the International Pharmaceutical Federation (FIP) in 1992. FIP is the international union which consists of three million pharmacists and pharmaceutical scientists around the world. Their duty is to provide the direction for national pharmaceutical organizations that can

motivate them to set their national standards. The context of Good Pharmacy Practice was proposed to the WHO Expert Committee in 1994. After WHO Expert Committee gave the recommendations, then it was approved by the FIP council in 1997. The joint FIP/WHO guideline on Good Pharmacy Practice was issued in 1999.[1] The objective of FIP is to improve the standards of pharmacy service by using the FIP/WHO guidelines on GPP as a framework. Furthermore, FIP conducted a pilot study from 2005 to 2007 which investigated the possibilities that it could provide technical assistance to help its members (such as Thailand, Cambodia and Vietnam, etcetera) to develop their GPP national standard. In 2007, the FIP South-East Asia Pharmaceutical Forum set the meeting, Bangkok declaration on Good Pharmacy Practice in the community pharmacy setting, in South-East Asia and also made a commitment from their members to improve the standards of pharmacy services. The policy of FIP and WHO was to establish the guideline to national pharmacy professional organizations. These organizations should develop their national good pharmacist guidelines according to FIP/WHO GPP guidance and the situation of using Good Pharmacy Practice will differ from each country.[1]

2.2.1 The Definition of Good Pharmacy Practice

WHO and FIP give a definition of Good Pharmacy Practice (GPP) as " *Good Pharmacy Practice is the practice of pharmacy that responds to the needs of the patients who use the pharmacists' services to provide optimal, evidence-based care. To support this practice it is essential that there be an established national framework of standards and guidelines.*"[1]

2.2.2 Pharmacists' Role in Good Pharmacy Practice guideline

The Joint FIP/WHO guidelines on GPP, it recommend the roles and activities in which a pharmacist should be involved.[1] Table 1 shows the summary of four major roles and some example activities of pharmacists regarding the GPP guideline.

Table 1 Roles and activities of pharmacist

Role1: Preparing, obtaining, stockpiling, assuring, distributing, dispensing and disposing of medical products	
Function	Example activities
Preparing extemporaneous medication and medical products	The preparation of extemporaneous medication should be performed in an appropriate area that is designed for preparation to drastically reduce possibility of medication errors by concern for the safety and cleanliness of the medication.
Receive, stockpile and secure the medical products	Establishing an emergency plan for shortage of medicine and assuring the appropriate storage for all medicines
Distribute medical preparation and medication	All medical products and medical samples should be handled with care and distributed by concern for safety and reliability.
Medications, vaccines, and injectable medicine management	Pharmacists should have a responsibility to set up the procedure in their workplace to prepare the medication and administer the medical products and monitor the outcome of medication administration.
Dispensing of medication	The pharmacists should provide sufficient counsel to confirm that the patients obtain and understand the benefits of their treatment.
Disposal of medicinal preparations and products	Pharmacist should assure that the recalled medication must be reserved separately for elimination and should be prevented from other dispensing or distribution of medications.

Table 1 Roles and activities of pharmacist (Continued)

Role2: Providing the efficient therapy management	
Function	Example activities
Evaluate health status of patients and needs	The pharmacists should evaluate individual patient by considering each patients' uniqueness such as their knowledge, their beliefs, literacy and their ability in terms of both physical and mental.
Administrate patient medication therapy	The pharmacist should adhere to the proper evidence base such as updated journal or standard treatment guideline regarding the safety, rationale and cost-effective utilization of medication.
Monitor patient progress and health outcomes	The pharmacists should record the essential information such as clinical data of patients in order to evaluate and monitor their treatment and follow up their health outcomes.
Offer information about medication and health-related concerns	The pharmacists should provide the adequate information about health-related issues, disease and drug information knowledge to patients in order to support patients' decision-making process.
Role3: Sustaining and improving the professional performance	
Function	Example activities
Establish the strategies about professional progress in order to improve the recent and future performance	The pharmacists should update their knowledge such as new information about medical products or new treatment guidelines in order to improve their clinical understanding, abilities and performance

Table 1 Roles and activities of pharmacist (Continued)

Role4: Leading to improve the health care system and public health	
Function	Example activities
Share and distribute the information about medications and varieties of self-care perspective	The pharmacists should assure that the data provided to their patients, other health-care professionals and society is correct, proper, comprehensible and evidence-based.
Involve in preventive care services	The pharmacist should involve in preventive care services such as health promotion, disease prevention
Abide by national professional responsibility, guidelines and regulations	The pharmacist should assure that they abide by their national regulation and ethics for pharmacists.
Support national policy that involves health promotion	The pharmacist should cooperate with other health-care providers to enhance health outcomes.

Reference : Joint FIP/WHO Guidelines on Good Pharmacy Practice: standards for quality of pharmacy services, 2011.[1]

2.2.3 Voluntary Good Pharmacy Practice program in Thailand

Pharmacy is the first primary health care facility which is easy for patients to access. It is the main place for distribution of medication to the patient. The number of self-medication increased from 20.9% in 2008 to 30.7% in 2012.[23] Most Thai patients went to buy medication by themselves when they got sick and only went to see a doctor if their symptoms were not cured.[24] As such, the government concerns about this problem and tries to control the distribution of medications to the patient effectively and safely. Thus, the Drug Act 1967 was set up and clearly specified the person who has responsibility in a pharmacy. Therefore, a pharmacist is a person who has to dispense rational use of medication, provide medication advice and provide the pharmaceutical care to patients regarding the efficacy of the medication and safety of the patient. Currently, the number of type I pharmacies in Thailand has increased

dramatically from 4,723 pharmacies in 1996 to 12,123 in 2013.[2] It has been found that there are many problems that need to be solved urgently. Even though the Drug Act 1967 stated that the pharmacy must have a full time pharmacist available during the operating time, absent pharmacist is still a major problem in Thailand. The Thai FDA report showed that only 33% of pharmacists were on duty during an audit in 2006. In addition, 25%, 40%, 64% and 76% of pharmacists were on duty during an audit in Kalasin, Ootaradit, Samutsongkarm and Nakorn Pra Nom provinces in 2010, respectively.[4] These increased the risk of dispensing inappropriate medication and directly affect to the health of patients. The other problems in pharmacies in Thailand were selling medications that were not permitted for pharmacies such as steroids,[3] and dispensing irrational use of antibiotics[24]. Some studies showed that the antibiotic that was prescribed for patients in developing countries were inappropriate. A study by Visanu showed that 50-100% of pharmacies in his study dispensed antibiotics in the condition that was not needed such as not appropriate medication and/or duration of treatment.[24] Irrational use of antibiotics not only affects health problem such as antibiotic resistance, but also affects patients' economic burden. The result of Sumpradit's study presented that the cost of antibiotic resistance was around 84.6-202.8 million US dollars for direct costs and 1,333 million in indirect costs.[25]

According to the major problems above, the Thai Food and Drug Administration collaborated with the Thai Pharmacy council and began a "Community Pharmacy Development and Accreditation" program (CPA) in 2003. This is a voluntary program which promotes the pharmacies to improve themselves under Good Pharmacy Practice (GPP). The vision of this program was focusing on the safety and rational use of medicines by improving the quality in community pharmacy service.[7] Although the CPA program is a graceful and valuable program for patients, there are only a small number of pharmacies accredited.

After the CPA program began in 2003, there were 316 stores which had been accredited by pharmacy council and this then increased to 648 stores in 2013. Nine years passed, and the qualification issue still exists because the quality of the 20,000 pharmacies in the whole of Thailand are still below the standard.[9] There was a study that explored factors affecting the decision of pharmacy's owners to join in CPA program and the result showed that the pharmacists in the CPA program saw the value

of participating in the CPA program because they had an opportunity to provide a good quality of pharmaceutical care services to patients. On the other hand, pharmacists in non-accredited pharmacies thought that business benefits are the more important reason for them to join this program.[8]

2.2.4 Good Pharmacy Practice Regulation by law enforcement in Thailand

The CPA program is a useful and valuable program for patients, but there were still a small number of pharmacies accredited. The FDA realize the benefit of GPP and tried to adopt this concept to implement as a regulation for pharmacies in Thailand. The Ministerial Regulation on Application and Issuance of License to Modern Pharmacy was revised by the Thai FDA because it was obsolete and not suited to the current situation. It was approved by the Royal Gazette on 27th December, 2013 and would be effective within 180 days or would begin on 26th June, 2014. The main context in this regulation is all new pharmacies have to pass the Good Pharmacy Practice (GPP) standard before continuing their pharmacy license, whereas old pharmacies will have a period to improve and must pass GPP standard within eight years. The purpose of revising this regulation was to improve the standard of pharmacies in terms of place, equipment, personnel and pharmacy service regarding safety and efficacy to patient. Besides improving the standard of pharmacies, the benefit from this regulation is that it is a positive approach, which increase opportunities for competition, and prepares the system of pharmacies in Thailand in order to have a potential to become part of ASEAN Economic Community (AEC). There are four main standards for GPP regulation in the Ministry of Public Health notification which are place and equipment, personnel, storage and quality control, and pharmaceutical care. (Table 2)

Before issuing any regulations, the government should evaluate the impact of the regulation that is developed for implementation to promote the best use of that regulation.

Table 2 Four main GPP standards in the Ministry of Public Health notification

Standard I : Place and Equipment
1. There must be a counseling and pharmacy service area, not including the storage area, at least 8 square meters with the shortest side not less than 2 meters. 2. If there is a drug storage area, It must have enough space to properly keep and not place drugs directly on the ground. 3. There must be an enough counseling area clearly separated from other services area with sign and have enough space for keeping patient medical history. 4. The pharmacy must be located in a place where patients can access, and have a household registration to the government. 5. The pharmacy must be in the permanent building. 6. The pharmacy must be clean, hygienic, tidy and have adequate ventilation. It must have insect prevention and no pet in the pharmacy area. 7. The pharmacy must have an appropriate environment to maintain drug quality. The storage area should be ventilated, dry, not more than 30 °C and prevented from sunlight. 8. There must be adequate lights in the pharmacy in order to read labels and product information clearly. 9. Prescription and controlled drugs should be placed by categories with clear labels. These sections must be closed with the informing message when pharmacist was not available. 10. There must be a refrigerator with enough space to properly keep the medication separately from other stuff in the pharmacy. 11. There must be separate drug counting trays for penicillin or sulfonamide or NSAID in the pharmacy. 12. There must be an automatic sphygmomanometer in the pharmacy. 13. There must be a weighing machine in the pharmacy. 14. There must be a stadiometer in the pharmacy. 15. There must be a fire extinguisher in the pharmacy.

Standard II : Personnel
16. Registered pharmacist must have knowledge and competency in providing community pharmacy services in the pharmacy. 17. Staff in the pharmacy must understand drug laws and regulations, their duty and have adequate continuing training. 18. Pharmacists must wear white coats with a symbol of Pharmacy Council. 19. Other staffs in the pharmacy have to dress properly and different from the pharmacist and not make patients misunderstand as a pharmacist. 20. The duties and responsibility of pharmacist and other staff are clearly separated.
Standard III : Storage and Quality Control Management
21. The pharmacy must select medication from manufactures or importers or distributors who have GMP (Good Manufacturing Practice). 22. The pharmacy must keep medicine in the appropriate temperature and protect from light. 23. The pharmacy must have an effective system to detect expired and deteriorated drugs in order to not dispense to the patients. 24. The pharmacy must have a system to return or destroy expired drugs in order to not cause environmental problem. 25. There must be a drug quality assessment and drug return system before its expiration date with the concern of efficacy and safety to the patients. 26. There must be real-time procurement and inventory documents in pharmacy. 27. They must select the suitable container with labeling for medication to prevent drug damage.
Standard IV : Pharmaceutical Care Service
28. The pharmaceutical care in the pharmacy must only be provided by pharmacists. 29. Pharmacist must ask necessary information from patients for supporting the decision to select safety and efficacy of medication or health products that are suitable for patients and rational use.

30. Labels on the prescription or controlled medicine container must show the following information: pharmacy's name, address, phone number, dispensing date, patient's name, medicine name (brand or generic name), strength, amount, indication, instruction, advices, cautions, and pharmacist signature.
31. Pharmacist must be the only one who dispenses prescription or controlled medicines to a patient with advice and information about medicine name, indications, dosage, instructions, side effects, adverse reactions, and cautions.
32. There must be an effective process to prevent repeated drug allergy problems.
33. There must be an appropriate screening and referral process for patients.
34. Extemporaneous preparation must be prepared with the equipment and in the area according to the standard requirement and with the concern of contamination.
35. The pharmacy must have systems to detect ADR, inappropriate drug use behavior, and drug quality problem and reporting system.
36. There must be an appropriate, reliable and updated drug information references in the pharmacy for supporting proper and safe use of drugs including drug information service (DIS)
37. Pharmacist must control educational and advertising media in order to not mislead patients. These medias must be endorsed 'permitted by the pharmacist'.
38. Any patient's health activities in the pharmacy must be permitted by pharmacist and pharmacist must control those activities under laws and regulations.
39. They must not sell tobacco products and alcoholic beverage in pharmacy.

2.3 Regulatory Impact assessment by using cost-benefit analysis.

Because of economic integration in ASEAN countries or AEC, The ASEAN Policy Guideline on Standards and Conformance is an essential issue of concern. The objective of this guideline is to provide the standard guideline for implementing in ASEAN member countries. Thailand, which is one of the ASEAN countries, has to

adopt this principle that focuses on improving the standard for all countries regarding law issuance following to ASEAN Good Regulatory Practice (ASEAN GRP). Moreover, the benefit of this guidance is to improve the consistency and transparency of the regulatory process, and reduce unnecessary trade restrictions.

2.3.1 What is the regulatory impact assessment (RIA)?

In order to implementing the effective and efficient regulation for society, the government has to work analytically. An inefficient regulation can produce costs for society such as business sector and decrease the potentiality of the government to reach its goals. Therefore Regulatory Impact Assessment (RIA) is the tool that is used to improve the quality of a regulation in terms of effectiveness and efficiency. RIA is recommended to use in regulatory practice for Organization for Economic Co-operation and Development (OECD) countries and countries in transition. From the introductory handbook for policy analysis undertaking RIA by OECD, the definition of RIA is defined as "*RIA is a process of systematically identifying and assessing the expected effects of regulatory proposal, using a consistent analytical method, such as benefit/cost analysis*".[11] The basic method that is used to conduct RIA is comparative method. After the government determines the public policy objectives of the regulation, the government has to identify all interventions or programs that can achieve them. Then all feasible options have to be evaluated by using comparative methods such as cost benefit analysis. The result can be used to support policy-makers about the effectiveness and efficiency of each alternatives, so the government or policy maker can systematically choose the best option.

2.3.2 What is cost-benefit analysis ?

Cost-benefit analysis (CBA) is the method that is used to compare both costs and benefits in monetary terms. The history of CBA theory came from welfare economics which is used to help make decisions towards public policy. The concept of welfare economics is to combine personal preferences and values and also balance the effective resource use to improve social wellbeing. The benefit of using CBA is we can compare the different outcomes from various interventions or programs in monetary terms whereas the drawback of this method is it is difficult to place the medical outcomes in monetary units. Even though the health promotion program

provides a good result of clinical outcome, economic problems influence for policy maker to make a decision. CBA can help to answer these questions: Does this program provide greater benefits than costs?, Which program will give the best benefit? Benefit to cost ratios is one kind of result for CBA which shows the ratio between costs and benefits. This result can be used to rank and compare the program which provides the same or different outcomes, so the policy maker can choose the program that has the highest benefit to cost ratio result to take full advantage of the investment.[15]

2.3.3 Method to conduct cost-benefit analysis

1) Determine the type of program or intervention

2) Identify alternatives

3) Determine the perspective of the study

The perspective of the study must be concerned when we determine costs and benefits. Perspective is used to explain which costs or benefits are important based on the objectives of the study.[15]

4) Identify the costs and benefits

4.1) Cost

4.1.1) Cost definition

Cost is any resource that is used in the project to produce goods or services for achieving the objective of the project.[26] Costs that come from the project are only used to analyze, while other costs that occurred in the past, known as "sink costs", are excluded. Sink cost is the resource spent in the activity in the past (before assessment) and cannot be reused.[26] According to Chartered Institute of Management Accountants (CIMA), cost is defined as "*the amount of expenditure (actual or motional) incurred or attributable to, a specified thing or activity*".[27] The definition of cost from New Zealand Treasury, a public organization and the economic policy advisor for government, is that it is a tangible resource that is used in the economy and also considers the other resources use that could be used (i.e. opportunity cost).[28]

4.1.2) Cost Categorization

For pharmacoeconomic-related costs, costs can be divided into four types, direct medical cost (i.e. medications, hospitalization, diagnostic test), direct nonmedical costs (i.e. travel costs to hospital), indirect costs (i.e. lost productivity for patient, lost productivity because of death), and intangible costs (pain and suffering, fatigue).[15]

When focusing on cost object or cost product, costs can be divided into two types, direct costs and indirect costs. Direct costs are defined as any cost which is identified specifically with a particular final cost objective or goal. Indirect cost is defined as any cost, incurred for joint objectives, and therefore not usually identified with a single final cost objective. In order to assess the cost of the regulation, direct cost of regulation is the cost from business or individual who is directly affected when complying with the regulation and the cost from the government sector which has a power to enforce the regulation.[11] Indirect costs should be included such as non-wage labor cost.

When focusing on a time period, costs can be divided into two types, fixed cost and variable cost. Fixed cost is a cost that is not changed with the level of activity change.[29] Variable cost is “a cost which can change with the amount of the level of activity change.[29]

4.2) Benefit

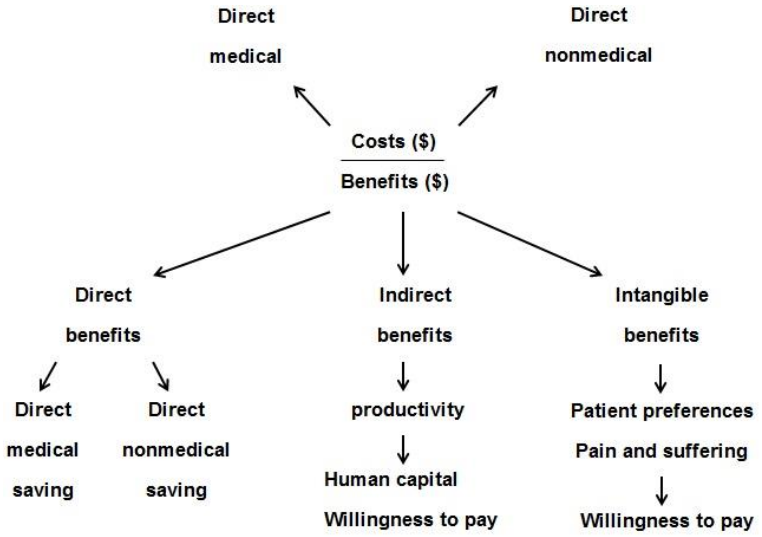
4.2.1) Benefit definition

New Zealand Treasury defines the definition of benefit as any gain which occurs from the production of a program or intervention being considered.[28]

4.2.2) Benefit categorization

American college of clinical pharmacy divided benefits into three categories, direct benefit (calculated from direct medical and direct nonmedical saving), indirect benefit (calculated from productivity using human capital and willingness to pay method), and intangible benefits (calculated from patient preference or pain and suffering using willingness to pay method).[15]

Figure 2 Components of cost-benefit analysis (CBA)



Reference: Rascati KL. Essentials of Pharmacoeconomics. The United States of America 2009.[15]

Libby et al, conducted a systematic review study about value of pharmacist services in community setting. The result showed that there are many benefits from providing pharmacist services in community setting such as improved patient outcome, reduced adverse drug event (ADE), improved appropriate use of medicine, reduced drug-related problems, improved intermediate outcome (eg. Blood pressure), reduced drug costs, improved compliance, and improved quality of life.[16] However, the current study will use two main benefits of implementing of GPP regulation. The first benefit will be reduction in medication error and the second benefit will be improvement in quality of life. The reason why we will use these two benefits is the availability of the data is scarce. Moreover, based on the context of pharmacies in Thailand, there is no good recording system in pharmacies to collect these data such as medication compliance.

