IMPACT OF REVERSE LOGISTICS ON MEDICINES TO INPATIENT SYSTEM AT SOMDECH PHRA DEBARATANA MEDICAL CENTER, RAMATHIBODI HOSPITAL

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IMPACT OF REVERSE LOGISTICS ON MEDICINES TO INPATIENT SYSTEM AT SOMDECH PHRA DEBARATANA MEDICAL CENTER, RAMATHIBODI HOSPITAL

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ABSTRACT

Nowadays, unused medicines returning from wards cause problems to hospitals, such as: high volume and price of returned unused medicines, a lot of unused medicines are rejected by inpatient pharmacy unit, inpatient pharmacy unit spend more time and labor to manage unused medicines, or wrong restoration of unused medicines caused medication errors. Somdech Phra Debaratana Medical Center, Ramathibodi hospital is experiencing this same problem. The purpose of this cross-sectional descriptive research was to analyse the impacts of reverse logistics on costs and manpower occurred at the in-patient wards, Somdech Phra Debaratana Medical Center, Ramathibodi hospital. The research began with a review of the existing reverse logistics system and problems at Somdech Phra Debaratana Medical Center, Ramathibodi hospital by a healthcare professional survey and quantitative data. The quantitative data collection on the amounts and value of medication dispensed and returned was conducted using the hospital database during 1st October, 2014 until 30th September, 2015. The proportion of value of the total medication returned and a total of medication dispensed was calculated.

This research found that the proportion of the value of the medication returned accounted for 22.09% (19,291,770.35 Baht) per one year. From all of the value of medication returned, the pharmacy department could not receive 931,409.75 BHT. The existing problems are lots of returned medicines and high volume of un-received returned medicines. Three main factors that impact the problems are the inappropriate drug distribution system, time consuming of reverse processes and the knowledge of healthcare professionals drug storage. If the hospital can fix the root cause of this problem, it can reduce the cost of patients and the burden of healthcare professionals.

KEY WORDS: MEDICINES LOGISTIC SYSTEM/ REVERSE LOGISTICS

90 pages

ผลกระทบจากโลจิสติกส์ย้อนกลับของยา ในระบบผู้ป่วยใน ณ ศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี

IMPACT OF REVERSE LOGISTICS ON MEDICINES TO INPATIENT SYSTEM AT SOMDECH PHRA DEBARATANA MEDICAL CENTER, RAMATHIBODI HOSPITAL

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บทคัดย่อ

การวิจัยนี้เป็นการวิจัยเชิงพรรณนา ณ จุดเวลาใดเวลาหนึ่งแบบตัดขวาง มีวัตถุประสงค์เพื่อวิเคราะห์ระบบการคืนยาระหว่างหอผู้ป่วยกับหน่วยเภสัชกรรมผู้ป่วยใน ณ ศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี โดยเริ่ม การศึกษาระบบการคืนยาและปัญหาที่เกิดขึ้นในปัจจุบัน จากการตอบแบบสอบถามของบุคลากรทางการแพทย์ที่มีประสบการณ์การทำงานเกี่ยวข้องกับระบบดังกล่าวมาเป็นเวลาอย่างน้อยสองปี ร่วมกับดำเนินการรวบรวมข้อมูลเชิงปริมาณของยาที่มีการเบิกและคืนยาจากหอผู้ป่วยสู่หน่วยเภสัชกรรมผู้ป่วยใน โดยใช้ฐานข้อมูลสารสนเทศของศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี ตั้งแต่วันที่ 1 ตุลาคม 2557 - 30 กันยายน 2558 คำนวณหาสัดส่วนร้อยละของมูลค่าการคืนยาเทียบกับการเบิกใช้ยา พร้อมทั้งวิเคราะห์หาปัญหาที่เกิดขึ้นเพื่อทบทวนและหาแนวทางแก้ไขให้แก่ผู้ปฏิบัติงาน

ผลการศึกษาวิจัยพบว่า สัดส่วนของมูลค่าของยาที่คืนเมื่อเทียบกับการเบิกใช้คิดเป็นร้อยละ 22.09 (19,291,770.35 บาท) ต่อปี ปัญหาของระบบคืนยา ณ ศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี ณ ปัจจุบันคือ ยาที่นำมาคืนในแต่ละครั้งมีปริมาณสูง และ ปริมาณยาที่ไม่สามารถรับคืนได้มีปริมาณที่สูงด้วยเช่นกัน จากการวิเคราะห์ปัญหา พบว่าสาเหตุหลักของปัญหา คือ การจัดการระบบกระจายยาที่ไม่เหมาะสม ระยะเวลาที่ใช้ในการคืนยา และ คุณภาพของยาที่นำมาคืนนั้นไม่สมบูรณ์ หากสามารถแก้ไขสาเหตุหลักของปัญหานั้นได้ก็จะสามารถลดมูลค่าของรายการยาที่สูญเสีย และลดภาระหน้าที่ของบุคลากรลงได้

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CHAPTER I
INTRODUCTION

Background and Rationale

In-patient medicines management system consists of forward and backward distribution. The drug distribution system will be different depending on the policy of the hospital. The policy will have effect on distribution pattern of the drugs in both positive and negative ways. A good in-patient medicines distribution should result in no or less unused medicines returning to pharmacy department.

Nowadays, unused medicines create problems to hospital pharmacy, such as:

1. delayed delivery of return (unused medicines) after patient discharge
2. unused medicines from many patients return to pharmacy at one time
3. uncertain quality of returned drugs to pharmacy
4. time consuming process to manage unused medicines at the inpatient pharmacy unit
5. wrong re-storage of unused medicines caused medication errors

All problems that mentioned above can be solved by the efficient reverse logistic. The reverse logistic is well known in supply chain management. Many industries including pharmaceutical industry use reverse logistics for goods returning.

The reverse logistics is the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal. Remanufacturing and refurbishing activities also may be included in the definition of reverse logistics. Reverse logistics is more than reusing containers and recycling packaging materials. Redesigning packaging to use less material, or reducing the energy and pollution from

transportation are important activities, but they might be secondary to the real importance of overall reverse logistics.

The waste from unused medicines create a burden in many countries such as England, United States, India, and also Thailand. The unused prescription medicines cost the National Health Service (NHS) in the UK an estimated £300million (15,728.63 million THB) every year (1). The consumers in United States wasted more than $ 418 billion in 2012 (2). According to the Central Pollution Control Board (CPCB) of India, the registered healthcare facilities generate pharmaceutical wasted 4,057 tons of waste per day (3). Although Thailand has no official report for pharmaceutical wasted but this situation create problems in many hospitals.

In Thailand, many hospitals concern about unused medicines from the outpatient but there is limited information about reverse logistics management on medicines in inpatient system. There are many studies that studied on unused medicines of outpatient system since 1998 (4).

There are different operating procedures among hospitals for the reverse logistics process. The three main factors have influence over the reverse logistics process. First is the money, second is time and the last thing is labor or human resource. Industries that have the efficient reverse logistics system will be made profit, in contrast inefficient logistics system will be loss.

Reverse logistics at hospitals mean the returning of unused medicines (include expired medicines, unwanted medicines (e.g., patient/resident discontinuous use) and waste medicines (e.g., patient/resident refuses to take or spits out) between wards and pharmacy unit. Nowadays the reverse logistics at hospitals in Thailand face same problems like the reverse logistics of industries that mentioned above. Some of the problems caused the disruption of hospitals while some problems have negative impact on the patient (5).

Somdech Phra Debaratana Medical Center in Ramathibodi hospital has been experiencing many problems arisen from reverse logistics of medicines. There are 18 wards, 16 operating rooms and 14 Intensive Care Units, and also comprehensive service centers such as Stem Cell Transplantation, Minimal Invasive Endoscopic Surgery Center, Elderly Care Unit, Child Development Center and Complicated Diseases Service by specialized doctors (6). Major problems faced by healthcare professionals

are related to reverse logistics. So this research will focus on impact of the reverse logistics of medicines at Somdech Phra Debaratana Medical Center in Ramathibodi hospital.

Research Questions

1. What is the process of reverse logistics of medicines in inpatient system at the hospital?
2. What are the extent of reverse logistics problems?
3. What are the root causes and factors of reverse logistics from wards into inpatient pharmacy?
4. What is the recommended system model at hospital to reduce the magnitude of reverse logistics?

Objectives of the study

General objective:

To study the reverse logistics on medicines at Somdech Phra Debaratana Medical Center, Ramathibodi hospital during 1st October, 2014 – 30th September, 2015.

Specific objectives:

1. to review the existing medicines logistic system of inpatient pharmacy
2. to describe the extent of the reverse logistic problem
3. to find out the root causes and factors of reverse logistics from wards into inpatient pharmacy
4. to suggest a model to reduce the magnitude of reverse logistics

Scope of the study

This study focused on the information of returned medicines from inpatients wards during 1st October 2014 until 30th September 2015 at Somdech Phra Debaratana Medical Center, Ramathibodi hospital. Both descriptive and quantitative approaches were used to collect the data. Admission number, drug name, amount of drugs and price of drug were collected from the hospital database to determine the outcome of reverse logistics.

Definition of terms

Logistics/ Forward flow

The logistics or Forward flow is the management of the flow of things between the point of origin and the point of consumption in order to meet requirements of customers or corporations. The resources managed in logistics can include physical items, such as food, materials, animals, equipment and liquids, as well as abstract items, such as time, information, particles, and energy. The logistics of physical items usually involves the integration of information flow, which is material handling, production, packaging, inventory, transportation, warehousing, and often security. The complexity of logistics can be modeled, analyzed, visualized, and optimized by dedicated simulation software. The minimization of the use of resources is a common motivation in logistics for import and export (7).

Reverse logistics/ Backward flow

The Reverse logistics/ Backward flow is the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal. More precisely, reverse logistics is the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal.

Remanufacturing and refurbishing activities also may be included in the definition of reverse logistics (8).

Medicines logistics systems

The Medicines logistics systems is the process concern the efficient and effective of goods transportation from pharmaceutical manufacturers to customers include hospitals, drug stores, clinics and consumers. The process in this study include medicine selection, procurement and purchasing, medicine receiving, inventory, distribution, storage and returning medicines (9).

Healthcare Manpower

There are seven categories of healthcare manpower as follow;

1. Medical specialists and general practitioners in private practice
2. Surgical specialists in private practice
3. Physicians employed by hospitals
4. Hospital interns and residents
5. Registered nurses
6. Allied health professionals and technicians including pharmacists
7. Nonmedical personnel (e.g., housekeeping, maintenance, clerical)

In this study interest only nurses, pharmacists, pharmacy assistances and messengers (outsource staffs) that work related on the wards (10).

Reverse logistics outcome indicators

The reverse logistics outcome indicator is a data collection instrument used to assess reverse logistics process efficiency. Efficient reverse logistics can show the fact that the organization get high performance to manage their medicines. A study by Mohammed et al in 2012, found that there are six indicators of reverse logistics including economic, product and technology, legislation, customer, industry and market, and corporate citizen ship. For this study the researcher will measure only three outcomes indicators; 1) physical outcome, 2) economic outcome and 3) satisfaction outcome indicator (11).

1) Physical outcome indicator

The physical outcome indicator measure total items and amount of returned medicines per time, percentage of returning medicines, percentage of not on-time returned prescription, percentage of reused medicines, and percentage of un-reused medicines.

2) Economic outcome indicator

The economic outcome indicator measure the value of returned medicines, un-return medicines and un-reused medicines.

3) Satisfaction outcome indicator

The satisfaction outcome indicator measure the healthcare workers satisfaction.

Expected outcomes and benefits:

It is expected to find out the effects of returned medicine such as the value of un-reused medicines, i.e., drugs were returned to a pharmacy with low quality, which cannot be used again (waste). It will increase the awareness of the hospital administrators if the reverse logistics can save budget by reducing the amount of returned drugs. The study will be able to build a reverse logistics model that could be used not only Somdech Phra Debaratana Medical Center in Ramathibodi hospital but also hospitals in Thailand.

Conceptual framework model

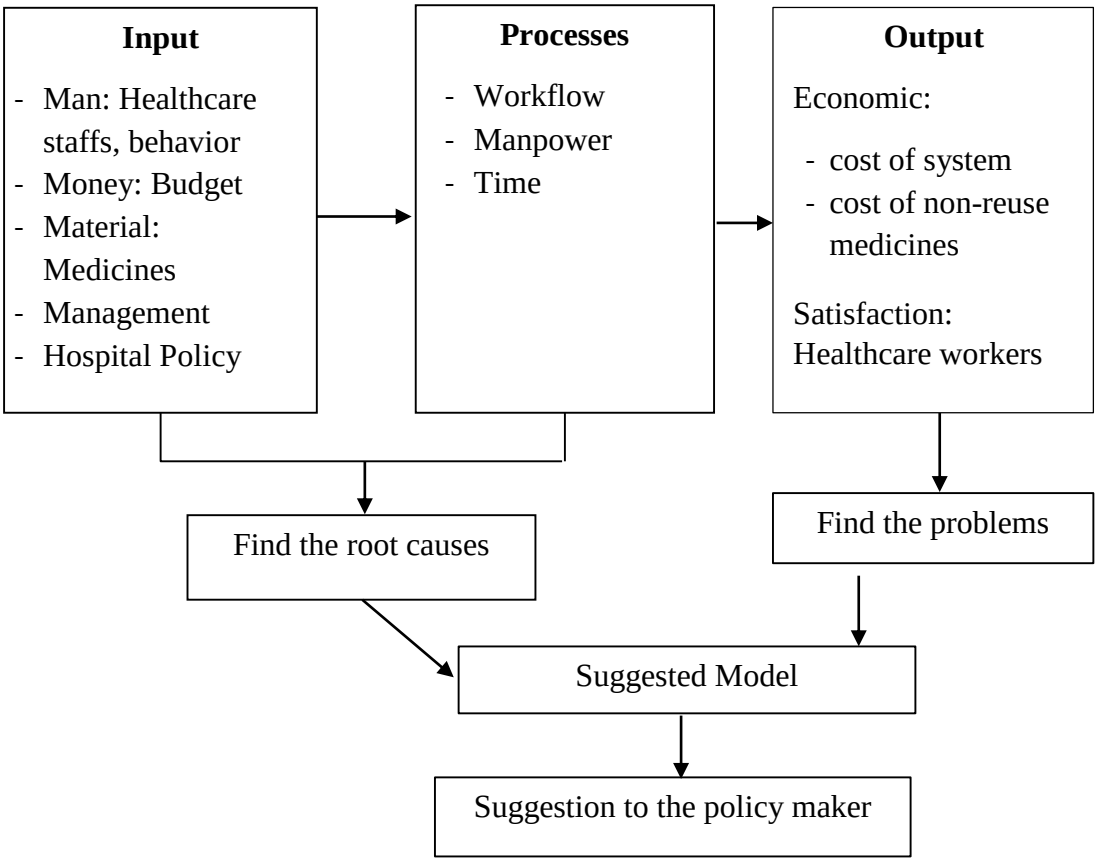

Figure 1.1 Conceptual framework model

CHAPTER II
LITERATURE REVIEW

The research study analysis of the impact of reverse logistics on medicines at Somdech Phra Debaratana Medical Center, Ramathibodi hospital. The researcher search intensively the relevant literature as follow;

1. Hospital/ Medical logistics
2. Reverse logistics
3. Hospital Pharmacy management
4. The introduction of the Somdech Phra Debaratana Medical Center, Ramathibodi hospital
5. The related studies of reverse logistics

2.1 Hospital/ Medical Logistics

In 2011 the Council of Supply Chain Management Professionals (CSCMP) defines logistics management as a part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirement. Logistics management is an integrating function, which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions including marketing, sales manufacturing, finance, and information technology. On the other hand, logistics activities as the operational component of supply chain management, including quantification, procurement, inventory management, transportation, and data collection and reporting (12).

Hospital/ Medical Logistics includes the supply of pharmaceutical, medical, surgical consumables, medical devices and equipment and other supplementary products necessary to support doctors, the nurses and of course patients of the hospitals.

Hygiene consumables and food supplies are also included. Due to the fact that the end users are responsible for the lives and the health of their patients, medical logistics is unique as it aims to improve the effectiveness and not the efficiency. The procedures of medical logistics are a big part of the health care system. In fact, the second highest health care cost after personnel is the cost of medical supplies (13).

The Fraunhofer institute defines hospital logistics as the efficient processes by appropriate logistics in hospitals. Logistics as useful instrument for efficiency, quality increase and cost decrease are focused more and more in hospitals. Now it is important to accommodate current changes in health care sector, to be aware of one's qualities and to take the right way to success. The development and realization of an optimal integrated logistics system is a great challenge for hospitals. With the help of professional support the hospital can be quickly led to the desired aims. A hospital is a complex technical system of many actions, structures, material flows and people. Different wards and areas of operations are involved in the daily routine of a hospital. Chemists, storage, laundry, kitchen, administration, laboratory, sterilization, cleaning, disposal etc. are influencing the success of a hospital enormously. Aside from the medical attendance, efficient actions and the coordination of all logistic items contribute to the hospitals quality. Logistics in hospitals are efficient when they fulfill their functions and are unnoticed by employees (14).

