DEVELOPMENT OF MEDICATION SAFETY MANAGEMENT SYSTEM FOR LOOK-ALIKE/SOUND-ALIKE DRUGS IN PUBLIC HOSPITALS

By

Chattraporn Chumchit

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree
Doctor of Philosophy Program in Social and Administrative Pharmacy
Department of Community Pharmacy
Graduate School, Silpakorn University
Academic Year 2013

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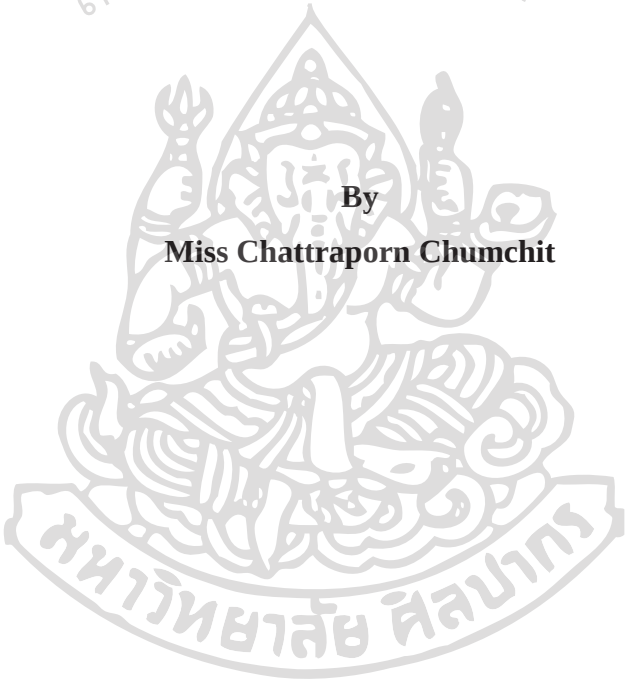

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การพัฒนาระบบการจัดการความปลอดภัยของยาที่มีรูปคล้าย เสียงพ้อง ในโรงพยาบาลของรัฐ

โดย
นางสาวฉัตราภรณ์ ชุ่มจิต

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเภสัชศาสตรดุษฎีบัณฑิต
สาขาวิชาเภสัชศาสตร์สังคมและการบริหาร
บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
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The Graduate School, Silpakorn University has approved and accredited the Thesis title of "Development of Medication Safety Management system for Look-alike/Sound-alike Drugs in Public Hospitals" submitted by Miss Chattraporn Chumchit as a partial fulfillment of the requirements for the degree of Doctor of Philosophy in Social and Administrative Pharmacy

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The World Health Organization (WHO) declared patient safety as an important principle in health care systems. In the context of quality program, medication safety is one of the key issues which need to be standardized. Later, WHO launched the Nine Patient Safety Solutions, of which look-alike/sound-alike (LASA) drug names was the first solution to be concerned. In Thailand, the Ministry of Public Health (MoPH) announced the National Patient Safety Goal (NPSG) 2007 – 2008 policy of with medication safety measure as one of the main issues, and look-alike/sound-alike drug as one of the priorities for actions. The objectives of this thesis were to study perceptions of pharmacists in public hospitals toward medication safety measure in the NPSG policy, to study the LASA drug problems in public hospitals, to study the medication management system (MMS), to solve LASA problems in public hospitals, and to obtain information necessary for establishing national guideline to solve LASA problems for all healthcare levels.

Data collection included questionnaire mail survey, in-person interview, expert brainstorming, and case study in three public hospitals. Questionnaires were mailed to all 971 public hospitals with 48.40% return rate. We found that the majority knew about the national policy on medication safety (88.52%). While most hospitals reported complete implementation of medication safety measure (76.62%), 19.41% reported incomplete implementation. Most hospitals (82.46%) ranked LASA incidents the most troublesome cause of medication errors. Most given LASA errors were commonly found in various hospitals. There were 7,964 total drug pairs of LASA medications with 3,205 unique pairs (40.24 %) identified. Generic name LASA errors were most frequently reported (1,158 pairs, or 15.05% of total pairs). The activity in MMS most successfully implemented was separating LASA drugs apart.

In brainstorming on 15 experts to find information necessary for national guideline, the experts proposed the solutions to solve the LASA drug problems both at national and hospital level. At national level, they proposed 1) prevention LASA drug problem at drug registration and pre-marketing phase, 2) monitoring LASA drug problems at post-marketing phase, and 3) establishing a database of drug monographs and LASA drugs problems. In addition, to motivate hospitals, MoPH official enforcement on policy to solve LASA problem and incorporating reporting system of the LASA drugs into the Pay-for-Performance policy of the National Health Security Office were also suggested by the panel. At hospital level, the experts suggested that the LASA problems be solved by several measures especially those for drug name problems including avoiding similar drug names in the hospital formulary, measures for prescribing step, and the use of Tall-man letter. The problems of look-alike labeling, packaging, and tablets/capsules could be alleviated by products that could be purchased by deal price. In addition, since the hospitals were mandated to buy a vast majority of drugs from the Government Pharmaceutical Organization (GPO), LASA problems of GPO products should be alleviated by hospitals enforcing the GPO to change its products' labels, packages, and tablet/capsules. This measure could be used with the private pharmaceutical companies as well. In the 3 case studies, different techniques to solve LASA problems in each of the 3 hospital were found. These were due to different contexts, work system, location and human factors.

In conclusion, various measures to solve look-alike/sound-alike medication problems were implemented by most public hospitals. A more efficient measure to alleviate the problems may be the utilization of national level databases for drug registration and for healthcare providers. In addition, a national guideline for practical steps should be established for all healthcare levels.

Program of Social and Administrative Pharmacy Graduate School, Silpakorn University
Student's signature…….. Academic Year 2013
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50354802 : สาขาวิชาเภสัชศาสตร์สังคมและการบริหาร

คำสำคัญ : ยาที่มีรูปคล้าย เสียงพ้อง, ความปลอดภัยด้านยา, ระบบการจัดการด้านยา

ฉัตราภรณ์ ชุ่มจิต : การพัฒนาระบบการจัดการความปลอดภัยของยาที่มีรูปคล้าย เสียงพ้อง ในโรงพยาบาลของรัฐ อาจารย์ที่ปรึกษาวิทยานิพนธ์: ภญ.ดร.เยาวลักษณ์ อ่ำรำไพ และ ภก.ผศ.ดร.เจริญ ตรีศักดิ์. 232 หน้า.

องค์การอนามัยโลก ได้ประกาศให้ความปลอดภัยของผู้ป่วยเป็นหลักการพื้นฐานที่สำคัญในระบบบริการสุขภาพ โดยความปลอดภัยด้านยาเป็นประเด็นสำคัญเรื่องหนึ่งที่ต้องปฏิบัติให้ได้มาตรฐาน ต่อมาองค์การอนามัยโลกได้ประกาศ " Nine Patient Safety Solutions" โดยมีเรื่องยาที่มีรูปคล้าย เสียงพ้อง เป็นอันดับหนึ่งที่ต้องดำเนินการ สำหรับประเทศไทย ก ระทรวงสาธารณสุขได้ประกาศนโยบายความปลอดภัยของผู้ป่วยระดับชาติ ปี พ.ศ. 2550 – 2551 โดยมีมาตรการความปลอดภัยด้านยา เป็นประเด็นหนึ่งในนโยบาย ซึ่งมีจุดเน้นที่สำคัญเรื่องหนึ่ง คือ ยาที่มีรูปคล้าย เสียงพ้อง ที่ต้องดำเนินการให้เกิดความปลอดภัยด้านยาในผู้ป่วย วัตถุประสงค์ของวิทยานิพนธ์นี้ คือ 1) เพื่อศึกษาการรับรู้มาตรการความปลอดภัยด้านยา นโยบายความปลอดภัยผู้ป่วยระดับชาติของกระทรวงสาธารณสุขของเภสัชกรในโรงพยาบาลของรัฐ 2) เพื่อศึกษาปัญหายาที่มีรูปคล้าย เสียงพ้องในโรงพยาบาลของรัฐ 3) เพื่อศึกษาแนวทางการนำระบบการจัดการด้านยามาใช้เพื่อแก้ปัญหายาที่มีรูปคล้าย เสียงพ้องในโรงพยาบาลของรัฐ และ 4) เพื่อหารูปแบบแนวทางแก้ไขปัญหายาที่มีรูปคล้าย เสียงพ้องในระดับประเทศ

วิธีการเก็บข้อมูลประกอบด้วย การศึกษาเชิงเอกสาร การส่งแบบสอบถาม การสัมภาษณ์บุคคล การประชุมระดมสมองผู้เชี่ยวชาญ และกรณีศึกษาใน 3 โรงพยาบาลของรัฐ แบบสอบถาม ส่งไปยัง โรงพยาบาล ของรัฐ จำนวน 971 แห่ง โดยพบอัตราการตอบกลับ 48.40% พบว่า 88.52 % รับรู้มาตรการความปลอดภัยด้านยา และ 76.62 % มีการดำเนินการตามมาตรการความปลอดภัยด้านยาแล้ว ขณะที่ 19.41% มีการดำเนินแล้วแต่ไม่ครบถ้วน โรงพยาบาลส่วนใหญ่ (82.46%) จัดให้ปัญหายารูปคล้าย เสียงพ้อง เป็นสาเหตุอับดับหนึ่งที่ทำให้เกิดความคลาดเคลื่อนทางยา โรงพยาบาลให้ข้อมูลคู่ยาที่มีรูปคล้าย เสียงพ้อง รูปแบบต่าง ๆ ทั้งสิ้น 7,964 คู่ โดยเป็นคู่ยาที่ไม่ซ้ำกัน 3,205 คู่ (40.24%) รูปแบบปัญหาที่มีการตอบกลับมามากที่สุด คือ ปัญหาชื่อสามัญทางยาคล้ายกับชื่อสามัญทางยา 1,158 คู่ (15.05 % ของคู่ยาทั้งหมด) การใช้ระบบการจัดการด้านยาช่วยแก้ไขปัญหายารูปคล้าย เสียงพ้อง พบว่า วิธีที่ใช้แล้วประสบความสำเร็จมากที่สุด คือ การแยกสถานที่วางยารูปคล้าย เสียงพ้อง ให้อยู่ห่างกัน

จากการประชุมระดมสมองผู้เชี่ยวชาญ 15 คน ได้แนวทางการแก้ไขปัญหายารูปคล้าย เสียงพ้อง ทั้งในระดับประเทศ และโรงพยาบาล ดังนี้ การแก้ไขระดับประเทศ ควรเริ่มตั้งแต่ 1) ป้องกันปัญหายารูปคล้าย เสียงพ้อง ในระบบการขึ้นทะเบียนยาก่อนที่ยาวางจำหน่าย 2) มีระบบติดตามปัญหายารูปคล้าย เสียงพ้อง หลังจากยาวางจำหน่ายแล้ว และ 3) สร้างระบบฐานข้อมูลยาทั้งข้อมูลยาที่ขึ้นทะเบียน และฐานข้อมูลปัญหายารูปคล้าย เสียงพ้อง สำนักงานปลัดกระทรวงสาธารณสุขควรมีการกำหนดนโยบายเกี่ยวกับการแก้ไขปัญหาที่ชัดเจน เพื่อให้โรงพยาบาลในสังกัดปฏิบัติตาม นำปัญหายารูปคล้าย เสียงพ้องเข้าเป็นเกณฑ์คุณภาพด้านยาของสำนักงานหลักประกันสุขภาพแห่งชาติ เพื่อให้โรงพยาบาลต่าง ๆ ปฏิบัติโดยใช้การได้ผลตอบแทนเพิ่มขึ้นเป็นแรงจูงใจ ในระดับโรงพยาบาล ปัญหายาที่มีรูปคล้าย เสียงพ้อง ต้องใช้การแก้ไขหลายวิธีการประกอบกัน โดยการแก้ไขปัญหาชื่อยาพ้องกัน โดยหลีกเลี่ยงนำยาที่มีชื่อพ้องกันเข้าโรงพยาบาล การมีมาตรการวิธีการเขียน สั่งใช้ยาของแพทย์ ที่ชัดเจน การใช้อักษรแบบ Tall-man letter ที่เป็นรูปแบบเดียวกันทั้งประเทศ ส่วนการแก้ไขปัญหาฉลาก บรรจุภัณฑ์ และเม็ดยาคล้ายกัน การหลีกเลี่ยงยาที่มีรูปลักษณ์คล้ายกัน จะทำได้กรณีซื้อด้วยวิธีตกลงราคา ควรใช้วิธีการแจ้งปัญหาให้องค์การเภสัชกรรมทราบเพื่อแก้ไข เนื่องจากการไม่ ซื้อยาจากองค์การเภสัชกรรม เป็นการปฏิบัติผิดระเบียบสำนักนายกรัฐมนตรีว่าด้วยการพัสดุฯ การแจ้งให้บริษัททราบถึงปัญหาโดยใช้มาตรการกลุ่ม ผ่าน การซื้อยาร่วมระดับจังหวัดหรือเขตผลักดันให้บริษัททำการแก้ไขปัญหา สำหรับกิจกรรมที่ใช้แก้ปัญหายารูปคล้าย เสียงพ้องในโรงพยาบาล 3 แห่งที่เป็นกรณีศึกษา พบว่ามีการใช้วิธีการที่แตกต่างกัน ขึ้นอยู่กับบริบทของโรงพยาบาล ระบบการทำงาน สถานที่ และบุคลากร

โดยสรุป มีการแก้ไขปัญหายารูปคล้ายเสียงพ้องในโรงพยาบาลส่วนมาก มาตรการที่มีประสิทธิภาพมากกว่าคือการแก้ไขที่การขึ้นทะเบียนยา การสร้างระบบฐานข้อมูลยาทั้งข้อมูลยาที่ขึ้นทะเบียน และฐานข้อมูลปัญหายารูปคล้าย เสียงพ้อง สำหรับผู้ปฏิบัติงานทุกระดับ และควรมีแนวทางการปฏิบัติระดับประเทศสำหรับผู้ปฏิบัติงานทุกระดับด้วย

สาขาวิชาเภสัชศาสตร์สังคมและการบริหาร บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร

ลายมือชื่อนักศึกษา..... ปีการศึกษา 2556

ลายมือชื่ออาจารย์ที่ปรึกษาวิทยานิพนธ์ 1..... 2.....

EXECUTIVE SUMMARY

The mailed questionnaires were sent to 971 hospital pharmacists and waiting feedback mailed questionnaires a long time in order to getting feedback mail much as possible. With the limitation of using questionnaire, 470 mailed questionnaires were returned (a response rate of 48.40%). In addition to the mailed questionnaires, information from another 9 hospitals not returning the mailed questionnaires was obtained by means of in-person interview. A total of 479 hospitals provided information regarding recognition on medication safety policy, situation of LASA drug problems and implementation of safety measures in their hospitals.

This study showed that the most hospitals recognized medication safety policy through Thai National Patient Safety policy and implemented such policy to prevent medication errors from LASA medications, HAD and severe ADR and repeated drug allergy. Medication errors attributable to LASA drug names with several drug pairs were found.

Data regarding drug pairs associating with LASA medication errors were from 476 of 479 hospitals. Of all 7,964 pairs of LASA medications reported, 3,205 unique pairs were identified (40.24% of all pairs). Of all 7,964 pairs of LASA medication pairs reported, generic drug name LASA errors were the most frequently reported type of LASA medication problems (1,158 of all 7,964 pairs). Among the unique pairs, however, the problem with the greatest magnitude was LASA errors associating with similar drug tablets or capsules, regardless of drug names, from different pharmaceutical companies (419 of all 3,205 unique).

Regarding specific LASA medication errors with the greatest magnitude, 10 unique pairs most frequently reported were selected consisting of 3 brand name and 7 generic name LASA pairs. Among various error types, Losec® and Lasix® was the most found as reported by 122 hospitals. For package related LASA errors, about 3 to 4 specific types of errors in each unique pair were found. For example, among 182 error pairs of amoxicillin 250 mg and amoxicillin 500 mg oral solid dosage form (tablet or capsule) reported from 127 hospitals, 4 types of package-related LASA problems were

identified including 1) look-alike labels from the same company, 2) look-alike boxes from the same company, 3) look-alike package foils or blisters from the same company and 4) look-alike tablets or capsules from the same company.

The steps in MMS mostly likely to succeed when implementing measures to solve the LASA drug problems were 1) drug storage, followed by 2) drug preparing and dispensing, 3) drug ordering, prescribing and transcribing medication order, 4) drug monitoring, 5) medication selection and procurement, and 6) drug administration, respectively. The solving of the LASA drug problems in various hospitals would not have a way as the best.

From the observational study, the various activities were applied to solve LASA drug problem that were separating look-alike drug name or package apart; making dissimilarity of LASA drug name in computerized database and on printed drug label; and informing the list of LASA drug names to all staff. It was found that there were different techniques to solve LASA problems in each hospital due to different contexts, working system, location and human factors. But LASA drug problems are moving all the times, so the effective monitoring system in each hospital may be a key success factor.

Each hospital should find a ways to prevent and solve problems in the own hospital to reduce the medication error to minimum. The risk management process should be applied to find problems, assess problems and select solutions to solve the problems.

The solutions to solve LASA drug problems at national level were further divided to 3 measures as follows: 1) prevention of LASA drug problems at drug registration and pre-marketing phase; 2) monitoring LASA drug problems at post-marketing phase; and 3) developing database of drug monographs and LASA drugs problems. The solving LASA drug problems in national level, if it can happen it will help prevent problems before the LASA drugs reach a hospital. Some LASA drugs can be solved by the drug registration system, the manufacturing of pharmaceutical companies. However, the prevention of problems in the hospitals still needs to be conducted continuously. If the monitoring information in overall incidence of the

country will cause learning problems and prevent recurring incidence in different hospitals following.

In Thailand, despite the fact that LASA medication errors remain the possible leading cause of medication safety problem, there has been no authoritative agent to collect and analyze the nationwide data. The information from the nationwide data could help push the patient safety policy especially implementing measures at national level. With its impact greater than the measure carried out by individual hospitals, national level measure could accelerate product change process on the manufacturer side, and reduce the burden of collective efforts on the hospital side. Not only solving the LASA problems at the manufacturer and policy maker level, such nationwide information could also help individual hospitals solve the problems that need local measures by means of sharing successful problem-solving methods. The Thai national level strategies to tackle LASA medication error problem at all health system levels is therefore in desperate need.

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LIST OF ABBREVIATIONS

ADR	=	Adverse Drug Reaction
DDMAC	=	Division of Drug Marketing, Advertising and Communication
DMETS	=	Division of Medication Errors and Technical Support
GPO	=	the Government Pharmaceutical Organization
HA-MSC	=	the Hospital Authority Medication Safety Committee
HAI	=	the Healthcare Accreditation Institute
HAD	=	High Alert Drugs
HSA	=	the Health Sciences Authority
IOM	=	the Institute of Medicine
ISMP	=	the Institute for Safe Medication Practices
ISMP Canada	=	the Institute for Safe Medication Practices Canada
JCAHO	=	the Joint Commission on Accreditation of Healthcare Organizations
LASA	=	Look-Alike/Sound-Alike
MERP	=	Medication Errors Reporting Program
MHRA	=	the Medicines and Healthcare products Regulatory Agency
NCC MERP	=	the National Coordinating Council for Medication Error Reporting and Prevention
NPSA	=	the National Patient Safety Agency
NPSG	=	National Patient Safety Goal
TGA	=	the Therapeutic Goods Administration
U.S.FDA	=	the United State Food and Drug Administration
USP	=	the United States Pharmacopeia
WHO	=	the World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Statements and significance of the problems

Institute of Medicine (IOM) of United States reported that medical errors were the cause of 44,000 – 98,000 death among Americans each year. Among these medical errors, medication errors alone have been estimated to cause about 7,000 deaths annually[1]. There has been reports of medication error problems relating to medications that look or sound alike other medications. These confusing pairs of medications are called look-alike/sound-alike medications (LASA medications). The errors relating to LASA medications were attributable to various misleading characteristics of the causative medication products, of which could be categorized into two main causes, drug names and packaging. Errors from well-known LASA medication names have been reported. For example, the confusion between Losec® (omeprazole) and Lasix® (furosemide), led to the incidents that the patients were given Lasix® instead of the prescribed Losec®, which resulted in the patients' death [2-3]. To prevent such unfortunate incidents, Merck Sharp and Dohme, the owner of Losec®, changed its product brand name to Prilosec®[4]. Unfortunately, this new brand name of omeprazole caused further confusion with Prozac® (fluoxetine, an antidepressant), and has been reported to result in an incident in which a patient mistakenly received fluoxetine instead of the intended omeprazole[5]. Another example of a somewhat hazard-prone confusion between Levoxine® (levothyroxine sodium) and Lanoxin® (digoxin), where the patients received Lanoxin® instead of the prescribed Levoxine®[6]. Various LASA medications have also been reported for errors that resulted in the potential and actual patient harm.

Medication safety is one of the elements of patient safety policy worldwide. In 2002, the World Health Organization (WHO) declared that patient safety is an important principle in healthcare system. The WHO members stated that

all involving parties should pay attention to solve the problem regarding patient safety and to establish and strengthen science-based systems necessary to improving patient safety and quality of healthcare. In the context of quality program, medication safety is one of the key issues which need to be standardized[7]. In 2003, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) of United States (US) issued National Patient Safety Goal (NPSG) 2003 for the patient safety. The third goal in NPSG is improvement in the safety in medication use. Later, in 2005 the JCAHO added medication Look-alike Sound-alike problems into NPSG 2005; specifically its statement 3C declared that the goal was to "*Identify and, at a minimum, annually review a list of look-alike/sound-alike drugs used in the organization, and take action to prevent errors involving the interchange of these drugs"*[8-9].

In addition to the JCAHO patient safety preventive effort, in May 2007, the WHO launched the "Nine Patient Safety Solutions" to help reduce the toll of healthcare-related harm affecting millions of patients worldwide. The nine solutions were made available in an accessible form for use and adaptation by WHO. In this set of WHO patient safety solutions, look-alike, sound-alike medication names was the first solution of concern[10].

In Thailand, the Institute of Hospital Quality Improvement and Accreditation Thailand, recently renamed the Healthcare Accreditation Institute (Public Organization), announced that 2006 HA-Thailand Patient Safety Goals were a target for patient safety. The third element of these goals is medication safety which had three prioritized problems including high-alert drug (HAD), repeated adverse drug reaction (type B ADRs), and adverse drug reactions (type A ADRs)[11].

In Thailand, the effort to establish patient safety policy has been evident in the last decade. In 2007, the Ministry of Public Health in collaboration with the WHO under the First Global Patient Safety Challenge announced the National Patient Safety Goal 2007 – 2008 policy which comprised of 2 main issues[12] namely 1) healthcare-associated infections with its campaign "Clean care is safer care," and 2) medication safety measure with the campaign "medication safety for patient safety." In its medication safety measure element, Thailand National Patient Safety Goal 2007

– 2008 policy has 3 prioritized problems including 1) LASA medication, 2) high-alert drug, and 3) severe adverse drug reaction and repeated drug allergy. In addition to the governmental sector effort, in 2008, the Healthcare Accreditation Institute (Public Organization) announced Thai Patient Safety Goal 2008 named SIMPLE of which each of its acronyms stands for major categories for patient safety[13] including S for Safe Surgery (2nd Global Patient Safety Challenge), I for Infection Control (Clean Care in 1st Patient Safety Challenge), M for Medication Safety and Blood Safety, P for Patient Care Process, L for Line, Tube, and Catheter, and E for Emergency Response. Specifically, Medication Safety component was further defined into M1 subcomponent which refers to "Safe from adverse drug events," M2 "Safe from medication error," M3 "Medication reconciliation / Assuring medication accuracy at transition in care," and M4 "Blood safety." In the M2 subcomponent, "Safe from medication error" refers specifically to errors associating with LASA medication names.