4.2.3) Method to convert costs and benefits to monetary units

Both costs and benefits have to convert to monetary units in cost-benefit analysis. This important issue needs to be concerned when benefits are converted to monetary units by using “cost saving” or cost avoidance

method because it can sometimes cause confusion. Therefore, it is necessary to ensure the difference between the two and assure that costs and benefits are appropriately put into the right side There are two most common approaches that are used to convert indirect and intangible benefits to a monetary unit, the human capital approach and willingness to pay approach.[15]

I. The human capital (HC) approach: Indirect benefit is from the increase in productivity after implementation of the intervention or program. Thus, indirect benefit can be converted to monetary value by using the human capital (HC) approach because this method can be used to approximate the salary and productivity loss from sickness, disability, or death. The two basic issues that are used to estimate human capital are wage rate and missed time (days, years) because of sickness. Wage rate can be calculated from income and the source of income can be found from the Bureau of Labor and Statistics or self-report. Missed time due to sickness can be found from self-report.[15]

II. Willingness-to-pay (WTP) approach: Willingness-to-pay can be used to calculate indirect and intangible viewpoints of disease or illness. This method measures how much patients are willing to pay for decreasing the likelihood of undesirable results of health outcome. In addition, it integrates patient preferences and intangible benefits (i.e. change in quality of life). Contingent valuation (CV) is a direct method that is used in order to figure the amount of WTP in monetary units. This method directly asks the respondent to value the scenario explaining the benefits of a specific program or intervention in monetary units. CV method consists of two basic components which are hypothetical scenario and bidding vehicle.[15]

5) Calculating Results of Costs and Benefits:

After determining all costs and benefits and converting to monetary units, the result will be displayed in a way that helps a policy maker to understand the worth of a program. There are three types of CBA result which are net benefit (or net cost), benefit-to-cost ratios, and internal rate of return (IRR).

5.1) Net Benefit (or Net Cost) Calculation

Net benefit can be calculated by using the difference between costs and benefits. Net benefit or net cost can be calculated as below:

Net benefit = total benefits – total costs

Net cost = total costs – total benefits

The policy maker should choose the program that provide Net Benefit > 0 or Net Cost < 0

5.2) Benefit-to-Cost (or Cost-to-Benefit) Ratio Calculation

The result of cost benefit analysis can be presented as benefit to cost (or cost to benefit) ratio and calculated from sum of total benefits divided by total costs. The policy maker should select the program that is cost effective, or when the result showed benefit-to-cost ratio > 1 or cost-to-benefit ratio < 1.

6) Discount rate

Time horizon of the program is an important issue to be considered when we select a method to show the result. It is significant to adjust or discount costs and benefits to one point in time, whenever we use retrospective data that are gathered for more than one year or the results that are evaluated for more than one year in the future. In the future, the present cash flow is less expensive than the future cash flow, because patients want to get money today rather than a future time, so money obtained today is valued more than the same quantity obtained next year. Thus, we have to modify time value by using discount rate to discount future revenues. The discount rate estimates capital cost by considering interest rate of loan money. The present value (PV) of future expenses and cost savings should be analyzed. The accepted discount rate established for a health program should be between 3% and 6%. (Do you have a reference to support this?) The equation for discount factor is $1/(1+r)^t$. Therefore, we can show the result as Net Present Value (NPV) instead of net benefit which is presented below:

$$NPV = \frac{B_0 - C_0}{(1+r)^0} + \frac{B_1 - C_1}{(1+r)^1} + \frac{B_2 - C_2}{(1+r)^2} \ldots\ldots\ldots + \frac{B_n - C_n}{(1+r)^n}$$

$$NPV = \sum \frac{B_t - C_t}{(1+r)^t} = \sum \frac{\text{Net benefit}}{(1+r)^t}$$

B_t benefits of the project which occur each year

C_t costs of the project which occur each year

$1/(1+r)^t$ discount factor

r discount rate

t number of years in the future in which expenses or savings arise (when t =0 means present year)

If NVP is positive, the benefit from the project is more than the cost of the project. It means that that project is cost effective.

7) Sensitivity analysis

Sensitivity analysis is the method that is used to explore how much the result of the analysis changes after varying a parameter over a range of values.[15] If there are small changes of the result after varying the parameter, the analysis is insensitive or robust. Consequently, the result of the study can be ensured. On the other hand, if there is a dramatically change of the result after varying the parameter, the analysis is sensitive and a researcher needs to be aware of interpretation. This following table shows the summary of all types of sensitivity analysis and description of each type.[30]

Table 3 Summary type of sensitivity analysis

Type of sensitivity analysis	Description
1. One-way (univariate) sensitivity analysis	One variable is changed at a time while the value of others are constant.
2. Two-way (bivariate) sensitivity analysis	Two variables are both changed at a time while the value of others are constant.
3. Multivariate sensitivity analysis	Multiple variables are changed at a time
4. Best-case analysis	It is a specific type of multivariate sensitivity analysis in which all most-favorable assumptions values are used
5. Worst-case analysis	It is a specific type of multivariate sensitivity analysis in which all least-favorable assumptions values are used
6. Probabilistic sensitivity analysis (Monte Carlo analysis)	It is used to examine all key and uncertain multiple parameters simultaneously and simulate multiple scenarios.

Reference: Arnold RJG. Pharmacoeconomics : From Theory to practice. The United States of America: Taylor and Francis Group; 2010.[30]

2.4 Related research

Good Pharmacy Practice Compliance in Thailand

There were several studies which examined pharmacy's compliance to "Standard of Accredited Pharmacy" by Pharmacy Council which followed the GPP concept. Boonchoong and colleague surveyed the accredited pharmacies compliance with the standard criteria of Community Pharmacy Development and Accreditation project (CPA) after they were accredited by the Pharmacy Council.[31] The standard criteria of CPA project were created according to the GPP concept. The population in this study was the pharmacists in accredited pharmacies. The result showed that pharmacies were able to follow to five sections of those standard criteria in order: 1) services and social participation in community (mean score: 4.51) 2) place and equipment (mean score: 4.32), 3) pharmaceutical service (mean score: 4.15), 4) law and ethic compliance (mean score: 4.08), and 5) quality management (mean score: 3.93), respectively. Pleanbangchang and colleague examined the understanding of pharmacies owners on the standard of accredited pharmacy by Pharmacy Council.[12] The target population was type I and type II pharmacies in Thailand. The result illustrated that the standard which seemed to be a major problem for most of pharmacies was standard 2.2: quality control. It was the standard that was difficult to understand for pharmacies' owner and low rate to comply. In addition, another standard that also showed low number of pharmacies to follow was standard 3.2: pharmaceutical service especially the criteria "providing full information on drug label" and "patient medication profile". Most pharmacies owners were unwilling to enroll to the CPA program because they lacked financial incentive and did not understand the meaning of standards. However, there was only one study from FDA officer report which examined the possibility of pharmacies to comply to the draft version of Public Health notification in terms of GPP regulation.[32] This study aimed to study the ability of pharmacies to comply with the standard criteria according to the GPP regulation and to examine the problems and barriers of pharmacies that can take place when implementing the GPP regulation. The population in this study was type I pharmacies that intended to be an accredited pharmacy. The FDA officer investigated only two standards of the GPP regulation which were personnel and pharmaceutical standards. The result from this study

showed that approximately 80% to 100% can comply with the personnel standard. For pharmaceutical care service standard, it showed that there were some rules that seemed to be an obstacle for pharmacies such as recording medical history for patient, providing proper information on drug label, reporting Adverse Drug Reaction (ADR) to surveillance office (such as FDA) and providing appropriate screening and referral system in pharmacy.

The benefit of pharmacist service in community setting

Libby et al, conducted a systematic review study about value of pharmacist services in community setting during 1990-2002. The result showed that there were many benefits from providing pharmacist services in community setting such as improved patient outcome, reducing Adverse Drug Event (ADE), improving appropriate using of medicine, reducing drug-related problems, improving intermediate outcome (ie. Blood pressure), reducing drug costs, improving compliance, and improving quality of life.[16] For the economic assessment of the value of pharmacist professional services, the researcher stated that it was limited. There were nine studies which met the criteria in order to evaluate the effect of pharmacist service on drug cost. Six out of nine presented the significant effect. Regarding the limitations of economic study, it is hard to discuss economic impact on drug cost or cost-effectiveness.

The benefit of reducing drug-related problems due to community pharmacist

There was a study which showed that pharmacists in community pharmacy setting are appropriate to detect and resolve Drug-Related Problem (DRP).[33] The example of drug-related problems are inappropriate prescription, drug interaction, and adverse drug reaction. DRP is a major issues of concern. In the United State, DRP contributed to the economic burden which increased from $76.6 billion in 1995 to $177.4 billion in 2000.[34] Several studies showed that 28% of all emergency cases resulted from DRPs and 24% led to hospital admission. It also found that 70% of DRPs could be avoided.[33] In Thailand, pharmacies are the primary health care service for patients because they are inexpensive, convenient and time saving. Survey data on health and welfare found that the number of self-medications had gradually increased from 20.9% in 2008 to 30.7% in 2012.[23] Even though the patient

advantages from pharmaceutical care services, adverse effect from drug utilization may occur as drug-related problem at any time. The crucial role of a pharmacist in a community pharmacy is taking medication history. This activity can help pharmacists to dispense the appropriate medication to patients and can avoid the undesirable result such as dispensing antibiotic medication to patients who are allergic to that kind of medicine.

Cheewarirungrueng and colleague studied drug related problems (DRPs) that occured due to incomplete asking of information from the patients about their history before dispensing the medication in the community pharmacy.[6] The result showed that 27.59% to 29.3% of patients would suffer at least one DRP if there were no history taking before dispensing the medication. The DRPs that most commonly occur in this case were no clear indication for drug use. This study stated that directly asking about a patient's history would prevent DRPs between 18.75% to 23.81%. Therefore the benefit of medication history taking from a patient is the important issue to concern for identifying and preventing drug related problems in a community pharmacy. There is a study which showed that the cost involved with drug-related problem (including total cost of drug-related morbidity and mortality) was more than the expenses for primary drug therapy. Drug-related problems are gradually understood to be a serious issue of concern, but most DRPs are preventable such as medical problems.

Economic impact assessment on pharmacist-related study

Adverse Drug Events (ADEs) are defined as an injury due to the use of medicinal product which results from medication error and adverse drug reaction. ADE can also contribute to medication related problems. The outcome when ADE occurs is often hospital admission, prolong hospitalization and increased cost of treatment. Medication related problems are the crucial health issues of concern. In the United State, adverse drug event was the 5th which contributed to cause of death. In Thailand, the incidence of ADR at Queen Sirikit National Institute of Child Health was 3.7% and contributed to cost 506.56 baht/case.[35] Pharmacist intervention is one resolution that is commonly used in order to reduce ADE. Uaviseswong and colleagues, conducted a systematic review of economic evaluation of pharmacist

intervention related to adverse drug event (ADE) among patients with hospitalization during 1990-2010.[35] There were five journals included in this study. The result of pharmacist intervention showed the positive economic benefit because it could save the treatment cost of ADE which could be prevented. In addition, pharmacist intervention presented a mean net benefit of 27.25 million pounds over five years timeframe due to reducing the medication error. In addition, Mitchell et al, conducted a study to evaluate the economic impact of a clinical pharmacy admission medication reconciliation program. From this study, the costs were from the expected total expenditure for the investment which consisted of labor costs and meeting room cost. For the benefits, total medication reconciliation savings were calculated by the number of serious medication errors in study period time with cost of serious ADEs. Then, the result of this study was shown as Net present value (NPV). The discount rate in this study was 10% which came from the average between not-for-profit and for-profit hospitals. The worst-case and best-case scenarios were used and random 50% change in all variables. Thus, it showed that providing clinical pharmacist in healthcare team in order to access medication reconciliation procedure could improve patient safety and provide economic benefit due to reducing preventable medication errors.[36] Cote and colleagues, studied about economic assessment of a pharmacy-based health promotion program implementation in hypertension patients, by using cost-benefit analysis in societal perspective. Thus, the costs from this study were fixed costs (software, service contract) and pharmacist intervention costs (cost of blood pressure readings, cost of verbal interventions, cost of pharmaceutical opinions). Whereas, the benefits were willingness to pay and cost savings. For cost savings, the researcher calculated from the difference of direct costs (antihypertensive drug, physician visits, hospitalization, and travel) and indirect costs (time cost to the pharmacist, time cost to patient) between two groups (exposed participants and not exposed participants). After obtaining both costs and benefits, the researcher compared costs and benefits between these two options; support the intervention by private sector and support the intervention by public sector. Then, the result was presented as net benefit and benefit to cost ratio. The result showed that mean direct costs significantly declined and participants were willing to pay Canadian $ 0.54 per month in the pharmacist intervention group. Moreover, they found that the benefits

were approximately ten times more than costs.[37] Shalom, I. et al, conducted a study that evaluated the economic impact of clinical intervention implementation in Australian community pharmacies. It was a randomized control trial study conducted in government perspective. The main outcome considered was cost savings from healthcare cost avoidance, healthcare cost from pharmacist, cost of medicine changing, pharmacy time and telephone calls. The result showed that the intervention group can provide a larger cost saving than the control group, so this result can support that pharmaceutical services to healthcare system can provide the value for money especially improving quality of care and cost savings.[38] There was a study which assessed the economic outcome of patient-focused pharmacist intervention in the community setting. The patients who were focused on by this study were hypertension, diabetes, asthma and hypercholesterolemia patients. The pharmacist intervention consisted of providing education, patient monitoring, counseling lifestyle or behavior modification and frequently following up with patients in order to manage drug-related problems. The result showed that this intervention provided cost savings approximately $143.95/patient/month to $293.39/patient/month.[39] Chompoo's study examined the costs and benefits in order to participate in an accredited pharmacy project. The incremental cost in this study consisted of present-period explicit costs and opportunity costs. The present-period explicit costs which consisted of fixed costs and variable costs was 131,900.84 baht per year. In comparison, the opportunity costs, which consisted of compensation costs of pharmacy owner who is pharmacist and cannot work for other job, promotion costs and interest, was 299,647.50 baht per year. Thus the total incremental cost was 431,548.34 baht per year. The incremental benefit in this study could not convert to monetary value. Therefore the summary of the incremental benefits were as follows; 1) participating in conference without registration, 2) obtaining the information, news, poster from Community Pharmacy Development and Accreditation project 3) improving pharmacy profession, and building trust to society 4) Obtaining useful suggestion from auditor to improve the pharmacy 5) Increasing new role of pharmacist in pharmacy such as screening, patient protection and pharmaceutical care.[40]

CHAPTER III

METHODOLOGY

Good Pharmacy Practice (GPP) in community and hospital pharmacy setting is a crucial standard for pharmacy services. Thai Food and Drug Administration (Thai-FDA) realized the benefit of GPP and tried to implement this concept as a regulation for every community pharmacy. The Ministerial Regulation on Application and Issuance of License to Modern Pharmacy was revised by the Thai FDA because it was obsolete and not suited to the current situation. Then it was approved by the Royal Gazette on 27th December, 2013 and would be effective within 180 days or would begin on 26th June, 2014. The main context in this regulation is all new pharmacies have to pass the Good Pharmacy Practice (GPP) standard before renewing their pharmacy license, whereas old pharmacies would have a period to improve and must pass GPP standard within eight years. The ability of old community pharmacies to follow the new regulation is still in questions. Thus, the first aim of this study was to explore the current situation and the readiness to comply with the draft of Ministry of Public Health notification of GPP regulation which consisted of four main categories; place and equipment, personal, effective drug management and pharmacy service standards. In addition, before issuing any regulations, the government should evaluate the impact of the regulation that is developed, for implementation to promote the best use of that regulation. Therefore, the second objective of this study was to evaluate the economic impact of Good Pharmacy Practice regulation from societal perspective by using cost-benefit analysis.

3.1 Study design

This study was a quantitative research. Survey design was used to collect data for the situation analysis by sending questionnaires to pharmacies' owners in order to know the current situation and impact of pharmacy to comply with GPP regulation under the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy and also explore the costs and benefits of GPP regulation. Moreover, in-depth interview was conducted to collect more information from policy makers and

pharmacy owners in order to get all comprehensive information about costs and benefits.

3.2 Study Period

The Ministerial Regulation on Application and Issuance of License to Modern Pharmacy was approved by the Royal Gazette on 27th December, 2013 and was effective within 180 days so it began on 26th June,2014. The draft of Public Health notification on GPP was in process and is being planned to issue in 2015. Therefore, the duration period for collecting data to conduct cost-benefit analysis occurred between July 1st, 2014 and September 30th, 2014.

3.3 Study Perspective

This study was conducted from societal perspective. The GPP regulation was used to enforce all pharmacies in Thailand, thus this regulation would impact to many stakeholders in society which were government sector (FDA), pharmacies' owners and patients. Therefore, the economic evaluation result from this study would be one of the useful information for government sector which helps making a decision in order to implement GPP regulation.

3.4 Study process

3.4.1 Step 1: Study framework

This step was to prepare for providing the information and knowledge about Good Pharmacy Practice concept, the benefit of having pharmacist to provide pharmaceutical care in community pharmacy, current situation of pharmacy compliance on GPP regulation in Thailand, GPP policy, regulatory impact assessment (RIA) process, and economic evaluation by using cost-benefit analysis.

3.4.1.1 Determine the type of program or intervention

Regarding the Ministry of Public Health notification of GPP regulation enforcement, it is the supportive regulation under the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy. This regulation was in a drafting process and planned to issue in 2015. Therefore, the type of program in this study was to find the best alternative in order to implement the GPP regulation.

3.4.1.2 Identify alternative

According to the main context in the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy, it stated that all new community pharmacies have to pass Good Pharmacy Practice (GPP) standard before renewing their pharmacy license. The old community pharmacies which opened before this new regulation had a period of time to adapt and must pass GPP standard within eight years.[10] Thus, this study used a timeframe of eight year for evaluating the economic impact of the GPP implementation under the Public Health notification from societal perspective.

The assumption of this cost-benefit analysis was some pharmacies would close down because some of them could not comply with the new GPP regulation. The probability of pharmacies closing down each year were from the survey. The model was the cumulative of cost and benefit of each year to eight years.

3.4.1.3 Determine the perspective of the study

The GPP regulation was used to enforce all pharmacies in Thailand, thus this regulation would impact to many stakeholders in society. This study was conducted from a societal perspective which was government sector (FDA), pharmacy's owners and patients.

3.4.1.4 Identify the costs and benefits

3.4.1.4.1 Cost of implementing the GPP

Cost is any resource that is used in the project to produce goods or services for achieving the objective of the project. Therefore, the Cost of implementing the GPP was all costs (direct, indirect,) that occurred when the GPP regulation was implemented from societal perspective. In this study, there were three stakeholders relating to this GPP regulation, so the cost of implementing GPP should come from government (FDA) perspective, pharmacies' owners' perspective and patients' perspective. Rate for converting Thai baht to US dollar as of 1 April, 2014 was 32.79 baht/US dollar. The three percent discount rate was used and the average inflation rate in Thailand was 4.5% from 1977 until 2014.[41]

1) Cost from Government (FDA) perspective

Cost from government (FDA) perspective included 1) cost of issuing law and regulation (the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy*)* 2) cost of GPP training course for authorities (FDA officers and outsourced authorities who are responsible for renewing pharmacies assessment) 3) cost of GPP information distribution and 4) cost of GPP handbook guideline for FDA officer.

1.1) Cost of issuing the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy

This study aimed to evaluate the impact of the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy, thus cost of issuing this major regulation was included. The data from the Annual Financial report of Thai-FDA in 2012 presented that the budget when the government issuing law and regulation was $5,909.04 dollar (193,757.36 baht).[42] Due to this information was more than one year, cost in 2012 needed to be adjust to the amount in 2014. To standardize the past cost, cost in 2012 was multiplied by the inflation rate.[15] The average inflation rate in Thailand was 4.54% from 1977 until 2014.[41] Therefore, cost of law and regulation in 2014 would be $6,457.76 dollar (211,749.89 baht).

Table 4 Calculation formula and source of information used to obtain total cost of issuing the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy

Total cost of issuing the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy = no. of law and regulation x average cost of issuing law and regulation.	
Variables	Source of information
No. of the law and regulation	FDA expert opinion
Average cost of issuing law and regulation	FDA report,2012 [42]

1.2) Cost of GPP training course for FDA officers and outsourced authorities

When implementing the GPP regulation, the government sector had to train FDA officer representatives from the seventy six provinces of Thailand and also outsource authorities about the GPP assessment principle. Cost of GPP training course for the

authorities per year was calculated from average cost of training per person per time, training hour per time, the no. of training course per year and the no. of authorities (FDA and outsourced authorities). The number of outsourced authorities was calculated from the cumulative number of pharmacies which had potential to comply with GPP each year (from survey) divided by working days in a year and then divided by the number of pharmacies inspected in a working day. There are two hundred and fifty working day in a year and two pharmacies being inspected per working day was used for the base case. The cumulative number of pharmacies which had potential to comply with GPP each year was calculated from the probability of pharmacy's owner who had potential to comply with the GPP regulation each year (data from the survey) and the number of type I pharmacies in Thailand.