The logistics system is a vital part of hospitals because this system may have responsibilities (activities) for purchasing, receiving, inventory management, management information system, telemedicine, food service, transportation, and home care services. It is important to examine the activities of this system to improve service and cut cost (15).

2.2 Reverse logistics

Reverse logistics deals with four basic tenets: reduce, substitution, reuse and recycle. There are two major supply chains to be concerned within any distribution system: the forward chain, and the reverse supply chain (reverse logistics system) (16).

Reverse logistics is for all operations related to the reuse of products and materials. It is the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal (8).

The reverse logistics process includes the management and the sale of unused as well as returned equipment and machines from the hardware leasing business. Normally, logistics deal with events that bring the product towards the customer. In the case of reverse logistics, the resource goes at least one step back in the supply chain. For instance, goods move from the customer to the distributor or to the manufacturer.

The activities of reverse logistics are composed of collection, selection, reprocessing, disposal and redistribution (see in figure 2.1).

- Collection of used products, which may include purchasing, transportation and storage activities.
- Selection: Inspection, which includes all operations determining whether returns are in fact recoverable and in which way.
- Reprocessing: Reconditioning returns, which means the actual transformation of used products into usable products again.
- Disposal is required for returns that are found to be unrecoverable due to technical or economical reasons.
- Redistribution of recovered products refers to directing them to a potential market and to physically moving them to future users. It may encompass sales (leasing, service contracts, etc.), transportation and storage activities.

The type of product recovery and the sequence of the required processing steps are often dependent on the quality condition of returns (17).

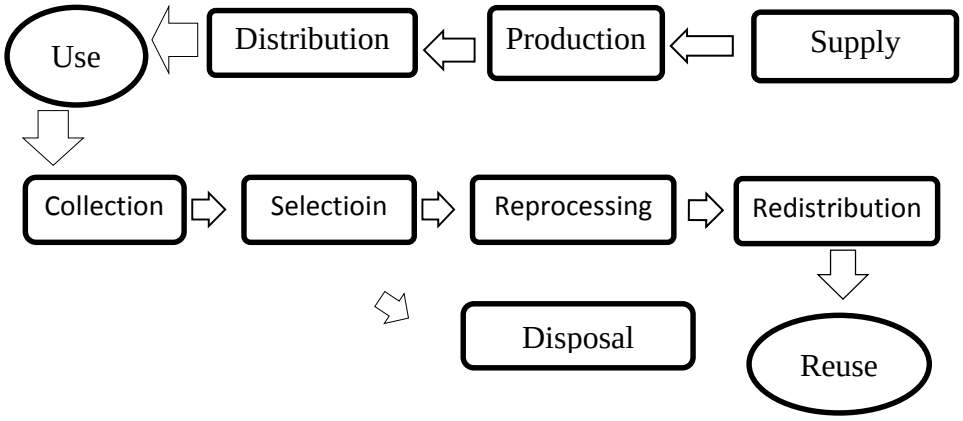

Figure 2.1 Group of activities in product recovery/ reverse system

The reasons for returning products can be distinguished by where the return initiated. The main return reasons such as (18);

- Customer not satisfied
- Installation or usage problems
- Warranty claims
- Faulty order processing
- Retail overstock
- End of product life cycle or product replacement
- Manufacturer recall programs

The volume and the method of processing returns drive the total cost of returns. Companies can reduce the costs associated with returns considerably through a number of different ways and even use their capabilities as a competitive weapon. Companies can change the way they are organized to manage returns, alter the way they process returns, use advanced technology to process more efficiently and to prevent returns or ultimately outsource their entire returns supply chain.

2.3 Hospital Pharmacy management

Appropriate medicines use in the hospital setting is a multidisciplinary responsibility that includes;

- Selection and formulary management by the hospital committee
- Prescribing by the physician
- Procurement, storage, medication order review, and preparation and dispensing by the pharmacist
- Medication administration by nurses
- Monitoring the effect of medicines on the patient by all healthcare workers

The hospital pharmacists should be expert on medicines who advises on prescribing, administering, and monitoring, as well as a medicines management to ensure that medicines are sufficient all medicines to use in the hospital (19).

In organizing hospital pharmacy services, there are two components that must be considered: staffs and physical organization

1) Staffs:

Hospital pharmacy staffs can be divided into three major categories;

i. The chief pharmacist who are responsible for procurement, distribution, and control of all pharmaceuticals used within the pharmacy unit.

ii. Professional staffs are the pharmacist who procure, distribute, control medication, and provide clinical consulting and medicine information.

iii. Support staffs include pharmacy technicians, clerical personals, and messengers

2) Physical organization:

The extent of the pharmacy's physical facility is determined by the size of the hospital and the service provided. A large pharmacy unit might have the following sections within one physical space or in separate locations throughout the hospital:

- Administrative offices
- Bulk storage
- Narcotic or dangerous drug locker

- Manufacturing and repackaging
- Intravenous solution compounding
- Inpatient and outpatient dispensing
- Medicine information resource center
- Emergency medicine storage

According to the processes of medicine management include medicines supply chain and hospital pharmacy process.

2.3.1 Medicines supply chain

From the healthcare perspective, the supply chain management is characterized by the information, medicines and money necessary to purchase and transfer the medicines and services from the supplier to the final user in order to control costs. The medicines supply chain management has an impact on human health requiring adequate and accurate medical supply conforming to the patients' needs. If medical supplies are out of stock, distributed to the wrong patient inadequately, patients may experience adverse events, and in some cases death. In fact, medical products, medicines and equipment are not totally standardized. Healthcare professionals are responsible for their selection, but their choice depends on the physical characteristics and health status of each patient. Indeed, they can request different kinds of products for patients undergoing the same treatment. Consequently, several products, medicines and equipment are required, resulting in differentiated and complex health services and generating negative impacts on the hospital finances. The hospital operations must deal with a complex distribution network composed of several storerooms and warehouses where different medical supplies are stored following a variety of regulations. The caregivers conduct a staggering number of logistics activities that do not fall under their formal responsibilities. For instance, Landry and Philippe estimated that "nursing staff will spend on average 10% of their time performing logistics tasks instead of taking care of patients, which can not only have cost and care implications, but in countries where there is professionals, social implications as well, such as stress-related diseases. Healthcare supply chains are characterized by multiple stakeholders that work together in order to ensure the flow of products and services. Inside and outside hospital, medicine management requires a wide variety of human intensive processes which are

poorly supported by technology. This results in an increased of workload and a higher possibility of errors. Healthcare supply chains are high regulated and must respect a number of standards and procedures. In fact, national and international healthcare organizations and government have defined several standards for the distribution, storage, preparation and administration of medical products and materials. Finally, healthcare supply chains are vulnerable to terrorism and criminal facts (20).

2.3.2 Hospital pharmacy process

The hospital pharmacy plays a vital role in patient care. It focuses on ensuring that the prescribed medication is precisely and timely dispensed to the intended patient. The hospital pharmacy must purchase, store and distribute medicines. These activities are known as pharmacy logistics processes which are under the responsibility of specialized staff because medicines must be managed under specific conditions and standards. Pharmaceutical logistics activities include planning of medicine supply, request of purchase order, reception of medicines, validation of package delivery, fitting and sorting of medicine packages, storage, preparation for distribution, distribution of medicines to wards and patients, and reverse logistics. Many hospitals look forward to reducing operation costs while ensuring the patient security. However, pharmacy logistics processes are related to several issues that impact negatively the cost and quality of the medication services. Several studies show different inefficiencies, namely out-of-stock, high costs, excessive manual labor, shrinkage, high frequency of reorder, counterfeit products and product recalls. Improving the efficiency of this logistics function is an indispensable option for ensuring the profitability of the healthcare organizations.

There are two medicine management flows at the hospital; Forward and Backward flow

1. Forward flow

Forward flow of medicine management involves four basic functions: selection, procurement, distribution, and used (figure 2.2).

- Selection: reviewing the prevalence health problems, identifying treatment of choice, choosing individual drugs and dosage forms, and deciding which drugs will be available at each level of healthcare.

- Procurement: quantifying drugs requirements, selecting procurement methods, managing tenders, establishing contract terms, assuring drug quality, and ensuring adherence to contract terms.

- Distribution: clearing customs, stock control, stores management, and deliver to drug depots and health facilities. the drugs distribution system for inpatient compose of four types as follow;

a) Floor stock or ward system: A floor stock system in a hospital involves the storage of pharmaceutical and over-the-counter drugs where they are needed, usually in a nurse's station, rather than in a pharmacy, as explained on Knowledge Source. The point of a floor stock system is to avoid the time required to get necessary medications from the pharmacy to the nurses who administer them.

b) Individual inpatient or Prescription order system: in this system, the medicine is dispensed according to a written prescription for an individual patient.

c) Combination of the individual inpatient system and the floor stock system. Most often used in hospitals in Thailand (21).

d) Unit dose system: Medications are dispensed in unit-dose packages (each dose is separately packaged) in separate bins or drawers for each patient. Commonly, a twenty-four-hour supply is provided. This is a preferred system from a patient care perspective which has a lower possibility for error.

The American Society of Health-System Pharmacists (ASHP) organization recommend the unit dose system for safety and economy. For reasons of safety and economy, the preferred method to distribute drugs in institutions is the unit dose system. Although the unit dose system may differ in form depending on the specific needs, resources, and characteristics of each institution, four elements are common to all: the first one is medications are contained in, and administered from, single unit or unit dose packages; the second one is medications are dispensed in ready-to-administer form to the extent possible; the third is for most medications, not more than a 24-hour supply of

doses is provided to or available at the patient-care area at any time; and the last one is a patient medication profile is concurrently maintained in the pharmacy for each patient. Floor stocks of drugs are minimized and limited to drugs for emergency use and routinely used “safe” items such as mouthwash and antiseptic solutions.

- Use: diagnosing, prescribing, dispensing, and proper consumption by the patient.

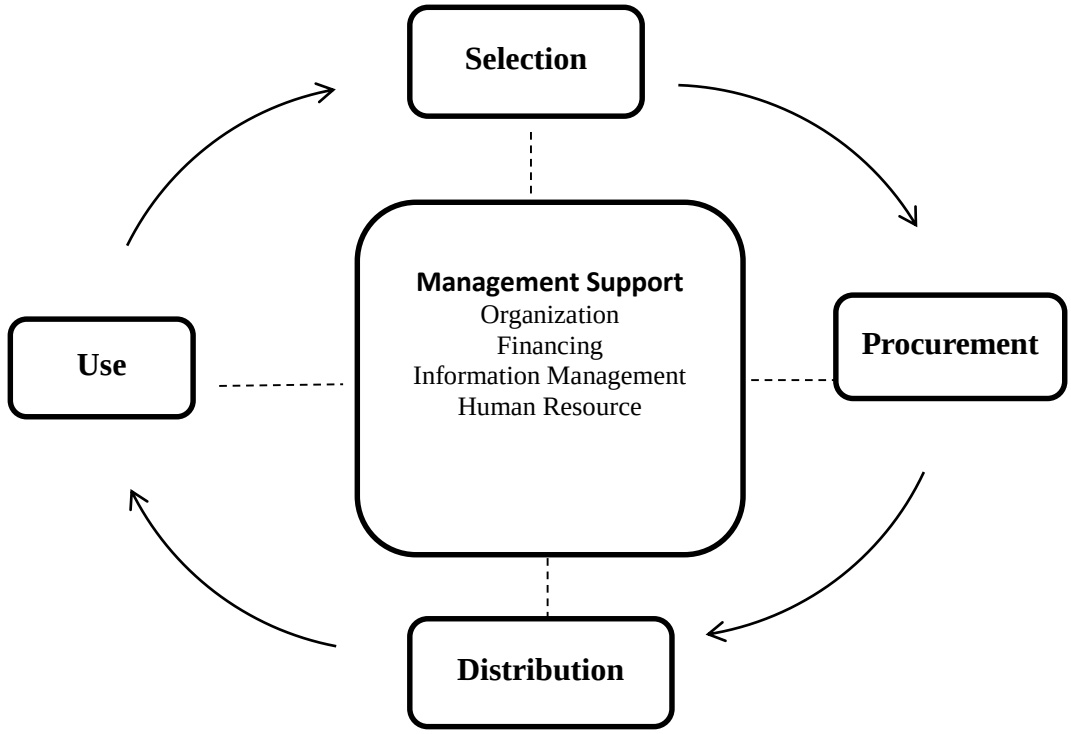

Figure 2.2 Forward flow of medicines management cycle

2. Backward flow

After use medicines, there are some medicines that unused, they should be returned to the pharmacy unit for redistribute again. The medicines returning or reverse logistic processes compose of five activities including collection, selection, reprocessing, disposal and redistribution. The medicines backward flow shows in figure 2.3.

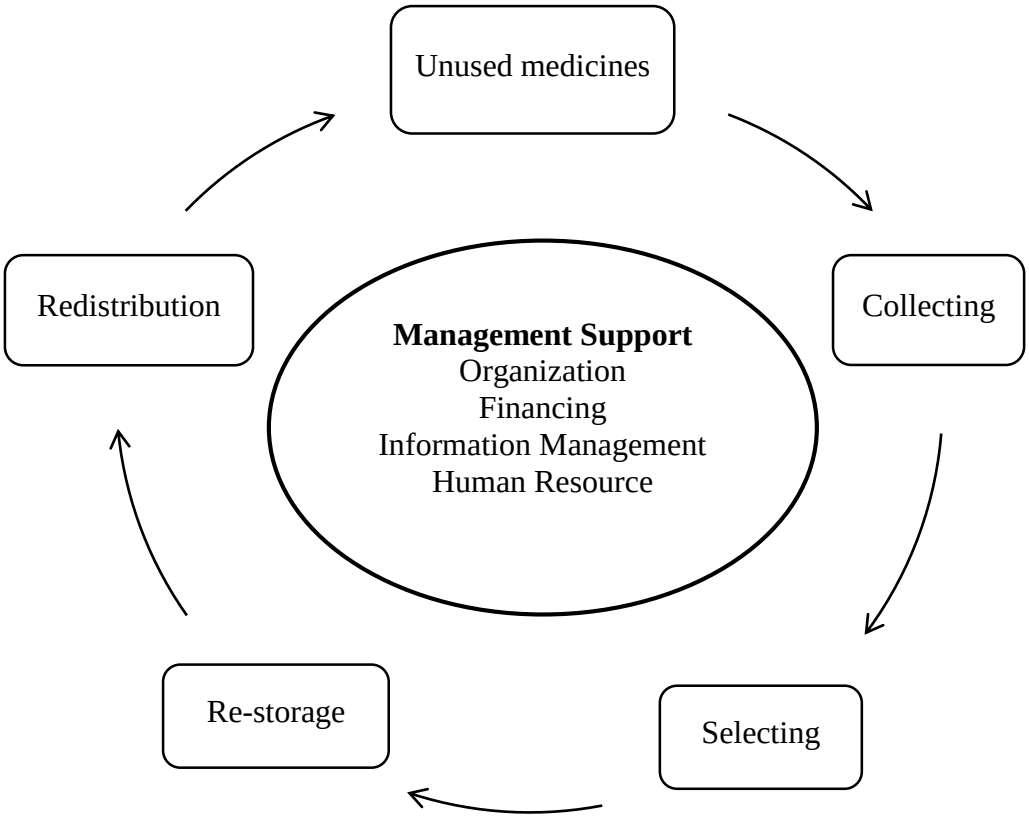

Figure 2.3 Backward flow of medicines management cycle

At the center of forward and backward flow of medicines management cycle is a core of management support system include organization, financing and sustainability, information management, and human resource management. These management support systems hold the drug management cycle together (22).

The reasons for reverse medicines from end-customers (nurses or patients) because of unused medicines. Because of patient refuses, medicine is no longer needed or not effective, treatment or dosage changes, or patient is discharged, so that occurs the unused medicines. Many returning medicines cause problem of hospitals. To reduce the quantity of unused medicines, hospitals may want to limit the number of doses dispensed to a patient at one time (unit dose packaging), use trial prescriptions or samples to determine medication effectiveness before writing a full prescription, and use smaller containers of medicines at the pharmacy and on nursing floors.

Types of unused medicines include expired medications, unwanted medications (e.g., patient/resident discontinues use), and waste medication (e.g.,

patient/resident refuses to take or spits out). In order to properly manage unused medicines, the hospital needs to identify the types of materials on site, including:

- Nonwaste (i.e., reusable or returnable medications);
- Hazardous waste, including dual wastes (hazardous and biohazardous);
- Nonhazardous waste;
- Controlled substances; and
- Chemotherapeutic pharmaceuticals

Many wards in hospital return their unused medicines, or at least a portion of them, to the dispensing pharmacy. Upon receipt, the pharmacy determines how the unused medicines should be managed, including:

- Reuse of medicines;
- Donation of medicines;
- Disposal of the unused medicines; and
- Disposal of the unused medicines.