The magnitude of LASA medication error problem has been known world-wide and locally among healthcare providers. In Thailand, several studies[14-17] show that LASA medication error was one of the causes of medication errors. The studies also found that LASA medication problems had been solved at the step of which medication errors occurred. The solutions used to solve the problem usually are medication management system processes.

Medication Management System (MMS) is the system offering processes of planning, organization, command and control to achieve an effective whole system of medication use. MMS consists of 6 main processes including 1) medication selection and procurement, 2) storage, 3) ordering, prescribing and transcribing medication orders, 4) preparing and dispensing, 5) administration, and 6) monitoring [18]. Moreover, medication errors from LASA medications were also classified as a sizable risk in drug system since adverse events could unexpectedly to rise and harm patients with any medication use regardless of illness severity[19]. Risk management (RM) is "the process of making and carrying out decisions that will minimize the adverse effects of accidental losses upon an organization"[20]. While MMS offers processes defined by steps of medication use cycle, risk management, a more general approach to problem-solving, could also be employed to detect, evaluate and prevent the

problems in every process. In risk management, specific processes, as tools for tackling risks in any steps of any systems including 1) risk identification, 2) risk assessment, 3) risk treatment, and 4) monitoring and evaluation[19].

Authoritative agents responsible for LASA medication error problems in any healthcare system are indispensable. Various countries have established agents that have been demonstrating effective handling of the problems. In Thailand, a policy was officially announced by the Ministry of Public Health, but there has not been a systematic data collection on medication error and LASA medication problems. In previous studies, LASA medication problems had been collected only in a few specific hospitals. It has been thus speculated that how much the hospitals or their workers recognize the national policy and how they implement the safety measures on the problems. The aggregated information on the LASA medication problems and experiences on solutions/measures to solve such problems have never been put together and considered by any large body of experts to reach a conclusion necessary for proposing a national guideline. This research was performed in order to determine the look-alike/sound-alike medication error problems in public hospitals and solutions or measures these hospitals used to solve LASA medication problems, and to define a national guideline to manage the LASA medication error problems in every level of Thai healthcare system. The knowledge gained from this study could be applied to further designate a national solution on LASA medication error problems.

1.2 Research questions

How can medication management system be used for solving look-alike/sound-alike medication error problems in Thai public hospitals?

1.3 Objectives of research

1. To determine perceptions of public hospital pharmacists on medication safety measures in National Patient Safety Goal of the Ministry of Public Health.

2. To identify the look-alike/sound-alike medication problems in public hospitals.

3. To describe the medication management system to solve look-alike/sound-alike medication problems in public hospitals.

4. To gain the information essential for proposing national guideline to solve the look-alike/sound-alike medication problems at every level of Thai healthcare system.

1.4 Scope of the study

This research was conducted only in government public hospitals which are under the Ministry of Public Health, the Ministry of Defense, the Ministry of Education, the Ministry of Justice, the Thai Red Cross Society and the Prime Minister's Office. The hospitals under the Local Administration were not included.

1.5 Definition of terms

1.5.1 Look-Alike/Sound-Alike (LASA) drugs are drugs with generic or brand names that look or sound like other drug names. This also includes drug products in which the packaging is visually similar to other products [21-22].

1.5.1.1 Look-alike drug names are brand names or generic names that have a written name that look similar to other drugs names.

1.5.1.2 Sound-alike drug names are brand names or generic names that have pronunciation similar to those of other drug names.

1.5.1.3 Look-alike labeling, packaging, tablets or capsules are labeling, packaging, tablets or capsules of drug that are similar to other drugs.

1.5.2 Medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems including 1) prescribing, 2) order communication, 3) product labeling, packaging, and nomenclature, 4) compounding, 5) dispensing, 6) distribution, 7) administration, 8) education, 9) monitoring, and 10) use [23].

1.5.3 Medication Management System (MMS) is defined as a component in the palliative, symptomatic, and curative treatment of many diseases and conditions. A safe medication management system addresses an organization's medication processes, including the following (as applicable):

1.5.3.1 Selection and procurement

1.5.3.2 Storage

1.5.3.3 Ordering and transcribing

1.5.3.4 Preparing and dispensing

1.5.3.5 Administration

1.5.3.6 Monitoring

1.5.4 Risk Management (RM) is the process of making and carrying out decisions that will minimize the adverse effects of accidental losses upon an organization. These processes include 1) risk identification, 2) risk assessment, 3) risk treatment, and 4) monitoring and evaluation [20].

CHAPTER 2

LITERATURE REVIEW

In this chapter, information from literature review relating to research objectives was obtained and presented. This includes information about patient safety policy, medication safety, medication error, look-alike/sound-alike medication and risk management system.

2.1 Patient Safety

In 2002 the World Health Organization (WHO) declared patient safety is an important principle in health care systems. The WHO members suggested that all involved parties pay the closest possible attention to the problem of patient safety and to establish and strengthen science-based systems necessary for improving patient safety and quality of healthcare. In the context of quality program, medication safety is one of the key issues which need to be standardized[7].

In May 2007 the WHO launched the "nine patient safety solutions" to help reduce the toll of health care-related harms affecting millions of patients worldwide. The nine solutions were being made available in an accessible form for use and adaptation by WHO member countries to re-design patient care processes and make them safer. They came under the headings of [10] :

1. look-alike sound-alike medication (LASA medication) names;
2. patient identification;
3. communication during patient hand-overs;
4. performance of correct procedure at correct body site;
5. control of concentrated electrolyte solutions;
6. assuring medication accuracy at transitions in care;
7. avoiding catheter and tubing misconnections;
8. single use of injection devices; and
9. improved hand hygiene to prevent health care-associated infection.

In the "nine patient safety solutions," look-alike, sound-alike medication names were the first solution. It pointed to LASA errors as an important problem. Solving LASA problems could help patient from medication error. Various countries that were WHO members had organizations and guideline to solve this problem. Their experiences are elaborated in the following.

2.2 Medication safety in foreign countries

Various countries have agencies involving in managing medication errors. Here we present experiences from the United States of America, Canada, the United Kingdom, New Zealand, Australia, Japan, and Singapore.

2.2.1 The United States of America (USA)

The USA has a few agencies involving in managing medication errors. These include the United States Food and Drug Administration, the Joint Commission on Accreditation of Healthcare Organizations, the Institute for Safe Medication Practice, and the United States Pharmacopoeia.

2.2.1.1 The United States Food and Drug Administration (US FDA)

The US FDA is an agency within the Department of Health and Human Services. The FDA's organization consists of the Office of the Commissioner and four directorates overseeing the core functions of the agency, namely, medical products and tobacco, foods, Global Regulatory Operations and Policy, and Operations[24].

The role of the US FDA on medical products is to conduct pre-market trademark evaluations and pursue post-market tracking for medication errors.

Pre-Market Evaluations: The FDA relies on it's Division of Medication Errors and Technical Support (DMETS) unit for pre-market trademark evaluations. A sponsor can request a review of one or two trademarks as early as the end of Phase II clinical trials. Under the current process, the request for trademark review is made to the Review Division that is handling the New Drug Application for the product. The Review Division then forwards the request to FDA's Division of Drug Marketing,

Advertising and Communication (DDMAC), where it undergoes an evaluation for non-safety issues, such as exaggerated safety or efficacy, unapproved indications, or unacceptable linkage to the generic name. After DDMAC approval, the trademark moves to DMETS for a safety evaluation.

Post-Market Tracking: There are times when the DMETS' theoretical concerns about the error potential of a trademark are at odds with a safety assessment by the sponsor that could include a positive opinion from an independent expert source. In these cases, the Review Division has the option to approve the trademark on a contingency basis. The contingency could be a Post-Market Medication Error Monitoring Program, often combined with a Risk Management Program. The details of both programs are negotiated and often include provisions for a name change in the event that serious medication errors persist in the face of intervention strategies aimed at the point of prescribing or dispensing or administration in the treatment setting. These post-market tracking programs call for periodic reports from the sponsor to the Review Division, where decisions are made for adjustments or additions to the intervention activities. The current experience is that these programs are in place for one to two years after launch[25].

2.2.1.2 The Joint Commission on Accreditation of Healthcare Organizations (JCAHO)

The JCAHO is an independent and not-for-profit organization. The Joint Commission accredits and certifies more than 19,000 health care organizations and programs in the United States. Joint Commission accreditation and certification is recognized nationwide as a symbol of quality that reflects an organization's commitment to meeting certain performance standards[26].

In 2003 JCAHO issued National Patient Safety Goal (NPSG) 2003 for the patient safety. In NPSG 2003 had 6 goals which the 3rd goal is Improve the safety of using high-alert medications. This goal was divided into 2 sub-goals that required to[8]:

3A Remove concentrated electrolytes (including, but not limited to, potassium chloride, potassium phosphate, sodium chloride >0.9%) from patient care units.

3B Standardize and limit the number of drug concentrations available in the organization.

In 2005 JCAHO added 3 goals in NPSG 2005, and in the 3rd goal, 1 sub-goal about Look-alike Sound-alike (LASA) problems was added. This sub-goal is to:

(3C) *Identify and, at a minimum, annually review a list of look-alike/sound-alike drugs used in the organization, and take action to prevent errors involving the interchange of these drugs*[9].

In 2009, JCAHO changed requirement 3 C to NPSG.03.03.01 in 2009 NPSG. It requires that *"the [organization] identifies and, at a minimum, annually reviews a list of lookalike/sound-alike medications used by the [organization] and takes action to prevent errors involving the interchange of these medications"* and further is divided into 3 elements of performance (EP) as follows[27]:

EP1 - The hospital identifies a list of look-alike/sound-alike medications used by the hospital. The list includes a minimum of 10 look-alike/sound-alike medication combinations selected from the tables of look-alike/sound-alike medications posted on The Joint Commission Web site at http://www.jointcommission.org.

EP2 - The hospital reviews the list of look-alike/sound-alike medications at least annually.

EP3- The hospital takes action to prevent errors involving the interchange of the medications on the list of look-alike/sound-alike medication list.

In 2010, JCAHO moved managing look-alike/sound-alike medications to medication management standard to MM.01.02.01 *"the organization addresses the safe use of look-alike/sound-alike medications."* This standard included elements of Performance for MM.01.02.01 as follows:

1. The organization develops a list of look-alike/sound-alike medications it stores, dispenses, or administers.

2. The organization takes action to prevent errors involving the interchange of the medications on its list of look-alike/sound-alike medications.

3. The organization annually reviews and, as necessary, revises its list of look-alike/sound-alike medication[28].

2.2.1.3 The Institute for Safe Medication Practices (ISMP)

The ISMP is the nation's nonprofit organization devoted entirely to medication error prevention and safe medication use. ISMP represents over 35 years of experience in helping healthcare practitioners keep patients safe and continues to lead efforts to improve the medication use process. The organization is known and respected worldwide as the premier resource for impartial, timely, and accurate medication safety information.

More than 35 years ago, ISMP started a cornerstone of its medication error prevention efforts - a voluntary practitioner error-reporting program to learn about errors happening across the nation, understand their causes and share "lessons learned" with the healthcare community. Each year, ISMP's national Medication Errors Reporting Program (MERP), receives hundreds of error reports from healthcare professionals[29].

2.2.1.4 The United States Pharmacopoeia (USP)

The USP is a private, non-profit, standards-setting organization that advances public health by ensuring the quality and consistency of medicines, promoting the safe and proper use of medications, and verifying ingredients in dietary supplements[30].

USP operates two nationally recognized medication error reporting programs: the USP-ISMP Medication Errors Reporting Program (MERP) and MEDMARX®. The MERP began in 1991 and enables healthcare professionals who encounter actual or potential medication errors to report confidentially to USP. Since its inception, the program has amassed more than 12,000 reports, many coming from community

pharmacies, home health agencies, hospitals, and patients. USP reviews and codes each report before entering the information into a database. USP shares copies of the reports with manufacturers, the United States Food and Drug Administration (US FDA) and ISMP.

On the basis of its experience with the MERP, USP created the MEDMARX® Program. MEDMARX® facilitates the collection and analysis of medication errors occurring in hospitals and related health systems. It is an anonymous, subscription-based, voluntary reporting program that incorporates a nationally recognized taxonomy of the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP). Because of the significant size of the database now more than 1.3 million medication error records, participating facilities can collect, analyze, compare, and disseminate their data, including the practical solutions taken in response to the error, to other subscribing facilities. Facilities can use the collective learning of all participating facilities as part of ongoing quality improvement efforts aimed at advancing safe medication use[25].

2.2.2 Canada

Canada has agencies involving in managing medication errors, namely, the Health Canada and the Institute for Safe Medication Practices Canada.

2.2.2.1 The Health Canada

Health Canada is a federal department responsible for helping Canadians maintain and improve their health, while respecting individual choices and circumstances[31]. Health Canada plays an active role in ensuring that people have access to safe and effective drugs and health products. The department strives to maintain a balance between the potential health benefits and risks posed by all drugs and health products. Their highest priority in determining the balance is public safety[32]. Health Canada cautions drug companies against using similar names in their product line extensions. Specifically, Health Canada is concerned about the practice of adding a modifying prefix or suffix to the name of a product to distinguish it from the original product.

In premarket drug name review process, under the LASA policy, Health Canada review all proposed drug names included in a submission for marketing approval to ensure that 1) the name is unlikely to be confused with existing brand or generic names and thus cause medication errors, and 2) the brand name is not misleading (i.e., it does not imply therapeutic claims). For postmarketing drug review process, the postmarketing review procedures are outlined in the policy entitled "Marketed Health Product Name Assessment: Look-alike Sound-alike (LA/SA) Health Product Names." When LASA drug and health product names are identified as a concerned postmarketing, the product manufacturers will be given an opportunity to suggest a strategy that will mitigate identified risks. For example, the manufacturer may suggest issuing fact sheets, sending "Dear Healthcare Professional" letters, or changing the packaging or labeling of the product. If the suggestions are not acceptable to Health Canada as a viable way to reduce the risks associated with the LA/SA name issue, the manufacturer may be required to change the name of the health product[33].

2.2.2.2 Institute for Safe Medication Practices Canada (ISMP Canada)

The ISMP Canada is an independent national not-for-profit organization committed to the advancement of medication safety in all healthcare settings. ISMP Canada works collaboratively with the healthcare community, regulatory agencies and policy makers, provincial, national and international patient safety organizations, the pharmaceutical industry and the public to promote safe medication practices. ISMP Canada's mandate includes analyzing medication incidents, making recommendations for the prevention of harmful medication incidents, and facilitating quality improvement initiatives[34].

The vision of ISMP Canada is to collaborate nationally and internationally to advance safe medication use. ISMP Canada is committed to the safe use of medications through improvement in drug distribution, naming, packaging, labeling, computer program design and drug delivery system design. The institute

collaborates with others to provide education about adverse drug events and their prevention[35].

2.2.3 The United Kingdom (UK)

The UK has agencies involving in managing medication errors, namely the National Patient Safety Agency and the Medicines and Healthcare products Regulatory Agency.

2.2.3.1 The National Patient Safety Agency (NPSA)

The NPSA leads and contributes to improved safe patient care by informing, supporting and influencing the health sector. NPSA has Patient Safety Division that to identify and reduce risks to patients receiving NHS care. They also lead on national initiatives to improve patient safety[36].

2.2.3.2 The Medicines and Healthcare Products Regulatory Agency (MHRA)

The MHRA is the government agency which is responsible for ensuring that medicines and medical devices work, and are acceptably safe. The MHRA is an executive agency of the Department of Health. The MHRA is responsible for the regulation of medicines and medical devices and equipment used in healthcare and the investigation of harmful incidents. The MHRA also looks after blood and blood products, working with UK blood services, healthcare providers and other relevant organizations to improve blood quality and safety[37].

2.2.5 The New Zealand

Medsafe is the New Zealand Medicines and Medical Devices Safety Authority. It is a business unit of the Ministry of Health and is the authority responsible for the regulation of therapeutic products in New Zealand[38].

2.2.6 Australia

The Therapeutic Goods Administration (TGA) is part of the Australian Government Department of Health and Ageing. It is responsible for regulating therapeutic goods including medicines, medical devices, blood and blood products. This includes goods that they rely on every day, such as sunscreens, through to goods used to treat serious conditions, for example prescription medicines, vaccines, blood products and implants. The TGA evaluates therapeutic goods before they are marketed and monitors products once they are on the market, it also assesses the suitability of medicines and medical devices for export from Australia. The TGA also regulates manufacturers of therapeutic goods to ensure they meet acceptable standards of manufacturing quality. It has a team of manufacturing inspectors that audit manufacturing facilities around the world to ensure that products supplied in Australia are of high quality. The TGA works with consumers, health professionals, industry and its international counterparts in order to effectively regulate increasingly complex products resulting from rapid scientific developments[39].

2.2.7 Japan

The Pharmaceutical and Food Safety Bureau is under the Ministry of Health, Labour and Welfare. The Bureau sets consistent regulations from production to sales and post-marketing safety measures based on the Pharmaceutical Affairs Act, in order to ensure the efficacy and safety of drugs, medical devices, etc. The Bureau is also working on various issues that are directly linked to people's lives and health, including blood projects such as blood donation, and measures against drug abuse[40].

2.2.8 Singapore

The Health Sciences Authority (HSA) is a multidisciplinary agency in health sciences expertise. The core capabilities encompass administering the national regulatory frameworks for pharmaceuticals, complementary medicines, medical devices and other health products; the running of the national blood bank

and provision of transfusion medicine services and the provision of forensic medicine expertise, investigative forensic and analytical science services[41].

In summary, in foreign countries there are agencies to manage the medication safety. Especially in the USA and Canada, there are 2 main processes as the following.

1. Pre-market evaluation: There are processes to evaluate drug name, trademark, and packaging. The responsible agency in the USA is US FDA and in Canada is Health Canada.

2. Post market tracking: They are concerned about post market medication error. The responsible agency in the USA is US FDA and in Canada is Health Canada. In their voluntary reporting system, the report systems are able to detect emerging causes of medication errors from a wide range of settings. New and serious threats to medication safety often emerge through these channels, as conscientious practitioners take the time to report errors that they have seen and made. In the US, there are the USP-ISMP Medication Errors Reporting (MER) Program, and USP's MEDMARX®. Canada has ANALYZE-ERR® that was designed by ISMP-Canada.

2.3 Medication safety in Thailand

2.3.1 The Healthcare Accreditation Institute (Public Organization)

The Healthcare Accreditation Institute (HAI) (Public Organization) (formerly the Institute of Hospital Quality Improvement and Accreditation Thailand (HA)) announced that the 2006 HA-Thailand Patient Safety Goals was a target for patient safety. The third goal is medication safety which had three priorities including[11] 1) High alert drug, 2) Repeated Adverse Drug Reaction: ADRs type B), and 3) Adverse Drug Reactions: ADRs type A.

Later, the HAI announced Thai Patient Safety Goal 2008 known as SIMPLE. SIMPLE is the abbreviation of the major categories for Patient Safety Goals for easy recognition, as follows[13]:

S = Safe Surgery (2nd Global Patient Safety Challenge)

I = Infection Control (Clean Care in 1st Patient Safety Challenge)

M = Medication Safety and Blood Safety

P = Patient Care Process

L = Line, Tube, Catheter

E = Emergency Response

Table 2.1 SIMPLE: Patient Safety Goals & Solutions[13].

	Patient Safety Goals & Solutions
S: Safe Surgery	
S 1	**SSI Prevention**
S 2	**Safe anesthesia**
S 3	**Safe surgical team**
S 3.1	Correct procedure at correct body site (High 5s / WHO PSS#4)
S 3.2	Surgical Safety Checklist
I: Infection Control (Clean Care is Safer Care)	
I 1	**Hand Hygiene / Clean Hand** (High 5s / WHO PSS#9)
I 2	**Prevention of Healthcare Associated Infection**
I 2.1	CAUTI Prevention
I 2.2	VAP Prevention (HA)
I 2.3	Central line infection Prevention (WHO PSS)
M: Medication & Blood Safety	
M 1	**Safe from ADE**
M 1.1	Control of concentrated electrolyte Solutions (WHO PSS#5) Managing Concentrated Injectable Medicines (High 5s)
M 1.2	Improve the safety of High-Alert Drug

Table 2.1 SIMPLE: Patient Safety Goals & Solutions[13] (continued).

	Patient Safety Goals & Solutions
M: Medication & Blood Safety	
M 2	**Safe from medication error**
M 2.1	Look-Alike Sound-Alike medication names (LASA) (WHO PSS#1)
M 3	**Medication Reconciliation / Assuring medication accuracy at transition in Care** (High 5s / WHO PSS#6)
M 4	**Blood Safety**
P : Patient Care Processes	
P 1	**Patients Identification** (WHO PSS#2)
P 2	**Communication**
P 2.1	Effective Communication –SBAR
P 2.2	Communication during patient care handovers (High 5s / WHO PSS#3)
P 2.3	Communicating Critical Test Results (WHO PSS)
P 3	**Proper Diagnosis** (HA)
P 4	**Preventing common complications**
P 4.1	Preventing Pressure Ulcers (WHO PSS)
P 4.2	Preventing Patient Falls (WHO PSS)
L : Line, Tube & Catheter	
L 1	Avoiding catheter and tubing mis-connections (WHO PSS#7)
E: Emergency Response	
E 1	**Response to the Deteriorating Patient / RRT**
E 2	**Sepsis** (HA)
E 3	**Acute Coronary Syndrome** (HA)
E 4	**Maternal & Neonatal Morbidity** (HA)

2.3.2 The Ministry of Public Health

The Ministry of Public Health in collaboration with the WHO under the First Global Patient Safety Challenge announced the National Patient Safety Goal 2007 – 2008 policy comprised of 2 main issues[12, 42]:

1. Health Care-Associated Infections, concerning to “Clean care is safer care”.
2. Medication safety measure, concerning to “Medication Safety for Patient Safety”.

Thailand National Patient Safety Goal 2007 – 2008 policy has 3 priorities for actions, namely 1) look-alike/Sound-alike medication, 2) high alert drugs, and 3) severe adverse drug reaction and repeated drug allergy.

In short, agencies in the USA that are responsible for the medication safety and LASA drug problems include JCAHO, US FDA, ISMP, USP and IOM. In Canada and the UK, there are two agencies responsible for this problem. In other countries, there are agencies that oversee the medication safety but it is not specific to LASA drug problems. This includes Thailand (Table 2.2).

Table 2.2 Agencies overseeing medication safety in Thailand and other countries.

Country	The agencies			
	Ministry	Registration	Accreditation	Medication safety
Thailand	The Ministry of Public Health	Thai FDA	The Healthcare Accreditation Institute (Public Organization)	NA
USA	Department of Health and Human Services	U.S.FDA	JCAHO	- ISMP* - USP
Canada	Health Canada	NA	NA	ISMP-Canada*
UK	Department of Health (United Kingdom)	Medicines and Healthcare products Regulatory Agency	NA	National Patient Safety Agency
New Zealand	Ministry of Health	Medsafe	NA	NA
Australia	Australian Government Department of Health and Ageing	TGA	NA	NA
Japan	Japan's Health Labour and Welfare Ministry	Pharmaceutical and Food Safety Bureau	NA	NA
Singapore	The Health Sciences Authority (HSA)	NA	NA	NA

*data pooled from USA and Canada

NA = none available

2.4 Medication error

The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) of USA defined a "medication error" as *"any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use"*[23].