Table 5 Calculation formula and source of information used to obtain total cost of GPP training course for FDA officer and outsource authorities per year

Total cost of GPP training course for FDA officer and outsource authorities per year = no. of authorities (FDA and outsourced) x average training cost per person per hour x no. of training hour = [(no. of needed officer per province x no. of province) + (no. of potential pharmacy to comply with GPP regulation/ working day/ no. of pharmacies being inspected in a working day)] x average training cost per person per hour x no. of training hour	
Variables	Source of information
Average training cost per person per hour	FDA report [42]
No. of training hour	Office hour
No. of FDA officer	No. of province
No. of outsourced	Survey, FDA expert opinion
No. of potential pharmacy to comply with GPP regulation	Survey
Turnover rate of new authorities per year	FDA expert opinion

1.3) Cost of GPP information distribution

FDA bodies planned for the information distribution strategy by sending newsletters to the pharmacies who still not comply with GPP regulation (non-GPP) in order to inform them about the GPP regulations and related information. The estimate number of non-GPP pharmacies each year was obtained from the survey. Data was calculated

from probability of a pharmacy that has potential to comply with GPP regulation each year, probability of pharmacy that has no potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand. The assumption in this model was that the Thai-FDA would invest for GPP information distribution once a year of implementation.

Table 6 Calculation formula and source of information used to obtain total cost of GPP information distribution

Total cost of GPP information distribution = no. of non-GPP pharmacies each year x average cost of newsletter per newsletter = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)] x average cost of newsletter per newsletter	
Variables	Source of information
Average cost of newsletter	Website [43]
Prob. of potential pharmacy to comply with GPP regulation	survey
No. of potential pharmacies to comply with GPP regulation	survey
No. of non-GPP pharmacy each year	survey
No. of pharmacies in Thailand	FDA database

1.4) Cost of the GPP guideline handbook for the FDA officers

FDA bodies planned to provide 350 GPP guideline handbooks for Thai-FDA officers in seventy six provinces of Thailand.

Table 7 Calculation formula and source of information used to obtain total cost of the GPP guideline handbook for the FDA officer

Total cost of the GPP guideline handbook for the FDA officer = no. of GPP handbooks x average cost of GPP handbook per handbook	
Variables	Source of information
No. of GPP handbook	FDA expert opinion
Average cost of handbook	Website [43]

2) Cost from Pharmacies' owners' perspective

From the pharmacy owners' perspective, there were eight incremental costs which occurred after the GPP regulation implementation: 1) Cost for renovating place and equipment, 2) Cost for adapting stock management, 3) Other variable costs after the GPP implementation, 4) Cost of GPP guideline handbooks for pharmacies, 5) Cost of full time pharmacists' fees, 6) Opportunity cost of a pharmacy closing when renovating the stores, 7) Cost of pharmacies' close down and 8) Assessment cost for renewing pharmacy licenses.

2.1) Cost for renovating place and equipment

This is the cost that increased after the GPP regulations implementation, which was the cost of preparing an eight square meter area, preparing the counseling area, cost of preparing a closed section for non-OTC medication, cost of 12,000 BTU air conditioner [40], thermometers [40], drug counting trays [40], automatic sphygmomanometers [40], weighing apparatus [40], stadiometers [40], fire extinguishers [40], pharmacists' sign with their picture [40], refrigerators [40] cost of pharmacists' uniform [44], and storage for keeping documents[40]. Probability of a pharmacy that had potential to comply with GPP regulation each year was obtain from the survey. The estimate number of pharmacies who has potential to comply with GPP regulation was obtain by probability of a pharmacy who had potential to comply with GPP regulation each year multiplied by number of type I pharmacies in Thailand.

Table 8 Calculation formula and source of information used to obtain total cost for renovating place and equipment

Total cost for renovating place and equipment = no. of potential pharmacy that comply with GPP regulation each year x average cost for renovating place and equipment = (prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year) x average cost for renovating place and equipment = (prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year) x average cost for renovating place and equipment ***Note:*** No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Average cost for renovating place and equipment	
- Eight square meter area	Expert opinion
- Counseling area	Expert opinion
- Air conditioning	Literature review[40]
- Closing area for dangerous medication	Expert opinion
- Thermometer	Literature review[40]
- Refrigerator	Literature review[40]
- Tray	Literature review[40]
- sphygmomanometer (automatic)	Literature review[40]
- weighing apparatus	Literature review[40]
- stadiometer	Literature review[40]
- fire extinguisher	Literature review[40]
- pharmacist sign with picture	Literature review[40]
- pharmacist uniform	Website[44]
- storage for keeping documents	Literature review[40]
Prob. of potential pharmacy to comply with GPP regulation each year	survey
No. of pharmacies in Thailand	FDA database

2.2) Cost for adapting stock management

For stock management, data was collected from literature review and expert opinion from pharmacies' owners in order to obtain the comprehensive information about stock management. Cost for adapting stock management included computer, pharmacy program and stock cabinet. Most of pharmacies' owner reported that they used 4 cabinets for managing medication inventory whereas some of them used 2 or 8 cabinets for managing their inventory. Therefore, four cabinets would be used for base case where as two and eight cabinets would be used for worse case and best case scenario, respectively. For the no. of potential pharmacy to comply with GPP was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand.

Table 9 Calculation formula and source of information used to obtain total cost for adapting stock management = the no. of remaining pharmacies x fixed cost for stock management

Total cost for adapting stock management = no. of potential pharmacy that comply with GPP each year x average cost for stock management = (prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year) x average cost for stock management ***Note:*** No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies to comply with GPP each year	survey
No. of pharmacies in Thailand	FDA database
Average cost for adapting stock management - Computer - Pharmacy program - Stock cabinet	 Literature review [40] Website Website
No. of stock cabinet	Expert opinion

2.3) Other variable costs after the GPP implementation

After the GPP implementation, the pharmacy owners reported that they would pay for equipment such as UV protective medicine containers, sticker label and electricity[40]. The cumulative number of potential pharmacies that can comply with GPP regulation each year would absorb this cost. The no. of potential pharmacy that can comply with GPP regulation each year was obtained from survey. Three percent discount rate was used for calculation every year

Table 10 Calculation formula and source of information used to obtain total other variable costs after the GPP implementation

Total other variable costs after the GPP implementation = the cumulative no. of pharmacies that comply with GPP each year x average other variable cost/month x 12 months = $\sum_i$ (no. of potential pharmacy that comply with GPP each year) x average cost for stock management = $\sum_i$ [(prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year)] x average cost for stock management ***Note:*** $\sum_i$ = summation of the 1st year to the 8th year No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies that comply with GPP	Survey
No. of pharmacies in Thailand	FDA database
Cumulative pharmacies that comply with GPP each year	Survey
Average variable costs after the GPP implementation (UV protective medicine containers, sticker label, electricity)	Literature[40], survey

2.4) Cost of GPP guideline handbooks for pharmacies

Thai Pharmacies Association planned to produce a GPP guideline handbook for distribution to pharmacies owners. This cost affected the potential pharmacy that can comply with GPP regulation each year. The no. of potential pharmacy that can comply with GPP regulation each year was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand.

Table 11 Calculation formula and source of information used to obtain total cost of GPP guideline handbook for pharmacies

Total cost of GPP guideline handbooks for pharmacies = no. of potential pharmacy to comply with GPP each year x average cost of GPP handbooks = (prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year) x average cost of GPP handbooks ***Note:*** No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies that had potential to comply with GPP	survey
No. of pharmacies in Thailand	FDA database
Average cost of GPP handbooks	Website[45]

2.5) Cost of full time pharmacists' fees

Pharmacy owners' must have a full time pharmacist providing the pharmacy service in their stores during operating hours. In Thailand, even though the Drug Act of B.E. 2510 stated that the person who had a responsibility to provide pharmacy service was the pharmacists, there still were problems of lacking pharmacists on duty during operating hours.[4, 5] After the GPP regulation implementation, the pharmacies which did not have full time pharmacists would pay this cost, thus the cumulative of potential pharmacies that can comply with GPP regulation would pay for this cost every year. The no. of potential pharmacies that can comply with GPP regulation each

year was calculated from probability of a pharmacy that has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand.

Table 12 Calculation formula and source of information used to obtain total cost of full time pharmacist fee

Total cost of full time pharmacist fee
= the cumulative no. of pharmacies to comply with GPP each year x average cost of fulltime pharmacist per month x 12 months

= $\sum_i$ (no. of potential pharmacy that comply with GPP each year) x average cost of fulltime pharmacist per month x 12 months

= $\sum_i$ [(prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year)] x average cost of fulltime pharmacist per month x 12 months

Note:
$\sum_i$ = summation of the 1st year to the 8th year

No. of non-GPP pharmacy each year
= [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]

Variables	Source of information
Prob. of potential pharmacies to comply with GPP	Survey
No. of pharmacies in Thailand	FDA database
Cumulative pharmacies to comply with GPP each year	Survey
Average cost of fulltime pharmacist/month (USD/year)	
- Operating time of pharmacies	Expert opinion
- Working day of pharmacist (hr.)	Expert opinion
- General rate of part time (days)	
- pharmacist's fee in community pharmacy (USD/hr.)	Expert opinion

2.6) Opportunity cost of a pharmacy closing when renovating the stores

After the GPP implementation, older pharmacies would need more time for renovating their store according to the GPP regulations such as preparing a place for standard equipment. They had to close their stores for renovating. Closing pharmacy for renovation would lead to a loss of profit. The amount of profit that the pharmacies would not obtain was derived from the self-administered questionnaire survey. Expert opinion from pharmacies' owner reported that they usually close approximately 5 days for the renovation. Some of pharmacies would close 2 or 14 days for renovation. Therefore, five days of renovation would be used a base case calculation whereas two and fourteen days of renovation would be used in a best case and worst case analysis, respectively, in the sensitivity analysis. This cost affected the potential pharmacy that can comply with GPP regulation each year. The no. of potential pharmacy that can comply with GPP regulation each year was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand.

Table 13 Calculation formula and source of information used to obtain opportunity total cost of pharmacy closing when renovating the stores

Total opportunity cost of pharmacy closing when renovating the stores = no. of pharmacy that had potential to comply with GPP each year x average loss of profit per day x 5 closing days = (prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year) x average loss of profit per day x 5 closing days ***Note:*** No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies that had potential to comply with GPP	survey
No. of pharmacies in Thailand	FDA database
Average profit of pharmacy per day (USD/ year)	Survey
No. of closing day for renovation (days)	Expert opinion
Average profit of pharmacy owner's per day	Survey

2.7) Cost of pharmacy close down

If the older pharmacies cannot not follow the GPP regulations at the 8th year, they had to close their pharmacy business. The probability of pharmacies closing down at the 8th year was collected from the survey. The number of non-GPP pharmacies each year was calculated from the probability of potential pharmacy that can comply with GPP regulation and no. of type I pharmacy in Thailand. Cost of pharmacy closing down was also obtained from the survey.

Table 14 Calculation formula and source of information used to obtain total cost of pharmacy close down

Total cost of pharmacy close down = no. of remaining non-GPP pharmacies at the 8th year x average cost of closing down ***Note:*** No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of remaining non-GPP pharmacies	survey
No. of pharmacies in Thailand	FDA database
Average cost of pharmacy close down (USD/Rx close down)	Survey

2.8) Assessment cost for renewing pharmacy licenses

Experts from the Thai-FDA planned that the pharmacies who were assessed by the authorities (FDA officer or outsource authority) had to pay for the assessment cost of renewing their pharmacy license. This cost affected potential pharmacies that can comply with GPP thus the cumulative of potential pharmacies that can comply with GPP regulation would pay for this cost every year. The no. of potential pharmacies that can comply with GPP regulation each year was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand.

Table 15 Calculation formula and source of information used to obtain total assessment cost for renewing drugstore license

Total assessment cost for renewing pharmacy license = the cumulative no. of pharmacies to comply with GPP each year x assessment cost for renewing pharmacy license = $\sum_i$ (no. of potential pharmacy that comply with GPP each year) x assessment cost for renewing pharmacy license = $\sum_i$ [(prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year)] x assessment cost for renewing pharmacy license ***Note:*** $\sum_i$ = summation of the 1st year to the 8th year No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies to comply with GPP	survey
No. of pharmacies in Thailand	FDA database
Assessment cost for renewing drugstore license	Expert opinion

3) Cost from Patients' perspective

The purpose of implementing GPP regulation was to improve the standard of the primary health care system in society through the pharmacies. When community pharmacies close down because of not complying to the regulation, patients have to go to the new community pharmacies which can be a cost in patient's perspective but we assume that there is no change in overall transportation cost. Therefore, our assumption in this model was no cost from the patients' perspective.

3.4.1.4.2 Benefits from GPP regulation

Benefits of implementing the GPP is defined as all direct benefits which occur when implementing the GPP regulation from the societal perspective. In this study, there were three stakeholders relating to this GPP regulation, so the total benefit of implementing GPP came from government (FDA)

perspective, pharmacies' owners' perspective and patients' perspective. All benefits have been transferred to monetary value. Rate for converting Thai baht to US dollar as of 1 April, 2014 was 32.79 baht/US dollar. The three percent discount rate was used and the average inflation rate in Thailand was 4.5% from 1977 until 2014.[41]

1) Benefits from government sector perspective:

The benefits from government sector was cost saving by the reduction of surveillance costs. Currently, the number of type I pharmacies in Thailand has increased dramatically from 4,723 pharmacies in 1996 to 12,123 pharmacies in 2013.[2] Even though the Drug Act B.E.2510 stated that the pharmacies must have a full time pharmacist available during the operating time, absence of pharmacists was still a major problem in Thailand. Thai FDA report showed that 33% of pharmacists were on duty during the FDA inspection in 2006. Another study showed that there were 25%, 40%, 64% and 76% of pharmacist on duty during the FDA inspection in Kalasin, Ootaradit, Samutsongkarm and Nakorn Pra Nom provinces in 2010, respectively.[4] Absence of pharmacists on duty increased the risk of inappropriate dispensing of medication and directly affected the patients' health. To minimize the absence of pharmacist on duty in the registered time period, FDA bodies randomly inspected the pharmacies. This caused surveillance cost. Thus, implementation of GPP regulations would save the cost of surveillance. The cost saving from reducing surveillance costs was calculated from the number of cumulative GPP-pharmacy that do not need to be inspected from FDA each year multiplied by average surveillance cost. FDA expert opinion reported that there were 3 FDA officers and one driver for each FDA inspection. Thus, the surveillance cost was computed from the salary of the FDA officer, salary of driver, working days, fuel costs and other expenses per day for four authorities. Each type I pharmacy in Thailand was expected to be inspected once a year. In this model, FDA expert opinion stated that the surveillance cost would reduce 50% after the GPP regulation implementation. Reducing 50% was used in a base case. For sensitivity analysis, no surveillance and reducing 20% of FDA surveillance inspection would be used in the best case and the worst case analysis, respectively. The total cost of savings made by

reducing surveillance costs have to be converted in the present year by using the 3% discount rate.

Table 16 Calculation formula and source of information used to obtain total cost saving of surveillance per year

Total cost saving of surveillance per year = no. of pharmacies that do not need to be inspected by FDA officers (GPP-Pharmacy) x average cost of surveillance/year = the cumulative no. of pharmacies to comply with GPP each year x average cost of surveillance/year = $\sum_i$ (no. of potential pharmacy that comply with GPP each year) x average cost of surveillance/year = $\sum_i$ [(prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year)] x average cost of surveillance/year ***Note:*** $\sum_i$ = summation of the 1st year to the 8th year No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies that comply with GPP	survey
No. of pharmacies in Thailand	FDA database
Average surveillance cost - Salary of FDA officer - Salary of driver - Working day for FDA inspection - Fuel cost - Expense per day for FDA officer - No. of FDA officer per day - No. of driver per day	Expert opinion

2) Benefit from pharmacies' owner perspective

We assumed that pharmacists would regularly examine drugs in the pharmacy as in the GPP standard. This can reduce the waste of expired drug. Thus, the benefit from pharmacy's owners' perspective was the cost saving by reducing the waste of expired drugs each year. Average cost of the waste of expired drugs per year was obtained from the survey. Total cost saving from reducing waste of expired drugs each year can be calculated from the number of cumulative GPP-pharmacy that would not have expired drugs each year multiplied by average cost of the waste of expired drugs per year.

Table 17 Calculation formula and source of information used to obtain total cost saving by reducing the waste of expired drugs per year

Total cost saving by reducing the waste of expired drugs per year = no. of pharmacies that would not have expired drugs (GPP-Pharmacy) x average cost of the waste of expired drugs per year = the cumulative no. of pharmacies to comply with GPP each year x average cost of the waste of expired drugs per year = $\sum_i$ (no. of potential pharmacy that comply with GPP each year) x average cost of the waste of expired drugs per year = $\sum_i$ [(prob. of pharmacy that had potential to comply with GPP regulation each year x no. of non-GPP pharmacy each year)] x average cost of the waste of expired drugs per year ***Note:*** $\sum_i$ = summation of the 1st year to the 8th year No. of non-GPP pharmacy each year = [no. of pharmacy in the previous year – (probability of potential pharmacy complied with the GPP regulation x no. of pharmacy in the previous year)]	
Variables	Source of information
Prob. of potential pharmacies that comply with GPP	survey
No. of pharmacies in Thailand	FDA database
Average cost of the waste of expired drugs per year	Survey

3) Benefit from patient perspective

A pharmacy is the primary health care service for people because it is inexpensive, convenient and time saving. The survey data on health and welfare found that the number of people self-medicating had increased from 20.9% in 2008 to 30.7% in 2012.[23] Even though the patient gains advantages from pharmaceutical care services, adverse results from drug utilization may occur any time such as drug-related problems. The crucial role of the pharmacist in a community pharmacy is medication history taking. This activity can help pharmacists to dispense the appropriate medication to patients and can avoid the undesirable result such as dispensing antibiotic medication to a patient who is allergic to that kind of medicine. Cheewarirungrueng and colleague studied drug related problems (DRPs) that occurred due to the incomplete information from the patients about their history before dispensing the medication in the community pharmacy.[6] The result showed that 27.59% to 29.3% of patients would exhibit at least one DRP if there was no history taking before dispensing the medication. The DRPs that are most common occurred due to the fact that there was no clear indication regarding drug use. This study stated that directly asking about patient's history would prevent DRPs occurring by between 18.75% and 23.81%. Therefore the benefit of medication history taking from the patient is the important issue to be considered in order to identify and prevent drug related problems in community pharmacies. This study assumed that having a pharmacist in community pharmacy on duty during the registered period as in the GPP standard would reduce drug related problem (DRPs). Thus, the benefit from the patients' perspective was cost saving from reducing drug-related problems (DRPs).

A study that showed that the cost involved with drug-related problems (including total cost of drug-related morbidity and mortality) was more than the expenses for primary drug therapy. Drug-related problems are gradually becoming known as a serious issue of concern, but most of DRPs are preventable such as medical problems. In the United State, DRPs contributed to the economic burden which increased from $76.6 billion in 1995 to $177.4 billion in 2000.[34] A systematic review related to cost of ADR presented that cost per case of ADR induced hospitalization ranged from 180 US dollars to 7,038 US dollars[46]. There was two

studies from systematic review conducted in Asia, India. First, Patel and colleague found that the economic burden of ADR in medical emergency department of a tertiary referral center was 180 US dollar per case in 2013.[47] Second, Pattanaik and colleague evaluated cost of treatment of drug-related events in a tertiary care public hospital and found that total cost was 428 US dollar in 2013 which conducted from the societal perspective. One study in Thailand showed that the average cost of ADE in intensive care unit was set at 53 USD.[48] Due to the lack of cost estimate of DRP in community pharmacy in Thailand, cost estimate of DRP in India was used as proxy in this study. Thus, cost of DRP per case would be converted from 428 US dollar in 2013 to 447.26 US dollars in 2014 by using 4.5% inflation rate for the base case. For worse case, 53 USD in 2008 was used and converted to 82.31 USD in 2014. For best case, cost of DRP from US study, 177.4 billion USD, was used to calculate cost per case. Therefore cost per case was estimated from the cost of DRP from US study (177.4 billion US dollar) divided by US population (317 million people in November,2013[49]) then multiplied by exchange rate (32.5 baht/US dollar[50]). The number of patients who can avoid DRP after the GPP implementation was 1,240,189 cases which was calculated from the number of people who went to pharmacies in Thailand (0.307%), the Thai population (64,785,909 people in December,2013[51]), the probability of DRP prevention from GPP regulation (0.21) and the probability of DRP in drugstore (0.29).[6] As a result, the total cost saving from reducing drug-related problems(DRP) was 179,938,963.10 USD per year (5,900,198,599.99 baht per year) for the first year in the base case. The total cost saving from reducing drug-related problems(DRP) that occur has to be converted in the present year by using the 3% discount rate.