To determine whether stock unused medicines can be reused or donated following return to the ward, ask the following questions:

1. Is the medicine in the original packaging or still in prepackaged unit doses from the pharmacy?
2. Is the expiration date a future date at least six months out?
3. Is the label intact? Is all the information for the medication such as type, dose, and expiration date clearly marked?
4. Has the medicine been properly stored, such as within the proper ranges for temperature, humidity, and light?

If the answers are “yes” to all the above questions, it might be able to return the unused medicines to the pharmacy for reuse. Every hospitals set policies for the return and reuse of unused medicines. Although the policies vary by board of hospital, most allow reuse of uncontaminated medications that have been in a controlled environment, excluding controlled substances. Medicines that can be reused are typically solid doses such as pills, tablets, and capsules that do not require special handling for temperature such as refrigeration.

If the answers are “no” to any of the above questions, the pharmacy cannot reuse the unused medicines. If the ward cannot return the unused medicines to the

pharmacy and it must be discarded, the unused medicines becomes waste. Some medicines cannot reuse but for the others can reuse.

When patients pay for part of the medication, long-term care hospital pharmacies typically cannot give credit to the patient for returned medicines. They are unable to give partial credit to the patient under existing Medicare and private insurance financial tracking systems. Thus, the long-term care facility pharmacies can accept the returned medicines (excluding controlled substances), but cannot resell them (23).

For manage the unused medicines from end of medicines users include nurses and patients, the healthcare workers must set the criteria of reuse and disposal medicines. Moreover the hospital should create the standard of procedure for reverse logistics processes. The efficient reverse logistics processes may reduce cost, time and manpower for the hospital.

2.4 The introduction of the Somdech Phra Debaratana Medical Center, Ramathibodi hospital

The Somdech Phra Debaratana Building is a new building of Ramathibodi hospital. It established by the faculty if medicine, Ramathibodi hospital, Mahidol University. The building located on Rama 6 road nearby Chitralada Palace. It serves as the most excellent service complex for thousands of out-patients. The building will have well-equipped facilities to perform high standards of healthcare in the Southeast Asian region. It provides 350 beds, 16 operating rooms and 14 Intensive Care Units, and also comprehensive service centers such as Stem Cell Transplantation, Minimal Invasive Endoscopic Surgery Center, Elderly Care Unit, Child Development Center and Complicated Diseases Service by specialized doctors.

The inpatient system of the Somdech Phra Debaratana Building is a new building of Ramathibodi hospital located on floor 6 - 9 in total 283 rooms with a variety of sizes. The design considerations of patient and environmental place convenience, proper, including natural garden and trees to feel relaxed. As well as safety during the hospital stay inside the room equipment according to the standards of high quality. Make room for ease of maintenance, safety, beauty, and accommodation for patients and

relatives. Caring by medical staffs, physician, and specialists, together with a team of healthcare professionals.

There are two pharmacy departments at Somdech Phra Debaratana Medical Center, Ramathibodi hospital. The first pharmacy department located at the first floor of the building, it serves out-patients. Another pharmacy department located at the sixth floor of the building, it serves inpatients (6).

2.5 The related studies of reverse logistics

The study of reverse logistics has increasingly become a unique area of interest over the last two decades. Though the conception of Reverse Logistics dates from long time ago, the denomination of the term is difficult to trace with precision. Terms like Reverse Channels or Reverse Flow already appear in the scientific literature of the seventies, but consistently related with recycling.

The Council of Logistics Management (Stock, 1992) defined the reverse logistic as the term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials and disposal.

In the same year Pohlen and Farris (1992) define Reverse Logistics as the movement of goods from a consumer towards a producer in a channel of distribution.

Kopicky et al. (1993) defines Reverse Logistics analogously to Stock (1992) but keeps, as previously introduced by Pohlen and Farris (1992), the sense of direction opposed to traditional distribution flows: “Reverse Logistics is a broad term referring to the logistics management and disposing of hazardous or non-hazardous waste from packaging and products. It includes reverse distribution which causes goods and information to flow in the opposite direction of normal logistics activities.”

In the end of the nineties, Rogers and Tibben-Lembke (1999) describe Reverse Logistics stressing the goal and the processes (the logistics) involved: “The process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the

point of consumption to the point of origin for the purpose of recapturing value or proper disposal."

The European Working Group on Reverse Logistics, RevLog (1998-), puts forward the following definition Dekker et al., (2003): "The process of planning, implementing and controlling flows of raw materials, in process inventory, and finished goods, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal" (24).

The generally accepted definition of reverse logistics is the process of planning, implementation and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal. Many industries interest about reverse logistics include pharmaceutical industries.

In 2006, Hawks, Karen (8) mentioned on Reverse Logistics Magazine, successful industries understand that managing reverse logistics effectively will have a positive impact on their bottom line. They have not had to spend much time and energy addressing return issues are now trying to make major improvements. Now, more than ever, reverse logistics is seen as being important.

The first study by Chen Ming in 2006 (25), analysed the driving factors of reverse logistics. The method that used were searching and reviewing literature. The study found that, there are two driving factors: internal and external driving factors. The internal driving factors of reverse logistics are economic interests (direct or indirect), legal restriction (environmental protection law) and social duty (social entitlement). For the external driving factors are more abstract such as products, components, raw materials and equipment, and even entire scientific systems. To implement the reverse logistics successfully could cut down the company and the whole supply chain's cost, and increase profits.

In year 2008, Coma, A., et al wanted to know about the amount of unused medicine, types of medicines returned to community pharmacies and to identify the reasons why they were not used. They also wanted to calculate the cost to the public health system of returned unused medicines in Barcelona, Spain. They get 38 community pharmacies by random sampling. The medicines were collected from 38

community pharmacies over a period of seven consecutive working days (excluding Sundays). The questionnaire was used in this study to evaluate each return medicines. The result found that there were 227 clients returned 1,176 packages of medicines to the pharmacy. The main reason of returning was the expiry date, in the second was patient's condition had improved and no further need. The estimated total cost of returned medicines was €8,539.9 (398,631.83 THB) in one week. This study confirmed the importance of analyzing the returned unused medicines to reduce unnecessary payment (26).

The third study by Pokharel *et al* in 2009, reviewed literature about the perspective in reverse logistics by using web based search engines, books and conference proceedings. They found that research and practice in reverse logistics are focused on all aspects of reverse logistics started from collection of used products, their processing and finally to the outputs of processing, namely, recycled materials, spare parts, remanufactured products and waste material disposal. The main perspective that needs to be covered in a reverse logistics situation includes not only networking and inventory analysis but also collection of used products, their pricing, use, resale, and remanufacturing through an established system. Therefore, the challenge to the decision makers in revers logistics business is not only to set up an economically efficient network but also to design systems in such a way that used products are received at the expected time, at expected price and at expected quantities. Many of the literature had also focused on case studies on various aspects of reverse logistics (27).

A study by Ryder System, Inc. in 2010. Studied about reverse logistics from black hole to untapped revenue stream in. They interested reverse logistics of companies in United States. They found that over 160 companies in the computer, consumer electronics, telecom, aerospace and manufacturing industries, those that used best-in-class reverse logistics processes report: average customer satisfaction rate of 93 percent (vs. 86 percent industry average), 4.4 average days parts return times (vs. 14.5 days industry average), 21 percent decrease in cost per return materials authorization over a 12-month period (vs. 6 percent industry average). So, they recognize that reverse logistics can drive real impact to the bottom line, this is an area of high priority for companies looking to reduce costs, add efficiencies, improve the customer experience and build sustainable supply chain practices. As a result, manufacturers are uncovering

the hidden value of returned assets and streamlining return, repair and product reallocation processes. Returns reduce the profitability of retailers marginally more than manufacturers. Returns reduce the profitability of retailers by 4.3 percent. The average amount that returns reduce the profitability among manufacturers is slightly less, at 3.80 percent. The returning goods reduce profitability because they cannot resold their returning goods but for the industries that can resold them it's can make profit (28).

A study in United States by Shroff et al in 2011, proposed a reverse framework that embodies environmental, economical and physical concern for end-of-life pharmaceutical products. They construct a model for reverse logistics system for end-of-life pharmaceutical products. The model consists of two main processes: 1) The collection process, and 2) The inspection process. They found that the model included a large variety of cost measures such as transportation, inventory, inspection, and end-of-life processing at every step. Furthermore, the model information technology infrastructure introduces additional cost measures such as equipment, training, and planning to ensure system reliability and efficiency. The end-of-life medicines that are not expired will be resold again if profitable. Furthermore, if the drugs are in good condition and their shelf life is also long, then those medicines can be sold at higher rate than the original one. The recyclers can use the difference between the acquisition cost and sale price to fund the expenses, including operation cost and profit. In addition, donation of these returned and refurbished end-of-life medicines would add value to the public, as well as decrease the environmental damage by preventing unnecessary consumption, incineration or land filling. Moreover, the effective use of technology incorporates effective management processes to reduce cycle time and cost throughout the entire reverse logistics system (29).

Two studies of pharmaceutical industry in India, the first study by Shaurabh *et al* in 2013, they proposed 5R (Reduce, Recycle, Reinforce, Report, and Regulate) optimum model for reverse logistics in pharmaceutical industry. Their literature reviewed focused on strategic framework of reverse logistics using information technology information. After reviewed, they found that the pharmaceutical industry should be implemented the reverse logistics because of the disposal of unused, expired medicines is become a burning issue both for household and pharmaceutical industry in India. Researchers concluded that in order to improve budgeting and cost efficiency of

forward distribution channel, the company should place equal weight on aligning their reverse logistics process. It becomes an important concern to develop a solid strategy in order to support the reverse logistics process as it does not only makes a firm more capable but also reduce the risk of customer while buying a medicine. Pharmaceutical company should think about the strategic reverse logistics and integrate it along with other operations to improve efficiency and effectiveness of the process (30).

Another study in India by Sushmita *et al* in 2014, they analyzed the reverse logistics in the pharmaceutical industry. They used a system thinking approach for analyzing. A systems model was developed for purpose using a participative approach. The model was analysed to identify a set of feedback loops operating in the system responsible for the complexities of the problem. The findings suggested strong linkage between reverse logistics network design and key activities in returns management. The study laid a platform for developing a simulation model (31).

A study in Ghana by Kwateng *et al* in 2014, they examined reverse logistics practices in the pharmaceutical manufacturing industry in Ghana. They used questionnaire as a tool of study. The managers, assistant managers, supervisors and staffs of pharmaceutical manufacturing companies in Ghana were interviewed and questionnaire. They found that the companies have a system in place to aid in tracking and collecting drugs. Several reasons accounted for the return of products with damage products or packages accounting for the most returns. Among the companies supply chain partners, the wholesalers often return the product and collection of the return product was done solely by the marketing department which was responsible for the sale of the product. The researchers recommended that companies should provide a central location point for the collection of returned product. This will reduce the costs involved in collecting drugs from multiple locations and saves time for other productive activities (32).

One study from Arab Emirates in year 2015, the aimed of this study was to design the efficient of reverse logistics system of the company. It focused on transportation process of reverse logistics system. The literature review and case study were used in this study. In this study, it has addressed the problem of a reverse logistics network by developing a mixed integer linear program to model it. Overall, it stated that the reverse logistics process encompasses the compilation, examination, recycling,

renovating, and remanufacturing of used items, involving leased or owned tools and machines. The liable parties require deciding on the number of services that need their capabilities and the most suitable sites as well. The result of this study found that transportation process was importance, the researchers introduced the important transportation considerations, by providing the option of using in-house fleet as well as outsourcing option. The result in case study showed that using recommended model provided useful insights, especially to companies that require very large and costly transportation systems, such as delivery companies (33).

Many hospitals in Thailand concerned about problems from unused medicines. There are lots of studies that studied about the unused medicines of outpatient system, rare for inpatient system. One of the studies in Thailand by Mrs. Faridah Moohamad in year 2003, studied about the drug distribution systems for inpatients at Pattani hospital. The objective of this study was compared between old-new drug distribution systems and unit dose-new drug distribution system of inpatient system at Pattani hospital. The study compared the data collected before and after the implementation of the new systems in two medical wards. The studied variables included pharmacy and nursing times for medication related medication errors, activities, unit costs per patient for each system, quantity and costs of ward stock and the attitudes of pharmacists, nurses and technicians toward drug distribution system. It conclude that the unit dose system can reduces administration errors and nursing times on medication related activities and also reduces the floor stock compared to the old and new systems. But costs in the unit dose are the highest compared to the others (21).

Another study that studied about problem solving of inpatients drug distribution system in the Crown Prince Kuchinarai Hospital, Kalasin Province in year 2008. The aimed of this study to analyze the dispensing process, to determine the extent of dispensed and returned medications as well as the total pharmacy workloads. It studied in community hospital, Kalasin province. The method started with review the document, interviewed the key informants, analysed the hospital database, and created the new model. This study found that the most problem was the return of unused medicines. It found that the returned medicines accounted for 12.9 %(18,077 units) of the total medicines dispensed during office hours per six months. Moreover this research

found that the returned medicines created a burden for pharmacists, so the new model suggested policy maker to change some medicines stock in wards (34).

A highly effective healthcare waste management system with strong control and understanding of the entire process is required. Segregation in the waste management process would bring in various financial, health and environmental benefits.

The results from studies of reverse logistics indicated that the reverse logistics are important for many industries especially for pharmaceutical industry. Because of the returning of unused pharmaceutical products are increasing, so the pharmaceutical concern the way that manage them. The reverse logistics can solve the occurring problems. The effective reverse logistics can make a profit to the company, environmental, and consumers.

CHAPTER III
RESERCH METHODOLOGY

3.1 Study designs

This study is quantitative descriptive research. A cross-sectional data were collected. Data were analyzed in the perspective of the hospital.

3.2 Study location

Somdech Phra Debaratana Medical Center, Ramathibodi hospital.

3.3 Study period

12 months, during June 2015 until May 2016

3.4 Population and sample

There were two groups of population and sample classified by type of study

3.4.1 Descriptive study

In descriptive study, the population were healthcare workers who work with inpatient system. There were 360 nurses, 6 pharmacists and 5 pharmacist assistances.

Selection criteria

Inclusion criteria

- All healthcare workers who participated in the medicines management of inpatient system.

Exclusion criteria

- The healthcare workers who have the expertise and experiences in managing inpatient system less than two years.

According to the inclusion and exclusion criteria. There were 178 nurses, 6 inpatient pharmacists and 5 pharmacist assistances met in the criteria.

3.4.2 Quantitative study

In quantitative study, the population was the hospital electronic database of inpatients who are admitted at Somdech Phra Debaratana Medical Center in Ramathibodi hospital during October 1st, 2014 until September 30th, 2015. There were 14,048 administration number of patients who admitted during the period.

Selection criteria

Inclusion criteria

- All inpatients who had the information of dispensing and returning hospital database during October 1st, 2014 until September 30th, 2015.

Exclusion criteria

- The inpatient who had uncompleted information both dispensing and returning data.

According to the inclusion and exclusion criteria. There were 10,597 inpatients met the criteria.

3.5 Study instrument

A semi-structure and open-end questionnaire was the instrument of this study. The questionnaire was developed in the following steps;

1) Construction of question related to the reverse logistics on medicines process and current problems.

2) Reviewing and assessing for content validity by three experts. Index of item-Objective Congruence (IOC) method was selected to check the completeness of the content, clarity of language, and relevance to the issues to be examined. This method was averagely score for each expert, there are three score that are +1, 0, and -1. The criteria for +1 score was indicating expert agreed with the question. The 0 score referred

to expert had uncertainty of the question. The last score was -1 mentioned to expert disagree to the question. The average score should be more than 0.5, it meant passed criteria. This questionnaire had 0.96 score, it meant that this questionnaire appropriate to use in this study.

3) Revising the questionnaires.

The developed questionnaire covered three parts as follow; (see appendix C)

– The first part of the questionnaire contained the general information of the respondent, including sex, age, experience, job positioning education and job department.

– The second part contained the process and problems that occurred in the reverse logistic process of inpatient system, consist of seven topics including:

i. Standard practice of reverse logistics process
ii. Compliant of healthcare staffs about the standard guideline
iii. Describing the reverse logistics process
iv. Identify the responsibility
v. The standard practice in each step
vi. The reason of returned medicines
vii. The satisfaction of reverse logistics process in inpatient system.

– The third part of questionnaire contained suggestion about the development of reverse logistics on medicines of inpatient system at Somdech Phra Debaratana Medical Center, Ramathibodi hospital.

3.6 Study procedure and Data collection

There were two parts of study procedure and data collection follow as;

- Questionnaire

Data collection

The researcher contacted the head of nurses and pharmacists then the questionnaires were placed in each ward and an inpatient pharmacy department for 178 nurses, 6 inpatient pharmacists and 5 pharmacist assistances. The questionnaires were placed on January 11, 2016 and collected on February 26, 2016.