2.4.1 Severity of medication error

On July 16, 1996, the NCC MERP adopted a Medication Error Index that classifies an error according to the severity of the outcome. It is hoped that the index will help health care practitioners and institutions to track medication errors in a consistent, systematic manner. The medication error index includes the following terms [43]:

No error

Category A: Circumstances or events that have the capacity to cause error.

Error, No harm

Category B: An error occurred but the medicine did not reach the patient.

Category C: An error occurred that reached the patient but did not cause patient harm.

Category D: An error occurred that resulted in the need for increased patient monitoring but no patient harm.

Error, harm

Category E An error occurred that resulted in the need for treatment or intervention and caused temporary patient harm.

Category F An error occurred that resulted in initial or prolonged hospitalization and caused temporary patient harm.

Category G An error occurred that resulted in permanent patient harm.

Category H An error occurred that resulted in a near-death event (e.g. anaphylaxis, cardiac arrest).

Error, death

Category I: An error occurred that resulted in patient death.

2.4.2 Causes of medication errors

The Institute of Safe Medication Practices (ISMP) has identified 10 key system elements that have the greatest influence on medication use. System-based causes of medication errors can be directly traced to weaknesses of failures in these key elements[44].

1. Patient information,
2. Drug information,
3. Communication related to medications,
4. Drug labeling, packaging, and nomenclature
5. Drug standardization, storage and distribution,
6. Medication delivery device acquisition, use and monitoring,
7. Environmental factors,
8. Staff competency and education,
9. Patient education,
10. Quality processes and risk management.

From these 10 key elements, there were 2 elements relating to drug names or drug labeling, packaging namely 1) communication related to medications, and 2) drug labeling, packaging and nomenclature.

2.4.2.1 Communication related to medications

Because failed communication is at the heart of many error, health care organization must enhance collaborative teamwork, eliminate communication barriers among health care providers, and standardize the way prescription orders and other drug information are communicated to avoid misinterpretation[44]. The causes of failed communication such as handwriting, drugs with similar names, zeroes and

decimal points, metric and apothecary systems, abbreviations and ambiguous or incomplete orders[45].

Poor handwriting can blur the distinction between two medications that have similar names. Moreover, many drug names sound similar, especially when spoken over the telephone, enunciated poorly, or mispronounced[45]. For example, a study in Thailand by Thepsuparangsikul [46] studied risk identification at outpatient dispensing service. This study found that illegible drug name was the first cause of wrong drug error in pre-dispensing step (87.85%). In a study by Eumkep et al[16] on medication errors in internal medicine ward at Buddhachinaraj Phitsanulok hospital, they found that illegible drug name was the third cause of prescription error (18.46%), while illegible handwriting was the forth cause of medication error (4.86%). Pattanajak [47] studied inpatient dispensing error at inpatient pharmacy services, at Maha Sarakham Hospital. This study found that illegible handwriting was a cause from individual error and it was in four-element cause of dispensing error.

For drugs with similar names, name mix-ups account for more than one – third of the medication errors reported to the USP MERP. Davis and colleagues published the names of more than 1000 products that have been confused with one another. For example, the gastrointestinal drug Losec® (omeprazole) which was first marketed in the United States, were frequently misread as Lasix® (furosemide) in hand written prescriptions. The manufacturer and the US FDA received so many error reports that the US FDA eventually mandated a name change[45]. Examples of sound-alike drug names that have caused medication errors include the anticoagulant Coumadin® and Kemadrin®, an anti-Parkinson drug. Taxol® (paclitaxel), an anticancer agent, and Paxil® (paroxetine), an antidepressant[45]. Generic names can also cause confusion. For example, amrinone (Inocor®), an inotrope used in patients with cardiomyopathy, looks and sound like amiodarone (Cordarone®), an antiarrhythmics. Finally, problems arise when generic name look or sound like brand names. Ritonavir (Norvir®), a protease inhibitor used in patients with human immunodeficiency virus (HIV) infection, looks similar to Retovir®, a brand of zidovudine[45].

In Thailand, Eng K [48] studied medication errors investigated in outpatient pharmacy service of Songklanagarind hospital. The pharmacists found prescribing errors that may harm patients with an estimate of 2 errors per day. Errors included wrong drug name or unclear drug name such as hydergine and hydrogen, flunarizine and fluoxetine, and cotrimoxazole and clotrimazole. For dispensing, errors from drug name confusion included metoclopamide and metoprolol and metformin, pseudoephedrine and prednisolone, and furosemide and fluoxetine. In step of preparing drugs, pharmacists found 148 wrongly prepared drugs. If left unfound, the patients could be harmed.

2.4.2.2 Drug labeling, packaging and nomenclature

Labeling and packaging problems are the second most frequent category of medication errors reported to the US Pharmacopeia Medication Errors Reporting Program (USP MERP). They account for over 20% of all reports. Most reports find that commercial labeling and packaging were the cause. The problem often stems from the use of nearly identical packaging for two separate items[45].

To facilitate proper identification and use of drugs, product manufacturers, regulatory agencies, and health care organization, especially pharmacies, should ensure that all drugs are provided in clearly labeled containers, including unit dose packages for institutional use, and should take steps to prevent errors with look-alike and sound-alike drug names, ambiguous drug packaging, and confusing or absent drug labels[44].

In Thailand, a study by Pattanajak [47] in Maha Sarakham hospital found the most frequent types of dispensing errors were wrong drug error (38.3%) and wrong dosage form error (34.0%). Medications that caused look-alike/sound-alike drug names included dobutamine and dopamine, while similarity of label or packaging was found in sodium penicillin G and streptomycin injection. Pattanajak [49] studied the factors associated with dispensing errors and evaluation of medication error reporting system. The most frequent types of dispensing error remained wrong drug error. The factors associated with dispensing errors that was found the most was human error (52.90%), confusion of drug name

and look-alike packaging (20.82%), miscommunication (11.95%), system (11.60%) and drug label look-alike (2.73%). The cause of confusion of drug name and look-alike packaging problems were sound-alike drug name and look-alike container.

Based on the information above, drug name and drug packaging have been a cause of medication errors. The problem of drug name or drug packaging arose from LASA drug name and look-alike drug packaging. In short, 2 elements related to drug names or drug labeling, packaging were the important cause of medication errors.

2.5 Look-alike/sound–alike medication

2.5.1 Definition

Look-alike/sound–alike (LASA) medications are defined as medications with generic or proprietary names that look or sound like other medication names. Confusing medication names may lead to potentially harmful medication errors[21].

Health Canada defines LASA health product as "*health products that have a similar written name or similar phonetic to another health product"*[50], while the Therapeutic Goods Administration, Department of Health and Ageing of Australia defines LASA medications as *"...medicine brand names that look or sound the same as other medicine brand names when written or spoken. Look-alike medicine packing refers to medicine containers or primary packaging that looks like that of another medicine. There are also safety concerns with medicines packaging that looks like a toy or a food"*[51].

Other definitions are also given including medication names that look similar or sound similar have been identified as a potential source of error in health care system[52]. The Children's Hospital of Alabama defines look-alike medications as medications in which the packaging is visually similar to another product or medication. Sound-alike medications are medications for which the generic or trade name of the product or medication sounds similar in the spoken or written word[22].

2.5.2 The role of drug names in medication errors

Brand names for drug products are intended to be unique and memorable to provide a simple and convenient way to identify products and distinguish one manufacturer's product from its competitors. The IOM reported pharmaceutical trademarks that look or sound alike have a major role in medication errors. Confusion related to product names is one of the most common causes of medication errors reported to the USP, the U.S.FDA and the ISMP [53].

The cause of drug name mix-ups occurred. Some would say that pharmaceutical manufacturers should be more careful in developing and adopting brand names. Other would say prescribers are too careless when they write or phone in order and too slow to adopt computerized prescribing. When names are blurred on handwritten prescriptions or slurred in spoken order, medication errors are more likely. Busy pharmacists may not have time to make phone calls to clarify or verify orders, or to implement error-prevention practices such as computerized reminders of problem names pairs. Health care institutions may not have adequate safety protocols. The US FDA and other regulatory organizations are often criticized for not doing more to prevent problem-prone names from entering the market and for reacting too slowly when problems surface.

Errors from well-known LASA medication names have been reported. For example, the confusion between Losec® (omeprazole) and Lasix® (furosemide), led to the incidents that the patients were given Lasix® instead of the prescribed Losec®, which resulted in the patients' death [3, 54]. Another example of a somewhat hazard-prone confusion between Levoxine® (levothyroxine sodium) and Lanoxin® (digoxin), where the patients received Lanoxin® instead of the prescribed Levoxine® [6].

During the timeframe 2003-2006, USP identified 1,470 unique drugs implicated in look-alike and/or sound-alike medication errors from the MEDMARX® and USP-ISMP Medication Errors Reporting Program. These drug names contributed to more than 3,170 pairs and each drug was listed along with the other drugs involved in the mix-up [25].

2.5.3 The role of drug packaging and labeling in medication errors

Health professionals are taught to read labels three times, specifically, when obtaining a drug package, when using it, and when returning it to stock or discarding an empty package. Most claim to do this routinely, but there is much evidence to the contrary. Although proper training and increased vigilance are undeniably important, attention to the design of drug packaging and labeling is also essential. Poor labeling and packaging frequently contribute to medication error [25].

The example error includes a patient admitted to the oncology unit with electrolyte imbalances was mistakenly administered Primacor® (milrinone, for heart failure) instead of potassium chloride, because Primacor® and Potassium chloride injection had similar foil-wrap packages. This reflected a look-alike packaging medication error. The patient fortunately suffered no significant harmful effects from the administration of Primacor®[55]. In Canada, in an infant requiring short-term ventilation and sedation, chloral hydrate oral liquid 70 mg was ordered for administration. Pharmacist inadvertently prepared and dispensed potassium chloride oral liquid instead. The hospital, in investigating and analyzing the incident, identified that the two stock bottles of liquid preparation (chloral hydrate and potassium chloride) appeared very similar. Both products were manufactured by same pharmaceutical company [56]. In addition, ISMP Canada reported a pharmacy technician picked up a carton of concentrated potassium chloride bottles instead of a carton of sodium chloride for injection of the renal dialysis patients. The confusion occurred because cartons of stocked potassium chloride solutions were located near sodium chloride solutions. The result of this incident was two patients deaths [57].

2.5.4 Examples of LASA drug in various countries

There are many LASA drug combinations that could potentially result in medication error reported in various countries. Reports by WHO and JCAHO had are shown in table 2.3.

Table 2.3 Examples of confused drug name pairs in selected countries[58].

Country	*Brand name* (generic name)	*Brand name* (generic name)
Australia	*Avanza* (mirtazapine)	*Avandia* (rosiglitazone)
	Losec (omeprazole)	*Lasix* (furosemide)
Brazil	*Losec* (omeprazole)	*Lasix* (furosemide)
	Quelicin (succinilcolina)	*Kefin* (Cefalotina)
Canada	*Celebrex* (celecoxib)	*Cerebyx* (fosphenatoin)
	Losec (omeprazole)	*Lasix* (furosemide)
France	Fluoxetine	*Fluvoxamine*
	Reminyl (galantamine HCl)	*Amarel* (glimeiride)
Ireland	*Losec* (omeprazole)	*Lasix* (furosemide)
	morphine	Hydromorphone
Italy	*Diamox* (acetazolamide)	*Zimox* (Amoxicillina triidrato)
	Flomax (morniflumato)	*Volmax* (Salbutamolo solfato)
Japan	*Almarl* (arotinolol)	*Amaryl* (glimepiride)
	Taxotere (docetaxel)	*Taxol* (paclitaxel)
Spain	*Dianben* (metformin)	*Diovan* (valsartan)
	Ecazide (captopril/hydrochlorthaizide)	*Eskazine* (trifluoperazine)
Sweden	*Avastin* (bvacizumab)	*Avaxim* (hepatitis A vaccine)
	Lantus (insulin glargine)	*Lanvis* (toguanine)

2.5.5 The suggested action to prevent LASA drug problems

In other countries and Thailand, suggestions to prevent LASA drug problems were as follows.

2.5.5.1 WHO [58] suggested strategies to prevent LASA drug problems as follows:

1. Ensuring that health-care organizations actively identify and manage the risks associated with LASA drug by:

a. Annually reviewing the LASA drugs used in their organization.

b. Implementing clinical protocols which:

b1. minimize the use of verbal and telephone orders.

b2. emphasize the need to carefully read the label each time a medication is accessed and again prior to administration, rather than relying on visual recognition, location, or other less specific cues.

b3. emphasize the need to check the purpose of the drug on the prescription/order and, prior to administering the drug, check for an active diagnosis that matches the purpose/indication.

b4. include both the nonproprietary name and the brand name of the drug on drug orders and labels, with the nonproprietary name in proximity to and in larger font size than the brand name.

c. Developing strategies to avoid confusion or misinterpretation caused by illegible prescribing or medication orders, including those that:

c1. require the printing of drug names and dosages.

c2. emphasize drug name differences using methods such as tall-man lettering.

d. Storing problem drugs in separate locations or in non-alphabetical order, such as by bin number, on shelves, or in automated dispensing devices.

e. Using techniques such as boldface and color differences to reduce the confusion associated with the use of LASA names on labels, storage bin and shelves, computer screens, automated dispensing devices, and medication administration records.

f. Developing strategies to involve patients and their caregivers in reducing risks through:

f1. providing patients and their caregivers with written drug information, including medication indication, nonproprietary and brand names, and potential medication side effect.

f2. developing strategies to accommodate patients with sight impairment, language differences, and limited knowledge of health care.

f3. providing pharmacist a review of dispensed drugs with patient to confirm indications and expected appearance, especially when dispensing a drug that is known to have a problematic name.

g. Ensuring that all steps in the medication management process are carried out by qualified and competent individuals.

2. Incorporating education on potential LASA drugs into the educational curricula, orientation, and continuing professional development for health-care professionals.

3. Ensuring that organizations with responsibility for procurement of drugs by:

a. incorporating LASA considerations and user testing into the new product acquisition process.

b. being aware that a single brand name may be associated with different drugs in different countries.

4. Advocating increased emphasis on patient safety in the naming of drugs and the elimination of LASA names through participation on national and international regulatory, standard, and advisory boards.

5. Collaborating with international agencies and industries to implement:

a. a universal drug naming convention.

b. screening of existing drug names for potential confusion with a new drug name prior to approval of the latter.

c. standardized suffixes (e.g. sustained released drugs).

d. strategies for focusing efforts on newly-introduced drugs.

2.5.5.2 Health Canada [59] provided the suggestion to minimize the potential for confusion between products with names that look or sound alike. The followings are some suggestions to reduce medication error.

1. Manufacturers can reduce the incidences of LASA health product names by:

a. researching the proposed name to ensure that there are no health products with similar names currently on the market;

b. choosing names that are distinctive, easily written and pronounced; and

c. informing Health Canada, health practitioners, pharmacists, consumers associations when a health product is identified as a LASA health product name.

2. Physicians and nurses, in order to avoid the potential for LASA confusion, can:

a. write prescriptions clearly by printing the name of the product in block letters, by not using abbreviations or by using electronic prescriptions;

b. include more information about the product (i.e., include both brand name and generic name, and the reason for prescribing the medication);

c. ensure that the strength, dosage and directions for use are clearly indicated on the prescription;

d. ensure the patient (or a family member) understands the reason the medication has been prescription and verify that the patient can read the prescription; and

e. spell out the name of the drug when giving verbal prescription order.

3. Pharmacists can reduce LASA error by:

a. keeping LASA health products separated from one another;

b. creating a warning system for staff to notify them of potential LASA health product (i.e., computer alert, warning on stock bottles);

c. verifying the name of the drug in written and verbal prescription;

d. contacting the prescriber if they have any questions or need clarification regarding the prescription;

e. confirming with the patient the reason they taking the health product; and

f. becoming familiar with LASA health product.

4. Consumers can prevent errors by:

a. ensuring that the prescriber has clearly written the name of the drug (i.e., the patient can read the name) and the reason for prescribing the drug;

b. speaking with their physician, pharmacist if there are any questions regarding the medication;

c. becoming more informed about their condition and medication;

d. ensuring that the drug is the same when getting a prescription refill or purchasing it from over-the-counter;

e. listening and understanding prescription detail given by the pharmacist, especially when obtaining a new prescription; and

f. being sure to tell the pharmacist about any changes in medical history of the patient, as well as any other medications that the patient is talking, including nonprescription and herbal products.

2.5.5.3 The Hospital Authority Medication Safety Committee (HA-MSC) of Hong Kong shared their good practices to manage LASA drugs [60] namely:

1. LASA Medication Safety Notice Board to alert colleagues on LASA drugs and drugs with appearance changed recently.
2. Prompting a LASA warning in pharmacy system.
3. Use of “LASA drug” alert labels during dispensing.
4. Reminder on drug shelf to check the drug label.
5. Separation of drug storage for different strength products/ LASA drugs.
6. Use of tall-man letters when labeling at pharmacy and in ward reminder.

2.5.5.4 Thailand,

In Thailand, Medication Safety in National Patient Safety Goal 2007 – 2008 of The Ministry of Public Health established guidelines of medication safety [12] as the following.

1. Announcement of medication safety measures according to the National Patient Safety Goal 2007 – 2008 to the head of pharmacy department in all levels of care, both public and private hospitals.

2. Campaigning to every hospital for organizing management system to increase medication safety. Measures to reduce medication error from LASA drug problems are:

a. Setting policy of hospital LASA drug list.

b. Systematic checking on drugs before dispensing.

c. Avoiding ordering drug by verbal order.

d. Being strict to procedure of new drugs selection into the hospital formulary

e. Encouraging pharmacists to read drug name on every prescription.

f. Making stickers to remind related staff.

g. Editing the drug name by using bold face and tall-man letter.

h. Producing computerized pop-up alert.

2.6 Medication Management System

Medication Management System (MMS) is the system offering processes of planning, organization, command and control to achieve an effective whole system of using medication. MMS consists of 6 main processes including[18] :

2.6.1 Medication selection and procurement

2.6.2 Storage,

2.6.3 Ordering, prescribing and transcribing medication orders,

2.6.4 Preparing and dispensing,

2.6.5 Administration,

2.6.6 Monitoring

2.7 Research related to using MMS to solve LASA drug problems

The solutions for solving look-alike/sound-alike drug problems by using MMS were found in articles and are shown by MMS steps as follows.

2.7.1 Medication selection and procurement

There were studies that suggested solutions to solve LASA drug errors related medication selection and procurement by not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules [48, 61-62]. In addition to selected drugs, other aids include clear labeling, easy to read and safety containers[61].

2.7.2 Storage

There were studies that suggested solutions to solve LASA drug errors related drug storage by separating the look-alike drugs apart in dispensing room and wards [59-60, 62-63]. In addition, some suggested informing dispensing room staff who took drug at storehouse weekly to aware of LASA drug[63] and to put reminder on drug shelf to check the drug label[60].

Moreover, there also found a study about solution to solve the LASA problem by not storing known problem medications alphabetically by name, but better storing them out of order, or in an alternate location. Affix “name alert” stickers to areas where known look-alike/sound-alike products are stored[64].

2.7.3 Ordering, prescribing and transcribing medication orders

There were studies that suggested solutions to solve LASA drug problems related to physician ordering and prescribing by 1) asking for cooperation from the physicians not to use abbreviations in prescribing[59] or having guideline to use abbreviation[61], 2) asking for clear writing for LASA drug names from physicians[59, 62], 3) asking for written drug strength for LASA drugs from physicians[59, 61, 64], 4) asking for written diagnosis on prescriptions or the reason for prescribing the medication [59, 62, 64], 5) encouraging prescribing drug via computerized system to reduce physician handwriting problem[59, 65], 6) discouraging phone ordering[62] or developing a specific policy for taking verbal or phone orders. For example, one

should clearly repeat back the medication, dose, route, frequency, and indication, and request or provide correct spelling. On should accept verbal or phone orders only when truly necessary [59, 64]. In addition, they also found that identifying both the generic name and brand name in prescription helps prevent errors [59, 62]. Some studies suggested that the patient (or a family member) understands the reason the medication has been prescribed and one should verifies that the patient can read the prescription labels [59].

There were studies that suggested solutions to solve LASA drug problems related to medication orders transcription by dispensing with unit dose or one-day dose, an pharmacists being able to see physician's handwriting directly [66-67].

2.7.4 Preparing and dispensing

There were studies that suggested solutions to solve LASA drug problems related to drug preparing and dispensing by 1) using tall-man letter on the label to help drug preparing and dispensing [60, 63-65], 2) checking drugs prescribed with physician's diagnosis or confirming with the patient the reason they taking the health product [59], 3) allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour in order to reduce the pressure and stress [48], 4) showing both generic and brand names of drugs in computer database[64] or bracket on the strength of the injectable drugs in order to differentiate tablet from injectable drugs [65].

In addition, some studies suggested informing staff about LASA drug problem by making the poster with image and drug information, informing staff in other department at least 1 drug pair per month, disseminating information by writing articles in the newsletters of the hospital every month [63], and having a public display to alert colleagues on LASA drugs and drugs with appearance changed recently [60].

Moreover, some suggested installing "flags" on all computer systems (pharmacy, order-entry, and electronic medical record) as well as on automated medication cabinets for the most seriously confused pairs so that an alert is generated

by entering either half of a pair. If possible, make the alert visual and auditory[59-60, 64] and employ at least two independent checks during the dispensing process, e.g. one person interprets and enters the prescription or order, another person compares the original order to the dispensed label [64].

2.7.5 Administration

There were studies that suggested solutions to solve LASA drug problems related to drug administration by having at least two nurses to check patient name, drug name and strength of drug before administering to the patient. They must read drug name and labeling carefully before picking up drug when preparing and administering drugs to patients [61-62]. Moreover, it also found that pharmacists on ward could help nurses screen strength of drugs, redundant drugs from several physicians and time to administer drug [68].

2.7.6 Monitoring

Pharmacists should establish procedures to monitor the effects of drug use in order to protect and quickly solve. The monitoring included medication errors in drug use, ADR, and no dose adjustment for patients with appropriate conditions [69].

Moreover, using MMS helps solve LASA drug problems. Health Canada[59] provided the suggestion to minimize the potential for confusion between products with names that look or sound alike. They suggested manufacturers could help reduce medication error by researching the proposed name to ensure that there are no health products with similar names currently on the market, choosing names that are distinctive, easily written and pronounced, and informing Health Canada, health practitioners, pharmacists, consumers associations when a health product is identified as a LASA health product name.

2.8 Risk management and medication errors

Medication use is a complex process and the possibility for risk is substantial. Although many errors result in no harm to the patient, the potential for serious injury with certain medication types, classes and routes of administration is substantial [20]. Risk management has been defined as *"the process of making and carrying out decisions that will minimize the adverse effects of accidental lasses upon an organization[70]."* In health care, the principles of risk management are applied to protect the safety and welfare of patient, visitors and staff. To prevent or minimize the effects of loss, risk are identified, analyzed, treated, and evaluated.

Risk management is defined in the Australian/New Zealand Risk Management Standard as "*the systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analyzing, assessing, treating, monitoring and communicating*"[71].

In risk management, it is an iterative process that, with each cycle, can contribute progressively to organizational improvement by providing management with a greater insight into risks and their impact.