Actually, there were other benefits of GPP implementation. For example, providing pharmaceutical care can improve patient outcome, reduce adverse drug events (ADE), improve appropriate use of medicine, improve intermediate outcome (ie. Blood pressure) and reduce drug costs.[16] There was a positive effect of pharmacist counseling such as improving quality of life in patients with dyspepsia[16, 17], 43% of patients changing their decision of medicine purchasing in non-prescription medicine, 4.2 % of patients were referred to a doctor and 7.3% of patients can be prevented from ADE,[16, 20] 63% of patients reported that their symptom

improved, 85% of patient thought that it was not essential to see the physicians when they had minor health problems.[16, 21, 22]. This study did not include them into the analysis because of the difficulty to find empirical data and converting factors into monetary value

Table 18 Calculation formula and source of information used to obtain total cost saving from reducing drug-related problems(DRP) per year

Total cost saving from reducing drug-related problems(DRP) per year = no. of people access to the pharmacy x prob. of DRP in pharmacy x prob. of reducing DRP due to GPP x average cost of DRP/case = (prob. people access to the Pharmacy x Thai population) x prob. of DRP in pharmacy x prob. of reducing DRP due to GPP x average cost of DRP/case	
Variables	Source of information
no. of people access to the pharmacy - prob. people access to the Pharmacy in 2012 - Thai population in December,2013 (people)	 Literature review [23] Literature review
Prob. of DRP in pharmacy	Literature review [6]
Prob. of DRP reduction due to GPP	Literature review [6]
Average cost of DRP per case	Literature review

3.4.2 Step 2 : Population and sample

3.4.2.1 Study population

The main context in the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy mainly impacts to type I pharmacy. This study targeted only type I pharmacies which were not accredited pharmacies in Thailand for collecting cost and benefit. The researcher excluded the accredited pharmacies because the accredited pharmacies can continue the license automatically by using an accredited pharmacy certificate, and do not have to obtain GPP assessment by FDA.

3.4.2.2 Sample size calculation

The first aim of this study was to explore the current situation regarding the extent to which pharmacies in Thailand can comply with GPP issued

under the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy. From the government data on 24th June, 2013, there were a total of 13,088 type I pharmacies in Thailand and 544 pharmacies are accredited pharmacies, so the targeted sample population should be 12,544 pharmacies. Thus, the member of samples needed was calculated by the equation below;

$$n = \frac{N}{1 + Ne^2} \quad \text{(Yamane)[9]}$$

$$n = \frac{12,544}{1 + (12,544)(0.05)^2}$$

$$n = 388$$

n = sample size

N = population

e = allowable error

The appropriate sample size for this study was 388. The expected respond rate would be 30%[9]. As a result, the total valid questionnaires that were sent to all pharmacy in Thailand was 388 x 100/30 = 1,300.

3.4.3 Step 3 : Tool

3.4.3.1 Questionnaire :

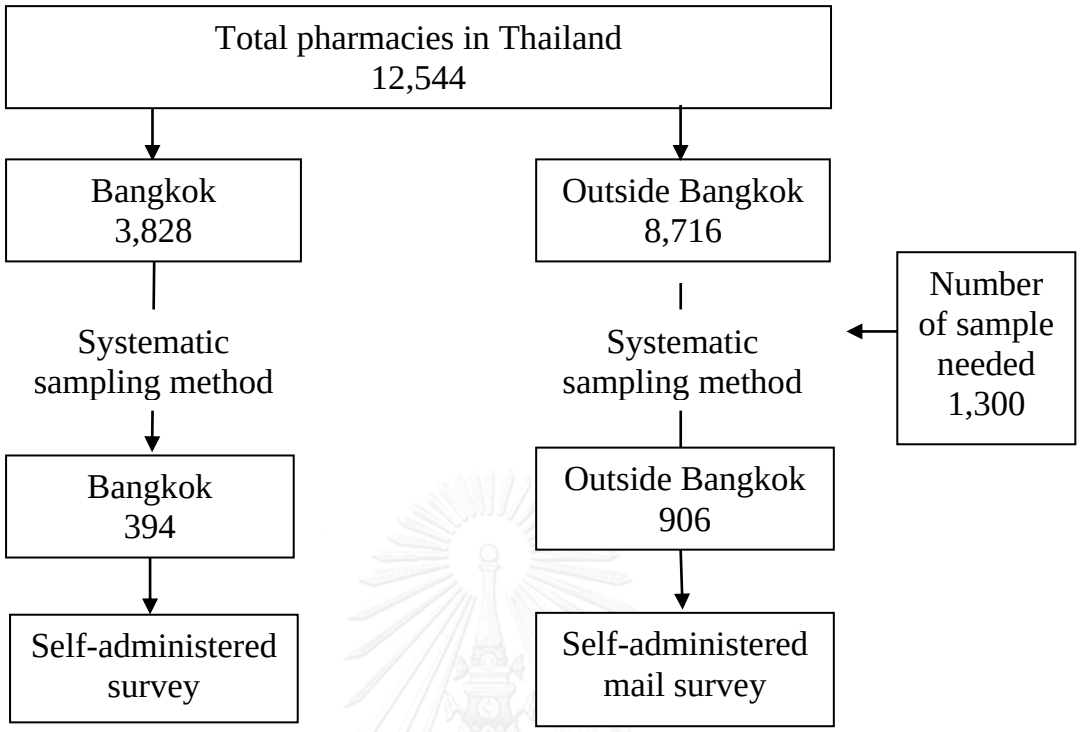
The questionnaire was developed from the Ministry of Public Health Notification of GPP regulation and literature review. Content validity of the questionnaire was examined by two expert opinion pharmacists from the faculty of pharmacy, Chulalongkorn University and one expert opinion from Thai FDA. For the pretest, the questionnaires were distributed to pharmacy owners during the meeting about GPP which was set by FDA. The questionnaire was adjusted some points after the pretesting to final version before mailing to 1,300 pharmacies. The participants had freedom to answer the questions in the questionnaire. All data of the participants from the survey would be keep confidentially. Content in the questionnaire consisted of three parts. The first part was demographic data of all pharmacies in Thailand. The second part explored the impact of implementing GPP regulation and possibility of

pharmacy complying with GPP regulation. The third part was costs and benefits from GPP implementation.

3.4.4 Step 4: Cost and benefit data collection

Source of cost and benefit data came from two sources which were questionnaire survey and in-depth interview from FDA expert opinion and pharmacies owners. From the government data on 24th June, 2013, there were a total of 13,088 type I pharmacies in Thailand and 544 pharmacies are accredited pharmacies, so the targeted sample population should be 12,544 pharmacies. There were 3,828 pharmacies in Bangkok and 8,716 outside Bangkok, so the proportion of pharmacies between Bangkok and outside Bangkok was 1:2.3. The number of questionnaire sent out that was needed for this study was 1,300. Therefore, 394 questionnaires were sent to randomly selected pharmacies in Bangkok and 906 questionnaires were sent to randomly selected pharmacies outside Bangkok. For Bangkok area, there are 50 district areas and the characteristics of pharmacy distribution is concentrated in some areas. Therefore, we used proportional allocation stratified sampling from 50 district areas of Bangkok. Whereas for pharmacies outside Bangkok, we used systematic sampling method. Systematic sampling method is a statistical method that is used for selecting the elements from an ordered sampling frame. The formula of systematic sampling is K = N/n , where K is sampling interval, n is sample size, and N is the population size). In this case, the population size (N) was 8,716 and the sample size (n) was 906, so the sampling interval (K) was 10 (8,716 / 906). Therefore, every 10th pharmacy was chosen after a random starting point between 1 and 10. If the random starting point is 2, then the pharmacy selected will be 2, 12, 22, 32, 42,….1,242. Then, the self-administered questionnaire mail survey was sent to pharmacies' owners.

Figure 3 Flow chart of the survey



3.4.5 Step 5: Data analysis

The data from the questionnaires was analyzed by using SPSS version 21 for demographic and descriptive data. To calculate costs and benefits, we used SPSS version 21 and Excel 2010 to analyze the data using eight years for time horizon, one year for life cycle and 3% for discount rate.

3.4.5.1 Calculating Results of Costs and Benefits

1) Net Present Value (NPV): Net present value could be calculated from net benefit multiply by discount factor to adjust cost and benefit because the cash flow from different points of time was not equal. Net benefit was calculated by using the difference between benefits and costs. The equation for net benefit is presented below;

$$\text{Net benefit} = \text{total benefits} - \text{total costs}$$

We multiplied net benefit with discount factor to adjust costs and benefits to one point of time because the cash flow from different points of time was not equal. Therefore, the future expenses and cost saving were converted to present value (PV). The

equation for discount factor is $1/ (1+r)^t$. Therefore, we could show the result as net present value (NPV) instead of net benefit which was presented below;

$$NPV = \frac{B_0 - C_0}{(1 + r)^0} + \frac{B_1 - C_1}{(1 + r)^1} + \frac{B_2 - C_2}{(1 + r)^2} \quad \ldots\ldots\ldots\ldots + \frac{B_n - C_n}{(1 + r)^n}$$

$$NPV = \sum \frac{B_t - C_t}{(1 + r)^t} = \sum \frac{\text{Net benefit}}{(1 + r)^t}$$

B_t	benefits of the project which occur each year
C_t	costs of the project which occur each year
$1/ (1+r)^t$	discount factor
r	discount rate
t	number of years in the future that expense or saving arise year

(when t =0 is meant present year)

If NVP is positive, the benefit from the project is more than cost of the project. It means that the project is cost effective.

2) Benefit to cost ratio: The result of cost benefit analysis can be presented as benefit to cost (or cost to benefit) ratio and calculated from the sum of total benefits divided by total costs. The policy maker should select the program that is cost effective, or when the result shows benefit-to-cost ratio over than 1 or cost-to-benefit ratio less than 1.

3.4.5.2 Sensitivity analysis

Sensitivity analysis is used to explore how much the result of the analysis changes after varying the parameter over a range of values.[15] If there is a small changes of the result after varying the parameter, the analysis is insensitive or robust. Thus, the result of the study can be ensured, when it is robust. In the other hand, if there is a dramatically change of the result after varying the parameter, the analysis is sensitive and researcher needs to be aware of interpretation. Best-case and worst-case analysis was used as a sensitivity analysis in this study. The variables that were changed for best-case and worst case were probability of potential pharmacies to comply with GPP, probability of pharmacy that cannot comply with GPP, costs for renovating place and equipment, costs for adapting stock management, other variable

costs after GPP implementation, opportunity cost of pharmacy closing down when renovating the store, cost of full time pharmacist fee, cost of pharmacy closed down, percent reduction of surveillance after the GPP implementation, cost of waste from expired medicine, the number of DRP in community pharmacy and cost of DRP.

3.4.6 Step 6: Conclusion

The result of this study was presented according to the objective based on information obtained.

1) Descriptive result of all pharmacies in Thailand.

2) Net present value from implementing the GPP regulation

3) Benefit to cost ratio from implementing the GPP regulation

4) Costs and benefits model of implementing the GPP regulation established in this study

CHAPTER IV

RESULT

As mentioned earlier, the Thai-FDA realized benefits of the Good Pharmacy Practice principles and tried to implement this concept as a regulation for all community pharmacies in Thailand. “The Ministerial Regulation on Application and Issuance of License to Modern Pharmacy” was revised by the Thai FDA because it was obsolete and not suited to the current situation. Eventually, it was approved by the Royal Gazette on 27th December 2013 and became effective on June 26th 2014. The main context in this regulation is the requirement for all new pharmacies to pass the Good Pharmacy Practice (GPP) standards before opening and renewing their drug store license. However, Thai-FDA gave a period of eight years to old pharmacies, the pharmacies that opened before June 26th, 2014 for the adaptation of this new regulation. The purpose of revising this regulation was to improve the standard of pharmacies in terms of place, equipment, personnel, effective drug management, and pharmacy services regarding safety and efficacy to customers. Nevertheless, a supportive regulation, The Ministry of Public Health notification of GPP regulation, is in the process of being drafted to set the best deadline within eight years. Therefore, the FDA needs to legislate based on the principle of Good Regulatory Practice (GRP) by using the Regulatory Impact Analysis (RIA) method in order to implement the regulation. This study has been conducted to examine the current situation and the readiness of non-accredited pharmacies to comply with the GPP standards under the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy. This study result can be benefits for FDA to set alternative in the RIA to further find the best alternative. In addition, it also evaluates the economic impact of the Good Pharmacy Practice regulations from a societal perspective by using cost-benefit analysis.

4.1 Descriptive data

By sending 1,300 questionnaires to type I pharmacies in Thailand, there were 155 questionnaires sent back and 195 questionnaires were returned due to the out of date address. It was 14.02% response rate. There were 147 pharmacies (98.7%) located outside department stores. A majority of respondents (96.7 %) were stand-alone pharmacies. There were 62.5% of pharmacies outside Bangkok and only 40.4% had been opened less than ten years. About half of the respondent (53.8%) sold medicine more than other products seventy five to hundred percent were medicine. There were 27.0% of pharmacies that had the pharmacists working approximately 16 to 40 hours per week. One-third of the pharmacies (32.5%) paid a pharmacists fee less than 5,000 baht. They reported that 51.4% of respondents were pharmacy owners, 7.4% were pharmacists, and 41.2% were both. (Table 19)

Table 19 Descriptive data (n=155)

Data	Frequency (valid %)	Data	Frequency (valid %)
Location		Type	
Department store	2 (1.3)	Stand Alone	145 (96.7)
Outside	147 (98.7)	Chain store	5 (3.3)
Location		Year of pharmacy (year)	
Bangkok	54 (37.5)	≤ 10 years	60 (40.4)
Outside Bangkok	90 (62.5)	11 -20 years	47 (31.8)
District area	44 (30.6)	21 – 30 years	22 (14.9)
Outside district area	46 (31.9)	> 30	19 (12.9)
Working time (hr./day)		Day/week	
≤ 4 hours	13 (8.4)	≤ 5 days	5 (3.2)
5 - 8 hours	5 (3.2)	6 days	57 (36.8)
> 8 hours	128 (82.6)	7 days	74 (47.7)
Percentage of selling medicine		Tax system	
≤ 25%	1 (0.9)	Vat	24 (16.4)
26% -50%	20 (17.1)	Include	115 (78.8)
51% – 75%	33 (28.2)	Etc.	7 (4.8)
75% -100%	63 (53.8)		
Pharmacist hour (hr./week)		Pharmacist salary(baht/month)	
5 – 15 hours	22 (18.0)	4,000 – 6,000	38 (32.5)
16 – 40 hours	33 (27.0)	6,001 – 8,000	20 (17.1)
41 – 60 hours	14 (11.5)	8,001 – 10,000	8 (6.8)
61 – 72 hours	11 (9.0)	10,001 – 15,000	4 (3.4)
73 – 84 hours	7 (5.7)	15,001 – 20,000	4 (3.4)
85 – 119 hours	11 (9.0)	20,001 – 25,000	2 (1.7)
		25,001 – 40,000	9 (7.7)
		40,001 – 70,000	2 (1.7)
Role			
Pharmacy's Owner	76 (51.4)		
Pharmacist	11 (7.4)		
Both	61 (41.2)		

4.2 Current situation of GPP regulation compliance

Regarding the draft of the Ministry of Public Health notification of GPP regulation, there are four main categories; 1) place & equipment, 2) personnel, 3) quality management and 4) pharmaceutical care standards. There were fifteen items for place & equipment, five items for personnel, seven items for quality management and twelve items for pharmaceutical care. (Table 20)

The results showed that over 92% of pharmacies were in a household registered permanent building that was located in a place which people can access, had adequate lighting, had at least two drug counting trays for penicillin or sulfonamide or NSAID separated from other kind of medicines and were not selling tobacco product or alcoholic beverages. Eighty five to ninety percent of them bought their medication from the manufactures, importers or distributors who had GMP (Good Manufacturing Practice) and who followed Good Storage Practice with the appropriate temperature & light protection and Good Distribution Practice principles. Their pharmacies were hygienic clean and had adequate ventilation and also provided a weighing machine for customers. The pharmacist in their pharmacies always asked for the necessary information before dispensing the medication. About 80-84% of pharmacy owners said that they had enough appropriate storage, and did not place drugs directly on the floor and they also provided an automatic sphygmomanometer for customers. Their staff dressed appropriately and their clothing was different from pharmacists. They kept their medicine in the appropriate condition and had drug quality assessment and a drug return system before its expiration date in their pharmacies. About 70-79% of pharmacy owners reported that they had an appropriate environment (<30 ◦C) to maintain drug quality, adhered to the First in First out (FIFO) principle, had a system for destroying expired medication and had a fire extinguisher. Their pharmacists wore white coats with a symbol of the Pharmacy Council and had controlled advertising media in the pharmacy in order to not mislead to customers.

Approximately sixty three to sixty nine percent of pharmacy owners reported that they had a registered pharmacist providing community pharmacy services, screening and referring patients and had appropriate, reliable and updating drug information resources for pharmacy services and drug information services (DIS).

Their staff had continued their education and had knowledge about the drug laws & regulations. They also had clearly defined duties and responsibilities of pharmacist and other staff. Their pharmacies had over eight square meters used for a service & counseling area, not including storage area. About sixty to sixty two percent of pharmacy owners said that they provided a refrigerator for keeping medication and had the repeated drug allergic prevention system. Any health activities for the customers had to be approved by their pharmacists. Fifty four percent of pharmacy owners reported that prescription or controlled medicine was dispensed with the appropriate advice by the pharmacist only. They had a drug surveillance system and a management & reporting system for inappropriate drug use behavior and drug quality problems. Forty three percent of pharmacy owners stated that they had a counseling area clearly separated from other services areas. Thirty nine percent reported that they closed the medication section during the absence of the pharmacist with the a message giving that information to the customers. Only thirty five percent of them could prepare the area for extemporaneous formulation and complete the labeling according to GPP standard.

Table 20 Current situation of pharmacies' compliance with Good Pharmacy Practice Regulation

Good Pharmacy Practice Standard	No. of pharmacy's compliance (valid %)
Place and equipment standard	
1. There must be a counseling and pharmacy service area, not including the storage area, at least 8 square meters with the shortest side not less than 2 meters.	99 (64.7%)
2. If there is a drug storage area, It must have enough space to properly keep and not place drugs directly on the ground.	123 (80.0%)
3. There must be an enough counseling area clearly separated from other services area with sign and have enough space for keeping patient medical history.	65 (42.2%)
4. The pharmacy must be located in a place where patients can access, and have a household registration to the government.	145 (93.5%)
5. The pharmacy must be in the permanent building.	150 (96.8%)
6. The pharmacy must be clean, hygienic, tidy and have adequate ventilation. It must have insect prevention and no pet in the pharmacy area.	137 (88.4%)
7. The pharmacy must have an appropriate environment to maintain drug quality. The storage area should be ventilated, dry, not more than 30 ◦C and prevented from sunlight.	108 (70.1%)
8. There must be adequate lights in the pharmacy in order to read labels and product information clearly.	148 (95.5%)
9. Prescription and controlled drugs should be placed by categories with clear labels. These sections must be closed with the informing message when pharmacist was not available.	58 (38.4%)

Good Pharmacy Practice Standard	No. of pharmacy's compliance (valid %)
10. There must be a refrigerator with enough space to properly keep the medication separately from other stuff in the pharmacy.	93 (61.2%)
11. There must be separate drug counting trays for penicillin or sulfonamide or NSAID in the pharmacy.	147 (94.8%)
12. There must be an automatic sphygmomanometer in the pharmacy.	128 (83.1%)
13. There must be a weighing machine in the pharmacy.	140 (90.9%)
14. There must be a stadiometer in the pharmacy.	119 (77.8%)
15. There must be a fire extinguisher in the pharmacy.	108 (70.6%)
Personnel standard	
16. Registered pharmacist must have knowledge and competency in providing community pharmacy services in the pharmacy.	98 (63.6%)
17. Staff in the pharmacy must understand drug laws and regulations, their duty and have adequate continuing training.	100 (65.4%)
18. Pharmacists must wear white coats with a symbol of Pharmacy Council.	113 (73.4%)
19. Other staffs in the pharmacy have to dress properly and different from the pharmacist and not make patients misunderstand as a pharmacist.	127 (81.9 %)
20. The duties and responsibility of pharmacist and other staff are clearly separated.	99 (64.7%)

Quality control standard	
21. The pharmacy must select medication from manufactures or importers or distributors who have GMP (Good Manufacturing Practice).	136 (87.7%)
22. The pharmacy must keep medicine in the appropriate temperature and protect from light.	128 (82.6%)
23. The pharmacy must have an effective system to detect expired and deteriorated drugs in order to not dispense to the patients.	121 (78.1%)
24. The pharmacy must have a system to return or destroy expired drugs in order to not cause environmental problem.	118 (76.6%)
25. There must be a drug quality assessment and drug return system before its expiration date with the concern of efficacy and safety to the patients.	126 (81.8%)
26. There must be real-time procurement and inventory documents in pharmacy.	72 (47.1%)
27. They must select the suitable container with labeling for medication to prevent drug damage.	130 (84.4%)
Pharmacy service standard	
28. The pharmaceutical care in the pharmacy must only be provided by pharmacists.	88 (57.5%)
29. Pharmacist must ask necessary information from patients for supporting the decision to select safety and efficacy of medication or health products that are suitable for patients and rational use.	136 (87.7%)
30. Labels on the prescription or controlled medicine container must show the following information: pharmacy's name, address, phone number, dispensing date, patient's name, medicine name (brand or generic name), strength, amount, indication, instruction, advices, cautions, and pharmacist signature.	54 (35.8%)

31. Pharmacist must be the only one who dispenses prescription or controlled medicines to a patient with advice and information about medicine name, indications, dosage, instructions, side effects, adverse reactions, and cautions.	83 (53.9%)
32. There must be an effective process to prevent repeated drug allergy problems.	96 (62.7%)
33. There must be an appropriate screening and referral process for patients.	103 (66.9%)
34. Extemporaneous preparation must be prepared with the equipment and in the area according to the standard requirement and with the concern of contamination.	53 (34.9%)
35. The pharmacy must have systems to detect ADR, inappropriate drug use behavior, and drug quality problem and reporting system.	82 (53.6%)
36. There must be an appropriate, reliable and updated drug information references in the pharmacy for supporting proper and safe use of drugs including drug information service (DIS)	99 (65.1%)
37. Pharmacist must control educational and advertising media in order to not mislead patients. These medias must be endorsed 'permitted by the pharmacist'.	110 (71.0%)
38. Any patient's health activities in the pharmacy must be permitted by pharmacist and pharmacist must control those activities under laws and regulations.	95 (61.7%)
39. They must not sell tobacco products and alcoholic beverage in pharmacy.	150 (96.8%)

4.3 Readiness of pharmacy to comply with GPP standard

The draft of Ministry of Public Health notification of GPP regulation under the Ministerial Regulation on Application and Issuance of License to Modern Community Pharmacy consists of four main categories; place & equipment, personnel, quality management and pharmaceutical care. There were total thirty nine items; fifteen items for place & equipment, five items for personnel, seven items for quality management and twelve items for pharmaceutical care. Most of pharmacy owners said that they are ready to implement nineteen standards within one year as shown below:

Place and equipment standard (10 items)

- If there is a drug storage area, It must have enough space to properly keep and not place drug directly on the ground.
- The pharmacy must be located in a place where patients can access, and have a household registration to the government.
- The pharmacy must be in the permanent building.
- The pharmacy must be clean, hygienic, tidy and have adequate ventilation. It must have insect prevention and no pet in the pharmacy area.
- There must be adequate lights in the pharmacy in order to read labels and product information clearly.
- There must be separate drug counting trays for penicillin or sulfonamide or NSAID in the pharmacy.
- There must be an automatic sphygmomanometer in the pharmacy
- There must be a weighing machine in the pharmacy.
- There must be an stadiometer in the pharmacy.
- There must be a fire extinguisher in the pharmacy

Personnel standard (1 item)

- Other staffs in the pharmacy have to dress properly and different from the pharmacist and not make patients misunderstand as a pharmacist.