- **Hospital database**

Data retrieval and transfer

Inpatient data were retrieved from hospital database and transferred to Microsoft Access and Excel data format. After that, data were checked the accuracy and completeness. The uncompleted data were eliminated. The uncompleted data such as there were only returned data or take home medicines were eliminated. There are two major parts of data that are Dispensing data and Returning data. The data include;

i. Name of drugs dispensed and returned
ii. Amount and price of drugs that the doctor key in
iii. Amount and price of drugs that the nurse key in for return
iv. Amount and price of drugs that the pharmacists key in to receive the returned medicines
v. Time that nurse key in for return medicines
vi. Time that pharmacist checks and confirms returned medicines

3.7 Data validation

The hospital database was the complicated, large system and unstable, so it is importance to validate data before analysis. Data validation checked the uncomplete information that was the return-medicines with no price. There are 17,612 of 64,233 records which no drugs price. The next step is find the drugs price by using drug code in dispensing information.

3.8 Data analysis

There were two parts in data analysis.

3.8.1 Descriptive

The data from questionnaires with key participants were recorded and transcribed into Microsoft Excel 2013 and Word 2013. The descriptive statistic such as mean, percentages, and standard deviation were used to describe the relationship between reverse logistics management and problems

3.8.2 Quantitative

The hospital electronic database were analyzed by Microsoft Access 2013 and Excel 2013. The physical and economic outcome indicators were analyzed.

Physical outcome indicator

For physical outcome indicator, the amount of returned medicines per one year, percentage of returned medicines, percentage of not on-time returned prescription, percentage of reused medicines, and percentage of un-reused medicines were analyzed. Physical indicator was categorized into five minor indicators as follow:

1) The total amount of returned medicines per one year = sum of amount of returned medicines per one year

2) Percentage of returned medicines

$$= \frac{\text{Total amount of returned medicines (nurse key)}}{\text{Total amount of dispensed medicines}} \times 100$$

3) Percentage of reused medicines

$$= \frac{\text{Total amount of returned medicines that pharmacist receive}}{\text{Total amount of returned medicines}} \times 100$$

4) Percentage of un-returned medicines

$$= \frac{\text{Total amount of returned medicines that pharmacist cannot receive}}{\text{Total amount of returned medicines}} \times 100$$

5) Percentage of delayed returned medicines

$$= \frac{\text{Total frequency of delayed returned medicines}}{\text{Total frequency of returned medicines}} \times 100$$

Economic outcome indicator

For economic outcome indicator, the value of un-returned medicines, time used for reverse logistics management and labor cost of reverse logistics management were analyzed.

Economic indicator was separated into 3 minor indicators, as follow;

1) Value of un-returned medicines per one year = total value of medicines that cannot return to inpatient pharmacy unit in one year

2) Time used for reverse logistics management in each step: this information come from the questionnaires, after they were sent back to the researcher, researcher calculate the mean of time in each steps. The mean of each step were represented for the time used of reverse logistics processes.

3) Labor cost of reverse logistics management

= working time (hour) × salary per hour

The working time was the time used in each step of reverse logistics processes that came from economic value number two. The salary of each jobs came from the Finance division department of Medical service in year 2011.

CHAPTER IV
RESULT

There are two parts of analysis; one part is the survey and another part is the hospital database. Analysis of the survey and the hospital database results compose of five parts, as follows;

1. Descriptive data of the population and hospital database
2. The current medicines logistic and reverse logistic process of inpatient system at Somdech Phra Debaratana Building, a new building of Ramathibodi hospital
3. The current issues that impact the reverse logistics process from wards into inpatient pharmacy
4. The root causes and factors of reverse logistics from wards into inpatient pharmacy
5. The suggestion model to reduce the magnitude of reverse logistics

Part I: Descriptive data of the population and hospital database

1.1 Descriptive data of the population

1.1.1) Response rate: of the 189 questionnaires sent, one hundred and thirty-three completed questionnaires were received. Table 4.1 presents the number of respondents classified by job positioning. It was found that almost 71 percent of questionnaires were from inpatient nurses. A total of 133 questionnaires were analyzed, providing response rate of 70.37% (133 from 189 questionnaires).

Table 4.1 Number of respondents classified by job positioning

Job positioning	Number of sent questionnaire	Number of respondent (%)	Respondent rate (%)
Nurse	178	126 (94.74)	70.79
Inpatient Pharmacist	6	5 (3.76)	83.33
Pharmacy assistance	5	2 (1.50)	40
Total	189	133 (100)	70.37

1.1.2) General information of the respondents

Table 4.2 presents the number of the respondent's education classified by job positioning. Most of respondents (95.49%) completed a bachelor's degree. 3.01% and 1.5% of respondents completed master's degree and under-graduated, respectively.

Table 4.2 Education of respondents classified by job positioning

Education	Nurse (N=126)	Inpatient Pharmacist (N=5)	Pharmacy assistance (N=2)	Total (%)
Under-graduated	0	0	2 (100%)	2 (1.50)
Master degree	122 (96.83%)	5 (100%)	0	127 (95.49%)
Doctoral degree	4 (3.17%)	0	0	4 (3.01%)
Total	126 (100%)	5 (100%)	2 (100%)	133 (100%)

1.2 Descriptive of hospital database

The hospital database came from sixteen wards (total 18 wards). 13,922 inpatients admitted during October 1st, 2014 until September 30th, 2015, but only 10,597 inpatients were analyzed. The hospital database came from sixteen wards (SDIPD62, SDIPD63, SDIPD64, SDIPD65, SDIPD72, SDIPD73, SDIPD74, SDIPD75, SDIPD82, SDIPD83, SDIPD85, SDIPD86, SDIPDNS, SDICU, SDNICU, and SDCCU) not include operating room and labor room. It was found that 13,922 inpatients admitted

during October 1st, 2014 until September 30th, 2015, but only 10,597 inpatients were analyzed. From hospital database, 16 information were retrieved, there are;

a) Hospital number
b) Admission number
c) Ward name
d) Inpatient type (inpatient, take home)
e) Medicine status (dispense, return)
f) Date of medicines key from ward
g) Time of medicine key from ward
h) Date of medicines key from pharmacy department
i) Time of medicine key from pharmacy department
j) Drugs name
k) Drugs code
l) Amount of withdrawal/ returning medicines
m) Amount of dispensing/ receiving medicines
n) The value of medicine withdrawal/ returning
o) The value of dispensing/ receiving medicines
p) The value of medicine per unit

From hospital database, drugs value of reverse logistics on medicines in one year was 19,291,770.35 THB but the inpatient pharmacist unit could receive only 18,360,360.60 BHT. In one year hospital and some patients spent unreasonable money equal to 931,409.75 THB. The detail of frequency, drug amount and, value shows in table 4.3.

Table 4.3 The frequency, drug amount and, value of reverse logistics on medicines in one year

Issue	Frequency/ one year	Drug amount (unit/one year)	Value (THB/one year)
Dispensing	373,787	1,947,010	87,346,015.70
Returning	64,233	290,795	19,291,770.35
Receiving	62,132	273,714	18,360,360.60
Cannot receive	3,183	17,081	931,409.75
Delayed return	2,101	8,585	524,598.00
Un-reuse medicines	1,082	8,496	406,811.75

1.3 Physical outcome indicators:

Physical indicator was categorized into five minor indicators as follow:

1) The total amount of returned medicines per one year = 290,795 units
2) Percentage of returned medicines = 14.94%
3) Percentage of reused medicines (receiving) = 14.06%
4) Percentage of un-returned medicines (cannot receive) = 0.88%
5) Percentage of delayed returned medicines = 2.95%

The drugs-return are all item of unused medicines whether it is a complete or incomplete dosage form. The example of a complete return medicines that is unopen container medicines and keep it with the optimum environment. For the incomplete return-medicines such as the medicines which need keep in 2-8 degree Celsius but were sent with the unsuitable container and made it high temperature, so that return-medicines were not received from the pharmacist.

1.4 Economic outcome indicator:

Economic indicators were separated into 3 minor indicators, as follow;

1) The value of un-returned medicines per one year equals to 931,409.75 THB that were reuse and un-reused medicines. The value of un-reuse

medicines cannot know exactly because some of the medicines which cannot receive from the pharmacist but can reuse because they returned and keep with optimum container but not on time, so the quality of medicines are also good and can be reuse again.

2) Time used for reverse logistics management in each step

The reverse logistics on medicines at inpatient system compose of four steps, start with nurse keys drugs-return, outsourcing staff transfers them to inpatient pharmacy department, pharmacist checks and confirm drugs-return via computer, then pharmacy assistance manages all of the drugs-return. Time to use in each step of reverse logistics on medicines of inpatient system shown in table 4.4.

Table 4.4 The time using in each step of reverse logistics on medicines of inpatient system at Somdech Phra Debaratana Medical Center, Ramathibodi hospital.

Step of reverse logistics process	Time use/ order (hour)
1. Nurse keys drugs-return	0.11
2. Transfer drugs to inpatient pharmacy	0.36
3. Pharmacist checks and confirms returned drugs	0.04
4. Pharmacy assistance manages returned drugs	0.23
5. Total	0.74

From table number 4.4, it can conclude that the transferring step is a procedure that takes time more than another step while the checking and confirming by pharmacist take the minimum time.

3) Labor cost of reverse logistics management

= working time (hour) × wage per hour

There are three professional staffs that are nurse, pharmacist and pharmacy assistance and one outsourcing staff (messenger) associate with the reverse logistic processes. The wage of each job positioning brought to calculate that was taken from the finance division department of Medical service[1]. The wage of each job positioning is shown in table 4.5.

Table 4.5 The wage of each job positioning

Job positioning	**Wage/day (7 hour)** (THB) *	**Wage/ hour** (THB)
1. Doctor/ Dentist	1,100	157.14
2. Pharmacist	720	102.86
3. Nurse	600	85.71
4. Pharmacy assistance	480	68.57
5. Messenger	300	42.86

*Site: The finance division department of Medical service[1]

From table number 4.5 the wage per hour in each job positioning can calculate to find the labor cost of each step in reverse logistics process. The labor cost per order equal to time use in each step multiplies with wage per hour. The labor cost per order in each step of reverse logistics process shows in table 4.6.

Table 4.6 The labor cost in each step of reverse logistics process

Step of reverse logistics process	**Time use/ order (hour)**	**Wage/hour (THB)**	**Labor cost per order (THB)**
1. Nurse keys in for return medicines	0.11	85.71	9.43
2. Transfer drugs to inpatient pharmacy	0.36	42.86	15.43
3. Pharmacist checks and confirms returned medicines	0.04	102.86	4.11
4. Pharmacy assistance manages returned medicines	0.23	68.57	15.77
5. Total	0.74	300.00	44.74

The highest labor cost of reverse logistics process is the drug-returned management. Normally this process take twice per day because it has not the urgent management. The other process that high labor cost is transferring. It takes time for this step, so sometime there is urgently order this step might the reasons for delayed return.

From table number 4.3, the frequency of un-received returned medicines in one year equal to 3,183 orders. And the labor cost of one-time revers process (table 4.5) was 44.74 BHT. So, this hospital spent the budget for irrational labor cost as 3,183 x 44.74 = 142,407.42 BHT per one year. Moreover, the healthcare workers waste time for unsuitable reverse process equal to time used of one reverse process (see in table 4.6) multiply with the frequency of un-received returned medicines in one year that was 0.74 hr x 3,183 orders = 2,355.42 hours per one year.

Part II: The current medicines logistic and reverse logistic process of inpatient system at Somdech Phra Debaratana Building is a new building of Ramathibodi hospital

The Somdech Phra Debaratana Building is a new building of Ramathibodi hospital. It serves as the most excellent service complex for thousands of out-patients. The building will have well-equipped facilities to perform high standards of healthcare in the Southeast Asian region. It will provide 350 beds, 16 operating rooms and 14 Intensive Care Units, and also comprehensive service centers such as Stem Cell Transplantation, Minimal Invasive Endoscopic Surgery Center, Elderly Care Unit, Child Development Center and Complicated Diseases Service by specialized doctors.

There are two pharmacy departments at Somdech Phra Debaratana Medical Center, Ramathibodi hospital. The first pharmacy department located on the first floor of the building, it serves out-patients. Another pharmacy department located on the sixth floor of the building, it serves inpatients. For the inpatient system, when patients admit, the doctor prescribes via a computer program and sends directly to the inpatient pharmacy. The current inpatient drug system of this section is a combination between three days for oral preparation and one day dose for injection forms.

There are three types of prescription order as follow;

1. Continuous orders: the doctor prescribes via hospital chart and a computer program, the program works automatically until the doctor stop to use the medicine. The drug distribution system of this inpatient separates with two categories. The first is injection dosage form, this type distributes with one day dose. When the doctor stops this type via a computer program, the medicines will stop suddenly. Others are three dose distribution, when the doctor stop using medicines via a computer program they are not dispensed to ward but sometimes still have unused medicines in the ward.

2. One day order: the doctor prescribes via hospital chart and computer program, the program generate only one time. If the doctor wants to use the medicines again need to prescribe via medical chart and computer again.

3. As need or prn: the doctor prescribes via hospital chart and computer program. The doctor prescribes for one time when medicines are exhausted, nurse can re-order via computer program.

The current inpatient logistic system at this hospital is a combined floor stock and individual logistic system. Criteria for floor-stock medicines selection depends on wards. When the doctor prescribes medicines via computer, pharmacist receives the order, checking, and submit the order via computer. The medicine preparing step, pharmacy assistances prepare and pack them into blue box in each ward. There are two types of medicines transferring boxes; a blue box for general orders and a blue box with an orange sticker for the urgent orders. The urgent order composes of home medication, medicines that doctor needs to use urgently, returned medicines of inpatient who will discharge, and medicines that must keep under 2-8 degrees Celsius.

The current drug dispensing and returning process of inpatient system show in figure 4.1 and 4.2, respectively.

Process	Patient	Doctor	Nurse	Pharmacist	P.A*	RFS**
1. Prescribing order via chart						
2. It is new order or not						
3. Prescribe order via computer program						
4. Nurse check order						
5. Nurse submits the order to pharmacist via computer						
6. Pharmacist check the order correct or not						
7. Pharmacist choose the ward which print label, submit finance department and confirm order						
8. Pharmacist print the conclusion of medicines then send it to preparing						
9. Prepare medicines for inpatient						
10. Pharmacist checks the medicines correct or not						
11. Pharmacy assistance pack the medicines in the blue box						
12. Pharmacy assistance call messenger to send medicines back to the ward						
13. The messenger send the medicines to the ward						
14. A nurse check the medicines correct or not						
15. A nurse administer medicines to the inpatient						
16. The doctor order to stop using some medicines						
17. The inpatient wants to return unused medicines						
18. The doctor orders discharge						

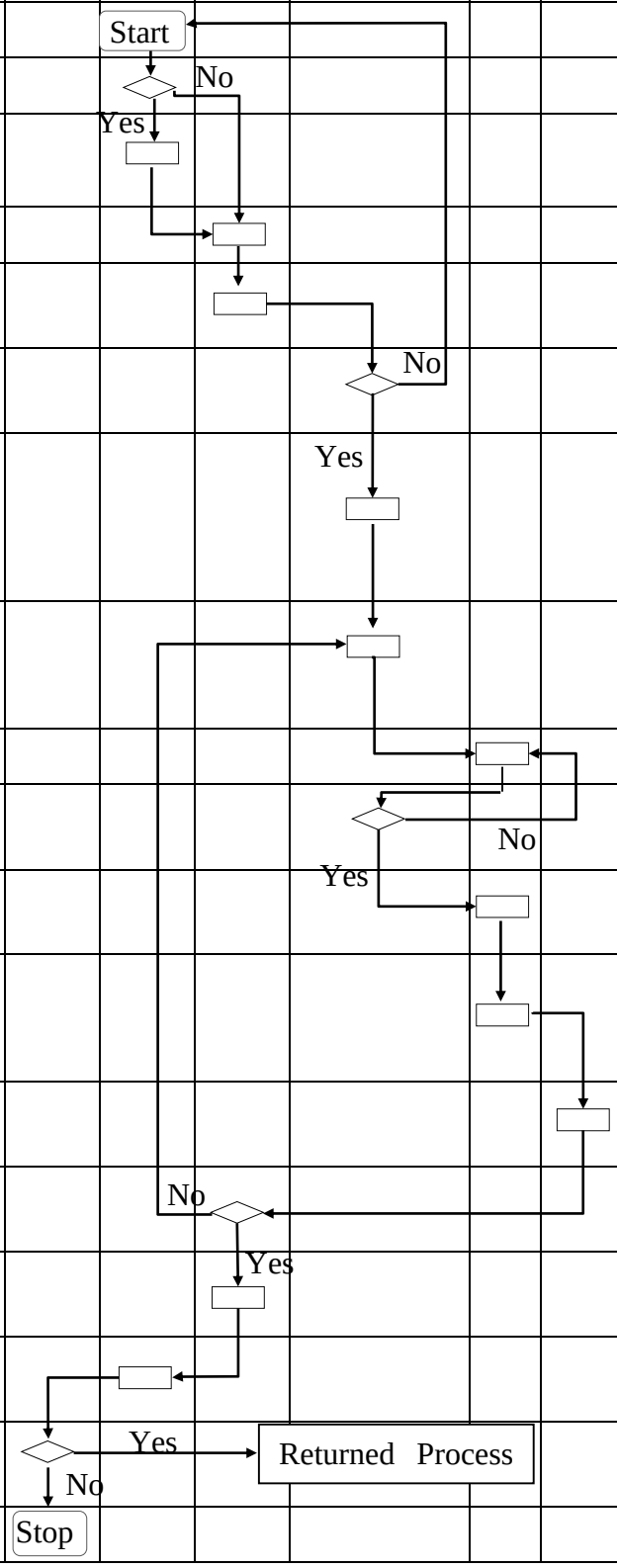

Figure 4.1 The forward (dispensing) process

*P.A = Pharmacy assistance **RFS = Messenger

Process	Patient	Doctor	Nurse	Pharmacist	P.A*	RFS**
1. The patient wants to return medicines	Start					
2. The doctor stop using medicines or not		No				
3. The nurse find the reason for returned medicines	Yes					
4. The doctor approve the returned medicines						
5. Nurse collects the medicines and key return via computer program						
6. The order is urgently or not		Yes				
7. Nurse pack medicines in blue box			No			
8. Wait for around the transportation						
9. Nurse pack medicines in blue box with orange sticker						
10. Call to messenger						
11. The messenger bring it to the pharmacy department						
12. Pharmacist check the receiving medicines program, correct or not			No			
13. The pharmacist submit information to financial department				Yes		
14. The pharmacy assistance manage the returned-medicines					Stop	