Risk management can be applied to all levels of an organization, in both the strategic and operational contexts, to specific projects, decisions and recognized risk areas[71]. (See also figure 2.1)

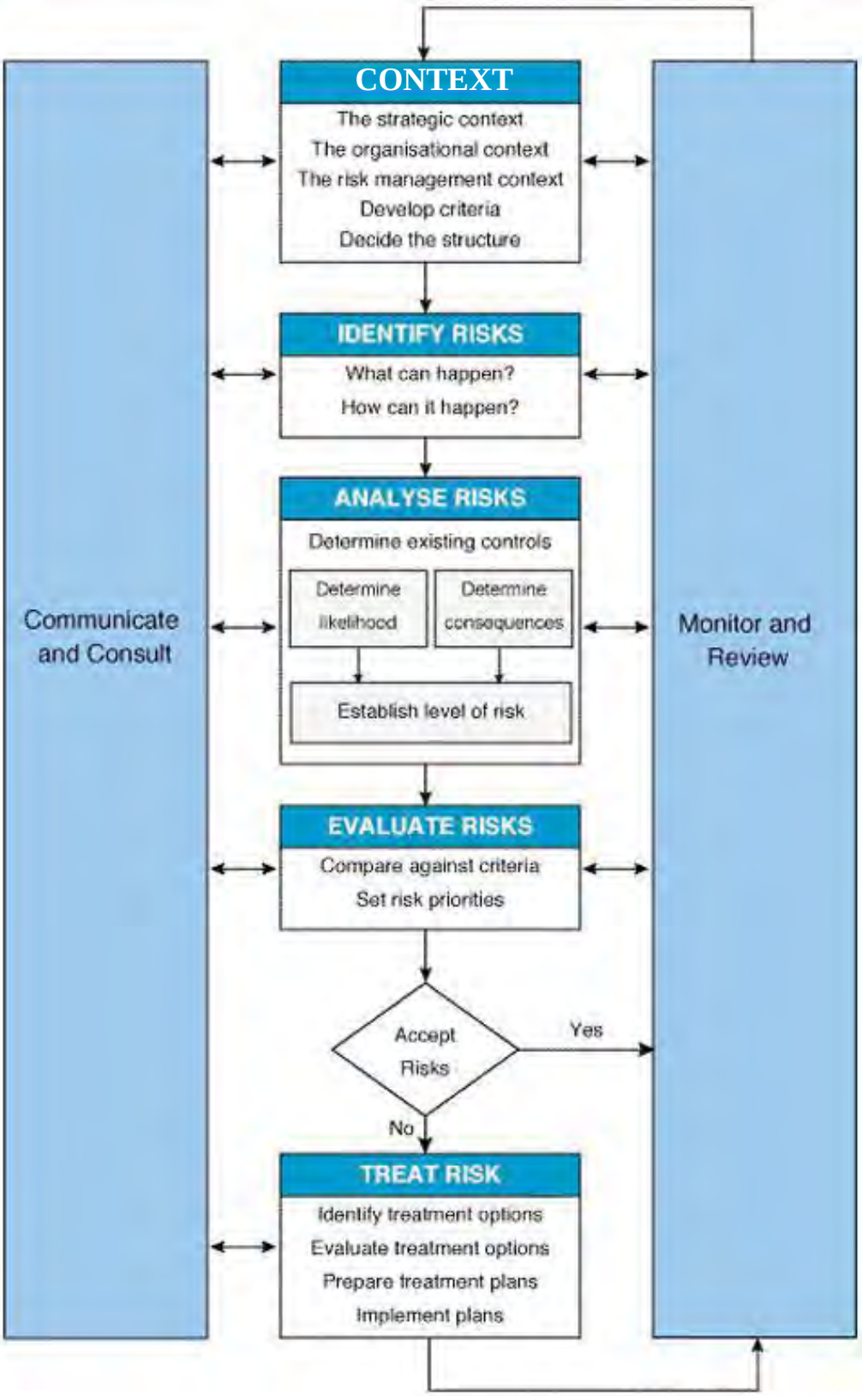


Figure 2.1 The risk management flow chart[71]

Risk analysis is best done in a group with each member of the group having a good understanding of the tasks and objectives of the area being analyzed.

The processes of risk management are as follows.

1. Established contexts means to define the external and internal parameters that organizations must consider when they manage risk. An organization's external context includes its external stakeholders, its local, national, and international environment, as well as any external factors that influence its objectives. An organization's internal context includes its internal stakeholders, its approach to governance, its contractual relationships, and its capabilities, culture, and standards.

2. Identify risks can be carried out by

a. Learning from past experiences which can be found by existing recording systems and experience of the individual.

b. Learn from the experience of others

c. Learn from the process of work

d. Learn from staff of other department.

3. Analysis risks involves ranking events in order according to their potential to produce adverse effects. This is accomplished by assessing the severity of loss, the probability that a loss will occur, and the probability that a similar loss may recur if the system is not modified.

4. Evaluate risks especially any risk that is rated as high or extreme should have additional controls applied to it to reduce to an acceptable level. The aspects to evaluate are what the appropriate additional controls might be, whether they can be afforded, and what priority might be placed on them.

5. Treat risks where strategies are based on the seriousness of the threat of loss to patients, visitors, staff, and the organization as a whole. If the probability of loss is minimal, the risk may be accepted and little or no change may be made in the system. If risk cannot be accepted or reduced, a decision may be made to avoid the service that gives rise to it or to transfer the potential financial loss to outside entities.

The example of using risk management to prevent medication error was performed by the US Joint Commission. They published the National Patient Safety Goal. Examples of potential errors and applicable safety strategies specific to each of the problem drug names are provided. It included potential problematic drug names, brand names & generic names, potential errors and consequence, and specific safety strategies[72].

CHAPTER 3
RESEARCH METHODOLOGY

This chapter describes methodology employed in this study. With 3 phases included, the chapter explains objectives and details of study design and conduct in each phase.

3.1 The study design

This research was divided into 3 phases:

Phase I: Objective of phase I was to study look-alike/sound-alike (LASA) drug situation in public hospital including pairs and types of LASA medications with safety measures the hospitals have implemented to solve such problems. Recognition on national medication safety policy was also determined.

Phase II: Select LASA medication errors with specific safety measures obtained from phase I were presented to the panel of experts to gain more insight and information necessary for proposing a national guideline to solve LASA medication error problem for all levels in Thai healthcare system.

Phase III: An observational study was conducted to gain more information on problems during real time pharmacy practice in 3 selected hospitals as cases for study.

The summary of methods used for study objectives is presented in table 3.1.

Table 3.1 Methods used for study objectives.

Objectives	Documentation study	Questionnaire survey	Semi-structure interview	Brainstorming	Case study strategy
To study recognition of pharmacists in public hospitals on medication safety measure in National Patient Safety Goal of the Ministry of Public Health.		yes			
To study the look-alike/sound-alike problems in public hospitals.		yes	yes		yes
To study the medication management system to solve look-alike/sound-alike problems in public hospitals.	yes	yes	yes	yes	yes
To obtain information necessary for proposing national guideline to solve the look-alike/sound-alike problems.	yes			yes	

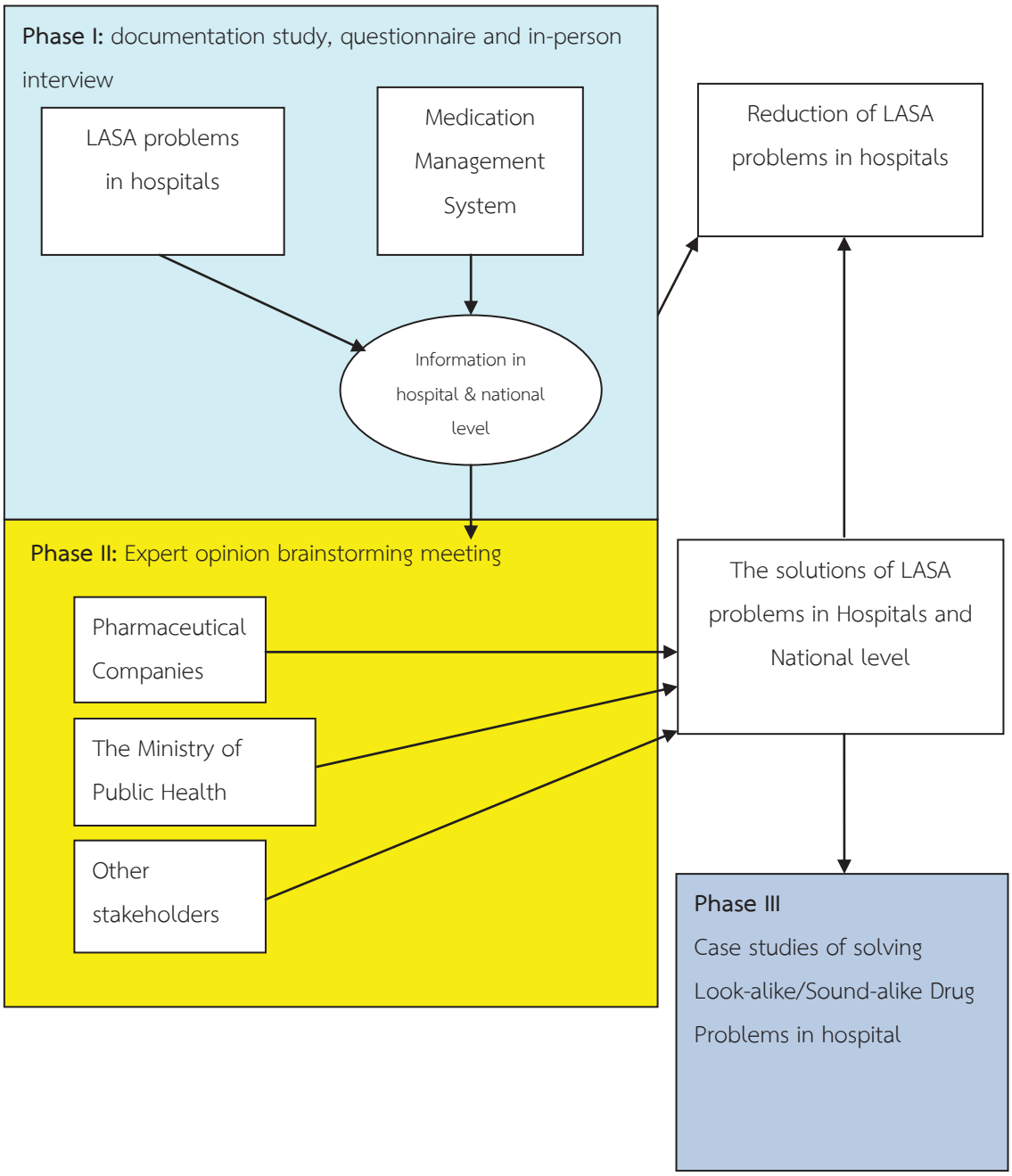


Figure 3.1 Research process

3.2 Study methods

3.2.1 To study recognitions of pharmacists in public hospitals on medication safety measures in National Patient Safety Goal of the Ministry of Public Health, and to study look-alike/sound-alike medication situation in public hospitals.

This part of the study consisted of 3 steps as follows; 1) documentation study, 2) questionnaire survey, and 3) in-person interview with pharmacists, physicians and nurses in public hospitals and pharmacists in pharmaceutical companies.

3.2.1.1 Documentation study

To gain information necessary for a better understanding on the LASA situation and for the subsequent survey questionnaire, extensive literature review on medication safety measures and LASA drug problems in Thailand and other countries was conducted. Solutions and measures to such problems nationwide and worldwide were also reviewed. We summarized such information and reported accordingly in this study result (chapter 4).

3.2.1.2 Questionnaires survey

3.2.1.2.1 Questionnaire development

The development of research survey questionnaire was guided by information obtained from the literature. The questionnaire was tested for content validity and understandability by asking a convenient sample of 30 pharmacists in 30 public hospitals. The information obtained from these pharmacists helped guide the researcher in revising the questionnaire. This new questionnaire was further commented by advisor, co-advisor and 2 hospital pharmacists. Another revision was made upon advices from these informants.

The final version of the questionnaire was divided into 4 parts as follows. (actual questionnaire in Appendix A)

Part I - General data: The questions asked the informants about general information of their hospital. The questionnaire could be answered by more than one informant in a given hospital. The questions requested the position of the informants, the hospital's information, number of pharmacists and number of prescriptions.

Part II - Information about pharmacist recognition on medication safety policy. The questions requested the informants whether they knew about the national patient safety policy, the source of such information they had learned, and the medication safety measures they had implemented.

Part III - Information of management about LASA drugs. This part consisted to two sections.

1. The survey about LASA drug pairs in various types. This section asked for medication pairs in various types by filling the pairs in the table, for example, types of generic name, brand name, and generic/brand name LASA medications. The informants were asked to fill in up to 3 pairs in each type.

2. The medication management system (MMS) to solve the LASA drug problem. This section asked about the methods or measures guided by MMS that were implemented in the hospitals to solve medication errors. The informants were also asked whether such implemented measures were successful.

Part IV - Additional comments and suggestions on LASA drug problems: This part asked the informants for additional comments and suggestions on the LASA drug errors policy and implementation they might have.

3.2.1.2.2 Data collection

Data were collected by mail questionnaire survey. The questionnaires were mailed to pharmacists in each of all 971 public hospitals in Thailand on September 16th, 2009. Before the reminder was sent, the questionnaire return for the first round of the survey was waited for until October 31st, 2009. The first reminder was followed by replacing questionnaire to the hospitals that did not return the questionnaire in the first round. The second-round questionnaire was waited until December 10th, 2009. With a relatively low response rate from the two

rounds of survey, the researcher mailed a postcard as a second-round reminder. In addition, copies of questionnaire were mailed per request for replacement from some hospitals. All questionnaires were waited until March 31st, 2010. Additional questionnaire replacement was also done at the Annual Meeting of Association of Hospital Pharmacy (Thailand) on August 2nd, 2010. The last questionnaire was expected to return no later than August 31st, 2010. However, the last questionnaire was returned on January 16th, 2011, and included in analysis.

3.2.1.2.3 Study population

In this phase of study, the study population referred to all public hospitals in Thailand. With the intention to gain information from all public hospitals, the study sample was equal to the study population. The population consisted of 971 public hospitals under various governmental agencies as follows.

Hospitals under the Office of Permanent Secretary of the Ministry of Public Health:

Regional hospitals	25 hospitals
General hospitals	69 hospitals
Community hospitals	736 hospitals

Hospitals under other departments of the Ministry of Public Health:

Hospitals under Department of Medical Service	27 hospitals
Hospitals under Department of Mental Health	16 hospitals
Hospitals under Department of Disease Control	2 hospitals
Hospitals under Department of Health	12 hospitals

Hospitals under other ministries:

Hospitals under the Ministry of Defense	64 hospitals
Hospitals under the Ministry of Education	13 hospitals
Hospitals under the Ministry of Justice	1 hospital
Hospitals under the Thai Red Cross Society	2 hospitals
Hospitals under the Prime Minister's Office	2 hospitals
Hospitals under other agencies	2 hospitals

3.2.1.2.4 Data analysis

Frequency with corresponding percentage was used to describe data obtained from Part I (general information) and Part II (recognition on medication safety policy). Data from Part III (LASA drug pairs in various types) were tabulated for frequency of specific pairs and of specific types. Data from section 2 of Part II (methods in medication management system (MMS) to solve LASA drug problems) were analyzed and presented as frequencies.

3.2.2 To describe methods or measures for medication safety the healthcare providers and other related personnel used in their settings by means of in-person interviews. These included pharmacists, nurses and physicians in public hospitals and personnel related to medication system, pharmacists from pharmaceutical company and pharmacist from the Food and Drug Administration.

3.2.2.1 Data collection

A series of in-person interviews had been conducted from February 23rd, 2010, to April 12nd, 2011. The interview with pharmacists in public hospitals were conducted to obtain information regarding techniques they used to solve LASA drug problems in their hospitals; while the interviews with physicians and nurses were to gather information about recognition on the LASA drug problems in their hospitals and notion to solve this problem.

3.2.2.2 Study sample

The study sample in this in-person interviews consisted of pharmacists, physicians, and nurses from public hospitals, pharmacists from pharmaceutical companies and a pharmacist from Bureau of Drug Control, the Food and Drug Administration.

Sixteen pharmacists from 16 public hospitals were as follows:

Regional hospitals	6 pharmacists
General hospitals	3 pharmacists
Community hospitals	5 pharmacists

Hospitals under Department of Medical service 1 pharmacist
Hospitals under Department of Mental Health 1 pharmacists

Among these 16 interviews with pharmacists from 16 hospitals, seven of them were those that returned the survey questionnaire in Phase I, and 9 were those not returning the survey questionnaire.

Three physicians from 3 public hospitals were as follows:

Internal medicine specialist	2 physicians
General practitioner	1 physician

Two nurses from 2 public hospitals were as follows:

Medicines ward	1 nurse
Emergency room	1 nurse

Four pharmacists from 4 pharmaceutical companies were as follows:

Government Pharmaceutical Organization (GPO)	1 pharmacist
Local pharmaceutical companies from 2 companies	2 pharmacists
Original pharmaceutical company	1 pharmacist

One pharmacist from the Bureau of Drug Control, the Food and Drug Administration.

3.2.2.3 Data analysis

Data from in-person interviews with pharmacists, physicians and nurses from public hospitals, and pharmacists from pharmaceutical companies and Thai FDA were summarized and presented as frequencies.

3.2.3 Brainstorming of expert panel based on LASA medication information from Phase I to obtain a consensus on information necessary for proposing a national guideline on LASA errors with measures that could potentially be implemented at each step of healthcare system in Thailand.

In Phase II of the study, the objective was to obtain the information necessary for proposing a national guideline to solve LASA medication errors. The information regarding LASA medication errors from Phase I and literature review was compiled and provided for the expert panel to make a consensus on each type of LASA medications errors and related measures or solutions deemed most effective in applicable steps of healthcare system. Information from brainstorming was summarized.

3.2.3.1 Expert opinion brainstorming meeting

Brainstorming of experts to make a consensus on data of LASA medication errors with associating measures was held as a meeting on June 6th, 2011, at Sasa International House (Sasa Nives), Chulalongkorn University. In the meeting, the researcher showed the data of LASA medication errors and related measures from various sources to the expert panel. The data consisted of examples of LASA drug pairs in each type and the problem-solving measures based on the MMS. For each type of LASA errors, the expert panel discussed the possibility to use each measure/solution at each level of healthcare system, i.e., national level and hospital level. In each healthcare system level, each of 3 types of LASA error problems were decided whether it was effective to be managed at each level. These 3 types of LASA error problems included problems of 1) similar drug name, 2) similar drug packaging, and 3) similar drug name and packaging. Example of issue provided for expert panel discussion is shown in table 3.2.

Table 3.2 Example of issues provided for expert panel discussion.

Recommendations from the literature review	Information found from survey and interview	Solution mostly likely to happen	Opinion from expert panel
In foreign countries, before a new drug product is registered, brand name or generic name of the new drug was verified whether it was not similar to any old drugs.	- Based on experience from Thai FDA, the agent compared new drug name with an old drug name with similar pronunciation. If for example, a syllable at the same order in both name red out similar, say C and Z, the new drug name needed to be changed. - Drug names with a tendency to exaggerate the drug benefit were also subject to change.	Drug registration should compare new drug name with old drug name in every aspect. If found similar or confusing, the change must be mandated before registration.	

3.2.3.2 The expert panel

The expert panel of 15 persons included physicians, pharmacists and nurses. Qualifications of the experts are detailed in Appendix B.

1. Hospital pharmacists: each of 5 pharmacists from each of the following hospitals:
    - Hospital under the Thai Red Cross Society which was equivalent to university hospitals
    - Hospital under Department of Medical Service
    - Regional hospital
    - General hospital
    - Community hospital
2. Two internal medicine physicians from 2 general hospitals.
3. One nurse from a general hospital

4. A pharmacist representative from the Association of Hospital Pharmacy (Thailand)
5. A pharmacist representative from the Food and Drug Administration
6. Four pharmacist representatives from 3 pharmaceutical companies.
    - Government Pharmaceutical Organization (GPO) 2 pharmacists
    - Original pharmaceutical company
    - Local pharmaceutical company
7. A professor from a school of pharmacy

3.2.3.3 Data analysis

The data were summarized and presented as consensus information.

3.2.4 An observational study on implementing solutions/measures to solve LASA medication problems practice.

This was phase III of the research. The aim of this phase was to describe how hospital pharmacists and associating personnel implemented measures or solutions to solve LASA medication error problems in their real time practice.

3.2.4.1 Data collection and study sample

Based on the survey questionnaire that indicated that drug storage and drug dispensing, in pharmacy department, were the most likely steps to solve LASA problems, the observation was specifically carried out in these two steps. This phase was conducted in 3 a convenience sample of 3 public hospitals including 1) the community hospital in Phetchaburi province, representing community hospital, 2) the community hospital in Nakhon Pathom province, representing large community hospital, and 3) the general hospital in Ratchaburi province, representing general hospital. For each hospital, 3 visits were planned for data collection. At the first visit, the pharmacist(s) were asked for specific LASA problems occurring in the last 3 months and the measures/solutions they used to solve them. For those they had

solved, the researcher further asked whether the success and sustainability were achieved. If there were any LASA problems subject to further management, the researcher followed the ongoing problem-solving process within the next 2 visits. All information from observation and discussion with the pharmacists were recorded.

1. The community hospital in Phetchaburi province: Data collection in this hospital was conducted from February 2 to May 22, 2012 (110 days). In this hospital, the pharmacist reported that no specific LASA problems had been documented in the last 3 months. Thus LASA problems were collected from documented records. With no possible prospective observation, only 2 visits to the hospital were made.

2. **The community hospital in Nakhon Pathom province**: Data collection in this hospital was done from February 21, to May 31, 2012 (100 days). Once asked for the problems that occurred in the last 3 months, the pharmacists informed that since several items were changed, LASA problems especially those with product packages and labels had not been detected. The pharmacists and staff therefore detected new LASA problems and applied measures/solutions to solve the problems. With prospective observation applicable, the researcher followed the on-going problem-solving process in the next 2 visits.

3. **The general hospital in Ratchaburi province:** Data collection in this hospital was done from March 1 to May 31, 2012 (92 days). With the inquiring for LASA problems that occurred in the last 3 months, the pharmacists selected LASA problems to be solved and further applied the solution to solve the problems. With prospective observations possible, all planned 3 visits to the hospital were made.

3.2.4.2 Data analysis

All problems and measures observed were summarized and presented in detail. Problems and measures commonly found in the 3 hospitals were also mentioned.

CHAPTER 4

SITUATION OF LOOK-ALIKE/SOUND-ALIKE MEDICATION PROBLEMS

This chapter presents look-alike/sound-alike medication error problems in Thai public hospitals. Specific medication pairs and types of errors are detailed. The data were collected from survey questionnaire and in-person interview with 16 hospital pharmacists.

From questionnaires sent to 971 public hospitals during September 2009 to January 2011, 470 hospitals returned the questionnaire (a response rate of 48.40%). Among 17 hospital pharmacists interviewed, 9 were those from the hospitals not returning the questionnaire and 7 were those from the hospitals that did. The total number of respondents for this analysis was then 479 hospitals. Therefore a new response rate for this analysis was 479 of 971 or 49.33%.

4.1 General information

4.1.1 Type of hospitals

Of 971 public hospitals in Thailand, the majority was those under the Ministry of Public Health (887 hospitals), of which 830 of them were those under the Office of Permanent Secretary. The other 84 public hospitals were under other ministries or governmental authoritative agents.

The largest proportion of returned questionnaire was from the hospitals under the Office of Permanent Secretary of the Ministry of Health (411 of 830 hospitals, or 49.52%) followed by those under the other offices of the Ministry of Public Health (28 of 57 hospitals, 49.12%), and those under other agents (31 of 85 hospitals, 36.47%), respectively.