Quality control standard (6 items)

- The pharmacy must select medication from manufactures or importers or distributors who have GMP (Good Manufacturing Practice).
- The pharmacy must keep medicine in the appropriate temperature and protect from light.
- The pharmacy must have an effective system to detect expired and deteriorated drugs in order to not dispense to the patients.
- The pharmacy must have a system to return or destroy expired drugs in order to not cause environmental problem
- There must be a drug quality assessment and drug return system before its expiration date with the concern of efficacy and safety to the patients.
- They must select the suitable container with labeling for medication to prevent drug damage.

Pharmacy service standard (2 items)

- Pharmacist must ask necessary information from patients for supporting the decision to select safety and efficacy of medication or health products that suitable for patients and rational use.
- They must not sell tobacco products and alcoholic beverage in pharmacy.

The result showed that they are ready to comply with ten standards within two years which are three standards in place & equipment, two standards in personnel, five standards in pharmacy service, as below.

Place and equipment standard (3 items)

- There must be a counseling and pharmacy service area, not including the storage area, at least 8 square meters with the shortest side not less than 2 meters.
- The pharmacy must have an appropriate environment to maintain drug quality. The storage area should be ventilated, dry, not more than 30 ◦C and prevented from sunlight.

- There must be a refrigerator with enough space to properly keep the medication separately from other stuff in the pharmacy.

Personnel standard (2 items)

- Staff in the pharmacy must understand drug laws and regulations, their duty and have adequate continuing training.
- Pharmacists must wear white coats with a symbol of Pharmacy Council.

Pharmacy service standard (5 items)

- There must be an effective process to prevent repeated drug allergy problems.
- There must be an appropriate screening and referral process for patients.
- There must be an appropriate, reliable and updated drug information references in the pharmacy for supporting proper and safe use of drugs including drug information service (DIS)
- Pharmacist must control educational and advertising media in order to not mislead patients. These medias must be endorsed permitted by the pharmacist.
- Any patient's health activities in the pharmacy must be permitted by pharmacist and pharmacist must control those activities under laws and regulations.

Pharmacies' owner reported that they are ready to follow nine standards within three years.

Place and equipment standard (2 items)

- There must be an enough counseling area clearly separated from other services area with sign and have enough space for keeping patient medical history.
- Prescription and controlled drugs should be placed by categories with clear labels. These sections must be closed with the informing message when pharmacist was not available.

Personnel standard (2 items)

- Registered pharmacist must have knowledge and competency in providing community pharmacy services in the pharmacy.
- The duties and responsibility of pharmacist and other staff are clearly separated.

Quality control standard (1 items)

- There must be real-time procurement and inventory documents in pharmacy.

Pharmacy service standard (4 items)

- The pharmaceutical care in the pharmacy must only be provided by pharmacists.
- Labels on the prescription or controlled medicine container must show the following information: pharmacy's name, address, phone number, dispensing date, patient's name, medicine name (brand or generic name), strength, amount, indication, instruction, advices, cautions, and pharmacist signature(median=2)
- Pharmacist must be the only one who dispenses prescription or controlled medicines to patient with advice and information about medicine name, indications, dosage, instructions, side effects, adverse reactions, and cautions.
- The pharmacy must have systems to detect ADR, inappropriate drug use behavior, and drug quality problem and reporting system.

Only one standard, extemporaneous preparation must be prepared with the equipment and in the area according to the standard requirement, that pharmacies' owners report that they need three and a half year to follow with.

Table 21 Readiness of pharmacy comply with Good Pharmacy Practice standard

Good Pharmacy Practice Standard	Mean	Median	Mode	Year of readiness
Place and equipment standard				
1. There must be a counseling and pharmacy service area, not including the storage area, at least 8 square meters with the shortest side not less than 2 meters.	1.53	0	0	>1-2
2. If there is a drug storage area, It must have enough space to properly keep and not place drugs directly on the ground.	0.79	0	0	0-1
3. There must be an enough counseling area clearly separated from other services area with sign and have enough space for keeping patient medical history.	2.65	1	0	>2-3
4. The pharmacy must be located in a place where patients can access, and have a household registration to the government.	0.31	0	0	0-1
5. The pharmacy must be in the permanent building.	0.12	0	0	0-1
6. The pharmacy must be clean, hygienic, tidy and have adequate ventilation. It must have insect prevention and no pet in the pharmacy area.	0.51	0	0	0-1

Good Pharmacy Practice Standard	Mean	Median	Mode	Year of readiness
7. The pharmacy must have an appropriate environment to maintain drug quality. The storage area should be ventilated, dry, not more than 30 °C and prevented from sunlight.	1.33	0	0	>1-2
8. There must be adequate lights in the pharmacy in order to read labels and product information clearly.	0.11	0	0	0-1
9. Prescription and controlled drugs should be placed by categories with clear labels. These sections must be closed with the informing message when pharmacist was not available.	2.50	1	0	>2-3
10. There must be a refrigerator with enough space to properly keep the medication separately from other stuff in the pharmacy.	1.46	0	0	>1-2
11. There must be separate drug counting trays for penicillin or sulfonamide or NSAID in the pharmacy.	0.13	0	0	0-1
12. There must be an automatic sphygmomanometer in the pharmacy.	0.59	0	0	0-1
13. There must be a weighing machine in the pharmacy.	0.31	0	0	0-1
14. There must be a stadiometer in the pharmacy.	0.74	0	0	0-1

Good Pharmacy Practice Standard	Mean	Median	Mode	Year of readiness
15. There must be a fire extinguisher in the pharmacy.	0.91	0	0	0-1
Personnel standard				
16. Registered pharmacist must have knowledge and competency in providing community pharmacy services in the pharmacy.	2.32	0	0	>2-3
17. Staff in the pharmacy must understand drug laws and regulations, their duty and have adequate continuing training.	1.690	0	0	>1-2
18. Pharmacists must wear white coats with a symbol of Pharmacy Council.	1.30	0	0	>1-2
19. Other staffs in the pharmacy have to dress properly and different from the pharmacist and not make patients misunderstand as a pharmacist.	0.79	0	0	0-1
20. The duties and responsibility of pharmacist and other staff are clearly separated.	2.05	0	0	>2-3
Quality control standard				
21. The pharmacy must select medication from manufactures or importers or distributors who have GMP (Good Manufacturing Practice).	0.53	0	0	0-1

Good Pharmacy Practice Standard	Mean	Median	Mode	Year of readiness
22. The pharmacy must keep medicine in the appropriate temperature and protect from light.	0.61	0	0	0-1
23. The pharmacy must have an effective system to detect expired and deteriorated drugs in order to not dispense to the patients.	0.73	0	0	0-1
24. The pharmacy must have a system to return or destroy expired drugs in order to not cause environmental problem.	0.87	0	0	0-1
25. There must be a drug quality assessment and drug return system before its expiration date with the concern of efficacy and safety to the patients.	0.74	0	0	0-1
26. There must be real-time procurement and inventory documents in pharmacy.	2.30	1	0	>2-3
27. They must select the suitable container with labeling for medication to prevent drug damage.	0.49	0	0	0-1
Pharmacy service standard				
28. The pharmaceutical care in the pharmacy must only be provided by pharmacists.	2.79	0	0	>2-3

Good Pharmacy Practice Standard	Mean	Median	Mode	Year of readiness
29. Pharmacist must ask necessary information from patients for supporting the decision to select safety and efficacy of medication or health products that are suitable for patients and rational use.	0.41	0	0	0-1
30. Labels on the prescription or controlled medicine container must show the following information: pharmacy's name, address, phone number, dispensing date, patient's name, medicine name (brand or generic name), strength, amount, indication, instruction, advices, cautions, and pharmacist signature.	2.85	2	0	>2-3
31. Pharmacist must be the only one who dispenses prescription or controlled medicines to a patient with advice and information about medicine name, indications, dosage, instructions, side effects, adverse reactions, and cautions.	2.56	0	0	>2-3
32. There must be an effective process to prevent repeated drug allergy problems.	1.40	0	0	>1-2
33. There must be an appropriate screening and referral process for patients.	1.26	0	0	>1-2

Good Pharmacy Practice Standard	Mean	Median	Mode	Year of readiness
34. Extemporaneous preparation must be prepared with the equipment and in the area according to the standard requirement and with the concern of contamination.	3.50	3	0	>3
35. The pharmacy must have systems to detect ADR, inappropriate drug use behavior, and drug quality problem and reporting system.	2.15	0	0	>2-3
36. There must be an appropriate, reliable and updated drug information references in the pharmacy for supporting proper and safe use of drugs including drug information service (DIS)	1.25	0	0	>1-2
37. Pharmacist must control educational and advertising media in order to not mislead patients. These medias must be endorsed 'permitted by the pharmacist'.	1.30	0	0	>1-2
38. Any patient's health activities in the pharmacy must be permitted by pharmacist and pharmacist must control those activities under laws and regulations.	1.98	0	0	>1-2
39. They must not sell tobacco products and alcoholic beverage in pharmacy.	0.07	0	0	0-1

4.4 Cost-benefit analysis of Good Pharmacy Practice regulation

Recently, the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy was approved by the Royal Gazette on 27th December, 2013 to become effective within 180 days, so it began on 26th June,2014. The main context in this regulation was all new pharmacies have to pass the Good Pharmacy Practice (GPP) standard before renewing their pharmacy licenses, whereas older pharmacies would have a time period to improve but must pass GPP standard within eight years. This regulation would affect several stakeholders in the society such as government sector (FDA), pharmacies' owners and the patients. It is, actually, necessary to evaluate the GPP regulation in terms of benefits and costs from societal perspective.

4.4.1 Cost from GPP regulation

4.4.1.1 Cost from the government sector perspective:

Costs from government (FDA) perspective included cost of issuing law and regulation (the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy), cost of GPP training for FDA officer and outsource authorities, cost of GPP information distribution and cost of GPP guideline handbook for FDA officer.

<u>Cost of issuing the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy</u>

This study aimed to evaluate the impact of the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy, thus cost of issuing this major regulation was included. The data from the Annual Financial report of Thai-FDA in 2012 presented that the budget when the government issuing law and regulation was $5,909.04 dollar(193,757.36 baht).[42] Due to this information was more than one year, cost in 2012 needed to be adjusted to the amount in 2014. To standardize the past cost, cost in 2012 was multiplied by the inflation rate.[15] The average inflation rate in Thailand was 4.54% from 1977 until 2014.[41] Therefore, cost of law and regulation in 2014 would be $6,457.76 dollar (211,749.89 baht). The number of law and regulation was one regulation, the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy. Total cost of issuing law

and regulation was calculated by multiplying no. of law and regulation with average cost of issuing the regulation. (Table 22)

Table 22 Cumulative total cost of issuing the Ministerial Regulation on Application and Issuance of License to Modern Pharmacy (US. Dollar)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Average cost of issuing regulation	6,457.76								
- Annual law and regulation cost	6,457.76								6,457.76
- Present value of annual law and regulation cost	6,457.76								6,457.76

Note: Average cost of issuing the regulation was 5,909.04 USD per regulation in 2012. It was converted to 6,457.76 USD in 2014.

Cost of GPP training for FDA officer and outsource authorities

When implementing GPP regulation, the government sector had to train FDA officer representatives from the seventy six provinces of Thailand and also outsourced authorities about the GPP assessment principle. The number of outsourced authorities was calculated from the cumulative number of pharmacies which had potential to comply with GPP each year (from the survey) divided by number of working days in a year and then divided by the number of pharmacy being inspected by an authority person in a working day. There are two hundred and fifty working day in a year and the number of pharmacies inspected in a working day was two pharmacies per day per authority person. These data were used in the base case. The cumulative number of pharmacies which had potential to comply with GPP each year was calculated from the probability of pharmacy's owner who had potential to comply with the GPP regulation each year (from the survey) and the number of type I pharmacies in Thailand. Therefore, there were eighty four authorities (76 FDA officer and 8 outsourced authorities) that would participate in the GPP training for the first year in base case (Table 23). The training cost for the authorities was $30.20 dollar/person/hour (990.31 baht/person/hour) in 2012 and it would be $33.01 dollar/person/hour (1,082.27 baht/person/hour) in 2014.[41, 42] The training period was eight working hours per day. Thai-FDA planned to set up the GPP training course every year for new authorities to refresh their GPP knowledge standard. The FDA expert opinion informed that turnover rate of new authorities was twenty five person per year. Thus, cost of training for FDA officer and outsourced authorities is $22,237.60 dollar (729,170.77 baht) for the first year (Table 23). Three percent discount rate was used for the calculation every year.[15]

The variable that would be varied was the number of pharmacy being inspected by an authority per day. For the best-case scenario (minimum cost and maximum benefit), the number of four pharmacies/authority/day were used in the best case whereas one pharmacy/authority/day was used in the worst-case scenario (maximum cost and minimum benefit). Other variables that would be changed were the number of pharmacies which were able to comply with the GPP each year (from the survey). Probability of pharmacy's owner who have potential to comply with the GPP regulation each year in each scenario were calculated by using the mean of

probability of base-case minus with one standard deviation for the best-case scenario whereas plus with one standard deviation for the worst-case scenario.

Table 23 Cumulative total cost of GPP training for FDA officer and outsource authorities per year (US. Dollar)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Average training Cost (USD/person/hr.)	33.01	33.01	33.01	33.01	33.01	33.01	33.01	33.01	
- No. of training hr. (working hr./day)	8	8	8	8	8	8	8	8	
- No. of FDA (person)	76	76	76	76	76	76	76	76	
- No. of outsource (person)	8	15	24	23	24	25	25	25	
- No. of authorities (FDA + outsource)	84	91	96	99	100	101	101	101	
- Turnover rate of new Authorities (percent)		25%	25%	25%	25%	25%	25%	25%	
- Annual GPP training for authorities cost	22,237.60	6,005.63	6,329.24	6,519.14	6,614.95	6,655.44	6,669.34	6,673.20	67,704.53
- Present value of annual GPP training for authorities cost	22,237.60	6,185.80	6,714.69	7,123.64	7,445.19	7,715.47	7,963.55	8,207.19	73,593.12

Note: Average cost of training was 30.2 USD/person/hr. in 2012. It was converted to 33.01 USD/person/hr. in 2014.
Rx = community pharmacy

Cost of GPP information distribution

FDA bodies planned for the GPP regulation information distribution by sending newsletters to the pharmacies who still not comply with GPP regulation in order to inform them about the GPP regulations and related information. Average cost of the newsletter was 3.05 US dollars per newsletter (100 baht/newsletter).[45] The estimate number of non-GPP pharmacies each year was obtained from the survey. Data was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand. Thus, the number of non-GPP pharmacy would be 8,445 pharmacies in the first year (Table 24). Therefore, total cost of GPP information distribution for pharmacies when the regulation was implemented in the first year was 38,286 US dollars (1,255,400 baht). Thai-FDA has planned to promote the remaining non-GPP pharmacies by sending GPP newsletter to them every year.

Table 24 Cumulative total cost of GPP information distribution (US. Dollar)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- No. of non-GPP Rx each year	8,445	5,065	2,614	1,176	450	143	38	9	
- Average cost of newsletter (USD/newsletter)	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	
- Annual GPP information distribution cost	38,286.06	15,447.62	7,972.31	3,585.77	1,372.51	437.37	116.09	27.06	67,244.80
- Present value of annual GPP information distribution cost	38,286.06	15,911.04	8,457.83	3,918.27	1,544.77	507.04	138.62	33.28	68,796.92

Note: Rx = community pharmacy

Cost of the GPP guideline handbook for the FDA officers

FDA bodies planned to provide 350 GPP handbooks for Thai-FDA officers in seventy six provinces of Thailand. Cost for the handbook was 30.50 US dollars (1,000 baht).[45] The total cost of the GPP handbook for the FDA officers in 76 provinces was 10,673.99 US dollar per year (200,000 baht per year). Thai-FDA has planned to revise the GPP handbook every five year. Therefore, this cost would occurred again in 2018.

Table 25 Cumulative total cost of the GPP guideline handbook for the FDA officer (US. Dollar)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- No. of GPP handbook	350			350					
- Average cost of GPP handbook (USD/handbook)	30.50			30.50					
- Annual GPP handbook for the FDA officer cost	10,673.99			10,673.99					21,347.97
- Present value of annual GPP handbook for the FDA officer cost	10,673.99			12,013.67					22,687.65

4.4.1.2 Cost from pharmacy's owner perspective:

From the drugstore owners' perspective, there were eight costs which occurred after the GPP regulation implementation;1) cost for renovating the place and equipment, 2) cost for adapting stock management, 3) other variable costs after the GPP implementation, 4) GPP guideline handbooks for pharmacies, 5) full time pharmacists' fees, 6) opportunity cost of a drugstore closing when renovating the stores, 7) cost of drugstore close down, and 8) assessment cost for renewing drugstore licenses.

Cost for renovating place and equipment

To abide by the GPP regulation, cost for the equipment and renovation must be occurred which were the cost of preparing an eight square meter area, preparing the counseling area, , cost of preparing a close down section when pharmacist was not available, cost of 12,000 BTU air conditioner [40], thermometers[40], refrigerators[40], drug counting trays [40], automatic sphygmomanometers[40], weighing apparatus[40], altimeters[40], fire extinguishers[40], pharmacists' sign with their picture[40], cost of pharmacists' suits[44], stationary for keeping documents[40]. Due to this information was collected more than one year before the study, it needed to adjust the cost to the amount in 2014. Therefore, the 2012 cost were multiplied by the inflation rate.[41] Approximated total fixed cost for place and equipment was 3,204.65 US dollar per year (105,080.62 baht). The estimate number of pharmacies that has potential to comply with GPP regulation was obtained from the survey (Table 27). Data was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year multiplied by no. of type I pharmacies in Thailand (12,554 pharmacies). As a result, the number of pharmacies who has potential to comply with GPP regulation in the first year was 4,109 pharmacies (0.33 x 12,544 of type I pharmacies). Hence, the remaining pharmacies would pay 13,167,360.53 US dollar (431,757,751.92 baht) for place and equipment in the first year. Three percent discount rate was used for calculation every year.