Figure 4.2 The reverse (drug-return) process

*P.A = Pharmacy assistance **RFS = Messenger

Inpatient pharmacy department receives the returned medicine from the wards every day. The returned medicines are medicines that unused, unwanted, nearly expired, or uncompleted. In each step of reverse logistic on medicines uses healthcare professionals such as nurses, pharmacists and pharmacy assistances, and outsourcing staffs that called the messenger. The process starts from the inpatient needs to return medicines then the nurse must find the reason for returning. For the most reason why the inpatient need to return is the patient stop using the medicines and another reason show in table number 4.7. When the inpatient needs to return and nurse know the reason the next step is nurse ask for doctor approve to return medicines. Then nurse collect the returned-medicines and key it via computer program submit to inpatient pharmacy unit. The information of returned medicine composed of name and amount that nurse wanted to return. After that waiting for outsourcing staff bring them to an inpatient pharmacy unit. There are two types of returned medicines follow as;

a) General returned medicines: there are two rounds per day (at morning and afternoon). Returned medicines in this type are not urgent.

b) Urgently returned medicines: nurse calls an outsourcing staff for bring them to inpatient pharmacy unit hurriedly.

When the returned medicine box arrived at inpatient pharmacy unit, a pharmacist checking medicines returned with an order that nurse key via computer. A pharmacist can correct a number of medicines returned. The reused and un-reused medicines, pharmacy assistances manage them all. Medicines that can reuse will be brought in their shelves. For medicines, that cannot be reused, waiting for destruction.

The returned medicines that pharmacist can receive are defined as follow;

1) The medicine has not been open.
2) The medicine has been kept in suitable temperature.

Table 4.7 The reason of returned medicines

Reason	Frequency	%
Stopped using medicines	64	48.12
Patient discharge	54	40.6
Incorrect sent medicines	13	9.77
Uncompleted medicines	1	0.75
Expired/ Nearly expired	1	0.75
Others	0	0

Moreover, one factor that impact the reverse logistics processes was the staff's satisfaction. The staff's satisfaction score with reverse logistics process of inpatients system shows in table 4.8.

Table 4.8 The satisfaction score of reverse logistics process

Satisfaction with the reverse logistics process of inpatients system	Mean	Meaning	SD
1. The process/ step in reverse logistics of inpatient system is proper and quick	3.27	Moderate	1.73
2. No errors evidence in the process/ step of reverse logistics	3.56	High	0.75
3. Enough healthcare staffs	3.53	High	0.76
4. The duration of each step is appropriate	3.49	High	0.78
5. The appropriate of equipment	3.65	High	0.78
6. The appropriate of communication between wards and pharmacy unit	3.51	High	0.79
7. The appropriate of communication channels	3.60	High	0.77
8. The appropriate of work place	3.82	High	0.75
9. Total	3.55	High	0.15

Score	Meaning
4.21 - 5.00	Extreme
3.41 - 4.20	High
2.61 - 3.40	Moderate
1.81 - 2.60	Low
1.00 - 1.80	Very Low

From table 4.8, the satisfaction survey of healthcare workers had found that the healthcare workers satisfaction in the reverse logistics process, by over view, was in high level (mean = 3.55, S.D. = 0.15). Considering healthcare worker's reverse logistics process satisfaction on the management, they were also in high level: no errors evidence in the process/ step of reverse logistics (mean = 3.56, S.D. = 0.75), enough healthcare staffs (mean = 3.53, S.D. = 0.76), the duration of each step is appropriate (mean = 3.49, S.D. = 0.78), the appropriate of equipment (mean= 3.65, S.D. = 0.78), the appropriate

of communication between wards and pharmacy unit (mean= 3.51, S.D. = 0.79), the appropriate of communication channels (mean = 3.60, S.D. = 0.77), the appropriate of work place (mean= 3.82, S.D. = 0.75). Only one management that was “the process/ step in reverse logistics of inpatient system is proper and quick” get the medium level (mean= 3.27, S.D. = 1.73).

Part III: The current issues that impact the reverse logistics process from wards into inpatient pharmacy

The current issue that impacts the reverse logistics process from wards to inpatient pharmacy as follow;

3.1 The large amount of returned medicines

From the table number 4.3 the frequency, drug amount and, value of reverse logistics on medicines in one year, there are almost 15% of dispensed medicines return to the pharmacy department and the value of returned medicines are 19,291,770.35 THB. It is quite a high rate amount return. That is one of the existing problems of this reverse logistics system. The result shows the amount of dispensed and returned medicines. The criteria for selection the medicines that are the returned medicines with a high amount and price. The top twenty of returned medicines with a high amount and price are selected are shown in table 4.9 and 4.10 show.

Table 4.9 The top twenty of returned medicines with high price

No.	Drug name	Total value (THB)	Total return amount (unit)	% of dispensed only one time	Frequency of dispensed
1.	Meropenam 1 Gm. Inj	1,145,856.00	1,047	3.92	Every day
2.	Tazocin inj (original)	620,103.00	1,002	4.08	Every day
3.	Maxipime inj	605,517.00	959	5.13	Every day
4.	20% Human albumin	580,729.00	584	9.33	Uncertain
5.	Imipenam inj	406,000.00	572	5.00	Every day
6.	Clindamycin inj	399,926.00	1,158	6.10	Every day
7.	Ondansetron 4 mg inj	360,627.75	10,179	68.24	Uncertain
8.	Mycamine inj	360,480.00	122	15.00	Every day
9.	Pegfilgrastim 6 mg in 1 ml inj	324,428.00	26	0.00	Every day
10.	Tigecycline inj	322,048.00	142	0.00	Every day
11.	Dynastat inj	316,848.00	1,315	34.96	Uncertain
12.	Tazocin inj (local made)	294,633.00	1,723	3.76	Every day
13.	Ertapenem inj	292,864.00	261	7.08	Every day
14.	Cefazolin inj	291,864.75	11,918	7.07	Every day
15.	Cymevene inj	288,176.00	170	0.00	Every day
16.	Norepinephrine inj	259,578.00	1,271	52.54	Uncertain
17.	Vancomycin inj	230,686.75	2,194	6.15	Every day
18.	Pantoprazole inj	222,600.00	847	6.30	Every day
19.	Cancidas inj	220,813.00	34	0.00	Every day
20.	Meronem 500 mg. inj.	213,012.00	249	10.77	Every day

Table 4.10 The top twenty returned medicines with large amount.

No.	Drug name	Total return amount (unit)	Total value (THB)	% of dispensed only one time	Frequency of dispensed
1.	Metoclopramide 5 mg/1 ml	14,209	65,493.00	81.46	Uncertain
2.	Cefazolin inj	11,918	291,864.75	7.07	Every day
3.	Paracetamol 500 mg	11,809	5,682.50	56.68	Uncertain
4.	Ondansetron 4 mg inj	10,179	360,627.75	68.21	Uncertain
5.	Tramadol 50 mg/ml in 1 ml	8,784	132,664.50	87.2	Uncertain
6.	Chlorpheniramine maleate 10 mg/1 ml	6,016	28,044.00	84.9	Uncertain
7.	Ceftriaxone 1 gm	4,746	148,608.00	7.89	Every day
8.	Prednisolone 5 mg	4,619	5,676.25	21.95	Every3 days
9.	Air-X 2 mEq	4,335	5,298.75	21.4	Every3 days
10.	Sodium bicarbonate 300 mg	4,170	1,962.50	6.72	Every3 days
11.	Senosides A & B 7.5 mg	4,156	6,917.75	45.01	Uncertain
12.	Loperamide 2 mg	4,129	29,565.00	95.22	Uncertain
13.	Tramadol 50 mg	3,996	6,769.00	50.4	Uncertain
14.	Morphine sulfate 10 mg/1 ml	3,643	32,993.50	56.08	Uncertain
15.	0.9% soium chloride 1% in 5 ml	3,540	29,503.50	13.73	Uncertain
16.	Domperidone 10 mg	3,492	3,227.00	40.41	Uncertain
17.	Lorazepam 0.5 mg	3,473	2,227.75	73.66	Uncertain
18.	Cefuroxime sodium 750 mg	3,357	161,815.50	4.16	Every day
19.	Ondansetron 8 mg inj	3,058	119,180.25	64.48	Uncertain
20.	Dexamethasone 4 mg	2,075	5,005.00	73.98	Every3 days

From the type of prescribing, there are three types that mentioned above but the hospital database can identify only one type that is a continuous type. For another two types (one day and prn type) are hard to identify because the medicines of this two type can be selected as one day or prn type such as Metoclopramide injection the doctor can prescribe for one day or prn based on the consideration of the doctor.

From table 4.9 and 4.10 found that the majority of returned medicines with high value is antibiotic drugs. The antibiotic drugs are the following

a) Meropenam 1 Gm. Inj
b) Tazocin inj (original)
c) Maxipime inj, Imipenam inj
d) Clindamycin inj
e) Tigecycline inj
f) Tazocin inj (local made)
g) Ertapenem inj
h) Cefazolin inj
i) Cymevene inj
j) Vancomycin inj
k) Cancidas inj
l) Meropenam 500 mg. inj
m) Ceftriaxone inj
n) Cefuroxime sodium 750 mg inj

All of the medicines were dispensed more than one time and dispensed every one day, it might conclusion that the antibiotic drugs are continuous types. Besides the antibiotic drugs, there are other medicines such as Pegfilgrastim 6 mg in 1 ml inj, Pantoprazole inj, and Omeprazole 40 mg inj that are the continuous type also because of they were dispensed every day. For other oral medicines left that are Sodium bicarbonate 300 mg tab, Prednisolone 5 mg tab, Air-X 2 mEq tab, and Dexamethasone 4 mg tab were dispensed every three days, so they are the continuous type also. Another medicine which have the frequency of dispensing uneven might be conclusion that they are prn or one-day medicines type.

From tables 4.9 and 4.10 can be concluded that the continuous drugs as follows:

1) Air-X 2 mEq tab
2) Dexamethasone 4 mg tab
3) Cancidas inj
4) Cefazolin inj
5) Ceftriaxone inj
6) Cefuroxime sodium 750 mg inj
7) Clindamycin inj
8) Cymevene inj
9) Ertapenem inj
10) Maxipime inj, Imipenam inj
11) Meropenam 1 Gm. Inj
12) Meropenam 500 mg. inj
13) Omeprazole 40 mg inj
14) Pantoprazole inj
15) Pegfilgrastim 6 mg in 1 ml inj
16) Prednisolone 5 mg tab
17) Sodium bicarbonate 300 mg tab
18) Tazocin inj (local made)
19) Tazocin inj (original)
20) Tigecycline inj
21) Vancomycin inj

The problem of a continuous type such as antibiotic drugs is a large amount of returned medicines per one time. It can see that the average returned medicines are slightly more than the average dispensed medicines but sometimes there are returned medicines with high volume, the example of continuous medicines show in figure number 4.3.

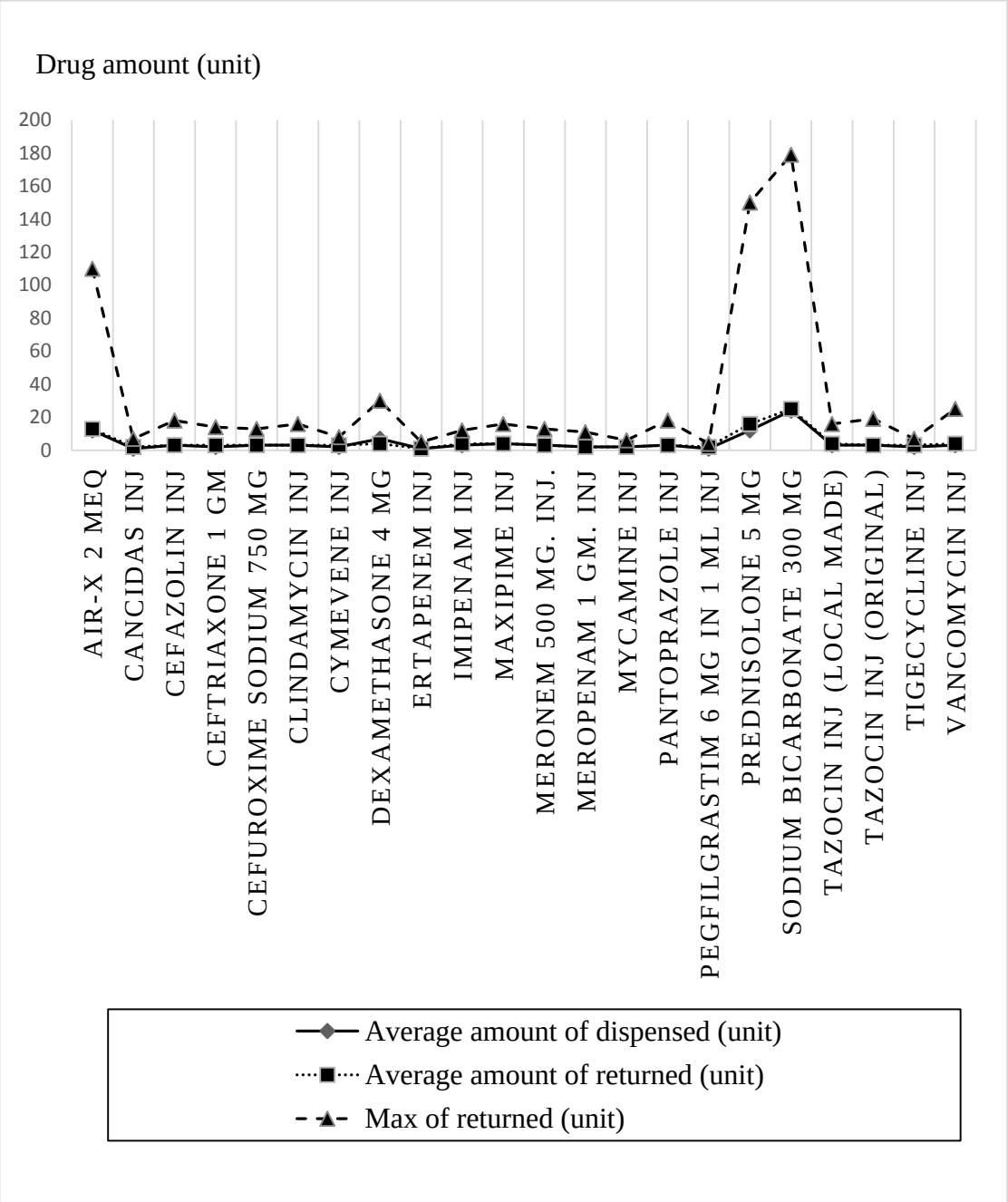

Figure 4.3 The average of dispensed and returned, and the maximum of returning of continuous injection medicines

The majority of the average returned medicines which are continuous type is equal to the average of dispensed, there are 12 items of them that more than that. Even the normally is slightly good logistics and reverse logistics system but sometimes there are returned with a large quantity of medicines that is the problem of the continuous

type. The example of this pattern is Tazocin injection (original), the average dispensed is 3 vials and returned is 4 vials per day but there are one time that highest amount return that is 19 vials. Normally, a patient returns only one time per medicine but sometimes returns more than once. The example of dispensed and returned Tazocin injection (original) of one patient is shown in table 4.11.