When considering only the hospital under the Office of Permanent Secretary of the Ministry of Public Health, the largest number of respondents was community hospitals (736 hospitals) with a response rate of 46.87% (345 of 736 hospitals). However the largest proportion of returning questionnaire was from regional hospitals (18 of 25 hospitals, 72%) followed by those from general hospitals (48 of 69 hospitals, 69.56%). It is worthy noting that even with the smallest response rate (46.87%), the majority of respondents were from community hospitals (345 of 479 hospitals, 72.02%).

Table 4.1 General information of public hospitals

Number of hospital by type and affiliation	Number of hospital (%)	
	By type	By affiliation
Hospitals under the Office of Permanent Secretary, Ministry of Health (n = 830)		
Regional Hospitals (n = 25)	18 (72.00%)	411 (49.52%)
General Hospitals (n = 69)	48 (69.56%)	
Community Hospitals (n = 736)	345 (46.88%)	
Hospitals under other offices, Ministry of Public Health (n = 57)		
Hospitals under Department of Medical service (n = 27)	16 (59.26%)	28 (49.12%)
Hospitals under Department of Mental Health (n = 16)	8 (50.00%)	
Hospitals under Department of Disease Control (n = 2)	1 (50.00%)	
Hospitals under Department of Health (n = 12)	3 (25.00%)	
Hospitals under other ministries (n = 84)		
Hospitals under the Ministry of Defense (n = 64)	21 (32.81%)	31 (36.47%)
Hospitals under the Ministry of Education (n = 13)	6 (46.15%)	
Hospitals under the Ministry of Justice (n = 1)	1 (100.00%)	
Hospitals under the Thai Red Cross Society (n = 2)	2 (100.00%)	
Hospitals under the Prime Minister's Office (n = 2)	1 (50.00%)	
Hospitals under the other agency (n = 2)	0 (0.00%)	

4.1.2 Hospital sizes and number of pharmacists (Table 4.2)

4.1.2.1 Hospitals under the Office of Permanent Secretary of the Ministry of Public Health

With the expected size, regional hospitals were the largest with number of 440 – 1,090 beds and 20 – 50 pharmacists. General hospitals had 170 – 570 beds with 6 – 34 pharmacists. Hospitals with smallest size were community hospitals with 10 – 250 beds and 1 – 14 pharmacists; while most of them (191 hospitals) had 30 beds. The lowest ratio of pharmacist number per bed was also found in community hospitals (1 pharmacist per 10 – 17 beds).

4.1.2.2 Hospitals under other offices of the Ministry of Public Health

Hospitals under Department of Medical Service had a wide range of size (40 – 1,200 beds) and corresponding number of pharmacists (1 – 29 pharmacists) with one hospital having no pharmacist. Hospitals under Department of Mental Health also had a wide range of size (90 – 700 beds) and a smaller range of number of pharmacists (1 – 9 pharmacists). With only one hospital under Department of Disease Control responding the questionnaire, this hospital had 650 beds and 15 pharmacists. The hospitals under Department of Health were all uniformly in small size (50 – 60 beds) and with small number of pharmacists (2 – 4 pharmacists). Overall, ratios of pharmacist number to number of beds among hospitals under various types of offices in the Ministry of Public Health were found the least burdensome in hospitals under Department of Health (a range of 1: 15 – 25) while the greater burdensome among other types, ranging from 1: 41 in hospitals under Department of Medical Service to 1: 77 – 90 in Hospitals under Department of Mental Health.

4.1.2.3 Hospitals with other governmental affiliations

Most data were from hospitals under the Ministry of Defense with a size range of 10 – 400 beds and 1 – 14 pharmacists, resulting in a ratio of pharmacist to bed numbers of 1: 10 - 28. Hospitals under the Ministry of Education had 100 – 1400 beds and 7 – 69 pharmacists with ratio range of 1: 14 - 20.

Table 4.2 Size of hospitals and number of pharmacists among responding hospitals.

Type of hospital	Size of hospital (beds)	Number of pharmacist	Ratio of number of pharmacist to bed number
Hospitals under the Office of Permanent Secretary of the Ministry of Public Health (n = 411)			
Regional Hospitals (n = 18)	440 – 1,019	20 - 50	1 : 20 - 22
General Hospitals (n = 48)	170 - 570	6 - 34	1 : 16 - 28
Community Hospitals (n = 345)	10 -250	1 - 14	1 : 10 – 17
Hospitals under other offices in the Ministry of Public Health (n = 28)			
Hospitals under Department of Medical Service (n = 16)	40 – 1,200	0 - 29	1 : 41
Hospitals under Department of Mental Health (n = 8)	90 - 700	1 – 9	1 : 77 – 90
Hospitals under Department of Disease Control (n = 1)	650	15	1 : 43
Hospitals under Department of Health (n = 3)	50 - 60	2 - 4	1 : 15 – 25
Hospitals with other governmental affiliations (n = 31)			
Hospitals under the Ministry of Defense (n = 21)	10 – 400	1 – 14 (12 hospitals each with 1 pharmacist)	1 : 10 - 28
Hospitals under the Ministry of Education (n = 6)	100 – 1,400	7 - 69	1 : 14 - 20
Hospitals under the Ministry of Justice (n = 1)	500	3	1 : 166
Hospitals under the Thai Red Cross Society (n = 2)	400 and 1,500	1 hospital with 68 pharmacists; another with no data	
Hospitals under the Prime Minister's Office (n = 2)	No data	No data	No data

4.1.3 General information of pharmacists responding the questionnaire and participating in-person interview

4.1.3.1 Information of pharmacist responding the questionnaire

Most respondents were head of pharmacy department (330 of 479 respondents, 68.89%) followed by pharmacists responsible for various tasks,

pharmacists responsible for drug system development, and other professionals, respectively.

4.1.3.2 Information of pharmacists participating in-person interview

Among 16 pharmacists interviewed, the majority was those in dispensing, followed by those in drug information service, and medication procurement.

4.2 Recognition on medication safety policy

4.2.1 Pharmacist's perception on medication safety policy according to the National Patient Safety Goal 2007 – 2008

From 479 hospitals, 424 hospitals (88.52%) knew about the National Patient Safety Goal; while 44 hospitals (9.18%) did not know and 11 hospitals (2.30%) did not respond. Most respondents stated that they knew such policy from head of pharmacy department; while the rest know other source such as conference, the Association of Hospital Pharmacy (Thailand) newsletter, Internet, and Thai academic journals.

4.2.2 Implementation of medication safety measures

The majority of the hospitals had implemented medication safety measure (376 of 479 hospitals, 76.62%), while 93 hospitals (19.41%) had implemented incomplete measure, and 6 hospitals (1.25%) had not. Six of these not implementing the measure consisted of 4 community hospitals, 1 hospital under Department of Medical Service, and 1 hospital under Department of Disease Control. With another 5 hospitals not responding this question, a total number of 468 hospitals were considered a denominator for the following analysis. Medication safety measure implemented by most hospitals was action toward LASA medication problems (435 of 468 hospitals, 92.94%), followed by high-alert drug (453 hospitals, 96.79%), and severe adverse drug reaction and repeated drug allergy (425 hospitals, 90.81%).

4.2.3 Medication safety measure and the cause of Medication Error

Once asked about their opinion, most hospital pharmacists (395) ranked LASA medication to be the first problematic cause of medication errors, followed by high-alert drugs, and lastly severe adverse drug reaction and repeated drug allergy (table 4.3).

Table 4.3 Perceived priority of the medication safety problems in hospitals (N = 479).

Rank	LASA medication (hospitals)	High alert drugs (hospitals)	severe ADR and repeated drug allergy (hospitals)
1	395	26	36
2	24	255	162
3	37	160	244
Total	*456*	*441*	*442*

4.3 Drug pairs with LASA medication problems

OF 479 hospitals, 476 hospitals informed about drug pairs with LASA medication problems. Of 7,964 total drug pairs reported, 3,205 unique pairs were identified (40.24%). The highest number of drug pairs in a hospital was 59 pairs; while the smallest was 1 pair. With the largest number of hospital, community hospitals altogether reported the greatest number of drug pairs (5,534 pairs). All information is shown in table 4.4.

Table 4.4 Number of drug pairs by type of hospitals.

Type of hospital	Number of drug pair	Range (pair)		Average		
		The least	The most	Mode	Mean	Median
Hospitals under the Office of Permanent Secretary of the Ministry of Public Health (n = 411)						
Regional hospitals (n = 18)	505	6	43	11, 26, 29, 39, 43	27	26
General hospitals (n = 48)	1,197	6	59	19	24	23
Community hospitals (n = 345)	5,534	1	44	13	16	14
Hospitals under other offices, Ministry of Public Health (n = 28)						
Hospitals under Department of Medical service (n = 16)	304	3	42	7	18	10
Hospitals under Department of Mental Health (n = 8)	89	5	23	11	13	11
Hospitals under Department of Disease Control (n = 1)	35	35		-	35	-
Hospitals under Department of Health (n = 3)	46	2	24	-	15	20
Hospitals under the other Ministry (n = 31)						
Hospitals under the Ministry of Defense (n = 21)	215	1	28	5	11	8
Hospitals under the Ministry of Education (n = 6)	137	5	46	-	23	18
Hospitals under the Ministry of Justice (n = 1)	9	9		-	9	-
Hospitals under the Thai Red Cross Society (n = 2)	60	22	38	-	30	-
Hospitals under the Prime Minister's Office (n = 1)	13	13		-	13	-

When considering each type of hospitals, regional hospitals, general hospitals and university hospitals reposted the greatest number of drug pairs (median = 26, 23 and 18, respectively). These reflected the fact that these types of hospitals had a large number of medications in their hospital formulary which further increased the likelihood of having LASA medication errors.

4.3.1 Number of drug pairs in each type of LASA medication problems (Table 4.5)

Considering type of problems, generic drug name LASA error was the most frequently reported (1,158 of 7,964 pairs, or 15.05% of total pairs). But once unique pairs were identified (a total of 3,205 unique pairs), the most frequently reported type of LASA error was the one with look-alike drug tablet or capsule from different pharmaceutical companies (419 pairs, 13.07% of total unique pairs).

With the highest number of pairs reported, the 1,158 pairs of LASA generic name problem were reported from a large number of hospitals (433 hospitals). Thus once identical pairs were identified; only 220 unique pairs were obtained. This reflects that for any given LASA generic drug name problem, it was found in several hospitals. This further reflects the fact that most hospitals had generic drugs in their formularies similar to each other.

The least problematic LASA error was that with similar drug boxes among different companies, 109 pairs from 78 hospitals. In addition, with 101 unique pairs identified, each pair was more likely to occur in one hospital.

For the look-alike tablet or capsule by different companies, the greatest number of unique pairs (419 unique pairs of the 558 total all pairs) reported by 303 hospitals indicated that a very small number of the same pairs were commonly found in many hospitals. In other words, different hospitals usually purchased any given products from different companies. All information can be seen in Table 4.5.

Table 4.5 Number of drug pairs by type of problem look-alike sound-alike medication errors.

Type of problems	Total pairs	Rank*	Unique pair	Rank**	% ***
Brand name look-alike/sound-alike	775	2	254	6	32.77
Brand/generic name look-alike/sound-alike	461	10	226	8	49.02
Generic name look-alike/sound-alike	1,158	**1**	220	10	19.00
Similar labeling by **the same company**	620	5	340	3	54.84
Similar labeling by different companies	254	14	220	11	86.61
Similar ampoule or vial injectable drug by **the same company**	590	6	166	13	28.14
Similar ampoule or vial injectable drug by different companies	417	12	254	6	60.91
Similar tablet or water drug bottle by **the same company**	500	8	226	8	45.20
Similar tablet or water drug bottle by different companies	262	13	200	12	76.34
Similar drug box by **the same company**	440	11	268	5	60.91
Similar drug box similar by different companies	109	15	101	15	92.66
Similar drug foil or blister by **the same company**	724	3	269	4	37.15
Similar drug foil or blister by different companies	462	9	360	2	77.92
Similar tablet or capsule by **the same company**	632	4	153	14	24.21
Similar tablet or capsule by different companies	558	7	419	**1**	75.09

* Rank of total pairs,

** Rank of unique pairs,

*** % of unique pair to total pairs in each type

In terms of specific drug name or product name in each type of LASA medication errors, Losec® and Lasix® was the most frequently reported LASA brand name, while diclofenac and dicloxacillin pair was the top one for LASA generic name. Label of diazepam injection and furosemide injection (figure 4.1), both from GPO, was the most frequently reported pair of similar labeling from the same company. Other top-three most frequently reported pairs of each LASA error type are also presented in table 4.6.

Table 4.6 Top 3 drug pair samples for each LASA type

Type of problem	Number of Drug pairs	Top 3 samples drug pair problem from many hospitals		Number of responding hospitals
		Drug name	Drug name	
Drug name look- alike/sound- alike				
Brand name look-alike/sound-alike	775	Losec® (AstraZeneca)	Lasix® (Sanofi-aventis)	122
		Voltaren® (Novatis)	Ventolin® (GlaxoSmithKline)	104
		Aldactone® (Pfizer)	Aldomet® (M&H)	37
Brand/generic name look-alike/sound-alike	461	Norflex® (Inova)	norfloxacin	22
		Prenolol® (Berlin)	propranolol	20
		Norgesic® (Inova)	norfloxacin	14
		Berodual® (Boehringer Ingelheim)	budesonide	14
		Madopar® (Roche)	methyldopa	14
Generic name look-alike/sound-alike	1,158	diclofenac	dicloxacillin	100
		hydralazine	hydroxyzine	99
		loratadine	lorazepam	96
Labeling look-alike				
Similar labeling by **the same company**	620	amoxicillin 250 mg	amoxicillin 500 mg	36
		(The Government Pharmaceutical Organization, GPO)		
		propranolol 10 mg	propranolol 40 mg	23
		(GPO)		
		enalapril 5 mg	enalapril 20 mg	22
		(Berlin pharm)		
Similar labeling by <u>different companies</u>	254	simvastatin 20 mg (GPO)	aspirin 81 mg (Osoth interlab)	8
		flunarizine (GPO)	dipotassium clorazepate (Polipharm)	6
		multivitamin dry syrup (GPO)	amoxycillin dry syrup (T. Man)	5
Packaging look-alike				
Similar ampoule or vial injectable drug by **the same company**	590	diazepam injection	furosemide injection	109
		(GPO)		
		vitamin K_1 1 mg/0.5 ml	vitamin K_1 10 mg/ml	71
		(Atlantic lab)		
		vitamin B1 injection	vitamin Bcomplex injection	29
		(ANB)		

Table 4.6 Top 3 drug pair samples for each LASA type (continued)

Type of problem	Number of Drug pairs	Top 3 samples drug pair problem from many hospitals		Number of responding hospitals
		Drug name	Drug name	
Packaging look-alike				
Similar ampoule or vial injectable drug by different companies	417	vitamin Bcomplex injection (ANB)	vitamin K_1 injection (Atlantic lab)	21
		diclofenac injection (Siam Bheasach)	ranitidine inection (Milimed)	14
		vitamin B1 injection (ANB)	vitamin K_1 injection (Atlantic lab)	14
Similar tablet or liquid drug bottle by **the same company**	500	furosemide 40 mg	folic acid 5 mg	43
		(GPO)		
		diazepam 2 mg	salbutamol 2 mg	22
		(GPO)		
		guaifenesin syrup	paracetamol syrup	21
		(GPO)		
Similar tablet or liquid drug bottle by different companies	262	hyoscine suspension (several companies)	domperidone suspension (several companies)	28
		multivitamin dry syrup (GPO)	amoxycillin dry syrup (several companies)	15
		ibuprofen suspension (GPO)	Paracetamol syrup (Thai Nakorn)	13
Similar drug box by **the same company**	440	amoxicillin 250 mg	amoxicillin 500 mg	31
		(GPO)		
		propranolol 10 mg	propranolol 40 mg	15
		(GPO)		
		rifampicin 300 mg	rifampicin 450 mg	11
		(GPO)		
Similar drug box by different companies	109	simethicone drop (T.Man)	ferous fumarate drop (Ranbaxy)	4
		nifedipine 20 mg (Stada)	atenolol 50 mg (Pharmdica)	2
		simvastatin 20 mg (GPO)	aspirin 81 mg (Osoth interlab)	2
		clobetasol cream (Polipharm)	clotrimazole (NIDA PHARMA)	2

Table 4.6 Top 3 drug pair samples for each LASA type (continued)

Type of problem	Number of Drug pairs	Top 3 samples drug pair problem from many hospitals		Number of responding hospitals
		Drug name	Drug name	
Similar drug box by different companies (continue)		finasteride 5 mg (T.O. chemical)	alfuzocin 10 mg (Sanofi-Aventis)	2
		simethicone drop (R.X.)	vitamin E drop (Ranbaxy)	2
Similar drug foil or blister by **the same company**	724	propranolol 10 mg	propranolol 40 mg	57
		(GPO)		
		amoxicillin 250 mg	amoxicillin 500 mg	54
		(GPO)		
		enalapril 5 mg	enalapril 20 mg	51
		(Berlin pharm)		
Similar drug foil or blister by different companies	462	omeprazole 20 mg (GPO)	amoxycillin + Clavulanic acid (several companies)	14
		simvastatin 20 mg (GPO)	aspirin 81 mg (Osoth interlab)	14
		flunarizine (GPO)	dipotassium clorazepate (Polipharm)	14
Tablet or capsule look-alike				
Similar tablet or capsule by **the same company**	632	diazepam 5 mg	dimenhydrinate 50 mg	82
		(GPO)		
		amoxicillin 250 mg	amoxicillin 500 mg	61
		(GPO)		
		phenobarbital 60 mg	propylthiouracil	54
		(GPO)		
Similar tablet or capsule by different companies	558	chlorpheniramine 4 mg (GPO)	bromhexine 8 mg (several companies)	31
		stavudine 30 mg (GPO)	indomethacin (several companies)	22
		aspirin 300 mg (several companies)	ibuprofen (several companies)	16

For look-alike packaging, about 3 to 4 problems were found in each unique pair. For example, amoxicillin 250 mg and 500 mg was (table 4.7 and figure 4.2) reported by 127 hospitals as a total number of 182 drug pairs, with an ultimate number of 4 LASA problems including 1) similar labeling by the same company, 2) similar drug box by the same company, 3) similar drug foil or blister by the same company, and 4) similar tablet or capsule by the same company (figure 4.1). The top 5 drug pairs with similar packaging problem are presented in table 4.7.

Table 4.7 Top 5 drug pairs with look-alike packaging problem.

Order	Drug pair	Number of drug pairs	Number of responding hospitals	Type of problem	Number of drug pairs
1	amoxicillin 250 mg and amoxicillin 500 mg (GPO) See figure 4.1	182	127	- Similar labeling by **the same company** - Similar drug box by **the same company** - Similar drug foil or blister by **the same company** - Similar tablet or capsule by **the same company**	36 31 54 61
2	diazepam 10 mg/2 ml and furosemide 20 mg/2 ml (GPO) See figure 4.2	121	112	- Similar labeling by **the same company** - Similar ampoule or vial injectable drug by **the same company** - Similar drug box by **the same company**	11 109 1
3	propranolol 10 mg and propranolol 40 mg (GPO) See figure 4.3	120	84	- Similar labeling by **the same company** - Similar drug box by **the same company** - Similar drug foil or blister by **the same company** - Similar tablet or capsule by **the same company**	23 15 57 25

Table 4.7 Top 5 drug pairs with look-alike packaging problem (continued).

Order	Drug pair	Number of drug pairs	Number of responding hospitals	Type of problem	Number of drug pairs
4	vitamin K_1 1 mg/0.5 ml and vitamin K_1 10 mg/ml (Atlantic Lab) See figure 4.4	88	76	- Similar labeling by **the same company** - Similar ampoule or vial injectable drug by **the same company** - Similar drug box by **the same company**	10 71 7
5	enalapril 5 mg and enalapril 20 mg (Berlin Pharm) See figure 4.5	82	67	- Similar labeling by **the same company** - Similar drug box by **the same company** - Similar drug foil or blister by **the same company** - Similar tablet or capsule by **the same company**	22 8 51 1

Figure 4.1 amoxicillin 250 mg and 500 mg (GPO)

Figure 4.2 diazepam injection 10 mg/2 ml and furosemide injection 20 mg/2 ml (GPO)

Figure 4.3 propranolol 40 mg and 10 mg (GPO)

Figure 4.4 Vitamin K_1 10 mg and 1 mg (Atlantic Lab)

Figure 4.5 Enalapril 5 mg and 20 mg (Berlin pharm)

4.3.2 Top 10 drug pairs by type of LASA medication problem

4.3.2.1 Brand name LASA error

This kind of problem consisted of 775 drug pairs with subsequent 254 unique pairs, reported from 343 hospitals. Of these hospitals, the least number of brand name LASA pair reported was 1 pair while the greatest number was 13 pairs. The most frequently reported pair was Losec® and Lasix®. Top 10 drug pairs of this problem are presented in table 4.8.

Table 4.8 Top 10 drug pairs of brand name look-alike/sound-alike errors.

No.	Drug name 1		Drug name 2		Number of reporting hospitals
	Brand name	Company	Brand name	Company	
1	Lasix®	Sanofi-aventis	Losec®	Astrazeneca	122
2	Ventolin®	GlaxoSmithkline	Voltaren®	Novartis	104
3	Aldactone®	Pfizer	Aldomet®	M&H	37
4	Ativan®	Wyeth	Atarax®	GlaxoSmithkline	28
5	Artane®	Wyeth	Atarax®	GlaxoSmithkline	24
6	Adalat®	Bayer	Atarax®	GlaxoSmithkline	23
7	Lopid®	Pfizer	Losec®	Astrazenega	19
8	Cardura®	Pfizer	Cordarone®	Sanofi-aventis	15
9	Merislon®	Eisai	Mestinon®	Inovail	10
10	Inderal®	Astrazeneca	Isodil®	Wyeth	9

In table 4.8, most drug pairs with brand name LASA errors were original brand name and drugs from international companies. Some brand names were not even currently used in Thailand. For example, Losec® (omeprazole) and Lasix® (furosemide) was the most common drug pair in our study and also reported in several countries such as the United States, Australia, Canada and Belgium[58]. Another world-wide drug pair was Lasix® and Losec®, where there has been reported that patients in the US had died by taking Lasix® instead of Losec® [3]. Merck Sharp & Dohme, the owner of Losec® in the US, changed the product trade name to Prilosec® [4]. The Lasix® and Losec® confusion however caused errors even in most hospitals where the two original trade names have not been available. In Thailand, omeprazole and furosemide have been manufactured by many local pharmaceutical manufacturers with several brands of generic products available. Unfortunately physicians are used to prescribe the two drugs with their original brand names. Therefore this drug pair of Lasix® and Losec® has remained a significant problem. The second drug name error pair was Voltaren® (diclofenac) and Ventolin® (salbutamol). The third drug pair, Aldactone® (spironolactone) and

Aldomet® (methyldopa) found in our study, was in particular of importance since it has been reported in the US Medmarx®2008 report with the error severity of class C – D [25].

Moreover we also found that a drug brand name could be similar to more than one brand name. For example, Losec® and Lasix® and Lopid®, Atarax® and Ativan® and Artane® and Adalat®.

4.3.2.2 Brand and generic name LASA error

The problem of confusion of brand name with other drug's generic name, and vice versa, was evident with 461 drug pairs reported from 250 hospitals, and with 226 unique pairs identified. This kind of problems was reported with the highest number of 8 pairs and lowest number of 1 pair from the reporting hospitals. The most frequently report pair was Norflex® and norfloxacin. Top 10 drug pairs in this problem are shown in table 4.9.