Table 26 Cost of place and equipment

Equipment	Cost as reported in the study (US. Dollar)	Cost in 2014 (US. Dollar)
- Eight square meter area	-	914.91
- Counseling area	-	1,168.04
- Air conditioning	423.91	505.52
- Closing area for dangerous medication	-	152.49
- Thermometer	3.05	3.64
- Refrigerator	167.73	200.03
- Tray	7.62	9.09
- sphygmomanometer (automatic)	60.99	72.74
- weighing apparatus	18.30	21.82
- stadiometer	9.15	10.91
- fire extinguisher	18.30	21.82
- pharmacist sign with picture	15.25	18.18
- pharmacist uniform	-	14.55
- storage for keeping documents	76.24	90.92

Table 27 Cumulative total cost for renovating place and equipment (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Average cost for renovating place and equipment (USD/year)	3.204.65	3.204.65	3.204.65	3.204.65	3.204.65	3.204.65	3.204.65	3.204.65	
- Annual renovating place and equipment cost	13,167,360.53	10,831,421.63	7,855,093.72	4,609,405.89	2,325,707.27	982,648.03	337,602.68	93,559.01	40,202,798.77
- Present value of annual renovating place and equipment cost	13,167,360.53	11,156,364.28	8,333,468.93	5,036,822.27	2,617,604.03	1,139,158.39	403,115.26	115,065.78	41,968,959.46

Note: Rx = community pharmacy

Cost for adapting stock management

The expert opinion from the pharmacies' owner informed that they used four inventory cabinets, a computer and pharmacies' computer program to manage their stock. Therefore, cost for adapting stock management was including all that addressed using reference price which was 1,585.82 US dollars (51,999 baht). All cost was calculated from 561.15 US dollars (18,400 baht) for four inventory cabinets (140.29 US dollars/cabinet[52]), a 490.97 US dollar (16,099 baht) for computer and 533.70 US dollar (17,500 baht) for pharmacies' computer program.[53] The past cost of computer were multiplied by the 4.5% inflation rate.[15, 41] The pharmacies that would have a potential to comply with GPP regulation each year need to pay for this cost. The number of potential pharmacy that comply with GPP was obtained from the survey (Table 28) and was calculated from the probability of pharmacy that has potential to comply with GPP regulation each year, and the number of all type I pharmacies in Thailand (12,554 pharmacies). As a result, the remaining pharmacies when implementing GPP in the first year were 4,109 pharmacies. Hence, total cost for adapting stock management would be 6,515,850.17 US dollars (213,654,727.11 baht) in the first year of GPP implementation. Three percent discount rate was used for calculation every year.

Table 28 Cumulative total cost for adapting stock management (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Average cost for adapting stock management (USD/year)	51,999.00	51,999.00	51,999.00	51,999.00	51,999.00	51,999.00	51,999.00	51,999.00	
- Annual adapting stock management cost	6,515,850.17	5,359,914.03	3,887,082.28	2,280,958.14	1,150,873.03	486,262.02	167,062.22	46,297.55	19,894,299.43
- Present value of annual adapting stock management cost	6,515,850.17	5,520,711.45	4,123,805.59	2,492,464.54	1,295,317.74	563,710.95	199,481.03	56,940.14	20,768,281.61

Note: Rx = community pharmacy

Other variable costs after the GPP implementation

Pharmacy owners reported that to abide by the GPP regulation, they had to pay for equipment such as UV protective medicine containers, sticker label and electricity 138.76 US dollars per month (4,550 baht per month) in 2010 or 165.48 US dollar per month (5,425.16 baht per month) in 2014.[40] These cost of other variable costs were multiplied by the 4.5% inflation rate[15, 41], as a result it was 65,111.52 baht per year in 2014. The cumulative number of potential pharmacies that can comply with GPP regulation each year had to absorb this cost. The number of potential pharmacy that can comply with GPP regulation each year was obtained from the survey (Table 29). As a result, the number of potential pharmacy in the first year was 4,109 pharmacies. Hence, They would pay 8,158,943.06 USD per year for other variable cost in the first year of GPP implementation. Three percent discount rate was used for calculation every year.

Table 29 Cumulative of total other variable costs after the GPP implementation (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Cumulative no. of Rx that comply with GPP each year (pharmacy)	4,109	7,489	9,940	11,378	12,104	12,411	12,516	12,545	
- Average other variable cost (USD/year)	1,985.71	1,985.71	1,985.71	1,985.71	1,985.71	1,985.71	1,985.71	1,985.71	
- Annual other variable cost	8,158,943.06	14,870,459.16	19,737,741.58	22,593,885.76	24,034,972.85	24,643,854.88	24,853,044.95	24,911,017.29	163,803,919.53
- Present value of annual other variable cost	8,158,943.06	15,316,572.94	20,939,770.04	24,688,949.00	27,051,573.69	28,568,982.06	29,675,835.40	30,637,409.12	185,038,035.31

Note: Rx = community pharmacy

GPP guideline handbooks for pharmacies

Thai Pharmacies Association planned to produce a GPP Guideline Handbook for distributing to pharmacy owners. Average cost of the GPP regulation handbook was 200 baht/handbook.[43] The potential pharmacy that would comply with GPP regulation had to pay for it. The number of potential pharmacy that can comply with GPP regulation each year was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year (Table 30) and number of type I pharmacies in Thailand(12,554 pharmacies). Using the probability, the number of potential pharmacies when implementing GPP in the first year was 4,109 pharmacies. Hence, total potential pharmacies would pay 25,061.44 US. Dollars (821,764.75 baht) for the first year. Three percent discount rate was used for calculation every year.

Table 30 Cumulative total cost of GPP guideline handbooks for pharmacies (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Average cost of GPP handbooks (USD/handbook)	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	
- Annual GPP handbook for pharmacies cost	25,061.44	20,615.45	14,950.60	8,773.08	4,426.52	1,870.27	642.56	178.07	76,518.01
- Present value of annual GPP handbook for pharmacies cost	25,061.44	21,233.91	15,861.10	9,586.59	4,982.09	2,168.16	767.25	219.00	79,879.54

Note: Rx = community pharmacy

Full time pharmacist fee

Pharmacy owners must have a full time pharmacist to provide pharmacy service in their stores during operating hours. In Thailand, even though the Drug Act of B.E. 2510 stated that the person who had a responsibility in order to provide pharmacy service must be the pharmacists, there still were the problems of lacking pharmacists on duty during operating hours [4, 5] and the payment for pharmacists was not full-time salary. After the GPP regulation implementation, the pharmacies had to pay for fulltime pharmacist. The pharmacies' owner reported that they would hired a part time pharmacist to provide pharmacy services in their store instead of hiring the full time pharmacy, the operating time of their store was usually twelve hours per day. On average, they pay for pharmacist one hundred baht per hour. Thus, cost for pharmacist fee was 1,097.90 US dollars per month (36,000 baht/month) (3.05 US. Dollars/hr. x 12 hr. x 30 working days) as shown in table 31. A full time pharmacist fee was approximately 1,097.90 US dollars per month or 13,174.75 US dollars per year (432,000 baht/year).[54, 55] Therefore, the cumulative number of potential pharmacies that can comply with GPP regulation would pay for this cost every year. The number of potential pharmacies that can comply with GPP regulation each year was calculated from probability of a pharmacy who has potential to comply with GPP regulation each year (Table 32) and number of type I pharmacies in Thailand(12,554 pharmacies). Using its probability, the potential pharmacies that implementing GPP in the first year were 4,109 pharmacies. Thus, the total cost for the potential pharmacies that have to hire a full time pharmacist was 54,132,719.36 US dollars (1,775,011,867.78 baht) for the first year. Three percent discount rate was used for calculation every year.

Table 31 Cumulative total cost of full time pharmacist fee (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Cumulative no. of Rx to comply with GPP each year (pharmacy)	4,109	7,489	9,940	11,378	12,104	12,411	12,516	12,545	
- Average cost of pharmacist fee (USD/year)	13,174.75	13,174.75	13,174.75	13,174.75	13,174.75	13,174.75	13,174.75	13,174.75	
- Annual full time pharmacist cost	54,132,719.36	98,662,092.26	130,955,396.81	149,905,259.60	159,466,542.51	163,506,335.44	164,894,263.66	165,278,896.82	1,086,801,506.46
- Present value of annual full time pharmacist cost	54,132,719.36	101,621,955.03	138,930,580.48	163,805,524.61	179,480,998.49	189,548,655.66	196,892,374.21	203,272,195.70	1,227,685,003.54

Note: Rx = community pharmacy

Average cost of pharmacist fee was calculated from operating time of pharmacies (12 hr.), working day of pharmacist (30 days), and pharmacist's fee in community pharmacy (3.05 USD/hr.)

Opportunity cost of pharmacy closing when renovating the stores

Pharmacists which opened before June 27, 2014 would need to close their store for renovating to follow GPP standard for place and equipment. Most of pharmacies' owner reported that they would close their store for five day if they have to renovate their store. Closing store for renovation would lead to a loss of the revenue thus the pharmacies that comply to GPP regulation would absorb this cost. The opportunity cost of closing pharmacies due to the renovations was calculated by number of closing day multiplied by amount of profits per day (data from the survey) which equaled 44.98 US dollars/day (1,475 baht/day). This total cost increase with the number of the potential pharmacy that can comply with GPP regulation each year. The no. of potential pharmacy that can comply with GPP regulation each year was calculated from probability of a pharmacy that has potential to comply with GPP regulation each year (Table 33) and no. of type I pharmacies in Thailand(12,554 pharmacies). As a result, the potential pharmacies when implementing GPP in the first year were 4,109 pharmacies. The total opportunity cost for the potential pharmacy paid when renovate was 924,140.75 US dollars (6,751,815.82 baht) for the first year.

Table 32 Cumulative total cost of opportunity cost of pharmacy closing when renovating the stores (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Average Profit of pharmacy (USD/year)	224.92	224.92	224.92	224.92	224.92	224.92	224.92	224.92	
- Annual opportunity cost of pharmacy closing for renovation	924,140.75	760,194.73	551,303.52	323,507.50	163,227.92	68,966.37	23,694.38	6,566.36	2,821,601.54
- Present value of annual opportunity cost of pharmacy closing for renovation	924,140.75	783,000.58	584,877.91	353,505.38	183,714.46	79,950.93	28,292.32	8,075.80	2,945,558.12

Note: Rx = community pharmacy

Average cost of opportunity was calculated by using 5 days for renovation in a base case and 44.98 USD/day for profit of pharmacy per day.

Cost of pharmacy close down

If the older pharmacies cannot not follow the GPP regulations at the 8th year, they had to stop their business, then the cost of pharmacy close down would occurred. The probability of pharmacies closing down at the 8th year was collected from the survey. The number of non-GPP pharmacies each year was calculated from the probability of potential pharmacy that can comply with GPP regulation (Table 33) and no. of type I pharmacy in Thailand. Cost of pharmacy closing down was also obtained from the survey (Table 33). Thus, the number of non-GPP pharmacy at the 8th year and had to close down their business was 9 pharmacies.

Table 33 Total Cost of pharmacy close down (US. Dollar)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- No. of non-GPP Rx each year (pharmacy)	8,445	5,065	2,614	1,176	450	143	38	9	
- Average cost of pharmacy close down (USD/pharmacy)	40,984.14	40,984.14	40,984.14	40,984.14	40,984.14	40,984.14	40,984.14	40,984.14	
- Annual pharmacy close down cost							363,636.85	363,636.85	
- Present value of annual pharmacy close down cost							447,227.46	447,227.46	

Note: Rx = community pharmacy

Assessment cost for renewing drugstore license

Experts from the Thai-FDA planned that the pharmacies who were assessed by the authorities (FDA officer or outsource authority) had to pay for the assessment cost of renewing their drugstore license 1,500 baht/assessment). Potential pharmacies that can comply with GPP would absorb assessment cost , thus the cumulative number of potential pharmacies that can comply with GPP regulation would pay for this cost every year. The number of potential pharmacies that can comply with GPP regulation each year was calculated from probability of a pharmacy that has potential to comply with GPP regulation each year and no. of type I pharmacies in Thailand. FDA expert opinion reported that one drugstore had to be assessed by the authorities for renewing drugstore license once every year. This cost would be calculated every year with the 3% of discount rate.

Table 34 Cumulative total cost of assessment cost for renewing pharmacy license (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Cumulative no. of Rx to comply with GPP each year (pharmacy)	4,109	7,489	9,940	11,378	12,104	12,411	12,516	12,545	
- Assessment cost for renewing drugstore license	45.75	45.75	45.75	45.75	45.75	45.75	45.75	45.75	
- Annual assessment cost	187,960.83	342,576.71	454,706.24	520,504.37	553,703.27	567,730.33	572,549.53	573,885.06	3,773,616.34
- Present value of annual assessment cost	187,960.83	352,854.01	482,397.85	568,769.18	623,197.91	658,155.05	683,654.08	705,806.24	4,262,795.15

Note: Rx = community pharmacy

4.4.1.3. Cost from the patients' perspective:

The purpose of implementing GPP regulation was to improve the standard of the primary health care system in society through the pharmacies. When community pharmacies close down because of not complying to the regulation, patients have to go to the new community pharmacies which can be a cost in patient's perspective but we assume that there is no change in overall transportation cost. Therefore, our assumption in this model was no cost from the patients' perspective.

4.4.2 Benefit from GPP regulation

4.4.2.1 Benefit from government sector perspective:

The benefit from government sector was cost saving by the reducing of surveillance costs. Currently, the number of type I pharmacies in Thailand has increased dramatically from 4,723 pharmacies in 1996 to 12,123 in 2013.[2] Even though Drug Act B.E.2510 stated that the pharmacies must have a full time pharmacist available during the operating time, absent pharmacists were still a major problem in Thailand. Thai FDA report showed that 33% of pharmacists were on duty during the FDA inspection in 2006. Another study showed that there were 25%, 40%,64% and 76% of pharmacist were on duty during the FDA inspection in Kalasin, Ootaradit, Samutsongkarm and Nakorn Pra Nom province in 2010, respectively.[4] Absence of pharmacists on duty increased the risk of inappropriate dispensing of medication and directly affected the patients' health. The government could control this problem by randomly inspecting the pharmacies. FDA regulators informed that implementation of GPP regulations would save the cost of surveillance. The cost saving from reducing surveillance costs was calculated from the number of cumulative GPP-pharmacy that do not need to be inspected from FDA each year multiplied by surveillance cost. FDA expert opinion informed that there must be 3 FDA officers and one driver for each pharmacy inspection. The surveillance cost per drugstore per day was 35.53 US dollar/drugstore/year (1,165 baht/drugstore/year). The surveillance was computed from the salary of the 3 FDA officers (1,372.37 US dollars/month), salary of a driver (274.47 US dollar/month), 20 working days, fuel costs (30.50 US dollars/day) and expense claim per day for four officials(29.28 US dollar). Each type I drugstore in Thailand was expected to be inspected once a year. In

this model, it was assumed that the surveillance cost would reduce 50% after the GPP regulation implementation as informed by FDA authority was used for a base case (20% for best-case analysis and 0% for worse-case in the sensitivity analysis). Total cost saving by reducing surveillance costs was 72,991.46 US dollars (2,393,390.84 baht) for the first year of implementation. The total cost of savings made by reducing surveillance costs have to be converted in the present year by using the 3% discount rate.

Table 35 Cumulative total benefit of cost saving from reducing surveillance costs per year (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Cumulative no. of pharmacies to comply with GPP each year (pharmacy)	4,109	7,489	9,940	11,378	12,104	12,411	12,516	12,545	
- Average surveillance costs per year (USD/year)	35.53	35.53	35.53	35.53	35.53	35.53	35.53	35.53	
- Annual surveillance costs	72,991.46	133,033.96	176,577.59	202,129.20	215,021.44	220,468.61	222,340.07	222,858.70	1,465,421.01
- Present value of annual surveillance costs	72,991.46	137,024.97	187,331.16	220,872.03	242,008.52	255,583.55	265,485.67	274,088.09	1,655,385.45

Note: Rx = community pharmacy

4.4.2.2 Benefit from pharmacies' owner perspective:

The benefit from drugstore's owner perspective was the cost saving by reducing the waste of expired drugs each year. Total cost saving from reducing waste of expired drugs each year can be calculated from the number of cumulative GPP-pharmacy that would not have expired drugs each year multiplied by average cost of the waste of expired drugs per year (from the survey). Thus, the total cost saving by reducing waste of expired drugs was 2,907,043.57 US dollars (95,321,958.51 baht) for the first year of implementation. The total cost of savings made by reducing the waste of expired drugs have to be converted in the present year by using the 3% discount rate.

Table 36 Cumulative total benefit of Cost saving by reducing the waste of expired drugs per year (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- Prob. of potential Rx that comply with GPP regulation	0.33	0.40	0.48	0.55	0.62	0.68	0.73	0.77	
- No. of potential Rx that comply with GPP (pharmacy)	4,109	3,380	2,451	1,438	726	307	105	29	
- Cumulative no. Of pharmacies to comply with GPP each year (pharmacy)	4,109	7,489	9,940	11,378	12,104	12,411	12,516	12,545	
- Average cost of the waste of expired drugs per year	707.51	707.51	707.51	707.51	707.51	707.51	707.51	707.51	
- Annual cost of the waste of expired drugs	2,907,043.57	5,298,366.75	7,032,586.73	8,050,235.15	8,563,696.63	8,780,642.21	8,855,176.94	8,875,832.57	58,363,580.54
- Present value of annual cost of the waste of expired drugs	2,907,043.57	5,457,317.75	7,460,871.26	8,796,709.31	9,638,516.00	10,179,170.87	10,573,544.36	10,916,154.51	65,929,327.62

Note: Rx = community pharmacy

4.4.2.3 Benefit from patient perspective:

A drugstore is the primary health care service for people because it is inexpensive, convenient and time saving. The survey data on health and welfare found that the number of self-medicating people has increased from 20.9% in 2008 to 30.7% in 2012.[23] Even though the patient gains advantages from pharmaceutical care services, adverse results from drug utilization may occur any time such as drug-related problem. The crucial role of the pharmacist in community pharmacy is medication history taking for reviewing the duplication of medication, drug interaction, and dose adjusting before dispensing patient medication. This activity can help pharmacist to dispense the appropriate medication to patients and can avoid the undesirable result such as dispensing antibiotic medication to a patient who allergic to medication. Cheewarirungrueng and colleague studied drug related problems (DRPs) that occurred due to the incomplete information from the customers about their history before dispensing the medication to patients.[6] Their results showed that 27.59% to 29.3% of patients would exhibit at least one DRP if there was no history taking before dispensing the medication. The DRPs that are most common occurred due to the fact that there was no clear indication regarding drug use. This study stated that directly asking about patient's history would prevent DRPs occurring by between 18.75% to 23.81%. Therefore the benefit of medication history taking from the customer is the important issue to be considered in order to identify and prevent drug related problems in community pharmacies. Moreover, there is a study that showed that the cost involved with drug-related problems (including total cost of drug-related morbidity and mortality) was more than the expenses for primary drug therapy.[56] Drug-related problems are gradually becoming known as a serious issue of concern but most of DRPs are preventable as are as medical problems. Thus, The benefit from the patients' perspective was cost saving from reducing drug-related problems(DRP). In the United State, the estimated annual cost of drug-related morbidity and mortality contributing to by drug-related problem (DRPs) in the ambulatory care in the United States was increased from $76.6 billion in 1995 to $177.4 billion in 2000.[34, 56] A systematic review related to cost of ADR presented that cost per case of ADR induced hospitalization ranged from 180 US dollars to 7,038 US dollars.[46] There was two studies from systematic review conducted in Asia, India. First, Patel and colleague

found that the economic burden of ADR in medical emergency department of a tertiary referral center was 180 US dollar per case in 2013.[47] Second, Pattanaik and colleague evaluated cost of treatment of drug-related events in a tertiary care public hospital and found that total cost was 428 US dollar in 2013 which conducted from the societal perspective. One study in Thailand showed that the average cost of ADE in intensive care unit was set at 53 USD.[48] Due to the lack of cost estimate of DRP in community pharmacy in Thailand, cost estimate of DRP in India was used as proxy in this study. Cost of DRP per case would be converted from 428 US dollar in 2013 to 447.26 US dollars in 2014 by using 4.5% inflation rate for the base case. For worse case, 53 USD in 2009 was used and converted to 82.31 USD in 2014. For best case, cost of DRP from US study, 177.4 billion USD, was used to calculate cost per case. Therefore cost per case was estimated from the cost of DRP from US study (177.4 billion US dollar) divided by US population (317 million people in November,2013[49]) then multiplied by exchange rate (32.5 baht/US dollar[50]). The number of patients who can avoid DRP after the GPP implementation was 1,240,189 cases which was calculated from the proportion of people who went to pharmacies in Thailand (0.307%), the Thai population (64,785,909 people in December,2013[51]), the probability of DRP prevention from GPP regulation (0.21) and the probability of DRP in drugstore (0.29).[6] As a result, the total cost saving from reducing drug-related problems(DRP) was 179,938,963.10 USD per year (5,900,198,599.99 baht per year) for the first year in base case. The total cost saving from reducing drug-related problems(DRP) that occur has to be converted in the present year by using the 3% discount rate.