Table 4.11 The example of one patient who had information about dispensing and returning of Tazocin injection (Original brand)

No.	Date	Time	Dispensed/ Returned	Amount (vial)
1	24/11/2014	16:22:30	Dispensed	5
2	25/11/2014	8:41:30	Dispensed	4
3	26/11/2014	7:16:30	Dispensed	4
4	27/11/2014	7:12:30	Dispensed	4
5	28/11/2014	7:05:20	Dispensed	4
6	29/11/2014	6:26:00	Dispensed	4
7	30/11/2014	7:41:30	Dispensed	4
8	1/12/2014	7:30:30	Dispensed	4
9	2/12/2014	7:14:00	Dispensed	4
10	3/12/2014	7:35:30	Dispensed	4
11	4/12/2014	7:31:30	Dispensed	4
12	5/12/2014	7:55:10	Dispensed	4
13	6/12/2014	0:45:40	Dispensed	4
14	7/12/2014	0:52:00	Returned	-19

Table number 4.11 shows that this medicine was stopped using at least 4 days but the medicine was sent into the ward and the nurse ignored to return them. The nurse did not return unwanted medicines on real time.

Another example comes from Prednisolone 5 mg tablet, the representative of the continuous type as a tablet. Table number 4.12 shows the example of one patient

who uses this medicines the information of this table compose of date, time, an amount of dispensed and returned medicines.

Table 4.12 The example of one patient who had information about dispensing and returning of Prednisolone

No.	Date	Time	Dispensed/ Returned	Amount
1	25/8/2015	12:59:10	Dispensed	28
2	28/8/2015	7:14:40	Dispensed	24
3	31/8/2015	6:26:20	Dispensed	24
4	3/9/2015	7:58:10	Dispensed	24
5	5/9/2015	18:37:50	Dispensed	12
6	6/9/2015	7:29:50	Dispensed	24
7	8/9/2015	7:53:30	Dispensed	9
8	9/9/2015	7:06:20	Dispensed	24
9	11/9/2015	7:25:30	Dispensed	9
10	12/9/2015	0:05:50	Dispensed	24
11	15/9/2015	7:20:20	Dispensed	24
12	18/9/2015	7:45:40	Dispensed	24
13	21/9/2015	7:52:40	Dispensed	24
14	23/9/2015	3:28:00	Returned	-150

It appears that this medicine was stopped using at least five days but the medicine was sent into the ward and the nurse ignored to return. The nurse did not return unwanted medicines on real time.

Another types of medicines are one day and prn type. For the one day and prn dispensed type, the percentage of one day dispensing is slightly higher than the continuous type can see in table 4.9 and 4.10. The only one time dispensed percentage is high and the dispensed frequency is uncertain, so the one day or prn medicines type follow as;

a) 0.9% Soium chloride 1% in 5 ml
b) 20% Human albumin
c) Chlorpheniramine maleate 10 mg/1 ml
d) Domperidone 10 mg tab
e) Loperamide 2 mg tab
f) Lorazepam 0.5 mg tab
g) Metoclopramide 5 mg/1 ml
h) Morphine sulfate 10 mg/1 ml
i) Norepinephrine inj
j) Ondansetron 4 mg inj
k) Ondansetron 8 mg inj
l) Paracetamol 500 mg tab
m) Senosides A & B 7.5 mg
n) Tramadol 50 mg tab
o) Tramadol 50 mg/ml in 1 ml

The problem of prn or one day type is the large amount of unused medicines same with the continuous type. When looked at the figure number 4.4, the percentage of unused medicines of this type is slightly high such as the Metoclopramide 5 mg/1 ml inj, the percentage of unused medicines is 64.8 it mean that the dispensed medicines have not used until return. This result showed about the burden of nurses and pharmacists that worked as double time. The percentage of unused medicines are shown in figure 4.4.

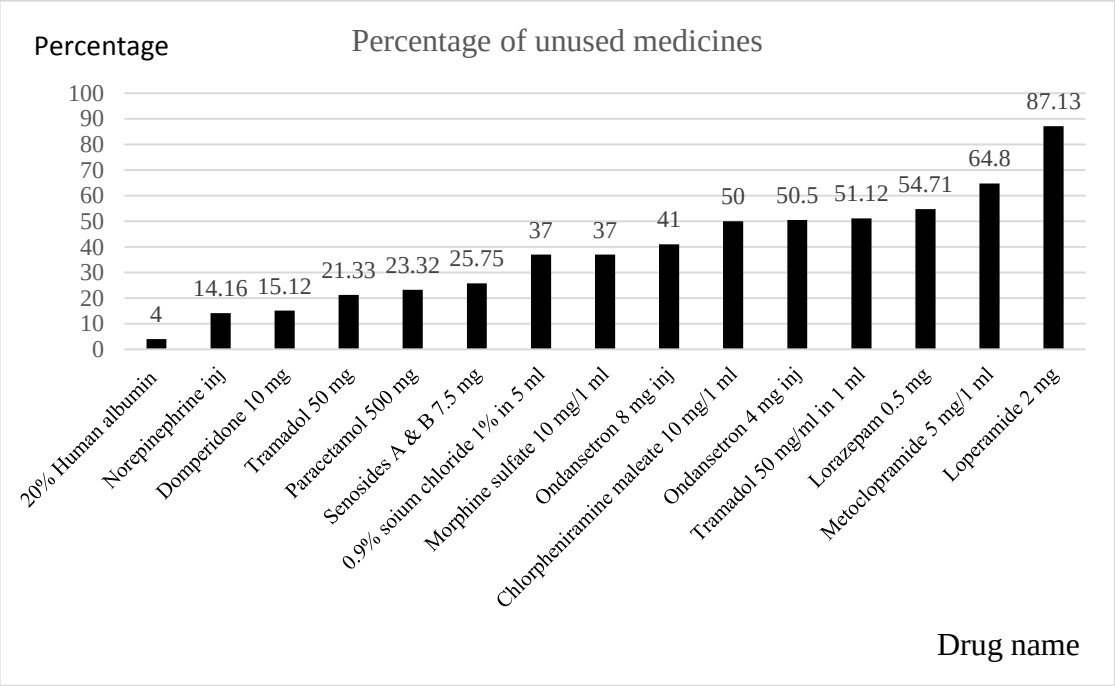

Figure 4.4 The percentage of unused medicines

There were 13,289 events of dispensed medicines that never used after they were dispensed to the ward. This result showed about the burden of nurses and pharmacists that worked as double time

3.2 The high volume and value of unable returned unused medicines

Another existing problem is high volume and value of unable returned unused medicines**.** The value of this event was 931,409.75 BHT in one year. This problem is the most mentioned in the questionnaire see in table 4.13.

Table 4.13 The existing problems mentioned in the questionnaire

Issue	Frequency	%
1. Unable to return unused medicines	42	58.34
2. Drugs information from computer program is not complete	12	16.67
3. Don't follow the guideline	10	13.89
4. Doctors not stop using medicines via computer	5	6.95
5. Cannot receive the separately tablets.	2	2.78
6. Uncertain quality of returned medicines	1	1.39
7. Total	72	100

There are two factors in this problem as follow;

1) Time

According to the detail of frequency, drug amount and, the value of reverse logistics on medicines that show in table 4.3, there were 2,101 of 3,183 return orders that no time receiving from the inpatient pharmacy department. The value of this event was 524,598.00 BHT in one year. From the personnel interviewing the healthcare workers who work at the hospital in this study, the meaning of no time receiving is the returned medicines are found after patients go home already. It might conclude that the importance factor that creates the high volume and value of unable returned unused medicines is time to return medicines.

2) Degenerate medicines returning

The last factor of this problem is cannot receive the uncertain quality of returned medicines. The majority of un-received medicines from inpatient pharmacy is medicines with keep in the 2-8 degree Celsius such as Micafungin injection, Recombinant human epidermal growth factor, etc. Even some medicine returned with less amount but get a high price. The top twenty of the unable to return medicines with high-value show in table number 4.14. Almost of this event are the medicines with keep temperature during 2-8 degree Celsius. There is only three oral form that is Ebixa solution, Lanthanum carbonate tablet, and Magnesium amino acid chelated that pharmacist cannot receive.

Table 4.14 The top twenty of the unable to return medicines with high value

No.	Drug name	Returned value (THB)	Returned amount (unit)	Storage*
1	Meropenem 1 Gm inj	21,261.00	19	Room temp.
2	Caspofungin inj	14,246.00	2	2-8 °C
3	Flixotide Nebules	7,353.00	114	Room temp.
4	Lenograstim (rhGCSF)	6,714.00	6	2-8 °C
5	Micafungin sodium inj	6,008.00	2	2-8 °C
6	Addamel-N	5,270.00	17	Room temp.
7	Recombinant Human Epidermal Growth Factor	4,742.00	2	2-8 °C
8	Lenograstim (rhGCSF)	4,422.00	3	2-8 °C
9	Ebixa Solution	4,399.00	1	Room temp.
10	Lanthanum carbonate tablet	4,038.50	41	Room temp.
11	Erythropoietin alfa	3,254.00	2	2-8 °C
12	Magnesium amino acid chelated	3,094.00	442	Room temp.
13	Filgrastim (GCSF)	3,000.00	4	2-8 °C
14	Levetiracetam inj	2,980.00	1	Room temp.
15	Clindamycin phosphate inj	2,872.00	8	2-8 °C
16	Octreotide inj	2,688.00	6	2-8 °C
17	Filgrastim (GCSF)	2,415.00	1	2-8 °C
18	20% Human albumin 50 ml	2,056.00	2	2-8 °C
19	MTV inj	2,007.00	9	Room temp.
20	Duratocin inj**	1,992.00	2	2-8 °C

*site: http://reference.medscape.com/drug/cancidas-caspofungin-342584#11

**site: https://www.betterhealth.vic.gov.au/searchresults?q=duratocin

The example of medicines with high price is Ebixa solution (4,399.00 BHT/ bottle), it was opened and returned to inpatient pharmacy. If the pharmacist did not check very well, the hospital will be loss.

Part IV: The root causes of reverse logistics problems from wards into inpatient pharmacy

According to the existing problems that describe in part III. There are two major problems that shows in this study as follow;

4.1 The large volumes of returned medicines when compare to dispensed medicines.

Normally, there are three types of medicines but the prescription pattern of one day and prn depend on the direction of the doctor, therefore only two types that are continuous and the one day or prn type.

4.1.1 The continuous type: the pattern dispensing of continuous medicines are different between injectable and oral dosage form that mentioned in part II. The three days dose dispensing of oral medicines are create a large amount of medicines stock in the ward more than one day dose dispensing of injectable medicines. So the study was to analyze the factors that are the root cause of this problem. The systematic thinking was used to analyze the factors as follow;

i. Man: According to the table number 4.8 the satisfaction score of reverse logistics process found that the man power of the process is enough, thus this factor is not the main cause of this problem.

ii. Money: This problem made the irrational payment for the patient that is some medicines especially for the separately tablet with price less than 50 THB were stopped using but dispensed to the ward. If the nurse ignore to return them, although these tablets are not high price, but it is wasting money by not properly of the patient.

iii. Management: This factor is the main root cause, first of all, the large amount of returned continuous medicines come from automatic

dispensed medicines with stopped using by the doctor. When the doctor stopped using medicines, they need to stop the two channels that are stop via medical chart and computer program. Currently, some events the doctor forgot to stop using medicines via computer program, so the continuous medicine will automatic dispensing and stock in the ward until patient discharge. The other importance root cause is the pharmacists do not see the hard copy of doctor order, they see it via computer program only. Another point is the three days dose distribution of oral medicines is the one of the root cause of this problem. For example, the doctor prescribes one oral medicine, take four tablets after meal three times per day, the automatic dispensed every three days so the medicines stock at the ward 36 tablets. If the next day the doctor ordered to stop using medicine, there are lots of the remaining medicine at the ward.

iv. Materials: The material that is involved in this problem is the uncomfortable to stop using medicines via computer by the doctor. When the doctors need to prescribe medicines, they will work as twice. Moreover, the insufficient of computer at the wards is the importance factor that causes this problem.

v. Process: The first importance process that is directly affecting is stop using medicines process. Because of a real root cause come from this process. This process allows only the doctor can stop using the medicines. Another factor is the revers process, the majority of this reverse process is the nurse return unused medicines only one time. In fact, the nurses must return unused medicines after doctor order stop using suddenly but they cannot because of their workload. According to the figure number 4.2 the drug-return processing at Somdech Phra Debaratana Medical Center, Ramathibodi hospital. Almost of this process occur at the ward, it make a nurse burden even make a return every day. Many times the return process is occur after doctors order discharge.

4.1.2 The one day or prn type: the pattern dispensing of one day or prn medicines are the same between injectable and oral dosage form. Normally, this two type start with the same pattern that is doctor order and pharmacist dispense via computer program, but there is one different that is the one day order cannot re-order but the prn can re-order by nurse. The existing problem of this two type medicines is a lot of unused medicines. The analysis of factors that involved this problem as follow;

i. Man: The same as a continuous type that is the sufficient of man power, based on the information from the respondent in table number 4.8.

ii. Money: This factor does not affect the problem.

iii. Management: This factor is the one of the main root cause. Because of this type is managed to withdraw and keep in the ward until patient gets a symptom. Many times found that the medicines have not been used, as the information found in figure number 4.4. Moreover, sometimes there is a double withdrawal especially for the prn medicines because it is only one type that allowed nurse to prescribe via computer program.

iv. Materials: The material that is involved in this problem is the large amount dispensing of one day and prn medicines. When they dispensed more, the returned would very much as well.

v. Process: The same as a continuous type that is the majority of this reverse process is the nurse return unused medicines only one time, it makes a lot of return medicines. In fact, the nurses must return unused medicines after doctor order stop using suddenly but they cannot because of their workload. According to the figure number 4.2 the drug-return processing at Somdech Phra Debaratana Medical Center, Ramathibodi hospital. Almost of this process occur at the ward, it makes a nurse burden even make a return every day. Many times the return process occurs after doctors order discharge.

After the analysis of the factors related to the issue were found that the management of drug distribution is the most importance factor that impacts this problem. If this hospital creates a suitable of drug distribution system, it can reduce the magnitude of the problem.

4.2 The second important issue is the high volume and value of unable returned unused medicines

The value of un-return medicines was 931,409.75 THB, information based on hospital database in table number 4.3. There are two factors of this issue as follow;

4.2.1 Time: there were 2,101 orders that delayed return. Time using in each step of reverse logistics is the most importance factor. The root causes of delayed return are analyzed as follow;

i. Man: Because of the mainly of un-return medicines are the urgent order, so this step needs to call the messenger to bring the medicines to pharmacy department. According to the time using in each step (table no.4.4) found that this step is the most time-consuming (0.36 hour or 21.6 min). If during that time, the other wards needed to run the service from outsourcing staff (the messenger) as it makes a number of staffs were not enough, therefore may cause delays. Moreover, time to search drug name of nurse is another root cause.

ii. Money: This problem made the irrational payment for the patient because of they did not use the medicines but had to pay.

iii. Management: Nurse is the main person who manages the return medicines especially the urgently return. The urgent return such as discharge order or medicines that must be kept temperature during 2-8 degree Celsius. This urgent return need the nurses call the messenger but they cannot call directly, need to inform the central of outsourcing staffs first then it called outsource staff. After that ward waits to the messenger for bringing the medicines to inpatient pharmacy, it takes time.

iv. Materials: The material that is involved in this problem is the same color boxes. Sometimes the returned medicines were already sent to inpatient pharmacy but they did not found them. Many boxes of returned medicines came to inpatient pharmacy and all urgent boxes are the same color and pattern, so it made pharmacist hard to find the correct one.

v. Process: This process starts form the doctor order discharge, nurse clear the unused medicines and key in the computer program after that call to the central of messenger to inform them about the urgent order and wait for them. The messenger came to the ward and bring the return medicines to inpatient pharmacy department suddenly. The waiting time of the process is the root cause of this problem because of the inpatient pharmacist did not find the return medicines, so they cannot receive them via a computer program.

In conclusion, the root causes of this factor are the time consuming of the return process, time using for searching drug name, and the return boxes.