Table 4.9 Top 10 drug pairs of brand name and generic name LASA errors

No.	Drug name 1		Drug name	Number of Reporting hospital
	Brand name	Company	Generic name	
1	Norflex®	Inova	norfloxacin	22
2	Prenolol®	Berlin	propranolol	20
3	Norgesic®	Inova	norfloxacin	14
	Berodual®	Boehringer Ingelheim	budesonide	14
3	Madopar®	Roche	methyldopa	14
6	Rulid®	Sanofi-aventis	ranitidine	12
	Fluimucil®	Zambon	flunarizine	12
8	Tranxene®	Sanofi-aventis	tranexamic acid	10
9	Danzen®	Takeda	dimenhydrinate	8
10	Norgesic®	Inova	naproxen	8

Data in table 4.9 show that most brand names with LASA generic names were original brand name and drug product from international companies. The exception was one pair of a local brand name Thailand, Prenolol®, which was confused with propranolol. The most common drug pair was Norflex® (orphenadrine), a muscle relaxant, and norfloxacin, an anti-infectives. This drug pair was reported in the US where norfloxacin 400 mg was prescribed but the patient was given Norflex®. In this case the physician prescribed with a shortened name "norflox" which looked like Norflex®. The patient experienced side effect from orphenadrine which included feeling weak, dizzy, and hallucinated [73]. Moreover norfloxacin was also found similar to Norgesic® (orphenadrine + paracetamol). The second most common drug pair was Prenolol® (atenolol) and propranolol, both of which were β-adrenergic blocker antihypertensive drug. Prenolol® is a brand name of atenolol from a local pharmaceutical company in Thailand. If Prenolol® was dispensed instead of the prescribed propranolol regimen, harm attributable to atenolol overdose atenolol could be a result. This is because propranolol is given 3 or 4 time per day[74] but atenolol is intended for once daily or twice a day dosing[75], and maximum dose of atenolol is 100 mg per day. If the patients mistakenly take atenolol 50 or 100 mg 3 or 4 times daily, they will receive atenolol up to 200 – 400 mg per day. The symptoms of atenolol overdose are lethargy, disorder of respiratory drive, wheezing, sinus pause and bradycardia. Additionally, common effects associated with overdosing any beta-adrenergic blocking agent, of which could also be expected in atenolol overdose, are congestive heart failure, hypotension, bronchospasm and hypoglycemia[70].

In this category, we also found that a drug name could be similar to more than one drug name. For example, norfloxacin could be similar to Norflex® and Norgesic® of which Norgesic® could also be similar to naproxen.

4.3.2.3 Generic name LASA errors

In this category, 1,158 drug pairs with 220 unique pairs were found from 433 hospitals. Among the reporting hospitals, the most and the least number of pairs reported were 15 and 1 respectively. The most common pair was diclofenac and dicloxacillin. Top 10 drug pairs of this problem are presented in table 4.10.

Table 4.10 Top 10 drug pairs of generic name LASA errors

No.	Generic name 1	Generic name 2	Number of reporting hospitals
1	diclofenac	Dicloxacillin	100
2	hydralazine	Hydroxyzine	99
3	loratadine	Lorazepam	96
4	glibenclamide	Glipizide	67
5	hyoscine	Hydroxyzine	52
6	metformin	metronidazole	31
7	simethicone	Simvastatin	29
8	metoclopramide	metronidazole	27
9	ceftriaxone	Ceftazidime	21
	ranitidine	Roxithromycin	21

The pair of diclofenac and dicloxacillin generic name confusion was unique to Thailand since there has not been any report on this pair in any other countries. The problem arose from doctor handwriting confusion. The second most common drug pair was hydralazine and hydroxyzine. This drug pair was reported in USA in Medmarx® 2008 report with a severity of medication error of category C to D [25]. Furthermore, in Thailand, products of the two drugs are available in two similar strengths, 10 and 25 mg; this makes it even more prone to errors. As a consequence, the US Food and Drug Administration (US FDA) and Institute for Safe Medication Practices (ISMP) solved this problem by writing drug names with recommended tall-man letters[76]. The third drug pair was loratdine and lorazepam which was also attributable to the doctor hand-writing confusion. This drug pair was

reported in USA in Medmarx® 2008 report with a severity of medication error of category C to D [25].

The incidents of one drug name could be similar to more than one other drug were also found. For example, hydroxyzine looked or sounded similar to hydralazine and hyoscine, and metronidazole looked or sounded similar to metformin and metoclopramide.

4.3.2.4 Similar labeling error by the same company

In this category, a total of 620 drug pairs with 340 unique pairs were reported from 301 hospitals. Among the reporting hospitals, the most and the least number of pairs reported by these hospitals were 5 and 1 respectively. The most commonly reported pair was amoxicillin 250 mg and 500 mg from GPO. Top 10 drug pairs of this problem are shown in table 4.11.

Table 4.11 Top 10 drug pairs of similar labeling by the same company.

No.	Generic name 1	Company name	Generic name 2	Number of Reporting hospitals
1	amoxicillin 500 mg cap	GPO	amoxicillin 250 mg cap	36
2	propranolol 10 mg tab	GPO	propranolol 40 mg tab	23
3	enalapril 5 mg tab	Berlin	enalapril 20 mg tab	22
4	furosemide 40 mg tab	GPO	folic acid 5 mg	18
5	amlodipine 5 mg tab	GPO	simvastatin 10 mg tab	16
6	diazepam injection	GPO	furosemide injection	11
7	enalapril 5 mg tab	Atlanta	enalapril 20 mg tab	10
	vitamin K 1 mg injection	Atlantic	vitamin K 10 mg injection	10
9	amlodipine 5 mg tab	GPO	hydrochlorothiazide 25 mg tab	9
10	diazepam 2 mg tab	GPO	salbutamol 2 mg tab	8

(See figure of each drug pair in Table C1 in Appendix C)

From table 4.11, most error pairs found in this category (similar labeling) were from the local pharmaceutical companies in Thailand. Most of these drug pairs were tablets and capsules. The errors associating with same drug but with different strengths were found more frequently than others. Many drugs reported were from the Government Pharmaceutical Organization (GPO). GPO is the governmental pharmaceutical company under the Ministry of Public Health. By the governmental rule since 1990, public hospitals have to purchase drugs from GPO, once available or manufactured by GPO. As expected, many error pairs were of products from GPO.

It is worthy noting that during the research, some pharmaceutical companies have changed labeling of product. For example, GPO changed labels of amoxicillin 250 mg and diazepam injection to differentiate the products from amoxicillin 500 mg and furosemide injection respectively.

4.3.2.5 Similar labeling by different companies

A total of 164 hospitals reported 254 drug pairs of similar labeling with different companies, with the resulting 220 unique pairs. In this category, a narrow range of pair numbers (1 – 3 pairs) reported from the reporting hospitals. The most common drug pair was aspirin 81 mg tablet (Osoth Interlab) and simvastatin 20 mg tablet (GPO). Top 6 drug pairs with this problem are shown in table 4.12.

Table 4.12 Top 6 drug pairs of similar labeling by different companies.

No.	Drug name 1		Drug name 2		Number of Responding hospitals
	Generic name	Company name	Generic name	Company name	
1	aspirin 81 mg tab	Osoth Interlab	simvastatin 20 mg tab	GPO	8
2	clorazepate 5 mg tab	Polipharm	flunarizine 5 mg tab	GPO	6
3	amoxicillin dry syrup	T.Man	multivitamin dry syrup	GPO	5

Table 4.12 Top 6 drug pairs of similar labeling by different companies (continued).

No.	Drug name 1		Drug name 2		Number of Responding hospitals
	Generic name	Company name	Generic name	Company name	
4	penicillin V dry syrup	Utopian	multivitamin dry syrup	GPO	4
5	amoxicillin + clavulanic acid tab	Siam Bheasach	omeprazole 20 mg tab	GPO	3
	diclofenac injection	Siam Bheasach	ranitidine injection	Millimed	3

From table 4.12, most error pairs of similar labeling by different companies were from local pharmaceutical companies in Thailand. In this category, every dosage forms were found. Due to the fact that the errors must be from products from different companies, the likelihood to find such errors was low, as shown by only 254 drug pairs and 220 unique pairs. However, it was found that labeling of one drug could be similar to several drugs. For example, labels of multivitamin dry syrup (GPO), amoxicillin dry syrup (T. Man), and penicillin V dry syrup (Utopian) were similar. These similarities were attributable to the use of same color of alphabets and label backgrounds.

4.3.2.6 Similar ampoule or vial of injectable drugs by the same company

Look-alike ampoules or vials of injectable drugs from the same company were somewhat prevalent with 590 drug pairs reported from 309 hospitals, and 166 unique pairs identified. A range of 1 to 6 pairs were reported by these hospitals. The most common pair was diazepam injection and furosemide injection (GPO). Twelve drug pairs of this problem are shown in table 4.13.

Table 4.13 Top 12 drug pairs of similar ampoule or vial of injectable drug by the same company.

No.	Generic name 1	Company name	Generic name 2	Number of reporting hospitals
1	diazepam injection	GPO	furosemide injection	109
2	vitamin K 1 mg injection	Atlantic	vitamin K 10 mg injection	71
3	hyoscine injection	GPO	terbutaline injection	29
4	vitamin B1 injection	ANB	vitamin Bcomplex injection	30
5	gentamicin injection	GPO	metoclopramide injection	26
6	ampicillin injection	Modern Manu	penicillin G sodium 1 mu	14
	ampicillin 250 mg injection	Modern Manu	ampicillin 1 g injection	14
8	haloperidol injection	Atlantic	vitamin K 1 mg injection	9
	vitamin K 1 mg injection	Roche	vitamin K 10 mg injection	9
10	ampicillin 500 mg injection	GPO	ampicillin 1 g injection	8
	ampicillin injection	Modern Manu	cloxacillin injection	8
	hyoscine injection	GPO	neostigmine injection	8

(See figure of each drug in table C2 in Appendix C)

Most drugs with problem of similar ampoule or vial of injectable drugs were from local pharmaceutical companies in Thailand; while only one pair was from original-brand pharmaceutical company.

The use of light brown or clear ampoule with text labels similar among various products was the mostly likely cause of the confusion. In case of vial-associated error, the use of similar color of plastic caps and similar text labels on vials led to such confusion. Since this problem is specific to products from the same company, the concept of creating the company product line identity could also contribute the look-alike ampoule and vials. In addition, an ampoule or vial of a given drug could also look like more than 1 other drug. For example, ampicillin injection vial from Modern Manu was similar to penicillin injection and cloxacillin injection; and

hyoscine injection ampoule from GPO was similar to terbutaline injection and neostigmine injection.

During the research, some pharmaceutical companies changed labels of their product. For example, GPO changed labels of amoxicillin 250 mg vial and diazepam injection ampoule, and Roche changed labels of Vitamin K_1 1 mg and 10 mg ampoules.

4.3.2.7 Similar ampoule or vial of injectable drug by different companies

The errors of similar ampoule or vial of injectable drugs by different companies were reported by 261 hospitals with 417 drug pairs and 254 unique pairs identified. Number of pairs reported was 1 to 4 pairs among these reporting hospitals. The most common drug pair was vitamin B complex injection (ANB) and vitamin K_1 injection (Atlantic). All top 11 drug pairs are shown in table 4.14.

Table 4.14 Top 11 drug pairs of similar ampoule or vial of injectable drug by different companies.

No.	Drug name 1		Drug name 2		Number of reporting hospitals
	Generic name	Company name	Generic name	Company name	
1	vitamin B complex injection	ANB	vitamin K_1 10 mg injection	Atlantic	21
2	diclofenac injection	Siam	ranitidine injection	Milimed	14
	vitamin B1 injection	ANB	vitamin K_1 10 mg injection	Atlantic	14
4	50 % magnesium sulfate injection	Atlantic	dimenhydrinate injection	LBS	12
5	diclofenac injection	GDH	dimenhydrinate injection	LBS	11
6	ranitidine injection	L.B.S	paracetamol injection	NIDA	10

Table 4.14 Top 11 drug pairs of similar ampoule or vial of injectable drug by different companies (continued).

No.	Drug name 1		Drug name 2		Number of reporting hospitals
	Generic name	Company name	Generic name	Company name	
7	ampicillin 500 mg injection	TP Drug	chloramphenicol 1 g injection	Atlantic	8
8	ampicillin 1 g injection	GPO	cefazolin 1 g injection	M & H	7
9	diclofenac injection	Umeda	paracetamol injection	NIDA	6
	dextrose 50% injection	TP Drug	lidocaine injection	GPO	6
	diclofenac injection	Umeda	ranitidine injection	LBS	6

(See figure of each drug pair in table C3 in Appendix C)

From table 4.14, the ampoule or vial of a given drug could be similar to more than one other drug. For example, vitamin K_1 10 mg injection ampoule (Atlantic) was similar to vitamin B complex injection ampoule (ANB) and also to vitamin B1 injection ampoule (ANB). From table 4.13, vitamin B complex injection ampoule and vitamin B1 injection ampoule (ANB) was one of the top 12 drug pairs. The two injectable drugs were also similar to vitamin K_1 10 mg injection ampoule (Atlantic). Moreover it was found that dimenhydrinate injection ampoule (LBS) was similar to 50% magnesium sulfate injection ampoule (Atlantic) and diclofenac injection ampoule (GDH). Diclofenac injection ampoule (Umeda) was similar to ranitidine injection ampoule (LBS) and also to paracetamol injection ampoule (NIDA). In addition, ampoule of paracetamol injection (NIDA) was similar to the one of ranitidine injection (LBS).

Confusion on ampoule from different companies was attributable to the similar color of text labels. In case of vial, similar labels and similar plastic caps of drug for different companies may also cause confusion.

4.3.2.8 Similar bottle of solid or liquid drug by the same company

Errors associating with similar bottle of solid or liquid drug by the same company were from 500 drug pairs with a range of 1 to 6 pairs reported by 264 hospitals. Of 500 pairs, 226 unique pairs were identified. The most common pair was bottle of furosemide 40 mg tablet and bottle of folic acid 5 mg tablet from GPO. In addition, the ten most common pairs were products of GPO. Bottles of solid and liquid drugs were found as the source of confusion with top 10 drug pairs of this problem shown in table 4.15.

Table 4.15 Top 10 drug pairs of similar bottle of solid or liquid drug by the same company.

No.	Generic name 1	Company name	Generic name 2	Number of Reporting hospitals
1	furosemide 40 mg tab	GPO	folic acid 5 mg tab	43
2	diazepam 2 mg tab	GPO	salbutamol 2 mg tab	22
3	guaifenesin syrup	GPO	paracetamol syrup	21
4	ammon carb. mixture	GPO	brown mixture	17
5	sodium bicarbonate syrup	GPO	salbutamol syrup	15
6	propylthiouracil 50 mg tab	GPO	trihexyphenidyl 2 mg tab	14
7	paracetamol syrup	GPO	chlorpheniramine syrup	11
	vitamin Bcomplex tab	GPO	multivitamin tab	11
9	propylthiouracil 50 mg tab	GPO	phenobarbital 60 mg tab	10
10	co-trimoxazole suspension	GPO	milk of magnesia 60 ml	9

(See figure of each drug pair in table C4 in Appendix C)

The cause of confusion with bottles was originated from shape, label pattern, and label color that were similar among various products. Bottler of a givn product could also look similar to more than one product. For example bottle of paracetamol syrup (GPO) was similar to bottles of guaifenesin syrup and chlorpheniramine syrup; bottle of propythiouracil 50 mg tablet (GPO) was similar to bottles of trihexyphenidyl 2 mg tablet and phenobarbital 60 mg tablet.

4.3.2.9 Similar bottle of solid or liquid drug by different companies

Errors associating with similar bottle of solid or liquid drug by different companies were from 262 drug pairs with a range of 1 to 4 pairs reported by 173 hospitals. Of 262 pairs, 200 unique pairs were identified. The most common pair was bottle of hyoscine suspension (several companies) and domperidone suspension (several companies). Bottles of solid and liquid drugs were found as the source of confusion with top 10 drug pairs of this problem shown in table 4.16.

Table 4.16 Top 10 drug pairs of similar bottle of solid or liquid drug by different companies.

No.	Drug name 1		Drug name 2		Number of Reporting hospitals
	Generic name	Company name	Generic name	Company name	
1	hyoscine suspension	several companies	domperidone suspension	several companies	28
2	amoxicillin dry syrup	several companies	multivitamin dry syrup	GPO	15
3	paracetamol syrup	Thai Nakorn	ibuprofen suspension	GPO	13
4	amoxicillin dry syrup	several companies	erythromycin dry syrup	several companies	8
5	dapsone 100 mg tab	Pond's chemical	allopurinol 100 mg tab	GPO	7

Table 4.16 Top 10 drug pairs of similar bottle of solid or liquid drug by different companies (continued).

No.	Drug name 1		Drug name 2		Number of Reporting hospitals
	Generic name	Company name	Generic name	Company name	
6	amoxicillin dry syrup	several companies	cloxacillin dry syrup	several companies	6
	domperidone suspension	several companies	albendazole suspension	GPO	6
	domperidone suspension	several companies	mebendazole suspension	several companies	6
	erythromycin dry syrup	Osoth Interlab	multivitamin dry syrup	GPO	6
	amoxicillin dry syrup	several companies	cephalexin dry syrup	several companies	6

(See figure of each drug pair in table C5 in Appendix C)

From table 4.16, bottles with different sizes and shapes from different companies contributed to this kind of confusion; especially bottles for dry syrup for children, either a size of 30 or 60 ml. For 30-ml bottle, domperidone suspension look like hyoscine suspension, and also look like albendazole suspension. For dry syrup, bottles of amoxicillin dry syrup, multivitamin dry syrup, erythromycin dry syrup and cloxacillin dry syrup looked similar to each other. This similarity was due to similar label color among different product bottles.

4.3.2.10 Similar drug box by the same company

In this category, 238 hospitals reported 440 error pairs with 1 to 4 pairs from each of the hospitals. Of 440 errors, 268 unique pairs were identified. The most common drug pair was box of amoxicillin 250 mg capsule and 500 mg capsule from GPO. Most pairs were from local pharmaceutical companies in Thailand. Boxes of tablet or capsule were reported; while boxes of the same drug

with different strengths were found more often than boxes of different drugs. Top 10 drug pairs in this category are shown in table 4.17.

Table 4.17 Top 10 drug pairs of similar drug box by the same company

No.	Generic name 1	Company name	Generic name 2	Number of Reporting hospitals
1	amoxicillin 500 mg cap	GPO	amoxicillin 250 mg cap	31
2	propranolol 40 mg tab	GPO	propranolol 10 mg tab	15
3	rifampicin 300 mg cap	GPO	rifampicin 450 mg cap	11
4	dicloxacillin 250 mg cap	GPO	dicloxacillin 500 mg cap	9
5	enalapril 5 mg tab	Berlin	enalapril 20 mg tab	8
	fluphenazine injection	Atlantic	haloperidol injection	8
	amlodipine 5 mg tab	GPO	simvastatin 10 mg tab	8
8	nifedipine 5 mg cap	Berlin	nifedipine 10 mg cap	7
	vitamin K_1 1 mg injection	Atlantic	vitamin K_1 10 mg injection	7
	budesonide 100 mcg/dose MDI	Cipla	budesonide 200 mcg/dose MDI	7

(See figure of each drug pair in table C6 in Appendix C)

From table 4.17, confusion due to similar boxes was originated from the box's similar color, text label and size which was created based on the company concept of product identity. Some companies changed their product labels during the time of this research, for example, GPO changed label on the box of amoxicillin 250 mg capsule, and Berlin Pharm changed label on the box of enalapril 5 mg tablet.

4.3.2.11 Similar drug box similar by different companies

A total of 109 drug pairs with similar drug box from different companies were reported by 78 hospitals with 1 to 3 pairs reported. Of 109 pairs, 101 unique pairs from were identified. Among all types of error problems, this category was reported with the least number of pairs and variation. The most

common error pair was confusion due to similarity between box of simethicone drop (T.Man) and box of ferrous fumarate drop (Ranbaxy). Only 6 unique pairs were reported and are shown in table 4.18.

Table 4.18 Top 6 drug pairs of similar drug box by different companies.

No.	Drug name 1		Drug name 2		Number of Reporting hospitals
	Generic name	Company name	Generic name	Company name	
1	simethicone drop	T.Man	fe fumarate drop	Ranbaxy	4
2	nifedipine 20 mg cap	Stada	atenolol 50 mg tab	Pharmdica	2
	aspirin 81 mg tab	Osth inter	simvastatin 20 mg tab	GPO	2
	clobetasol cream	Polipharm	clotrimazole	NIDA	2
2	simethicon drop	R.X.	vitamin E drop	Ranbaxy	2
	finasteride 5 mg tab	T.O. chemical	alfuzosin 10 mg tab	Sanofi-Aventis	2

(See figure of each drug pair in table C7 in Appendix C)

4.3.2.12 Similar drug foil or blister by the same company

A total of 724 drug pairs with 269 unique pairs were found in 355 hospitals with 1 to 6 pairs reported from each of these hospitals. Most problems were from drugs from local pharmaceutical companies in Thailand. Of the top 10 drug pairs, 5 of them were pairs of the same drug with different strength. Specific pair mostly reported was the blister of propranolol 10 mg and 40 mg from GPO. This pair was reported by 57 hospitals. Top 10 drug pairs of this problem are shown in table 4.19.

Table 4.19 Top 10 drug pairs of similar drug foil or blister by the same company.

No.	Generic name 1	Company name	Generic name 2	Number of Reporting hospitals
1	propranolol 10 mg tab	GPO	propranolol 40 mg tab	57
2	amoxicillin 500 mg cap	GPO	amoxicillin 250 mg cap	54
3	enalapril 5 mg tab	Berlin	enalapril 20 mg tab	51
4	amlodipine 5 mg tab	GPO	simvastatin 10 mg tab	44
5	spironolactone tab	Berlin	atenolol tab	27
6	amlodipine 5 mg tab	GPO	hydrochlorothiazide 25 mg tab	24
7	amlodipine tab	Berlin	simvastatin tab	23
8	dicloxacillin 250 mg cap	GPO	dicloxacillin 500 mg tab	21
9	metformin 500 mg tab	GPO	metronidazole 200 mg tab	16
10	enalapril 5 mg tab	Atlanta	enalapril 20 mg tab	12

(See figure of each drug pair in table C8 in Appendix C)

From table 4.19, the use of silver foil and drug name print with the same color and pattern caused this problem. From the interview with persons from the pharmaceutical company with this type of problem, the company usually used the concept that a line of a given with different strength should be identified with a similar package pattern. In addition, a given drug could look similar to more than 1 drug. For example, a blister pack of amlodipine 5 mg tablet (GPO) was similar to that of simvastatin 10 mg tablet (GPO) and that of hydrochlorothiazide 25 mg tablet (GPO). For any patients with chronic diseases including hypertension and dyslipidemia, confusion is more likely to happen.

During research conduct, some pharmaceutical companies changed labels of their products. For example, GPO changed blister of propranolol 10 mg tablet, foil colors of hydrochlorothiazide 25 mg tablet, simvastatin 10 mg tablet and metronidazole 200 mg tablet. Berlin Pharm changed label of enalapril 5 mg and 20 mg tablets to differentiate one from another.