Actually, there were other benefits of GPP implementation but it was difficult to find empirical data and converting factor for transferring benefit to monetary value. For example, providing pharmaceutical care can improve patient outcome, reduce adverse drug events (ADE), improve appropriate use of medicine, improve intermediate outcome (ie. Blood pressure) and reduce drug costs.[16] There was a positive effect of pharmacist counseling such as improving quality of life in patients with dyspepsia[16, 17], 43% of patients changing their decision of medicine purchasing in non-prescription medicine, 4.2 % of patients were referred to a doctor and 7.3% of patients can be prevented from ADE,[16, 20] 63% of patients reported

that their symptom improved, 85% of patient thought that it was not essential to see the physicians when they had minor health problems.[16, 21, 22]

Table 37 Variable data for converting benefit (cost saving from reducing drug-related problems) into monetary term

Variables	Source of information	Cost as reported in the study (US. Dollar)	Cost in 2014 (US. Dollar)
no. of people access to the pharmacy - prob. people access to the Pharmacy in 2012 - Thai population in December,2013 (people)	 Literature review [23] Literature review		Table 38 0.307 64,785,909
Prob. DRP in pharmacy	Literature review [6]	-	0.293
Prob. reduce DRP due to GPP	Literature review [6]	-	0.2128
Cost of DRP per case (USD/case)	Literature review	428	447.26

Table 38 Cumulative total benefit of Cost saving by reducing drug-related problems(DRP) per year (US. Dollars)

	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)	Year 6 (2019)	Year 7 (2020)	Year 8 (2021)	Total
- No. of people who can avoid DRP due to GPP Regulation (people)	1,240,188	1,240,188	1,240,188	1,240,188	1,240,188	1,240,188	1,240,188	1,240,188	
- Average cost of DRP (USD/year)	447.26	447.26	447.26	447.26	447.26	447.26	447.26	447.26	
- Annual cost of the DRP	179,938,963.1	327,956,082.55	435,300,103.04	498,290,078.45	530,072,101.44	543,500,507.79	548,114,027.43	549,392,560.87	3,612,564,424.67
- Present value of annual cost of DRP	179,938,963.1	337,794,765.03	461,809,879.31	544,495,022.55	596,600,820.11	630,066,048.05	654,476,813.21	675,683,552.47	4,080,865,863.84

Note: Rx = community pharmacy

4.4.3 Net Present Value (NPV)

Net present value can be calculated from net benefit timed with discount factor $1/ (1+r)^t$ to adjust cost and benefit to one time point because the cash flow from different point of time is not equal. Net benefit can be calculated by using the difference between costs and benefits. The equation for net benefit is presented below;

Net benefit = total benefits – total costs

The present value (PV) of future expenses and cost saving were analyzed. The equation for discount factor is $1/ (1+r)^t$. Therefore, we can report the result as Net present value (NPV) instead of net benefit using formula presented below;

$$NPV = \frac{B_0 - C_0}{(1 + r)^0} + \frac{B_1 - C_1}{(1 + r)^1} + \frac{B_2 - C_2}{(1 + r)^2} \quad \ldots\ldots\ldots\ldots + \frac{B_n - C_n}{(1 + r)^n}$$

$$NPV = \sum \frac{B_t - C_t}{(1 + r)^t} = \sum \frac{\text{Net benefit}}{(1 + r)^t}$$

B_t benefits of the project occurs each year

C_t costs of the project occurs each year

$1/ (1+r)^t$ discount factor

r discount rate

t number of years in the future that expense or saving arise year

(when t =0 is meant present year)

If NVP is positive, the benefit from the project is more than cost of the project. It means that the project is cost effective.

The result in table 39 had provided the value of implementing the GPP regulation in terms of cost and benefit from three perspectives. Total costs for the entire eight-years of implementing the GPP regulation was $1,317.90 million dollars (48,639.61 million baht). Cost incurred by the government perspective was $171,535.45 dollars (5.62 million baht) which included cost of issuing law and regulation, cost of GPP training for FDA officers and outsource authorities and cost of GPP information distribution. The cost from pharmacies' owners' perspective accounted for $1,483.19 million dollars (48,633.99 million baht). There was no cost from patient's perspective. Total benefit was equal to $3,672.34 million dollars (136,027.69 million baht). The benefits included in the analysis were cost saving by

reducing of surveillance costs, cost saving by reducing waste of expired drug each year and cost saving from reducing DRP. Cost saving from reducing DRP showed the largest proportion of the benefits which accounted for $4,080.87 million dollars (133,811.59 million baht). The net present value (NPV) from cost-benefit model when implementing GPP regulation was $2,087.79 million dollars (68,458.75 million baht) from societal perspective.

4.4.4 Benefit to cost ratio

The result of cost benefit analysis can be presented as benefit to cost (or cost to benefit) ratio and calculated from the sum of total benefits divided by total costs. The policy maker should select the program that is cost effective, when the result showed benefit-to-cost ratio > 1 or cost-to-benefit ratio < 1

The result showed that benefit-to-cost ratio was 2.79 which was more than one, thus it implied that the GPP regulation would be cost-effectiveness. (Table 39).

Table 39 8-Year return on implementing the Good Pharmacy Practice regulation in community pharmacy (USD)

	Year 1 2014	Year 2 2015	Year 3 2016	Year 4 2017	Year 5 2018	Year 6 2019	Year 7 2020	Year 8 2021
Annual costs	83,189,691.55	130,868,727.23	163,470,576.31	180,252,399.25	187,718,114.82	190,264,760.17	190,855,645.41	191,280,737.26
Present value of annual costs	83,189,691.55	134,794,789.04	173,425,934.40	196,966,663.48	211,278,392.03	220,569,003.71	227,891,621.71	235,251,179.72
Annual benefits	182,918,998.12	333,387,483.26	442,509,267.35	506,542,442.80	538,850,819.51	552,501,618.61	557,191,544.43	558,491,252.14
Present value of annual benefits	182,918,998.12	343,389,107.76	469,458,081.74	553,512,603.89	606,481,344.63	640,500,802.46	665,315,843.24	686,873,795.07
Net benefit	99,729,306.57	202,518,756.03	279,038,691.05	326,290,043.55	351,132,704.69	362,236,858.44	366,335,899.02	367,210,514.87
Present value of net benefit	99,729,306.57	208,594,318.71	296,032,147.33	356,545,940.42	395,202,952.61	419,931,798.75	437,424,221.53	451,622,615.35
NPV	2,087,793,655.55							
Benefit-Cost Ratio	2.78							

4.4.5 Sensitivity Analysis

Sensitivity analysis is the method that is used to explore how much the result of the analysis changes after varying the parameter over a range of values.[15] If there are small changes in the result after varying the parameter, the analysis is insensitive or robust. The result of the study can be ensure. In the other hand, if there are dramatic changes in the result after varying the parameter, the analysis is sensitive and the researcher needs to be aware of the interpretation. Best-case and worse-case analysis were used for performing sensitivity analysis in this study. The result showed that net benefit ranged from -$856.14 million dollars to $20,815.45 million dollars (– 28,072.91 to 682,538.71 million baht). Cost of pharmacy closing down was the least sensitive variable in this model (NPV varied from $2,354-5 million dollars (just over $76 billion dollar)), whereas costs of DRP per case and number of DRPs in community pharmacies was another important factor which might contribute to an impact on net benefit.

Table 40 Variable costs and probabilities of GPP implementation for sensitivity analysis

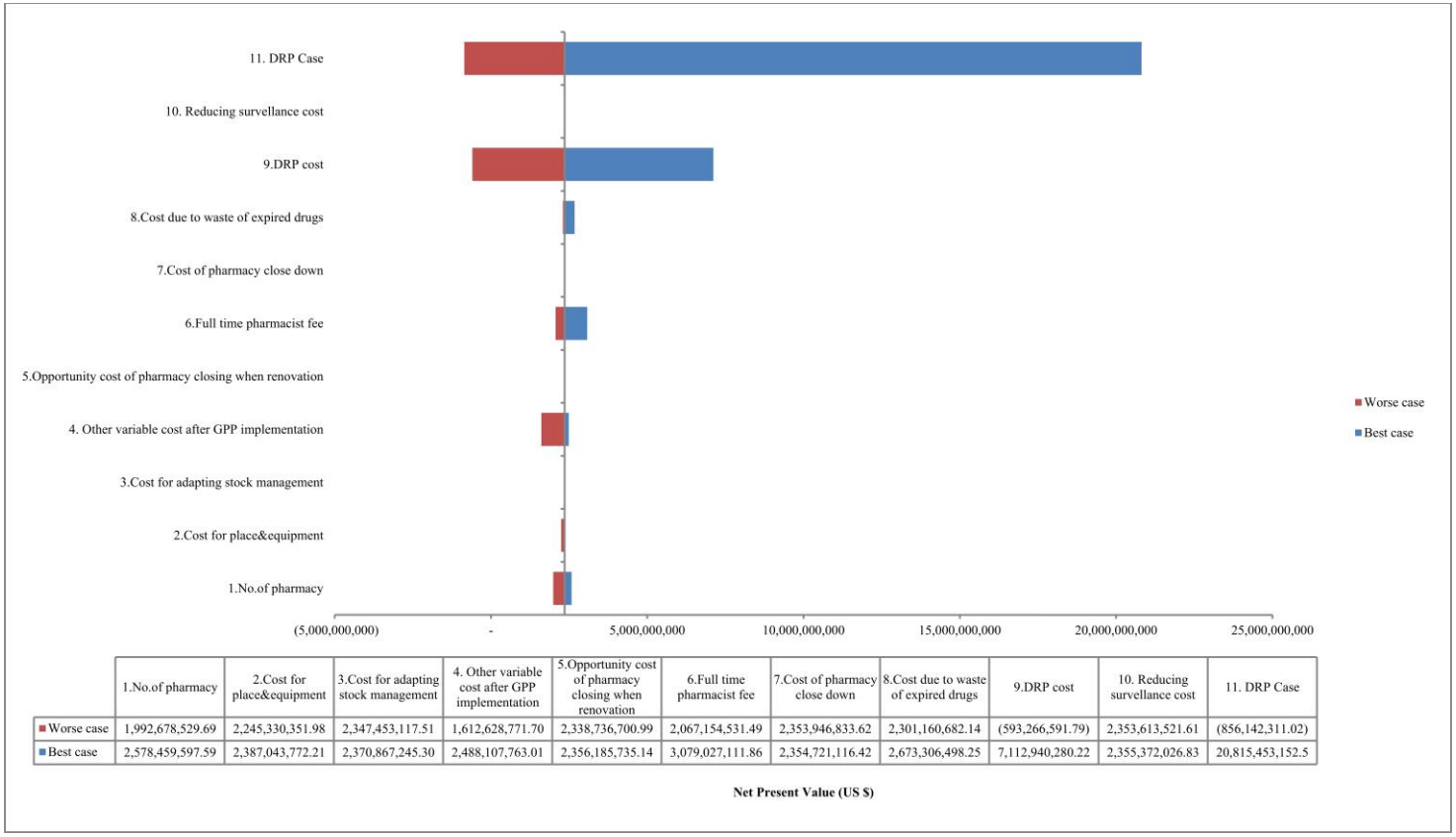
	Base case	Sensitivity Analysis (Range)	Reference
1. prob. of potential Rx to comply with GPP regulation			Survey
- Year 1 (2014)	0.33	0.15 - 0.50	
- Year 2 (2015)	0.40	0.23 - 0.57	
- Year 3 (2016)	0.48	0.33 - 0.64	
- Year 4 (2017)	0.55	0.40 - 0.70	
- Year 5 (2018)	0.62	0.47 - 0.76	
- Year 6 (2019)	0.68	0.54 - 0.83	
- Year 7 (2020)	0.73	0.59- 0.88	
- Year 8 (2021)	0.77	0.62 - 0.91	
2. No. of potential Rx to comply with GPP			Survey
- Year 1 (2014)	4,109	1,904 - 6,313	
- Year 2 (2015)	3,380	2,496 - 3,532	
- Year 3 (2016)	2,451	1,726 - 2,694	
- Year 4 (2017)	1,438	686 - 2,194	
- Year 5 (2018)	726	226 - 1,542	
- Year 6 (2019)	307	58 - 923	
- Year 7 (2020)	105	11 - 473	
- Year 8 (2021)	29	1 - 204	
3. No. of pharmacies that have no potential comply with GPP			Survey
- Year 1 (2014)	8,445	6,241 - 10,650	
- Year 2 (2015)	5,065	2,708 - 8,153	
- Year 3 (2016)	2,614	982 - 5,459	
- Year 4 (2017)	1,176	296 - 3,265	
- Year 5 (2018)	450	70 - 1,723	
- Year 6 (2019)	143	12 - 800	
- Year 7 (2020)	38	1 - 327	
- Year 8 (2021)	9	0 - 123	

	Base case	Sensitivity Analysis (Range)	Reference
Cost			
4. Cost for renovating place and equipment (USD/year)	3,204.65	$609.94 - $11,906.23	Survey
5. Cost for adapting stock management (USD/year)	1,585.82	$280.57 - $2,146.97	Survey, Website[52]
6. Other variable Costs after GPP implementation (USD/year)	165.48	$30.50 - $914.91	Survey
7. Full time pharmacist fee (USD/month)	1,097.90	$365.97 - $1,388.17	Expert opinion, Literature[40]
8. Opportunity cost of pharmacies closing for renovation (USD/year)	224.92	$89.97 - $1,480.87	Survey
9. Cost of pharmacy close down (USD)	40,984.14	$15,248.55 - $102,515.05	Survey

	Base case	Sensitivity Analysis (Range)	Reference
Benefit			
10. Prob. of reducing surveillance Rx	0.5	0 - 0.8	Expert opinion
11. Cost saving by reducing the waste of expired drugs (USD/year)	707.51	$60.99 - $4,574.57	Survey
12. Cost saving from reducing DRP	443.30	$81.58 - $1,027.22	Literature [34, 46, 48, 57]
13. Prob. DRP in community Rx	0.29	0.04 - 0.5	Literature[6, 35], Expert opinion
14. Prob. of DRP prevention due to history taking	0.21	0.19 - 0.76	Literature[6]

Note:
- Number of outsource authorities was varied due to the number of potential Pharmacy to comply with GPP was varied.
- Cost in table 40 was adjusted to cost in 2014
- Rx = community pharmacy

Figure 4 Tornado diagram and sensitivity analysis of variable



	1.No.of pharmacy	2.Cost for place&equipment	3.Cost for adapting stock management	4. Other variable cost after GPP implementation	5.Opportunity cost of pharmacy closing when renovation	6.Full time pharmacist fee	7.Cost of pharmacy close down	8.Cost due to waste of expired drugs	9.DRP cost	10. Reducing survellance cost	11. DRP Case
Worse case	1,992,678,529.69	2,245,330,351.98	2,347,453,117.51	1,612,628,771.70	2,338,736,700.99	2,067,154,531.49	2,353,946,833.62	2,301,160,682.14	(593,266,591.79)	2,353,613,521.61	(856,142,311.02)
Best case	2,578,459,597.59	2,387,043,772.21	2,370,867,245.30	2,488,107,763.01	2,356,185,735.14	3,079,027,111.86	2,354,721,116.42	2,673,306,498.25	7,112,940,280.22	2,355,372,026.83	20,815,453,152.5

CHAPTER V

DISSCUSSION AND CONCLUSION

5.1 Current situation and readiness of pharmacies in Thailand to comply with the GPP regulation

Most of pharmacy owners are able to comply with place and equipment standard which are similar to the previous studies.[12, 31] According to the GPP regulation, It was obligated to close prescription and controlled medicine section when pharmacist was not available in the pharmacy. Only 38.4 percent abided by this regulation. Most of them used the curtain with the print screen massage of "Pharmacist is not available now" to close the shelf of prescription and controlled medicine. However, majority of pharmacy owners did not want to close the section. Since their major products were prescription and controlled medicines, if they closed this section, they would lose their major income. Only 42.2% of them had enough counseling area clearly separated from other services area with sign and have enough space for keeping patient medical history and our readiness data show that they would need to comply with the standard of separated counseling area within three year. The rest of them said that when they had sensitive issues to counsel with their customers, they had just walked away from other customers. The privacy issue might not a big deal in Thai culture, so the standard of having counseling area separately from other services area may be flexible depending on the area of each pharmacy. In addition, data about the readiness showed that over 80% of pharmacies' owners need eight years for achieving to follow this rules.

There are five criteria in personnel standards. Over 80% of pharmacy owners can comply with the criteria of " Other staffs in the pharmacy have to dress properly and different from the pharmacist and not make patients misunderstand as a pharmacist". About 60% to 70% can comply with other four criteria. Whereas, the report from Thai FDA officer study in 2013 showed 86% to 100% of pharmacies complied with these five criteria in personnel standard. Our result showed lower than their result because they collected data from only 50 pharmacies that intend to be

accredited pharmacies. Our data collected from randomly sampling 1,300 type I pharmacies in Thailand with excluding the accredited pharmacies.

Our result showed about the same proportion of pharmacy owner that can comply with the criteria of “the pharmacy must have an effective system to detect expired and deteriorated drugs in order to not dispense to the patients” in the quality control standard with the study of Thai FDA officer (78.1% and 70%, respectively).[14] Most of pharmacy owners (76.6% to 87.7%) can comply with all criteria in quality control and ready to do them within one year. However, only 47.1% of pharmacy owners can complied with the criteria of “there must be real-time procurement and inventory documents in pharmacy” and ready to do it within three year. Some pharmacy owners said that it is difficult to do and it is not necessary to do real-time procurement and inventory documents because they did not have so many stocks in their community pharmacy.

Eighty eight percent of pharmacist in this study asked for essential information of clients before medication dispensing. FDA study in 2013 showed a hundred percent of pharmacist asked for essential information. Data from former study in 2006 showed only 70.3% of pharmacist did these activities.[12] All results implied that pharmacist has more responsibility or do better standard to the patient than before.

There are four criteria in pharmaceutical care standard that seem to be obstacles to comply with. First, only 35.1% of pharmacy dispensed medication with fully detailed labels as said in the draft of GPP regulation. Our finding is similar to the previous study.[12, 14] Thai FDA study reported that pharmacist did not pay attention to put date, drug name, phone number, and pharmacy name on the labels. Second, 57.5% of pharmacies had full-time pharmacist to provide the pharmaceutical care services directly to patients. Our study showed no difference from the study of Pleanbangchang et al. Some pharmacy’s owners reported that almost half of the pharmacies did not have pharmacist covered all the operating period. This problem might occur because of the high salary of pharmacist. Furthermore, most of pharmacies in the urban area were not able to hire a full-time pharmacist because of the travelling cost of pharmacist. This criteria is very important for the patient safety, so some interventions must be urgently implemented. Future research should study the best intervention to conquer this crucial problem. Third, 66.9% of pharmacies

conducted the appropriate screening and referral process for patient. Moreover, the Thai FDA report in 2013 showed that only 43.3% of pharmacies conducted this activity. Both studies showed that continuing of care, which is very important to promote the better health, was not emphasized in Thai health care system. Therefore, the government should set up the screening and referral system between community pharmacies and hospitals. Fourth, 53.6% of pharmacies had ADR/ drug utilization monitoring system and related activities. The education about ADR/ drug utilization monitoring system might be needed for pharmacist who working in the community pharmacy in order that they can do this activity.

5.2 Economic impact assessment of GPP regulation

The result presented that implementing the GPP regulation is cost beneficial which provided 2.78-fold benefits higher than cost and NPV accounted for $ 2,087.79 million dollars (68,458.75 million baht). Even though, the benefits in this model were limited to three cost saving 1) reducing pharmacy surveillance, 2) reducing expired medicine and 3) reducing drug-related problems (DRP), the result of NPV was a very large amount. It did not cover other intangible benefits which are not easily measureable in monetary value. There were other benefits of GPP implementation but it was difficult to find empirical data and converting factor into monetary value. For example, providing pharmaceutical care can improve patient outcome, reduce adverse drug events (ADE), improve appropriate use of medicine, improve intermediate outcome (ie. Blood pressure) and reduce drug costs.[16] There was a positive effect of pharmacist counseling such as improving quality of life in patients with dyspepsia [16, 17], 43% of patients changing their decision of medicine purchasing in non-prescription medicine, 4.2 % of patients were referred to a doctor and 7.3% of patients can be prevented from ADE[16, 20], 63% of patients reported that their symptom improved, 85% of patient thought that it was not essential to see the physicians when they had minor health problems.[16, 21, 22] When comparing to the proportion of all of these benefits, it was found that the benefit from patients' perspective or cost saving from reducing DRPs was the highest proportion. Cost and benefit in this model were based on questionnaire, published literature review and expert opinion. To strengthen the results, best-case and worse-case sensitivity analysis were performed.