4.2.2 Deteriorated medicines returning: the deteriorated or uncertain quality of returned medicines such as some medicines need to keep the temperature below 8 degrees of Celsius but when they have returned the temperature in their box was not suitable. Some medicines were launched, the inpatient pharmacist cannot receive it. The root causes of this factor were analyzed as follow;

i. Man: Because of the mainly of uncertain quality medicines with high price are medicines to be kept during 2-8 degree Celsius such as Recombinant Human Epidermal Growth Factor, Erythropoietin alfa, Filgrastim (Neutromax), Clindamycin phosphate, Octreotide, and Filgrastim (Neuprogen). The knowledge of drugs storage is a limitation, some staffs have a little.

ii. Material: The returned boxes are the material that creates a problem because it is not appropriate. Although the boxes are devices that provide cooling, but the cold might have not long enough. When they come to inpatient pharmacy, the temperature is not appropriate.

iii. Money: A budget of this hospital is enough, so the money is unlikely to be the main cause of the problem.

iv. Management: The knowledge management of drug storage is not enough. The workload is the foundation may make some staffs forgot to be aware of this.

v. Process: This return process of this kind of medicine same the others that are when the nurse key return they prepare the medicines into the box and wait for transferring step. But for the medicines that must be kept in the refrigerator, if the nurses know that they will pack them into the box with a cooling device and call the messenger suddenly. The one root cause comes from the staffs who do not know about the drug storage and the other root cause come from the packing process. Normally, the packing process, the nurse will pack after key suddenly and wait for the messenger, so this step take more time consuming. Moreover, the selecting process is the one root cause of this problem because the nurse did not select only reused medicines that can key-return but they key return all of the medicines that collected. Therefore, the number of degenerate medicines were keyed return as to high volume.

In conclusion, the most importance root cause of this factor is the knowledge of staffs.

Part V: The suggestion model to reduce the magnitude of reverse logistics

There are three suggestion models for this hospital as follow;

5.1 The suggestion for forward models

The suggested model come from the first problem that is the big amount of returned medicines. There are three suggestion models as follow;

5.1.1) For the injectable medicines, the distribution is still in its original form is one day dose. Due to problems in the present day the oral medicines are dispensed and returned in large quantities, so they should be changed to one day dose or unit dose for reducing the quantities of medicines. It can conclude that the unit dose distribution system is the appropriate model to solve this problem.

5.1.2) For the large amount of returned medicines that come from the one day or prn, the root cause is the almost dispensed medicines never open to use. Many times the amount returned medicines is equal to the dispensed. So the new model will change the management to add the medicines stock at ward by select the medicines with getting high percent of unused medicines such as Ondansetron 4 mg injection (see table number 4.9 the top twenty of returned injection medicines with high price). Currently, after the doctor order, the medicines were dispensed and wait for using. The new model will change to after doctor order via computer program but not send it to the inpatient pharmacy. When the patient needs to use the medicines, the nurse use medicines at stock ward after that send a request to the inpatient pharmacist for medicines withdrawal, this step the nurse can adjust the number of drugs that they use. After that the inpatient pharmacist checks the sent order with the copy order (the copy order may be sent by scan or paper depend on the hospital policy). This model comfortable for the nurse and can reduce the amount and value of unused medicines.

5.1.3) The last model is the continuous medicines management. The suggestion management is change to the confirming and checking order step.

Currently, the nurses have been assigned to this duty but should be changed to the pharmacist. Another management with should be changed is the stop using management step, the pharmacists can stop it via computer program when they see the order that doctor prescribe to stop using the medicines. So the pharmacists should take action about doctor order inseam of nurses.

The root cause of large amount returned medicines is not come from the reverse logistics process but come from the logistics process.

5.2 The suggestion for backward (reverse) models

These suggestion models come from the second problem that is the high volume and value of unable returned unused medicines. There are four suggestion models as follow;

5.2.1) The nurses key all unused medicines to inpatient pharmacy even they were deteriorated. It means that the nurse did not select the re-use medicines. The suggestion is the deteriorated medicines need to return without key, return for destroying. The nurse might be separate the re-used and non-reuse medicines in other color boxes. This suggestion can reduce the magnitude of returned medicine volume and save the risk of hospital loss.

5.2.2) Another point is the time consuming of searching for the drug name. Because of each medicine is many trade names but only one generic name, this problem make a burden for nurses. Some nurses know only trade name some know both generic and trade name. The main data information of medicines was generic name, so some nurses did not found the name of returned medicines when they search. A choice for solve a problem is to add the generic name on the label every medicine and tell them to look on a label before key in computer. The computer program can help the medical staffs in this case if the program allows only dispensed medicines can type into the returning program, it can reduce the time consuming. So, the suggested model for reducing the searching time is revised the computer program to appropriate using.

5.2.3) Another importance factor of the problem is the time consuming in transferring process. Currently, the transferring process of an urgently returned medicine of inpatient system starts with nurse call the outsource staff then waiting for them. This process took more time consuming that was more than 20

minutes. The new model will be changed to nurse aid for bringing the urgently returned medicines to inpatient pharmacy. This model can save labor cost 15 THB per one time and can save money for patient was 931,409.75 THB per one year.

5.2.4) The last suggestion is solved for the uncertain quality of returned medicines. From table number 4.14 the top twenty of the unable to return medicines with high value. The main type of uncertain quality medicines is medicines that to be kept in refrigerator (2-8 °C), the main root cause of this type comes from the knowledge of drug storage and the returning process. The new model for solve this problem is the pharmacist should provide the information or training staffs about drug storage, especially for the refrigerator medicines. Another suggestion is to add important information on drug label and supply the cooling boxes in every wards. The process should change that is when there are cooling medicines wait to return before transfer might keep them into the refrigerator and place the symbol on the return box.

CHAPTER V
DISCUSSION

In this chapter, the discussion is presented in four parts, as follow;

1. Descriptive data of the population and hospital database management process.
2. The current medicines logistic and reverse logistic process of inpatient system at Somdech Phra Debaratana Building, a new building of Ramathibodi hospital.
3. The current issues that impact the reverse logistics process from wards into inpatient pharmacy.
4. The root causes and factors of reverse logistics from wards into inpatient pharmacy.
5. The suggestion model to reduce the magnitude of reverse logistics.
6. The limitations of the study.

Part I: Descriptive data of the population and hospital database management process

1.1 Descriptive data of the population

The response rate of this study was 70.37%, which represented and sufficient number of study population (35). It was found that, response rate from inpatient pharmacists was the highest (83.33%) and the lowest was from pharmacist assistance (40%). It might be explained that the number of inpatient pharmacist (6 pharmacists) less than nurses (178 nurses) and they interested on this study, so they cooperated in answering the questionnaire as well. For the pharmacist assistances might not be interested this issue, so they sent back at least. It might be said that almost of data analysis came from nurses.

1.2 Data management process

Data in this study are taken from a drug module in hospital database which comprises one table. In a table related with medicines dispensing and returning data of inpatient who visited during study period. The analysis focused on the value, amount, and time of medicines dispensing and returning data. From data retrieval and validating process, there are some problems when retrieving electronic database that are 1) incomplete data record, such as no record of admission number and 2) no record of price in some returning medicines. These problems were also found in the study of Noksakda N. (36) when they used electronic database.

Details of such problems in data management process follow as;

1) The problem found in incomplete dispensing and returning data record that is no record of admission number of inpatient. From data validation process with 501,244 records in medicines dispensing and returning data table, it is found that 16,440 had no record of admission number but still had hospital number and also ward name. One possible cause for this problem is a technical technic such as computer program error in that time.

2) In medicines returning data which no record of time receiving from pharmacy unit, the medicines price had no record. From data validation process with 501,244 records in medicines dispensing and returning data table, it is found that 3,183 had no record of medicines returning price. One example from this problem that is the nurse keyed returning medicine which wrong code, so it no price data. The possible cause of this problem come from computer program and human error. The possible prevention of this problem could be revising the computer program especially for the returning data. The returning data might allow only dispensing medicines in that case can return.

1.3 Physical and Economic outcome indicators

From the physical and economic outcome indicators found that total amount of returned medicines per one year was 290,795 units and the value of returned medicines was 19,291,770.35 BHT. The proportion of the returned and dispensed medicines was 14.94% which is higher than the study of Leelaudomlipi (34), the study results that the proportion of the returned and dispensed medicines at the Crown Prince

Kuchinarai Hospital, Kalasin Province was 12.9%. The returning and dispensing proportion at Somdech Phra Debaratana Medical Center, Ramathibodi hospital was higher than the Crown Prince Kuchinarai Hospital because of the unsuitable drug distribution system, improper the re-check doctor order and unappropriated returned medicines process. Hospitals in Thailand face the same problems as the Crown Prince Kuchinarai Hospital, Kalasin Province and Somdech Phra Debaratana Medical Center, Ramathibodi hospital about lots of returned medicines.

This hospital spent the budget for irrational labor cost as 142,407.42 BHT per one year, 11,867.29 BHT per month, it meant that this hospital spent was like as hiring a nurse to work in this hospital because of the nurse's salary as 13,200 (37). The majority of this labor cost came from a messenger and a pharmacy assistance in transferring and managing returned drugs, respectively (see in table 4.6). The wage of those two staffs that were worth less, so the value of losing a year was not much volume. Although this loss budget less, but it is a capital loss not expedient. Moreover, the healthcare workers waste time for unsuitable reverse process equal to 2,355.42 hours per one year as 295 working days (2,355.422 hr/8 hr), for nearly a year, the hospital lost without benefit. It meant that in one year the hospital loss of time, to be developed on the other side a lot.

Part II: The current medicines logistic and reverse logistic process of inpatient system at Somdech Phra Debaratana Building, a new building of Ramathibodi hospital.

Reviewing of the hospital logistics, reverse logistics, and pharmacy management in the literatures found that there were two ways of the medicines management flows which is the forward and backward (reverse) flow. The current inpatient logistic system at this hospital is a combination of the individual inpatient system and the floor stock system as found in other hospitals in Thailand. The time intervals for dispensing are different between oral and injectable drugs. The time intervals for injectable drugs is one day and oral drugs is three days. The unit dose is a distribution system that the American Society of Health-System Pharmacists (ASHP)

organization recommends for safety and economy. There are several limitations of the unit dose system such as the knowledge of healthcare staffs, the number of staffs who work at inpatient pharmacy, the unit dose equipment, and communication with co-workers. In this case face the limitations that mention above, so it cannot select the unit dose system for inpatient.

The reverse logistics process in the literature review composed of collection, selection, reprocessing, disposal and redistribution. In this study, there are all processes except the reprocessing process. All processes in the literature review are done by the distributer because it is a pharmaceutical manufacturer. But for the hospital, only the collection that is done by the users (nurse) other processes are done by the distributer (pharmacy department). Moreover the reasons for reverse medicines in this study are the same as literature reviewing which patient refuses, medicine is no longer needed or not effective, treatment or dosage changes, or patient is discharged.

The other factor was staff's satisfaction, from the result found that most of healthcare staffs satisfied on the management of the reverse process on the medicine, but only one management that they gave a less score that was the "the process/ step in reverse logistics of inpatient system is proper and quick". They considered about the time used in each step, especially for the transferring step that took more time for send the returned medicines, that was the reason why the healthcare workers gave a less score for this management.

To increase the rate of satisfaction in this topic, there should be a threat to the transferring step more quickly. The example for threat this issue was change the transfer staff from a messenger to a nurse aid.

Part III: The current issues that impact the reverse logistics process from wards into inpatient pharmacy.

The problem of reverse logistics on medicines that impacts the entrepreneur is lots of returned medicines, in this research was 290,795 units per one year. These huge amount impacted the workload of all staff to manage the system such as finance, documentation, labor work, etc. One time of reverse logistics, there were completed and

uncompleted medicines as well as in the study of Aditya Suruchi (38). They studied about pharmaceutical waste in India. They found that the healthcare facilities generate 4,057 tons of waste/day. Although it was pharmaceutical industry, it can tell that the unused medicines create a big problem for entrepreneur and environment. According to the questionnaire, the main reverse logistics problem found in this research was unable to return unused medicines on time (58.34%). This problem creates a burden for hospital and patients. Hence, the hospital needs to reduce this burden by find the root cause and create an efficient reverse logistics model as same as the study of Alshamsi & Diabat, (33). Alshamsi and Diabat studied about reverse logistics network design to provide the optimal reverse logistics of washing machines and tumble dryers in the United Arab Emirates.

The last problem is the uncertain quality of returned medicines, in this case 8,496 units equal to 406,811.75 BHT per one year. If the pharmacist cannot check the returned medicines, it means that the hospital loss 406,811.75 BHT. Many hospitals in Thailand face this problem as this hospital. Mainly uncertain quality medicines are the refrigerated drugs which are expensive drugs.

Part IV: The root causes of reverse logistics from wards into inpatient pharmacy.

From part III of the discussion there are three factors in the reverse logistics problems on medicines, as follow;

1) The first factor is high return rate of unused medicines. There are two types of high return rate that are high value and high amount rate of return medicines. The main type of unused medicines with high value is the antibiotic drugs which is continuous type. The root cause of this factor is the doctor does not stop using the continuous medicines but the real root cause is the inappropriate medication management system. This hospital use on-line prescribing order and allow only doctors to order the medicines include stop using process. Moreover, pharmacists could not see the doctor order which is not an inappropriate management. On the other hand,

Christopher Olson who write the Hospital Pharmacy Management title in year 2012, recommended that the right organization to verify medicine order is the pharmacy (19).

Another type of medicines which has the same problem as continuous type is the prn and one day type. The root cause of this type is the medicines are not use after withdrawal. Most of them are injectable drugs with is used when patient get a symptom such as Metoclopramide injection, Ondansetron injection, or Tramadol injection, etc. Because of the all step of prescribing medicines, the doctors are the solely responsible, so the prn or one day medicines are withdrawn then stock at the ward until the patient get symptoms. Normally, less than 50% of them are used. The root cause of this factor is the inappropriate prescription management. Because of this, the hospital selects the combination of the individual inpatient system and the floor stock drug distribution system so the floor stock can select the prn or one day medicines commonly used such as the medicines that mentioned above. Moreover, the priority should be changed in the medicines withdrawal step to allow other healthcare workers, especially for the nurse should be able to adjust the amount of medicines that they want to withdraw.

2) The second factor is unable to return unused medicines on time, the root cause is the number of messengers is not enough when many wards need simultaneously. This hospital uses the external messengers to reduce the workload of healthcare workers but they did not concern about the number of the messenger if they are enough or not. Another root cause of this factor is the similar to returned boxes. The boxes of all wards are similar, so difficult for a pharmacist to find the correct one. Furthermore, the criteria of returned medicines which need to key return is not clear. There are no criteria for key return, so after nurses collect the unused medicines, they key all of them return to the pharmacy. It is not like the selection step because the nurse does not select only the reused medicines that need to key return but they key all. The responsible team to select the reused medicines is pharmacy but it takes time to do like this and increases workload to the pharmacy. The Environmental Protection Agency suggested (5) that the pharmacy takes a responsibility to determine unused medicines can be reused or not. In this study, it took double time for selection step that is at first, nurse collects, selects and keys to the pharmacy. Second, the pharmacist check it again that medicines can reused or not. An importance is some criteria nurse can determine that the unused medicines can reuse or not such as the opened injectable drugs or the

separating tablets which price less than 50 BHT (hospital policy). Another root cause is time consuming in key-returned step. When the nurses need to key return, they key the alphabet of the drug name. The computer program show all of drug name that have the keyed alphabet, so the nurse take time to find the correct one.

The second part of input is management analysis. In most case, the urgent returning order is patient discharge. The current management of this case starts with the nurse clear all of unused medicines of the inpatient who will be discharge sent back to the pharmacy department and key drug return information via computer program. Although some items are not received by the pharmacist but need to key return. The computer skill for searching drug name of nurses is not equal, so the time using of this step is long (6.6 min: see table 4.4 in chapter IV). Because the nurse types drug name (generic or trade name) via computer, some nurse found correct one, sometime could not found. Sometimes, there are errors because key with incorrect drug name and more time using. After nurse complete key return they pick them in the urgent box wait for outsourcing staffs sent it to pharmacy department together, several times it make a return after discharge.

3) The last factor is cannot receive the uncertain quality of returned medicines, the main root cause of this factor is the knowledge or concern of drug storage especially for the refrigerated drugs. Although the process is good, the staffs ignore the core of the process so, the outcome is not good such as this event.

This study analysed only the internal factors. The internal factors of this reverse logistics on medicines are economic (value of medicines, labor cost), hospital policy and the management. The study did not include the external factors as the study by Chen Ming in 2006 (25). Chen Ming analysed the driving factors of reverse logistics. The study found that there are two driving factors: internal and external driving factors. The internal driving factors of reverse logistics are economic interests (direct or indirect), legal restriction (environmental protection law) and social duty (social entitlement). For the external driving factors are more abstract such as products, components, raw materials and equipment, and even entire scientific systems. To implement the reverse logistics successfully could cut down the company and the whole supply chain's cost, and increase profits.

Part V: The suggestion model to reduce the magnitude of reverse logistics.

The suggestion model created based on the root causes of the factors to reduce the magnitude of reverse logistics on medicines. The suggestion models compose of model for forward and backward. There are three suggestion for forward models that are the unit dose distribution system, adjust the proper of ward stock medicines, and change the responsibility to determine medical order is a pharmacist. For the backward suggestion models compose of the nurse take a first collecting step, revised computer program, change the deliver return urgent medicines to nurse aid, and training the employees to recognize the importance of storage medicines.