4.3.2.13 Similar drug foil or blister by different companies

A total of 462 drug pairs, and 360 unique pairs identified, were reported from 251 hospitals, with 1 to 5 pairs reported from these hospitals. Examples of similar package of drug from different companies included foil packs of omeprazole 20 mg capsule (GPO) and amoxicillin + clavulanic acid capsule (several companies), foil pack of aspirin 81 mg tablet (Osth inter) and 0 simvastatin 20 mg tablet (GPO), foil pack of flunarizine 5 mg tablet (GPO) and clorazepate 5 mg tablet (Polipharm). These pairs of confusion were most frequently reported by hospitals (14 hospitals) as shown in table 4.20.

Table 4.20 Top 11 drug pairs of similar drug foil or blister by different companies

No.	Drug name 1		Drug name 2		Number of Reporting hospitals
	Generic name	Company name	Generic name	Company name	
1	omeprazole 20 mg cap	GPO	amoxicillin + clavulanic acid	several companies	14
	simvastatin 20 mg tab	GPO	aspirin 81 mg tab	Osoth inter	14
	flunarizine 5 mg cap	GPO	clorazepate 2 mg cap	Polipharm	14
4	ranitidine 150 mg tab	Berlin	simethicone 80 mg tab	R.X.	13
5	ethambutal 400 mg tab	GPO	enalapril 5 mg tab	Berlin	9
6	calcium carbonate tab	several company	gemfibrozil 600 mg tab	several companies	8
7	ofloxacin 200 mg	Farmaline	enalapril 5 mg tab	Berlin	7
8	fluconazole 200 mg	GPO	Itraconazole	several companies	6
	isosorbide dinitrate 10 mg	GPO	hyoscine	Greater pharma	6
10	colchicine 0.6 mg	Milimed	hyoscine	T.O.	5
	vitamin B1-6-12 tablet	Medicpharm	glipizide 5 mg tablet	several companies	5

(See figure of each drug pair in table C9 in Appendix C)

From table 4.20, the cause of confusion was the use of silver foil and printed drug name with same color and pattern. One drug could be similar to more than one product. For example, the foil pack of enalapril 5 mg tablet (Berlin Pharm) was similar to that of ofloxacin 200 mg tablet (Famaline) and that of ethambutol 400 mg tablet (GPO).

During the research, some pharmaceutical companies changed labels of their products. For example, GPO changed foil pack of flunarizine 5 mg tablet to a blister pack and Polipharm changed foil color of clorazepate 5 mg tablet.

4.3.2.14 Similar tablet or capsule by the same company

In this category, 632 drug pairs with 153 unique pairs were reported from 326 hospitals with a range of 1 to 6 pairs reported from the hospitals. The top 11 drug pairs were products of GPO. The most common pair was dimenhydrinate 50 mg tablet and diazepam 5 mg tablet from GPO. All 11 drug pairs are shown in table 4.21.

Table 4.21 Top 11 drug pairs of similar tablet or capsule by the same company.

No.	Generic name 1	Company name	Generic name 2	Number of responded hospital
1	dimenhydrinate 50 mg tab	GPO	diazepam 5 mg tab	82
2	amoxicillin 500 mg ca	GPO	amoxicillin 250 mg cap	61
3	propylthiouracil 50 mg tab	GPO	phenobarbital 60 mg tab	54
4	amitriptyline 10 mg tab	GPO	vitamin Bcomplex tab	50
5	trihexyphenidyl 2 mg tab	GPO	diazepam 2 mg tab	34
6	trihexyphenidyl 2 mg tab	GPO	trihexyphenidyl 5 mg tab	28
7	propranolol 10 mg tab	GPO	propranolol 40 mg tab	25
8	propylthiouracil 50 mg tab	GPO	isoniazid 100 mg tab	23
9	paracetamol 500 mg tab	GPO	Alumina-Magnesia® GPO	17
10	diazepam 2 mg tab	GPO	furosemide 40 mg tab	14
	dicloxacillin 250 mg cap	GPO	dicloxacillin 500 mg cap	14

(See figure of each drug pair in table C10 in Appendix C)

From table 4.21, pairs of given drugs with different strengths with similar tablets or capsules were found the most due to the concept of product line identity. Moreover, 1 drug could be similar to more than 1 product. For example, diazepam 2 mg tablet (GPO) was similar to furosemide 40 mg tablet and to trihexyphenidyl 2 mg, and propylthiouracil 50 mg tablet (GPO) was similar to phenobarbital 60 mg tablet and to isoniazid 100 mg tablet.

During the research, GPO changed their drug tablet several ways. For example, 1) adding strength number of drug on the tablet such as diazepam 2 mg tablet, and phenobarbital 60 mg tablet, 2) adding abbreviation of drug name on the tablet such as "PB" on phenobarbital 60 mg tablet, and "F" on furosemide 40 mg tablet, and 3) changing color of the capsule such as amoxicillin 250 mg capsule.

4.3.2.15 Similar tablet or capsule by different companies

In this last category, 558 drug pairs with 419 unique pairs were reported from 303 hospitals. This problem was reported with 1 to 9 pairs from the hospitals. Compared to all categories previously described, this category included the largest number of unique pairs. The most common problems were those with the same tablet color. The most common pair was chlorpheniramine 4 mg tablet (GPO) and bromhexine 8 mg tablet (several companies). Top 10 drug pairs in this problem are shown in table 4.22.

Table 4.22 Top 10 drug pairs of similar tablet or capsule by different companies.

No.	Drug name 1		Drug name 2		Number of Reporting hospitals
	Generic name	Company name	Generic name	Company name	
1	chlorpheniramine 4 mg tab	GPO	bromhexine 8 mg tab	several companies	31
2	stavudine 30 mg cap	GPO	indomethacin 25 mg cap	several companies	22
3	aspirin 300 mg tab	several companies	ibuprofen tab	several companies	16

Table 4.22 Top 10 drug pairs of similar tablet or capsule by different companies (continued).

No.	Drug name 1		Drug name 2		Number of Reporting hospitals
	Generic name	Company name	Generic name	Company name	
4	vitamin Bcomplex tab	GPO	diclofenac 25 mg tab	several companies	14
5	amitriptyline 10 mg tab	GPO	diclofenac 25 mg tab	several companies	10
	mefenamic acid 250 mg cap	several companies	indomethacin 25 mg tab	several companies	10
7	chlorpheniramine 4 mg tab	GPO	verapramil 40 mg tab	Berlin	8
	amitriptyline 10 mg tab	GPO	verapramil 40 mg tab	Berlin	8
9	prednisolone 5 mg tab	GPO	metoclopramide 10 mg tab	several company	7
	allopurinol 100 mg tab	GPO	levothyroxine 0.1 mg tab	GSK	7

(See figure of each drug pair in table C11 in Appendix C)

In table 4.22, the problems were often due to similarity in size and color of tablets or capsules. Based on interview with a person from a pharmaceutical company, to have alphabet or number engraved on the tablets means increasing manufacturing cost since the many of punch and die must be replaced.

Like all previous problems, a given drug could be similar to more than 1 drug. For example, chlorpheniramine 4 mg tablet (GPO) was similar to bromhexine 8 mg tablet (several companies) and to verapamil 40 mg tablet (Berlin pharm), and amitriptylin 10 mg (GPO) was similar to diclofenac 25 mg tablet (several companies) and to verapamil 40 mg tablet (Berlin pharm).

4.4 The summary

Of all questionnaires mail to 971 hospitals, 470 were returned (a response rate of 48.40%) with the highest response rate found in hospital under the Ministry of Public Health (439 of 887 hospitals, or 49.49%). The majorities of all returned questionnaires were from the community hospitals (345 of 470, or 73.40%). In addition to the mailed questionnaire, information from another 9 hospitals not returning the mailed questionnaire was obtained by means of in-person interview. Taking these 9 hospitals into account, a total of 479 hospitals provided information regarding recognition on medication safety policy, list of LASA errors, and implementation of safety measures in their hospitals.

In this survey on the recognition on national patient safety policy, we found that patient safety policy has been recognized by 88.52% of the hospitals, specifically, 76.62% had implemented the safety measures in their hospitals. The measures which most hospitals already implemented were for detection and prevention of errors associating with high-alert drugs, followed by LASA medications and severe adverse drug reaction and repeated drug allergy, respectively. It was reported that LASA drug errors were the number-one cause of medication errors by most hospitals (82.46%).

In terms of magnitude of LASA related problems, we found that generic drug name LASA errors were the most frequently reported type of LASA problems. In addition, look-alike tablets or capsules, regardless of drug names, from different companies were the most frequently found LASA error unique pairs.

In terms of specific types of LASA medication error problems, a large number of diverse pairs of problematic drugs were found. This was likely due to the differences in drugs lists among hospitals and in brand names for any given generic drug from various pharmaceutical companies. To be able to compare with incidents in other reports, we categorized problems associating with LASA drugs pairs into 4 groups, namely those with 1) LASA drug name, 2) look-alike labeling, 3) look-alike packaging, and 4) look-alike tablet or capsule. These 4 types of problematic LASA drug pairs have been reported worldwide and some incidents caused severe consequences as reported in other countries.

First, the most frequently found and reported LASA error was those associating with LASA drug names. This type of problems could be further classified into 3 groups namely LASA brand name errors, LASA generic name error, and LASA generic/brand name errors. For the LASA brand name errors, confusion between Losec® (omeprazole) and Lasix® (furosemide) was the most common reported pair. For the second category of LASA drug name error, LASA brand name/generic name, the survey found the pair of Norflex® (orphenadrine), a muscle relaxant, and norfloxacin, an anti-infectives was the most frequently reported. For the third category, LASA generic drug names, the survey found diclofenac - dicloxacillin confusion was the most reported pair in the category.

The problems caused by look-alike labeling were often found among products from the same pharmaceutical company. The likeness of labeling among products in a given company may be based on the unique identity concept. This concept was even more obvious in the case of labeling of products of a given drug with different strengths. For example, propranolol 10 mg, 40 mg tablet would have identical design and labels on the product foils. In addition, one would be able to see the look-alike labeling of products of different drugs from the different companies, for example, simvastatin 20 mg tablet (GPO) and aspirin 81 mg tablet (Osoth Interlab).

The errors associated with look-alike packaging could be found in various forms of containers including ampoule and vial for injectable drug, bottles for tablets or liquid drug, and pill box, foil or blister for tablets or capsule. The packaging-related problem was originated from the same cause as the labeling problem, which was the identity of the manufacturer. Even with different drugs from different companies, small look-alike ampoules and even worse, with look-alike font, size, and color of the product names printed on both ampoules could have the persons confused and mistake one for another. For vials of a given drug product with two different strengths, with the likelihood of errors similar to that of ampoule, their plastic caps with similar color could also cause mistaking one strength for another. For a given drug with the same strength, their bottles with similar actual size but with different intended volume of the liquid drug, especially dry syrup for children, could also cause confusion. In terms of foils or blisters for tablets or

capsules, the common silver-colored patterns with look-alike labels on such packages of various products easily confuse the workers.

Another problem was look-alike tablet or capsule. For the problematic products from the same company, there were more likely to be from given drug with different strengths, although different drugs could also have look-alike tablet or capsule. The most frequently found error pair in this category was amoxicillin 250 mg capsule and 500 mg capsule from the GPO. This look-alike dosage unit was also directed by the concept of creating unique product-line identification.

Since the problem with look-alike product labeling, packaging, and capsule/tablet of different products or identical drug with different strength from the same company, there has been an effort to inform the company to differentiate the look-alike products. To date, some manufacturers had changed their product package in response to request from various hospitals. These include the differentiation of amoxicillin capsule 250 mg and 500 mg capsules of GPO by changing 500 mg capsule to the color of blue-green instead of the yellow-black which resemble the color of the 500 mg capsule, and the color of the 250 mg capsule box. Another example from GPO was the change of label on diazepam injection ampoule to differ from furosemide injection ampoule. Package change was also seen in Anapril (enalapril) 5 mg and 20 mg tablet products of Berlin Pharma, where the box of 5 mg tablet was changed from red to pink and a solid blue line was drawn in the middle of the 20 mg tablet foil.

CHAPTER 5
USING MEDICATION MANAGEMENT SYSTEM TO SOLVE LOOK-ALIKE/SOUND-ALIKE DRUG PROBLEMS

The data in this chapter were collected from questionnaires and interviews with pharmacists, physicians and nurses in hospitals, pharmacists in pharmaceutical company, and a pharmacist in Bureau of Drug control, the Food and Drug Administration.

The results showed the activities in medication management system (MMS) to solve look-alike/sound-alike (LASA) drug problems. MMS comprises 6 steps as follows: 1) medication selection and procurement, 2) drugs storage, 3) drug ordering and prescribing including transcribing medication orders, 4) drug preparing and dispensing, 5) drug administration and 6) drugs monitoring.

5.1 Medication Selection and Procurement

In this step, activities to solve LASA drug problems included 1) defining only a single strength for each drug item in hospital, 2) avoiding LASA drugs name in the hospital formulary, 3) not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules, 4) considering LASA drug problems in the drug purchasing at provincial or regional level, and 5) informing the pharmaceutical companies about LASA drug problems of their own product and packaging.

The activity applied to solve LASA problems successfully was avoiding drug purchase from companies that have an appearance similar to another drug product or package (62.83%). Unsuccessful method used to solve the LASA problems was informing the pharmaceutical companies about LASA drug problems of their own product and packaging (23.16%). It was found that 72.25% of hospitals never applied avoiding LASA drugs name in the hospital formulary to solve the LASA drug problems. All details are shown in table 5.1.

Table 5.1 Numbers and percentages of hospitals applying given activities in medication selection and procurement step.

Activities in medication selection and procurement step	Number of hospital; applying the activities to solve the problem (n,%)		
	successfully	unsuccessfully	Never applied
Defining only a single strength for each drug item in hospital. (n = 419)	152 (36.28%)	51 (12.17%)	216 (51.55%)
Avoiding LASA drugs name in the hospital formulary. (n = 382)	60 (15.71%)	46 (12.04%)	**276 (72.25%)**
Not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules. (n = 417)	**262 (62.83%)**	60 (14.39%)	95 (22.78%)
Considering LASA drug problems in the drug purchasing at provincial or regional level. (n = 376)	123 (32.71%)	40 (10.64%)	213 (56.65%)
Informing the pharmaceutical companies about LASA drug problems of their own product and packaging. (n = 380)	173 (45.53%)	**88 (23.16%)**	119 (31.31%)

5.1.1 Defining only a single strength for each drug item in hospital

There were 152 of 419 responding hospitals (32.28%) reporting that they defined only a single strength for each drug item in their hospital to solve LASA drug problems successfully. The respondents informed 108 LASA drug pairs (57 unique pairs) were solved by this method successfully. The examples of top 5 drug pairs are shown in table 5.2.

Table 5.2 Examples of top 5 drug pairs of which defining only a single strength for each drug item in hospital to solve LASA problems was implemented successfully.

Order	Drug name 1	Drug name 2	Number of hospitals
1	potassium chloride 20 mEq injection	potassium chloride 40 mEq injection	14
2	amlodipine 5 mg tab	amlodipine 10 mg tab	6
	hydrochlorothiazide 25 mg tab	hydrochlorothiazide 50 mg tab	6
	propranolol 10 mg tab	propranolol 40 mg tab	6
	magnesium sulfate 10% injection	magnesium sulfate 50% injection	6

The techniques that the hospitals used to select a single strength of drugs were selecting medium strength, strength with high frequency of use, and strength indicated by the Pharmacy and Therapeutic Committee (PTC) of the hospital. This activity was however unsuccessfully implemented in 51 hospitals (12.17%). Among these hospitals, reasons for using many drug strengths were 1) the physicians insistence to have many strengths to treat some diseases including chronic diseases and psychiatric disorders (35 hospitals), and to be available for patients with specific ages (children or elderly) and for practical dose adjustment, and 2) physician requesting many strengths with no specific reasons (7 hospitals).

There were 216 hospitals (51.55%) that never applied this activity. The reasons for using many drug strengths were 1) the insistence to use as previously described (111 hospitals), 2) physician requesting many strength with no specific reasons (12 hospitals), and 3) higher drug cost when having only one strength.

5.1.2 Avoiding LASA drugs name in the hospital formulary

Among 382 hospitals, 60 (15.71%) were successful in solving LASA drug problems by avoiding LASA drugs name in the hospital formulary. The respondents informed that 29 LASA drug pairs (20 unique pairs) were successfully solved using this activity. The examples of top 4 drug pairs are shown in table 5.3.

Table 5.3 Examples of top 4 drug pairs of which avoiding LASA drugs name in The hospital formulary was successful in solving LASA problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	Loxonin® 60 mg tab	Lanoxin® 0.25 mg tab	5
2	dopamine injection	dobutamine injection	3
	Norflex® tab	norfloxacin tab	3
4	gliclazide tab	glipizide tab	2

The technique that the hospital used to select drugs to avoid LASA drug name was selecting drug with high utilization rate. However, selecting drug with high utilization rate was applied with no success in 46 hospitals (12.04%). The reasons for still using LASA drug names were 1) some drugs were used to treated different diseases (hydralazine and hydroxyzine, loratadine and lorazepam, diclofenac and dicloxacillin) (21 hospitals), 2) physician request with no specific reasons (9 hospitals), and 3) human errors.

Among 382 hospitals, 276 (72.25%) never applied this activity. The reasons for still using drugs with LASA names were 1) the drugs were for different diseases (96 hospitals), 2) such similar drug names were not caught (9 hospitals), 3) no review on hospital drug list (7 hospitals), 4) physician request to use with no specific reasons (6 hospitals), and 5) some were those in the National Essential Drug List (6 hospitals).

Moreover, the technique to solve similar drug name but different indication such as Lanoxin® and Loxonin® was changing drug name label of one drug to another name, such as chaning from Lanoxin® to generic name “digoxin.” (Interview with hospital pharmacist XIV)

5.1.3 Not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules

There were 262 of 417 hospitals (62.83%) stating that they did not buy drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules to solve LASA drug problems, and were successful in doing so. The respondents informed 169 LASA drug pairs (122 unique pairs) were solved successfully using this activity. The examples of top 5 drug pairs are shown in table 5.4.

Table 5.4 Examples of top 5 LASA drug pairs that were solved successfully by not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules

Order	Drug name 1	Drug name 2	Number of hospitals
1	amoxicillin 250 mg cap	amoxicillin 500 mg cap	9
2	diclofenac injection	ranitidine injection	8
3	amlodipine tab	simvastatin tab	7
4	enalapril 5 mg tab	enalapril 20 mg tab	6
5	potassium chloride injection	sterile water for injection	5

To know about the LASA drug problems that could be solved by not buying drugs from companies that have a similar appearance to the product or package, pharmacists were informed by physicians and nurses (interview with hospital pharmacist III and VIII)

The techniques used included 1) viewing the product sample before purchase (interview with hospital pharmacist III), 2) PTC selecting top three drugs in order to reserve when LASA drug problems found (interview with hospital pharmacist VII), 3) recording reason when not to buy the drug which lower cost or the drug of company is based on the Prime Minister's regulations mandating the purchase (interview with hospital pharmacists IV and VIII), 4) pharmacist responsible for dispensing service participating product selection process (interview with hospital

pharmacist IX), and 5) making decision based on PTC recommendation (interview with hospital pharmacist XIII).

Sixty hospitals (14.39%) applied this activity but with no success. The reasons for still buying drugs from companies that have look-alike appearance were 1) the Prime Minister's regulations about parcel 1992 commanding a purchase with GPO (17 hospitals), 2) purchase at provincial or region level requesting such LASA drugs (8 hospitals), 3) only few manufacturers or single manufacturer for given drugs (7 hospitals), 4) urgent purchase for loss of supply (4 hospitals), 5) difficulties when dealing with other companies (4 hospitals), 6) the companies not notifying the hospital once the package changed, and 7) physician requesting products from specific companies.

There were 95 hospitals (22.78%) never applying this activity. The reasons for buying drugs from companies that have a appearance similar to the product or package of other products were 1) being required to purchase at provincial or region level (20 hospitals), 2) the Prime Minister's regulations about parcel 1992 commanding a purchase from GPO (13 hospitals), 3) only few manufacturers or single manufacturer available (7 hospitals), 4) selecting product by quality and price (4 hospitals), and 5) being mandated by the policy of the hospital PTC (3 hospitals).

5.1.4 Considering LASA drug problems in drug purchasing at provincial or regional level

There were 123 of 376 responding hospitals (32.71%) that considered LASA drug problems in drug purchase at provincial or regional level to solve LASA drug problems, and they were successful in doing so. The respondents informed 40 LASA drug pairs (28 unique pairs) which were successfully solved, examples of top 3 drug pairs are shown in table 5.5.

Table 5.5 Examples of top 3 drug pairs that were successfully solved by considering LASA drug problems in drug purchase at provincial or regional level.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enalapril 5 mg tab	enalapril 20 mg tab	7
2	enalapril 5 mg ของ Atlanta	ranitidine 150 mg ของ Atlanta	3
3	calcium carbonate tab	gemfibrozil 600 mg tab	2

The techniques the hospitals used in considering LASA drug problems in drug purchase at provincial or regional level were 1) raising specific LASA error pairs in the meeting of drug purchase at provincial or regional level, 2) requesting specific color of pill or capsule in specification, 3) bargaining price with the companies with no LASA problems, 4) forcing the companies to learn about LASA problems at the provincial or regional level, and 5) getting rate to the drug products where a given product, if different from others, will get more rating points than others.

Among 40 hospitals (10.64%) that were unsuccessfully applying this activity, the reasons for no success were 1) using quality and price in purchasing (12 hospitals), and 2) different LASA drug problems in each hospital (2 hospitals and interview with hospital pharmacist IX).

The reasons that 95 hospitals (56.65%) never applied this activity were 1) not being the hospitals under the Office of Permanent Secretary of the Ministry of Public Health (23 hospitals), 2) not raising the LASA problems in the drug purchasing at provincial or regional level (11 hospitals), 3) no LASA problems found in drugs purchased at provincial or regional level (9 hospitals), 4) using quality, price and specification as criteria for purchase (7 hospitals), and 5) drug specification might be unfair to certain companies (interview with hospital pharmacist XI).

5.1.5 Informing the pharmaceutical companies about LASA drug problems of their own product and packaging.

There were 173 of 380 responding hospitals (45.53%) that solve LASA problems by informing the pharmaceutical companies about LASA drug problems of their own product and packaging, and successful in doing so. The respondents informed 80 LASA drug pairs (52 unique pairs) that were successfully solved. Examples of top 5 drug pairs are shown in table 5.6.

Table 5.6 Examples of top 5 drug pairs that were successfully solved by informing the pharmaceutical companies about LASA drug problems of their own product and packaging.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enalapril 5 mg tab	enalapril 20 mg tab	10
2	amlodipine 5 mg (GPO)	hydrochlorothiazide 25 mg (GPO)	8
3	metronidazole tablet	norfloxacin tablet	4
4	phenobarbital 60 mg (GPO)	propylthiouracil 50 mg (GPO)	3
	vitamin K_1 1 mg injection	vitamin K_1 10 mg injection	3

The technique pharmaceutical companies used to solve LASA drug problems after being informed from hospitals was adding a sticker on package in order to differentiate from other drugs (interview with hospital pharmacists IV and IX) (see figure 5.1).

Figure 5.1 Adding a color sticker on the drug blister by pharmaceutical company in order to solve the similar drug blister problems.

There were 88 hospitals (23.16%) unsuccessfully applied this activity. The reasons for no success in informing the pharmaceutical companies about LASA drug problems of their own product and packaging were 1) pharmaceutical companies did not execute or waited for nationwide data (36 hospitals), and 2) pharmaceutical companies reluctant to inform the FDA (6 hospitals).