The result of implementing the GPP regulation showed cost benefit except when the two variables of DRP cost and number of DRP cases were varied. Varied DRP cost provided NPV ranged from -$593.27 million dollars to $7,112.94 million dollars (-19,453.211 to 233,233.31 million baht), whereas varied DRP cases provided NPV raged from -$856.14 million dollars to $20,815.45 million dollars (-28,073.91 to 682,538.71 million baht). Both of these variables show negative NPV in worse-case scenario. In conclusion, the results indicated that implementing the GPP regulation in community pharmacies in Thailand was cost beneficial and provided positive financial return on investment to the society since the first year. Our recommendation is the lag time for old community pharmacies can be less than eight years and it might be better to implement to all community pharmacy before the integration of AEC in 2015.

5.3 Limitations of the study

1. Sample needed for the first objective, to explore the current situation and readiness regarding the extent to which pharmacy stores in Thailand can comply with the Good Pharmacy Practice issued under the Ministerial Regulation on Application and Issuance of License to Modern Pharmacies, was 390 pharmacies. However, only 155 pharmacies participated in this study. One main reason for the low respond rate might be the out of date of the community pharmacy database from FDA. Another reason might be the pharmacy's owners did not see the benefit from answering the questionnaire. Time limitation of the study made the researcher could not send out more questionnaires.

2. Probability of pharmacy that can comply to the GPP regulation was not calculated from the real situation. Our study had to proxy this data by the intention to comply with the GPP regulation using self-administered questionnaire survey.

3. There was no study about amount and cost of DRP in community pharmacy in Thailand. Thus, our study proxy this data by using the published literature from other countries.[34]

5.4 Recommendation and suggestions for policy maker and further Study

Our study showed benefit over cost since the first year after the implementation of GPP regulation (NPV = 2,087.79 million USD, B/C ratio = 2.78). However, our readiness data showed that readiness of all criteria in the GPP standards were difference. Our study recommended that government should not enforce all GPP standards to all community pharmacies. Government should vary time period for each criteria as the readiness result in this study but should not more than 3.5 years.

This study aimed to evaluate the economic impact of only one option which was Good Pharmacy Practice regulation by using cost-benefit analysis. Full Regulatory impact assessment (RIA) should be performed in the future research to find the best alternative instead of the option of providing eight year for the community pharmacy that opened before June 27, 2014.

This study was not included the other type of pharmacies in Thailand. Thus, the further study should be extended to type II or type III pharmacies in order to issue the Public Health notification for these types of pharmacies.

This study use best-case and worse-case analysis in order to perform a sensitivity analysis. The recommendation for the further study will be used other sensitivity analysis methods to strengthen the result such as Monte Carlo simulations.

REFERENCES

1. World Health Organization. *Joint FIP/WHO Guidelines on good pharmacy practice : standards for quality of pharmacy services*. WHO Technical Report Series 2011; Available from: http://apps.who.int/medicinedocs/documents/s18676en/s18676en.pdf.
2. Bureau of Drug Control. *Statistic of drugstore license in Thailand from 1996 - 2013*. Available from: http://drug.fda.moph.go.th/zone_search/sea001.asp.
3. Plianbangchang, P., S. Junpratat, and T. Thongphoem, *Steroid Tablet Inappropriate Selling Behavior among Drug Stores in Muang District, Phitsanulok.* Journal of Health Science, 2001. **10**(4).
4. Kaewon, P., S. Lerkiatbundit, and W. Saengcharoen, *Is There any Difference in the Quality between the Pharmacies Accredited by the Pharmacy Council and Non-accredited Pharmacies?* Thai Journal of Pharmacy Practice, 2012. **4**(2): p. 39-64.
5. Niyomdacha, S. and S. Lerkiatbundit, *Barriers in Law Enforcement for Pharmaciests' License Hanging: Case Study of the Provincial Public Health Offices in the South.* Thai Journal of Pharmacy Practice, 2013. **5**: p. 131-149.
6. Cheewasrirungrueng, N., S. Lerkiatbundit, and S. Soorapan, *Drug Related Problems due to Incomplete History Taking in Community Pharmacies: Cases of Purchasing Drugs for Others and Demanding for Specific Drugs.* Thai Journal of Pharmacy Practice, 2010. **2**(1): p. 60-75.
7. The Office of Pharmacy Advancement Project. *Background of Community Pharmacy Accreditation*. Available from: http://newsser.fda.moph.go.th/advancepharmacy/2009/index.php.
8. Puntaluck, P., *Understanding Decision of Pharmacy-Owning Pharmacists to Enroll in the Community Pharmacy Accreditation Program in Nakhornatchasima Province,* in *Faculty of Pharmaceutical Science*. 2008, Chulalongkorn University.
9. Setsuntree, P., *Factor affecting the drugstores' tendency to join the pharmacy advancement project for quality drugstore.* Health Service Support Journal, 2012. **32**: p. 44-56.
10. Bureau of Drug Control. *Good Pharmacy Practice for FDA officer*. Available from: http://drug.fda.moph.go.th/zone_service/ser061.asp.
11. Organization for Economic Co-operation and Development. *Introductory Handbook for Undertaking Regulatory Impact Analysis (RIA)*. 2008.
12. Plianbangchang, P. and D. Hongsamut, *Drugstore Owners' Opinions on Drugstore Standards of the Pharmacy Council : A Nation-wide Survey.* Journal of Health Science, 2006. **15**(1): p. 111-122.
13. Nonglek, B., et al., *Compliance with the Community Pharmacy Project after Accreditation by the Pharmacy Council.* KKU Res J, 2007. **12**(1): p. 53-65.
14. Vimolkittipong, S., *Possibility of drugstore to comply with the Ministry of Public Health notification on Good Pharmacy Practice regulation*. 2012, Thai Food and Drug Administration: Bureau of Drug Control.
15. Karen, L.R., *Essentials of Pharmacoeconomics*. 2009, The United States of America. 250.

16. Libby, R., S. Susan, and V. Agnes, *The value of Pharmacist Professional Services in the Community Setting : A systematic review of the literature 1990-2002*, in *Quality Use of Medicines and Pharmacy Research Centre*. University of South Australia: Australia. p. 202.
17. Krishnan HS, S.M., *Evaluation of the impact of pharmacists' advice giving on the outcomes of self-medication in patients suffering from dyspepsia.* Pharmacy World and Science, 2000. **22**: p. 102-103.
18. Bynum A, H.D., Thomas A, Copeland N, Irwin C, *The effect of telepharmacy counseling on metered-dose inhaler technique among adolescents with asthma in rural Arkansas.* Telemedicine Journal and e-Health, 2001. **7**: p. 207-217.
19. Williford, S. and D. Johnson, *Impact of pharmacist counselling on medication knowledge and compliance.* Military Medicine, 1995. **160**: p. 561-564.
20. Sclar DA, R.L., Skaer TL, *Pharmacy consultation and over-the-counter medication purchasing outcomes.* Journal of Clinical Pharmacy and Therapeutics, 1996. **21**: p. 177-184.
21. AC., D., *Research into aspects of pharmacists service.* South African Pharmaceutical Journal, 1995. **62**: p. 196.
22. Dreyer AC, S.J., van der Meer HL, Wagner S., *Cost savings effected by community pharmacists' interventions in the supply of medicines in the Republic of South Africa.* Journal of Research in Pharmaceutical Economics, 1999. **9**(4): p. 1-20.
23. Technology, M.o.I.a.C. *The 2012 Household Socio-Economic Survey*. 2012; Available from: http://service.nso.go.th/nso/nsopublish/themes/files/SociosumRep55.pdf.
24. Thamlikitkul, V., *Antibiotic dispensing by drug store personnel in Bangkok, Thailand.* Journal of Antimicrobial Chemotherapy, 1988. **21**: p. 125-131.
25. Sumpradit, N., et al., *Antibiotics Smart Use: a workable model for promoting the raional use of medicines in Thailand.* Bull World Health Organ, 2012. **90**: p. 905-913.
26. เยาวเรศ ทับพันธุ์, การประเมินโครงการตามแนวทางเศรษฐศาสตร์. 2541: สำนักพิมพ์มหาวิทยาลัยธรรมศาสตร์. 180.
27. Rajasekaran, V. and R. Lalitha, *Cost Accounting*. 2010, Pearson Education India. p. 848.
28. New Zealand Treasury, *Cost Benefit Analysis Primer*. 2005, DEPARTMENTAL CFISNET RELEASE.
29. Garrison, Noreen, and Brewer, *Managerial Accounting*. 2006, The McGraw-Hill.
30. Renee, J.A., *Pharmacoeconomics : From Theory to practice*. Drug discovery series ;13. 2010, The United States of America: Taylor and Francis Group. 243.
31. Boonchoong, N., et al., *Compliance with the Community Pharmacy Project after Accreditation by the Pharmacy Council.* KKU Res J, 2007. **12**(1): p. 53-65.
32. S, V., *The Possibility of Drugstore comply to GPP regulation under the Public Health Notification* 2011, Ministry of Public Health: Thailand's Food and Drug Administration (FDA).

33. Hammerlein, A., N. Griese, and M. Schulz, *Survey of Drug-Related Problems Identified by Community Pharmacies.* The Annuals of Pharmacotherapy, 2007. **41**: p. 1825-1831.
34. Ernst, F.R. and A.J. Grizzle, *Drug-Related Morbidity and Mortality: Updating the Cost-of-illness Model.* Journal of the American Pharmacists Association, 2001. **41**(2): p. 192-199.
35. Uaviseswong, T., U. Chaikledkaew, and P. Tragulpiankit, *Systematic Review of Economic Evaluation of Pharmacist Intervention Related to Adverse Drug Event Prevention among Patients with Hospitalization.* Mahidol University Journal of Pharmaceutical Science, 2012: p. 38-43.
36. Mitchell, S.B., et al., *Impact of a Clinical Pharmacy Admission Medication Reconciliation Program on Medication Errors in "High-Risk" Patients.* Annals of Pharmacotherapy, 2013.
37. Côté, I., et al., *A pharmacy-based health promotion programme in hypertension: cost-benefit analysis.* Pharmacoeconomic, 2003. **21**: p. 415-28.
38. Shalom, I.B., et al., *Economic Impact of Increased Clinical Intervention Rates in Community Pharmacy : A Randomised Trial of the Effect of Education and a Professional Allowance.* Pharmacoeconomic, 2000. **18**(5): p. 459-468.
39. Munro, P.W., et al., *Economic Evaluation of Pharmacist Involvement in Disease Management in a Community Pharmacy Setting.* Clinical Therapeutics, 1997. **19**(113-123).
40. Chompoo, T., *Economic evaluation to participate in an accredited pharmacy in Chiengmai*, in *Economic*. 2010, Chiengmai University.
41. Trading Economics. *Thailand Inflation Rate 1977-2014.* [cited 2014 26 December 2014]; Available from: http://www.tradingeconomics.com/thailand/inflation-cpi.
42. Thai Food and Drug Administration, *Annual Financial Report for Subdivision Activities 2012*. 2012: Thai Food and Drug Administration.
43. Company, K. *Kanpim.com.* [cited 2014 5 December]; Available from: http://www.kanpim.com/?P=101.
44. *The Pharmacy Council of Thailand*. [cited 2014 5 December]; Available from: http://www.pharmacycouncil.org/index.php?option=content_detail&menuid=0&itemid=445.
45. Tonchabub Company. *All kinds of Printing services, Offset Printing*. [cited 2014 8 December]; Available from: http://www.tonchabub.co.th/en.
46. Siltharm, C. and M. Thavorncharoensap, *Cost of Adverse Drug Reactions (ADRs) Induced Hospitalization: A Systematic Review.* Journal of Pharmaceutical Science, 2013. **40**(4): p. 40-49.
47. Patel, K., et al., *Evaluation of the prevalence and eco-nomic burden of adverse drug reactions presenting to the medical emergency department of a tertiary referral centre: a prospective study.* BMC Clinical Pharmacology, 2007. **7**(8): p. 1-5.
48. Saokaew, S., S. Maphanta, and P. Thangsomboon, *Impact of pharmacist's interventions on cost of drug therapy in intensive care unit.* Pharmacy Practice, 2009. **7**(2): p. 81-87.

49. Bureau, U.C. *US Populatio by year*. 2013 [cited 2014 5 December]; Available from: http://www.multpl.com/united-states-population/table.
50. Bank of Thailand. *Foreign Exchange Rate as of 4 December 2014*. [cited 2014 6 December]; Available from: http://www.bot.or.th/english/statistics/financialmarkets/exchangerate/_layouts/Application/ExchangeRate/ExchangeRate.aspx.
51. Department of Provincial Administration. *Thai Population as of 31 December 2013*. 2013 [cited 2014 6 December]; Available from: http://stat.bora.dopa.go.th/stat/y_stat56.html.
52. OfficeMate. [cited 2014 5 December]; Available from: http://www.officemate.co.th/.
53. *SmartDrugstore : Drugstore Management System*. [cited 2014; Available from: http://www.software.worldmedic.com/dms/main/index.php.
54. Kelly Services. *Kelly Services Thailand : 2013/14 Salary Guide*. 2013 [cited 2014 9 December]; Available from: http://www.kellyservices.co.th/uploadedFiles/Thailand_-_Kelly_Services/4-Resource_Center/White_Papers_and_Reports/Thailand%20Salary%20ebook%202013-14.pdf.
55. Ngosurachet, S., et al., *2012 Pharmacist Compensation Survey in Thailand.* Thai Journal of Pharmacy Practice, 2013. **5**(2): p. 121-130.
56. Johnson, J.A. and J.L. Bootman, *Drug-Related Morbidity and Mortality: A Cost-of-Illness Model.* Arch Intern Med, 1995. **155**: p. 1949-1956.
57. Pattanaik, S., et al., *Evaluation of cost of treatment of drug- related events in a tertiary care public sector hospital in Northern India: A prospective study.* British Journal of Clinical Pharmacology, 2008. **67**(3): p. 363-369.

APPENDIX

Part 1 Practical standard for Good Pharmacy Practice "(regulation of standard or pharmacy's service in pharmacy's store for all drugs selling regarding safety to of drug's administration)

Please check ✓ into ☐ if you can do it immediately, if not please complete the number into ….. per your expected timeline to complete.

Good Pharmacy Practice Standard	Can you perform it immediately?	
	Yes	NO (which year you expected to do?)
1. The pharmacy must be located in a place where people can access, and have a household registration to the government.	❒	..... Year
2. The pharmacy must be in the permanent building.	❒	..... Year
3. The pharmacy must be clean, hygienic, tidy and had adequate ventilation. It must have insect prevention and no pet in the pharmacy area.	❒	..... Year
4. There must be adequate lights in the pharmacy in order to read labels and product information clearly.	❒	..... Year
5. Prescription and controlled drugs should be placed by categories with clear labels. These sections must be closed with the informing message when pharmacist was not available.	❒	..... Year
6. There must be a refrigerator with enough space to properly keep the medication separately from other stuff in the pharmacy.	❒	..... Year
7. There must be separate drug counting trays for penicillin or sulfonamide or NSAID in the pharmacy.	❒	..... Year
8. Registered pharmacist must have knowledge and competency in providing community pharmacy services in the pharmacy.	❒	..... Year
9. Staff in the pharmacy must understand drug laws and regulations, their duty and have adequate continuing training.	❒	..... Year
10. Pharmacists must wear white coats with a symbol of Pharmacy Council.	❒	..... Year
11. Other staffs in the pharmacy have to dress properly and different from the pharmacist and not make people misunderstand as a pharmacist.	❒	..... Year
12. The duties and responsibility of pharmacist and other staff are clearly separated.	❒	..... Year
13. The pharmacy must select medication from manufactures or importers or distributors who have GMP (Good Manufacturing Practice).	❒	..... Year
14. The pharmacy must keep medicine in the appropriate temperature and protect from light.	❒	..... Year
15. The pharmacy must have an effective system to detect expired and deteriorated drugs in order to not dispense to the patients.	❒	..... Year
16. The pharmacy must have a system to return or destroy expired drugs in order to not cause environmental problem	❒	..... Year
17. There must be a drug quality assessment and drug return system	❒	.....

Good Pharmacy Practice Standard	Can you perform it immediately?	
	Yes	NO (which year you expected to do?)
before its expiration date with the concern of efficacy and safety to the customers		Year
18. They must select the suitable container with labeling for medication to prevent drug damages	❒	..... Year
19. There must be an effective process to prevent repeated drug allergy problems..	❒	..... Year
20. There must be an appropriate screening and referral process for patients.	❒	..... Year
21. There must be an appropriate, reliable and updated drug information references in the pharmacy for supporting proper and safe use of drugs including drug information service (DIS)	❒	..... Year
22. They must not sell tobacco products and alcoholic beverage in pharmacy.	❒	..... Year
23. If there is a drug storage area, It must have enough space to properly keep and not place drug directly on the ground.	❒	..... Year
24. There must be an enough counseling area clearly separated from other services area with sign and have enough space for keeping patient medical history.	❒	..... Year
25. There must be an automatic sphygmomanometer in the pharmacy.	❒	..... Year
26. There must be a weighing machine in the pharmacy.	❒	..... Year
27. There must be a stadiometer in the pharmacy.	❒	..... Year
28. There must be a fire extinguisher in the pharmacy.	❒	..... Year
29. There must be real-time procurement and inventory documents in pharmacy.	❒	..... Year
30. There must be a counseling and pharmacy service area, not including the storage area, at least 8 square meters with the shortest side not less than 2 meters.	❒	..... Year
31. The pharmacy must have an appropriate environment to maintain drug quality. The storage area should be ventilated, dry, not more than 30 ◦C and prevented from sunlight.	❒	..... Year
32. The pharmaceutical care in the pharmacy must only be provided by pharmacists.	❒	..... Year
33. Pharmacist must ask necessary information from customers for supporting the decision to select safety and efficacy of medication or health products that are suitable for patients and rational use.	❒	..... Year
34. Labels on the prescription or controlled medicine container must show the following information: pharmacy's name, address, phone number, dispensing date, customer's name, medicine name (brand or generic name), strength, amount, indication, instruction, advices,	❒	..... Year

Good Pharmacy Practice Standard	Can you perform it immediately?	
	Yes	NO (which year you expected to do?)
cautions, and pharmacist signature.		
35. Pharmacist must be the only one who dispenses prescription or controlled medicines to the customer with advice and information about medicine name, indications, dosage, instructions, side effects, adverse reactions, and cautions	❒	..... Year
36. Extemporaneous preparation must be prepared with the equipment and in the area according to the standard requirement and with the concern of contamination	❒	..... Year
37. The pharmacy must have systems to detect ADR, inappropriate drug use behavior, and drug quality problem and reporting system.	❒	..... Year
38. Pharmacist must control educational and advertising media in order to not mislead customers. These medias must be endorsed permitted by the pharmacist	❒	..... Year
39. Any customer's health activities in the pharmacy must be permitted by pharmacist and pharmacist must control those activities under laws and regulations.	❒	..... Year

Part 3 information to calculate cost & benefit of alternative

1. If you follow "Good Pharmacy Practice" standard (part 1) how do you think about the chance of complaint from patient will be
   ☐ Increase……. % ☐ No change ☐ Decrease ……%
2. If you follow "Good Pharmacy Practice" standard (part 1) how the income of your pharmacy will be /per month
   ☐ Increase……. % ☐ No change ☐ Decrease ……%
3. If you cannot follow "Good Pharmacy Practice" standard (part 1) and you decide to stop the pharmacy store, you will lose the budget about …….. THB lose net income after minus expense about…… THB/year and other (please indicate)……THB/year
4. If you cannot follow "Good Pharmacy Practice" standard and you decide to sell the pharmacy store, you will
   ☐ Lose money…… THB
   ☐ At cost
   ☐ Got income …… THB
5. Currently, how many expired/exchanged medicines with the company around ……THB/year
   And wasted medicines that cannot be returned or exchanged with the company around ……..……. THB/year

Part 5 General information for pharmacy's store

1. Your pharmacy was located in
   ☐ department's store ☐ community pharmacy
2. Type of pharmacy ☐ single store ☐ franchise
3. Year of opening ……. Years
4. Location of your pharmacy
   District……..Province……
5. Opening time from ……..to……..Days/week
6. Proportion of income for medicines per other products = …… : …..…
7. Your role in pharmacy store (can be answered more than 1)
   ☐ Owner ☐ Registered pharmacist
   ☐ Other (please indicate)……..
8. Working hour for registered pharmacist…..……. Hour/week
9. Salary for registered pharmacist……. THB/Month/1 person
10. Type of Tax
    ☐ VAT
    ☐ Commuted Tax
    ☐ Other (please indicate)……

VITA

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