4.1 The suggestion for forward models

1) Unit dose distribution system: there are many studies in Thailand that studied about the appropriate drug distribution system including the study by Faridah Moohamad in year 2003 (21). The result of study showed that the unit dose distribution system is appropriate to implement at the Pattani hospital because this system can reduce the administration errors and nursing time on medication related activities. However, cost in unit dose are high. The hospitals desire to implement the unit dose distribution should have enough budget, the Somdech Phra Debaratana Medical Center, Ramathibodi hospital is ready to implement this system.

2) Adjust the ward stock medicines properly: the most hospitals in Thailand implement the combined floor stock and individual prescription system because the cost of this system is less than the unit dose system (21, 39-40). However, the appropriately selecting the appropriate medicines in stock wards can reduce the workload and medicines value. This suggested model is easy to do because it just analyze the list of prescription drugs are not being used at all after dispensing.

3) The pharmacists take a responsibility to check the doctor order instead of nurse. As a study by Aungkurn Phawasutthipaisit (40), the study suggested that the pharmacist should take responsibility to check the doctor order. The advantages of this suggestion are to reduce the prescription errors, control the amount of dispensed medicines, and reduce the time consuming. At the Somdech Somdech Phra Debaratana Medical Center, Ramathibodi hospital can take this suggested model

because it slightly change from the original process. However, the direct effect is the number of inpatient pharmacists because the new model can create the burden of pharmacists. There are six inpatient pharmacists now, if change to the new model the number of pharmacists should increase.

4.2 The suggestions for backward (reverse) models

1) One factor that impact the time delayed return and high volume of unable returned unused medicines is nurse collects and keys return all of them. This problem solve with nurse selects the reused medicines before key-return to inpatient pharmacy. This suggested model needs the basic knowledge of medicines that can be reused. By the four questions that mentioned in Managing Access to Medicines and Health Technologies(19), the questions are easy to understand, the healthcare workers can understand. However, the pharmacists might check it again. This hospital can submit this suggestion because there are quality of healthcare workers that are able to develop themselves and ready to learn all the time.

2) Revise the computer program such as allows only the dispensed medicines that can key-returned. From a personal information, the returned program that allow only the dispensed medicines can key return is implemented at the Thammasat university hospital and other hospitals where implement the program of Abstract Computers company. This suggested model needs the budget if change the computer system. This hospital is the medical school, so there are enough budget and has the quality professional staffs that can create a suitable return-program.

3) For the urgent return, the nurse aid take a responsibility instead of the messenger. Because of the enough number of nurse aids or staffs at the wards, so this suggested model can develop at the first. Many hospitals in Thailand use the nurse aids or clerks at wards to send the order and returned medicines including Thammasat university hospital but some cases as urgently they use other device that is the tube to send it.

4) Train the employees to recognize the importance of storage medicines especially the refrigerated medicines. Training in the medical school hospital as this hospital is not difficult to do, but the concern of people is hard to change.

Part VI: The limitations of the study

1. The perspective of this study was considered only the two departments (Nurse and inpatient pharmacy) not including other departments (doctors, messengers, and finance).
2. The researcher has limited knowledge of reverse logistics, so in this study not include the last step of reverse logistics (storage and dispose unused medicines).
3. Because of the time limit, this study conduct only one hospital, it too small population.

CHAPTOR VI
CONCLUSION AND RECOMMENDATIONS

This chapter provide the conclusion of the study and recommendations for future study. The study combined questionnaire and retrospective hospital database analysis of reverse logistics on medicines inpatient system.

6.1 Conclusion

The current logistics on medicines of inpatient at Somdech Phra Debaratana Medical Center, Ramathibodi hospital is combined the floor stock and individual prescription system. The online prescription was used in this hospital, so the doctors and nurses take a major responsibility of this system. All of steps in the online depend on only the doctor, the role of pharmacist only confirm order via computer program. It decrease the pharmacist workload but sometimes creates some problems in other processes such as reverse logistics. In conclusion, there are three factors that are causing the reverse process problems, as follows:

1) The current reverse logistics process on medicines at Somdech Phra Debaratana Medical Center, Ramathibodi hospital is still having problems. The first factor that create the burden to staffs was the huge amount of returned medicines. The root cause of that factor was the unappropriated medicines management in all three types of medicines. To reduce this factor, the appropriate medicines management that is the unit dose drug distribution system should be implemented in this hospital. That for the continuous medicines type but for the prn and one day type, the appropriate management is selected the medicines that doctors order more often but rarely to administer such as Metoclopramide injection in the result part showed the high percentage of unused. When selected those medicines to stock at ward after doctor orders, nurses use the medicines at stock ward then withdraw with real use amount from the inpatient pharmacy. In that case, it can reduce time, workload and labor cost.

2) The major factor that creates dissatisfaction on healthcare staffs was the returned delay. The root causes of that factor were delayed-transfer and pharmacist did not see the returned medicines. To decrease this factor, the urgent order especially for discharge order, when the doctor prescribe, nurse should clear (key and pack) the unused medicines suddenly. When finish the key and pack step, the previous next step was calling the outsource staff to bring the returned medicines to pharmacy unit, but we suggest the new step that nurse aids can do this procedure to reduce time and cost. Another root cause of this factor was that pharmacist did not see the returned medicines, because of the same package of urgent order no matter if it is withdrawal or returned medicines, recommendation for this step is changing the package with difference style or color to use only for urgent returned medicines.

3) The last factor is uncertain quality returned medicines, this factor create the unappropriated disposed medicines. The valuable of those medicines are high especially refrigerated drugs but some medicines are low. For the refrigerated drugs, the root cause is the knowledge of drug storage, improper keeping boxes, and unsuitable refrigerated drugs reverse logistics process. In order to reduce this factor, first of all provide the information of drugs storage to healthcare workers who work relate to drugs used such as nurses, nurse aids, etc. Another point is support the suitable cooling boxes for refrigerated drugs in every wards. Moreover, the appropriate reverse logistics of refrigerated drugs such as return with appropriate cooling box and quickly. Another returned medicines with uncertain quality is separated tablets and medicines are opened from the package, cannot reuse following by the hospital policy. In this case all staffs in the hospital need to know, so the return step should not be happen.

6.2 Recommendations

6.2.1 Recommendation for the Policy maker

Due to the problems of reverse logistics on medicines occur many hospitals in Thailand. The national policy maker should concern about this issue to fine the optimum ways for reduce the problems.

6.2.2 Recommendation for other hospitals

1. Electronics database of the hospital is an important source for keep information. In some cases can detect the error from the hospital database. Moreover, the hospital database is the important information for learning the hospital management. However, the error can occur in the system. So the hospitals should have the data validation process monitoring continuously.

2. From the study, it could be concluded that if the hospital had an appropriate management of logistics and reverse logistics on medicines of inpatient system, it would be possible to decrease the magnitude of problems.

3. The system thinking was used to analyze the root cause of problems in this study. It would be possible that other hospitals select this technique to analyze their current problems.

6.2.3 Recommendations for future studies

1. Because only collecting and selecting return process between inpatient wards and pharmacy department were analyzed in this study, it would be beneficial to study the all processes of reverse logistics on medicines.

2. Another interesting aspect is to conduct the hospital data compare with medical records in some case.

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APPENDICES

APPENDIX A
LISTS OF EXPERT

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APPENDIX B

ETHICAL CLEARANCE

คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
๒๗๐ ถนนพระราม ๖ แขวงทุ่งพญาไท เขตราชเทวี กทม. ๑๐๔๐๐
โทร. (๐๒) ๒๐๑-๑๐๐๐

Faculty of Medicine Ramathibodi Hospital, Mahidol University.
270 Rama VI Road, Ratchathewi, Bangkok 10400, Thailand
Tel. (662) 201-1000

Documentary Proof of Ethical Clearance
Committee on Human Rights Related to Research Involving Human Subjects
Faculty of Medicine Ramathibodi Hospital, Mahidol University

MURA2015/629

Title of Project (EC_590054)	Impact of Reverse Logistics on Medicines to Inpatient System at Somdech Phra Debaratana Medical Center, Ramathibodi Hospital
Protocol Number	ID 10-58-40
Principal Investigator	Miss. Chiraporn Waimittra
Official Address	Faculty of Pharmacy Mahidol University

The aforementioned project has been reviewed and approved by the Committee on Human Rights Related to Research Involving Human Subjects, based on the Declaration of Helsinki.

Signature of Chairman Committee on Human Rights Related to Research Involving Human Subjects	..... Prof. Pat Mahachoklertwattana, M.D.
Date of Approval	October 28, 2015
Duration of Study	3 Months

APPENDIX C
DATA COLLECTING FORM

แบบสอบถามเพื่อการวิจัย

เรื่อง ผลกระทบของการคืนยา ศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี คณะเภสัชศาสตร์ มหาวิทยาลัยมหิดล

คำชี้แจง

1. แบบสอบถามฉบับนี้มีจุดมุ่งหมาย เพื่อศึกษาวิเคราะห์ผลกระทบของการคืนยา ณ ศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี
2. แบบสอบถามแบ่งออกเป็น 3 ตอน คือ 1) แบบสอบถามเกี่ยวกับข้อมูลทั่วไปของผู้ตอบ
   2) แบบสอบถามเกี่ยวกับกระบวนการและปัญหาที่เกิดขึ้นในขั้นตอนการคืนยาของผู้ป่วยใน
   3) ข้อเสนอแนะเพิ่มเติมเกี่ยวกับการพัฒนาระบบคืนยาผู้ป่วยใน
3. แบบสอบถามฉบับนี้ใช้สำหรับการศึกษาวิจัยเท่านั้น การตอบแบบสอบถามจะไม่มีผลกระทบต่อท่านแต่อย่างใด แต่จะเป็นประโยชน์ในการกระบวนการทำงานของบุคลากรทางการแพทย์ที่ทำงานเกี่ยวข้องกับระบบงานผู้ป่วยใน

ตอนที่ 1 แบบสอบถามเกี่ยวกับข้อมูลทั่วไปของผู้ตอบแบบสอบถาม

คำชี้แจง โปรดทำเครื่องหมาย ✓ ลงในช่อง ☐ ที่ตรงกับสภาพเป็นจริงของท่าน

1. เพศ ☐ หญิง ☐ ชาย
2. อายุ …….. ปี
3. ระดับการศึกษา ☐ ต่ำกว่าปริญญาตรี ☐ ปริญญาตรี ☐ ปริญญาโท ☐ ปริญญาเอก
4. ตำแหน่งหน้าที่ในการทำงาน
   ☐ พยาบาล ☐ เภสัชกร ☐ ผู้ชวยเภสัชกร ☐ ผู้ช่วยพยาบาล
5. หน่วยงานที่ท่านปฏิบัติ.....(โปรดระบุ)
6. ประสบการณ์ การทำงานในระบบงานผู้ป่วยใน.....ปี (โปรดระบุ)

ตอนที่ 2 แบบสอบถามเกี่ยวกับกระบวนการและปัญหาที่เกิดขึ้นในขั้นตอนการคืนยาของผู้ป่วยใน

<u>คำชี้แจง</u> โปรดทำเครื่องหมาย ✓ลงในช่อง ☐ ที่ตรงกับตามความรู้สึก/ความคิดเห็นของท่านมากที่สุด

1. กระบวนการ/ ขั้นตอนการคืนยาผู้ป่วยใน มีแนวปฏิบัติที่เป็นมาตรฐานหรือไม่

   ☐ มี ☐ ไม่มี (ข้ามไปตอบข้อที่ 3)

2. ท่านได้ปฏิบัติตามมาตรฐานที่กำหนดไว้หรือไม่

   ☐ ปฏิบัติตาม ☐ ไม่ปฏิบัติตาม เพราะ.....(กรุณาระบุเหตุผล)

3. โปรด อธิบายกระบวนการ/ ขั้นตอนการจัดการยาที่ผู้ป่วยไม่ได้ใช้, แพทย์สั่งหยุดใช้ยา หรือ กรณีผู้ป่วยกลับบ้าน

   .....

.....

.....

4. ท่านปฏิบัติหน้าที่ใดในระบบการคืนยาผู้ป่วยใน (ตอบได้มากกว่า 1 ข้อ)

   ☐ 4.1.คีย์ยาคืนห้องยา เวลาที่ใช้ในแต่ละครั้ง.....นาที (โปรดระบุ)

   การคีย์ยาคืนในแต่ละครั้ง ท่านคีย์คืนในลักษณะใด

   ☐คีย์ยาคืนทันทีเมื่อผู้ป่วยไม่ได้ใช้ ☐รวบรวมยาแล้วคีย์คืนเมื่อผู้ป่วยมีคำสั่งกลับบ้าน

   ☐ อื่นๆ (โปรดระบุ).....

   ☐ 4.2. ส่งยาคืนห้องยา เวลาที่ใช้ในแต่ละครั้ง.....นาที (โปรดระบุ)

   ลักษณะของการส่งยาคืนมาที่ห้องยา

   ☐ ส่งคืนทันทีเมื่อมีการคีย์คืนยา ☐ ไม่นำยาส่งคืนในทันทีเมื่อมีการคีย์คืนยา

   ☐ อื่นๆ (โปรดระบุ).....

   ☐ 4.3. ตรวจสอบยาที่ส่งคืน เวลาที่ใช้ในแต่ละครั้ง.....นาที (โปรดระบุ)

   ลักษณะของการตรวจสอบยาคืน

   ☐ ตรวจสอบทันทีเมื่อมียามาคืน ☐ ไม่ตรวจสอบทันทีเมื่อมียามาคืน

   ☐ อื่นๆ (โปรดระบุ).....

   ☐ 4.4. คีย์รับจำนวนยาที่สามารถรับคืนได้ เวลาที่ใช้ในแต่ละครั้ง.....นาที (โปรดระบุ)

   ลักษณะของการคีย์รับยาที่สามารถรับคืนได้

   ☐ คีย์รายการยาที่สามารถรับคืนได้ทันที ☐ ไม่คีย์รายการยาที่สามารถรับคืนได้ทันที

☐ อื่นๆ (โปรดระบุ).....

☐ 4.5. บริหารจัดการยาที่รับคืนมาจากหอผู้ป่วย (เก็บยาขึ้นชั้น) เวลาที่ใช้ในแต่ละครั้ง.....นาที

ลักษณะของการจัดการยาที่ได้รับคืนมาในแต่ละครั้ง

☐ นำยาที่สามารถนำกลับมาใช้ใหม่ได้เก็บขึ้นชั้นวางทันที

☐ มีช่วงเวลาที่จัดเก็บยาคืนที่สามารถนำกลับมาใช้ใหม่ได้

☐ อื่นๆ (โปรดระบุ).....

5. ในแต่ละขั้นตอนมีแนวปฏิบัติที่ชัดเจนหรือไม่

☐ มี ☐ ไม่มี

6. เหตุผลในการคืนยา (กรุณาใส่หมายเลข 1-5 เรียงลำดับสาเหตุของการคืนยาจากมากไปหาน้อย)

☐ผู้ป่วยกลับบ้าน ☐แพทย์สั่งหยุดใช้ยา ☐รายการยาที่ส่งมาไม่ถูกต้อง

☐ยาหมด/ ใกล้หมดอายุ ☐ยาเสื่อมสภาพ ☐อื่นๆ ……

7. สำรวจความพึงพอใจที่มีต่อกระบวนการจัดการยาคืนของผู้ป่วยใน กรุณาทำเครื่องหมาย √ ลงในช่องที่ท่านคิดว่าเหมาะสมที่สุด

(5 = มากที่สุด, 4 = มาก, 3 = ปานกลาง, 2 = น้อย, 1 = น้อยที่สุด)

ความพึงพอใจที่มีต่อกระบวนการจัดการยาคืนของผู้ป่วยใน	**ระดับความพึงพอใจ**				
	5	**4**	**3**	**2**	**1**
1. กระบวนการ/ ขั้นตอนในการคืนยาผู้ป่วยในมีความเหมาะสม และรวดเร็ว					
2. กระบวนการ/ ขั้นตอนในการคืนยาผู้ป่วยใน ไม่มีข้อผิดพลาด และถูกต้อง					
3. จำนวนเจ้าหน้าที่ที่ปฏิบัติมีเพียงพอ					
4. ระยะเวลาในการปฏิบัติแต่ละขั้นตอนมีความเหมาะสม					
5. ความทันสมัยของอุปกรณ์ที่ใช้ในการปฏิบัติงาน					
6. การสื่อสารระหว่างหน่วยงานมีความสะดวก รวดเร็ว					
7. มีช่องทางในการสื่อสารที่เหมาะสม					
8. สถานที่ในการปฏิบัติงานมีความเหมาะสม					

ตอนที่ 3 ข้อเสนอแนะเพิ่มเติมเกี่ยวกับการพัฒนาระบบการคืนยาผู้ป่วยใน ณ ศูนย์การแพทย์สมเด็จพระเทพรัตน์ โรงพยาบาลรามาธิบดี

จุดเด่นของระบบปัจจุบันที่เป็นอยู่

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ปัญหาส่วนใหญ่ที่พบ

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สิ่งที่ควรปรับปรุง

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BIOGRAPHY

NAME	Miss.Chiraporn Waimittra
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