There were 119 hospitals (31.31%) that never applied this activity. The reasons for never informing the pharmaceutical companies about LASA drug problems of their own product and packaging were 1) using other activities (changing the companies, separating LASA drug apart) (11 hospitals), 2) lack of bargaining power in small hospital, and 3) difficulty in informing.

Information from questionnaires and hospital pharmacists interview revealed that the pharmaceutical companies took no action or delayed in modifying package. But from interview, pharmacists in pharmaceutical companies stated that they executed when the company was informed by the hospital. They explored the problem and also looked for solutions to solve. If it was worth to do, they would change package or label because they were required to report such changes to the FDA. On the contrary, if they changed the drug tablets or capsules, they must file for registration of those drugs again. The solution of changing products' package or label of the local and original pharmaceutical companies helped differentiate one from another. However, local companies could execute using this solution

straightforward; while original international companies needed to figure whether to change only package for product specifically in Thailand or for universal package. If it was specific only for package available in Thailand, they would execute with no hesitation, but if not, they must be permitted by the overseas headquarter. Sometimes another different package in other continental zone was brought to replace the one in Thailand. However, if such different package could not be found, they would make a sticker to attach the old package and replace the lots with look-alike problem to the hospital reporting the problem. Some pharmaceutical companies had changed their drug capsule because they were complained by many hospitals with too many problems to solve successfully just by changing package only. However, in doing so, it needs a 12-month waiting period due to drug stability requirement before submission to Thai FDA.

After label and package change, the companies must report to Thai FDA. The pharmacist from the Thai FDA stated that the changing of color on label, package design, text layout and/or image on label which have been registered could be done by the companies then reported to the Thai FDA. However, if changes involve shape, color or flavor of the drug tablet or capsule, the drug with new change must be re-filed for registration as a new product.

In summary, there were pros and cons in activities to solve LASA problems that were applied in medication selection and procurement step as detailed in table 5.7.

Table 5.7 Pros and cons in each LASA problem-solving activity in medication selection and procurement step

Activity in medication selection and procurement step	Pros	Cons
Defining only a single strength for each drug item in hospital	Solving the look-alike labeling, packaging, tablets or capsules problems	Insistence to have such drugs for some diseases (chronic diseases, psychiatric), for some age group and for dose adjustment.
Avoiding LASA drugs name in the hospital formulary	Solving the LASA drug name problems	Some LASA drugs were needed for different diseases
Not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules	Solving the look-alike labeling, packaging, tablets or capsules problems	- Prime Minister's regulations about parcel 1992 assigned to purchase drug form GPO. - Some drugs have few or single manufacturers.
Considering LASA drug problems in the drug purchasing at provincial or regional level	Solving the look-alike labeling, packaging, tablets or capsules problems	- Main considering by quality and price - Each hospital has different LASA drug problems.
Informing the pharmaceutical companies about LASA drug problems of their own product and packaging	Solving the look-alike labeling, packaging, tablets or capsules problems	- The pharmaceutical companies did not execute and waited for nationwide data

5.2 Drug Storage

In this step, activities to solve LASA drug problems included 1) separating the look-alike drug apart, 2) making remarkable symbols on the LASA drugs, and 3) informing staff the list of LASA drug names.

The most successful activity applied to solve LASA problems was separating the look-alike drugs apart (85.12%). Unsuccessful activity was informing staff the list of LASA drug names (20.00%). It was found that 22.46% of hospitals never applied the solution of making remarkable symbols on the LASA drugs to solve the LASA drug problems (table 5.8).

Table 5.8 Numbers and percentages of hospitals applying activities to solve LASA drug problems in drugs storage step.

Activities in drug storage step	Applied to solve the problem (n,%)		
	successfully	unsuccessfully	Never applied
Separating the look-alike drug apart (n = 437)	**372 (85.12%)**	36 (8.24%)	29 (6.64%)
Making remarkable symbols on the LASA drugs (n = 414)	281 (67.87%)	40 (9.66%)	**93 (22.46%)**
Informing staff the list of LASA drug names (n = 420)	316 (75.24%)	**84 (20.00%)**	20 (4.76%)

5.2.1 Separating the look-alike drug apart

There were 372 of 437 responding hospitals (85.12%) stating that separating the look-alike drug apart in their hospitals successfully. The respondents informed 379 LASA drug pairs (194 unique pairs) were successfully solved by this activity. Examples of top 5 drug pairs are shown in table 5.9.

Table 5.9 Examples of top 5 drug pairs successfully applied separating the look-alike drug apart to solve LASA drug problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enalapril 5 mg tab	enalapril 20 mg tab	36
2	amoxicillin 250 mg	amoxicillin 500 mg	27
3	propranolol 10 mg	propranolol 40 mg	23
4	amlodipine 5 mg	simvastatin 10 mg	11
5	diazepam 2 mg	diazepam 5 mg	9

From interview with the hospital pharmacist, separating the look-alike drug apart was applied when there was incident of medication error from LASA drug. It was applied both in medical supplies storehouse and dispensing room.

There were 36 hospitals (8.24%) applied this activity with no success. The reasons for the failure were 1) human error (unclear label reading, lack of concentration in work) (22 hospitals), 2) inconvenience to pick up drug separated apart (2 hospitals), and 3) lack of working space (2 hospitals).

There were 29 hospitals (6.64%) that never applied this method. The reasons for never separating the look-alike drug apart were 1) sorting drugs by conventional alphabet order according pharmacotherapy system for convenience (5 hospitals), 2) inconvenience to pick up drugs separated apart (2 hospitals), and 3) using another more effective solution to solve the problem.

5.2.2 Making remarkable symbols on the LASA drugs.

There were 372 of 414 responding hospital (67.87%) employing making remarkable symbols on the LASA drugs successfully. The respondents informed 222 LASA drug pairs (135 unique pairs) were successfully solved by this method. Examples of top 5 drug pairs are shown in table 5.10.

Table 5.10 Examples of top 5 drug pairs that were solved successfully by making remarkable symbols on the LASA drugs to solve LASA drug problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enalapril 5 mg tab	enalapril 20 mg tab	16
2	vitamin K_1 1 mg injection	vitamin K_1 10 mg injection	9
3	hydralazine tab	hydroxyzine tab	7
	lorazepam tab	loratadine tab	7
5	diclofenac tab	dicloxacillin cap	6
	propranolol 10 mg	propranolol 40 mg	6
	glibenclamide tab	glipizide tab	6

The techniques that hospital used in making remarkable symbols on the LASA drugs were 1) using the warning sign on the drug shelves, 2) using color sticker with “LASA” label or “ยาชื่อพ้อง มองคล้าย” in Thai or other text for careful handling, 3) highlighting drug name on label, 4) showing LASA drug photo on the shelves, and 5) using different text labels.

From interview, hospital pharmacists made the warning sign in several formats. Examples of warning sign are shown in figure 5.2.

Figure 5.2 Examples of warning signs of LASA drugs from hospitals.

There were 40 hospitals(9.66%) unsuccessfully applying this activity. The reasons for no success in making remarkable symbols for the LASA drugs were 1) human error (unclear label reading, lack of concentration in work) (14 hospitals), 2) symbol visually interfering with locating the drugs causing inconvenience to get the drug, and 3) returning and keeping drug in a wrong place.

There were 93 hospitals (22.46%) never applying this tactic. The reasons for never making remarkable symbols on LASA drugs were 1) already successful by separating the look-alike drugs apart (10 hospitals), 2) still looking for the model suitable for context of the hospital (9 hospitals), 3) insufficient staff and time to do (3 hospitals), 4) inconvenience to do, 5) an increase in workload in doing so, 6) lack of space, 7) too many symbols to do, and 8) being forbidden to do by the hospital 5-S policy.

5.2.3 Informing the list of LASA drug names to all staff.

There were 372 of 420 responding hospitals (75.24%) that used informing staff the list of LASA drug names to solve LASA drug problems successfully. The respondents informed 281 LASA drug pairs (173 unique pairs) were successfully solved by this tactic. The examples of top 4 drug pairs are shown in table 5.11.

Table 5.11 Examples of 4 drug pairs successfully solved by informing staff the list of LASA drug names to solve LASA drug problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enalapril 5 mg tab	enalapril 20 mg tab	14
2	diclofenac	dicloxacillin	9
3	dimenhydrinate 50 mg	diazepam 5 mg	8
4	amoxicillin 250 mg	amoxicillin 500 mg	7
	hydralazine tab	hydroxyzine tab	7
	roxithromycin 150 mg	ranitidine 150 mg	7

The techniques that hospitals used were 1) showing LASA drug list (10 hospitals and interview), 2) using letter to inform staffs (2 hospitals), 3) holding a meeting to explain LASA drug problems, and 4) demonstrating the LASA drugs on a notice board.

From the interview with hospital pharmacists, the techniques that hospitals used to decrease LASA drug problems were 1) analyzing medication error situation every 3 months, 2) collecting medication error reports from all departments in hospitals, 3) selecting top 3 drug pairs to notify staff, and 4) setting campaign activity to search for LASA drugs in each department and motivating by rewards. Example activities are shown in figure 5.4.

Figure 5.3 Activity to search for the LASA drug in each department and to find solution to solve problem reported by hospital pharmacist XIII.

There were 84 hospitals (20.00%) applying this activity with no success. The reasons for such failure included 1) human error (being not careful, lack of concentration, lack of cooperation in work) (40 hospitals), 2) urgency in work and too much workload (12 hospitals), 3) high turnover rate of pharmacy's staff (4 hospitals), 4) forgetting LASA drug pairs (2 hospitals), 5) difficulty reading physician handwriting, and 6) frequent change of drug package.

There were 20 hospitals (4.76%) never applying this tactic. The reasons for never informing the list of LASA drug names to all staffs were 1) using other activities (2 hospitals), and 2) checking drugs before dispensing is more effective.

The summary, there were pros and cons in activities applied in drugs storage step as shown in table 5.12.

Table 5.12 Pros and cons in each action in drugs storage step.

Actions in drugs storage step	Pros	Cons
Separating look-alike drugs apart	Solving the LASA drug names and the look-alike label, package, tablets or capsules problems	- Human error (unclear label reading, lack of concentration in work) - Inconvenience to pick up drugs. - Urgency in work and too much workload.
Making remarkable symbols on LASA drugs	separating look-alike drugs away from each other (N = 437)	
Informing staff the list of LASA drug names	separating look-alike drugs away from each other (N = 437)	

5.3 Ordering, prescribing and transcribing medication step

In this step, the processes of ordering drug with prescription, computer system, telephone and dispensing drugs with unit dose or one-day dose were involved. It was found that the solutions to solve LASA drug problems in these processes included 1) asking for cooperation from the physicians not to use abbreviations in prescribing, 2) asking for clear writing for LASA drug names from physicians, 3) asking for written drug strength for LASA drugs from physicians, 4) asking for written diagnosis on prescriptions, 5) encouraging prescribing drug via computerized system to reduce physician handwriting problem, 6) avoiding ordering drug by telephone, 7) dispensing with unit dose or one-day dose, pharmacists being able to see physician's handwriting directly, and 8) printing drug history on prescription pad for physician's prescribing.

The activity applied to solve the LASA problems successfully was dispensing with unit dose or one-day dose and pharmacists seeing the physician's handwriting directly (80.92%). Unsuccessful activity applied to solve the LASA problems was asking for cooperation from physicians not to use abbreviations in prescribing (45.52%). It was found that 65.45% of hospitals never applied printing

drug history on prescription pad before physician's prescribing to solve the LASA drug problems. Details can be seen in table 5.13.

Table 5.13 Numbers and percentages of hospitals that applied activities in step of ordering, prescribing and transcribing medication.

Activities in drug ordering and prescribing including transcribing medication orders step	Applied to solve the problem (n,%)		
	successfully	unsuccessfully	Never applied
Asking for cooperation from the physicians not to use abbreviations in prescribing. (n = 424)	169 (39.86%)	**193 (45.52%)**	62 (14.62%)
Asking for clear writing for LASA drug names from physicians. (n = 393)	173 (44.02%)	115 (29.26%)	105 (26.72%)
Asking for written drug strength for LASA drugs from physicians. (n = 429)	282 (65.73%)	110 (25.64%)	37 (8.62%)
Asking physicians to write medical diagnosis on prescriptions. (n = 420)	241 (57.38%)	83 (19.76%)	96 (22.86%)
Encouraging prescribing drug via computerized system to reduce physician handwriting problem. (n = 443)	282 (63.66%)	65 (14.67%)	96 (21.67%)
Avoiding ordering drug by telephone. (n = 413)	112 (27.12%)	163 (39.47%)	138 (33.41%)
Dispensing with unit dose or one-day dose, pharmacists being able to see physician's handwriting directly. (n = 435)	**352 (80.92%)**	39 (8.97%)	44 (10.11%)
Printing drug history on prescription pad for physicians prescribing. (n = 411)	117 (28.47%)	25 (6.08%)	**269 (65.45%)**

5.3.1 Asking for cooperation from physicians not to use abbreviations in prescribing

There were 169 of 424 responding hospitals (39.86%) employing asking for cooperation from physicians not to use abbreviations in prescribing to solve LASA drug problems successfully. The respondents informed 47 LASA drug pairs (26 unique pairs) were solved successfully by this activity. Examples of top 4 drug pairs are shown in table 5.14.

Table 5.14 Examples of 4 drug pairs successfully solved by asking for cooperation from physicians not to use abbreviations in prescribing.

Order	Drug name 1	Drug name 2	Number of hospitals
1	methotrexate (MTX)	multivitamin (MTV)	13
2	chlorpromazine (CPZ)	chlordiazepoxide (CDZ)	3
	dopamine injection	dobutamine injection	3
4	amitriptyline 10 mg	amitriptyline 25 mg	2
	chlorpromazine (CPZ)	carbarmazepne (CBZ)	2
	chlorpromazine (CPZ)	chlorpheniramine (CPM)	2
	methotrexate (MTX)	methimazole (MMI)	2

The techniques that hospital applied in asking for cooperation from physicians not to use abbreviations in prescribing successfully were 1) the hospital policy on using abbreviations (6 hospitals), 2) prescribing drugs via a computerized system (7 hospitals), 3) using generic names (interview with hospital pharmacist III), 4) compiling drug name abbreviation list (interview with hospital pharmacists III, VIII, XII).

There were 193 hospitals (45.52%) applied this activity with no success. The reasons for such failure were 1) no cooperation from physicians (68 hospitals), 2) physician's personal prescribing habit and having too little time for individual patient care (40 hospitals), and 3) high turnover rate of physicians (29 hospitals).

There were 63 hospitals (14.62%) never applying this activity. The reasons for never asking for cooperation from the physicians not to use abbreviations in prescribing were 1) not being mentioned in hospital meeting (6 hospitals), 2) physicians not writing the suggested abbreviations (4 hospitals), and 3) already implementing computerized prescribing system (2 hospitals).

From interview with hospital pharmacist XIV, some abbreviations were used. For example, potassium chloride was abbreviated as KCl with prior approval from physicians committee.

From interview with physicians, the reasons for using drug abbreviations in prescribing were 1) avoiding writing lengthy drug names (eg. hydrochlorothiazide), 2) repetitive writing both on prescription and OPD card, and 3) time-saving. Moreover, physicians also gave the solutions to use abbreviation as 1) using universal abbreviations, and 2) listing drugs abbreviations by committee of the hospital.

From interview with nurses, they stated that if there was a need for using abbreviations, a list of drug abbreviations should be provided to physicians. For the high-alert drugs or drugs for severe disease, their names should not be abbreviated.

5.3.2 Asking for clear writing for LASA drug names from physicians.

There were 173 of 393 responding hospitals (44.02%) asking for clear writing for LASA drug names from physicians to solve LASA drug problems and they were successful in doing so. The respondents informed 86 LASA drug pairs (58 unique pairs) were successfully solved by this activity. Examples of top 5 drug pairs are shown in table 5.15.

Table 5.15 Examples of top 5 drug pairs successfully solved by asking for clear writing for LASA drug names from physicians to solve LASA drug problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	diclofenac	Dicloxacillin	5
	Voltaren®	Ventolin®	5
3	glibenclamide	Glipizide	4
	lorazepam	Loratadine	4
5	Losec®	Lasix®	3
	roxithromycin	Ranitidine	3

From interview, successful techniques were 1) pharmacist demonstrating the good and poor prescription writing to new intern doctors (hospital pharmacist IV), 2) using brand names or generic name in a pair of LASA drug name (hospital pharmacists X, XI), and 3) asking physicians to write strength of drug (hospital pharmacist XV).

There were 115 hospitals (29.26%) applying this activity with no success. The reasons for the failure were 1) no cooperation from physicians (41 hospitals), 2) physician's personal prescribing habit and having too little time for individual patient care (17 hospitals), 3) physician handwriting were difficult to read (8 hospitals), and 4) high turnover rate of physicians (7 hospitals).

There were 105 hospitals (26.72%) that never applied this activity. The reasons for never asking physician to write LASA drug name clearly were 1) no established hospital guidelines for this activity (9 hospitals), 2) already implementing computerized prescribing system (7 hospitals), and 3) physician handwriting was hard to solve.

From interview with physicians, changing habitual confusing handwriting and forcing writing generic drug name were difficult to do in practice. However, computerized prescribing system and writing larger and neater letters might also help solve the problem.

From interview with nurses, they stated that many nurses red prescription and confirmed with prescribing physicians. This could also help solve the problem.

5.3.3 Asking physicians to write strength of drug in prescription.

There were 282 of 429 responding hospitals (67.73%) asking physicians write strength of drug in prescription to solve LASA drug problems successfully. The respondents informed 201 LASA drug pairs (71 unique pairs) were successfully solved by this activity. Examples of top 5 drug pairs are shown in table 5.16.

Table 5.16 Examples of top 5 pairs successfully solved by asking physicians to write strength of drug in prescription to solve LASA drug problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enalapril 5 mg	enalapril 20 mg	30
2	propranolol 10 mg	propranolol 40 mg	26
3	amoxicillin 250 mg	amoxicillin 500 mg	15
4	diazepam 2 mg	diazepam 5 mg	13
5	paracetamol 325 mg	paracetamol 500 mg	9

From interview with hospital pharmacists I, X, and XII, physicians should determine strength of drug in every regimen. However, this measure was long implemented in some hospitals.

There were 110 hospitals (25.64%) applying this tactic with no success. The reasons for such failure were 1) poor cooperation among physicians (50 hospitals), 2) habitual prescribing (15 hospitals), and 4) physician's inability to remember all strengths of drug.

There were 37 hospitals (8.62%) never applying this activity. The reasons for never asking physicians to write strength of drug in prescription were 1) only one strength of drug in each drug available in the hospital (9 hospitals), 2) already implementing computerized prescribing system (4 hospitals), and 3) being difficult to implement in practice.

From interview with physicians I and III, the failure of the measure was due to the fact that physicians were not required by the hospital policy to write strength of drug. However, they thought that if physicians did not write strength of drug, pharmacists should confirm with the prescribing physicians. The cause of not writing strength of drug might also be forgetting the strengths. Physicians should determine strength of drug in order to match with desired strength for individual patients. It was critical especially for drugs with many strengths such as enalapril tablet of both 5 mg and 20 mg strengths. Furthermore, determining drug strength would be useful for physicians to familiarize with all strengths of any given drugs.

In the nurse's prospective, strength of drug should be determined for every drug item. If physicians did not determine strength of drug, the nurses should confirm with the prescribing physician.

5.3.4 Asking physicians to write medical diagnosis on prescriptions.

There were 241 of 420 responding hospitals (57.38%) asking physicians to write medical diagnosis on prescriptions successfully. The respondents informed 39 LASA drug pairs (31 unique pairs) were successfully solved by this activity. Examples of top 5 drug pairs are shown in table 5.17.

Table 5.17 Examples of top 5 drug pairs successfully solved by asking physicians to write medical diagnosis on prescriptions to solve LASA drugs.

Order	Drug name 1	Drug name 2	Number of hospitals
1	hydralazine	hydroxyzine	4
2	Voltaren®	Ventolin®	3
3	lorazepam	loratadine	2
	methotrexate	multivitamin	2
	metronidazole	metformin	2

From interview with hospital pharmacist IX, the diagnosis, laboratory critical values and vital signs should be notified on the prescription. They were useful in verifying the drugs and in explaining the patient.

There were 83 hospitals (19.76%) unsuccessfully applying this activity. The reasons for such failure were 1) no cooperation from physicians (45 hospitals), 2) inconvenience in practice (10 hospitals), 3) not being able to write information for all diseases (7 hospitals), 4) not necessary since the information could be viewed from computerized medical records (3 hospitals), 5) insufficient time to read diagnosis in the prescriptions, 6) LASA drug names used to treat the same disease, and 7) hospital committee not agreeing with writing diagnosis on prescriptions.

There were 96 hospitals (21.67%) never applying this activity. The reasons not for asking physicians to write medical diagnosis on prescriptions were 1) already implementing computerized medical records that pharmacists can access (24 hospitals), 2) no cooperation from physicians (7 hospitals), and 3) physician arguing that diagnosis information was the patient's confidential information especially HIV patients which should not be disclosed.

From interview with physicians I, II and III, the physicians stated that they agreed with writing diagnosis information on prescriptions so that drug items could be checked against diagnosis for correctness. But the problems of this activity were 1) new pharmacists unable to remember indications of all prescribed drugs and some would confirm with prescribing physicians for wrong drugs, 2) too many diagnoses to write on prescription since more than one diagnosis for given patients, and 3) in computer system, the diagnosis included were only those specified by International Classification of Diseases 10 (ICD-10) codes. Moreover in some hospitals physicians were asked to redundantly prescribe on prescription pad and into computerized system. As a result, the physicians had less time to write diagnosis on prescription.

From interview with nurses, the diagnosis in doctor's order sheet was useful for nurses to figure whether the prescribed drugs were the right ones for such diagnosis.

5.3.5 Prescribing drug via computerized system to reduce physician handwriting problem.

There were 282 of 443 responding hospitals (63.66%) successfully prescribing drug via computerized system to reduce physician handwriting problem. The respondents informed 57 LASA drug pairs (40 unique pairs) were successfully solved by the method. The examples of top 5 drug pairs are shown in table 5.18.

Table 5.18 Examples of top 5 drug pairs successfully solved by prescribing drug via computerized system to reduce physician handwriting problem.

Order	Drug name 1	Drug name 2	Number of hospitals
1	hydralazine	hydroxyzine	5
	Losec®	Lasix®	5
3	calcium carbonate	colchicine 0.6 mg	3
	Voltaren®	Ventolin®	3
5	diclofenac	dicloxacillin	2
	enalapril 5 mg	enalapril 20 mg	2
	glibenclamide	glipizide	2
	hyoscine	hydroxyzine	2
	methotrexate	multivitamin	2

One hospital pharmacist informed that drugs were prescribing via computerized system helped alleviated LASA problems with various causes including abbreviation problem, handwriting problem, and problem associating with prescribing with no strength specified. Another two hospital pharmacists (number V and VI) stated that the limitation was that some hospitals used computerized prescribing system only for out-patient service.

There were 65 hospitals (14.67%) applying this activity with no success. The reasons for such failure in prescribing drug via computerized system were 1) no cooperation from physicians (23 hospitals), 2) physicians simply entering wrong drugs to the computerized prescribing system, (15 hospitals) 3) availability of the system only in out-patient department (9 hospitals), and 4) poor computer system and no administrator (3 hospitals).

There were 96 hospitals (21.67%) never applying this activity. The reasons for not implementing this method were 1) poor computer system (20 hospitals), 2) physicians denying to prescribe to computerized system (15 hospitals), and 3) insufficient budget to implement the system (3 hospitals).

From interview with physicians, they also confirmed that prescribing via computerized system would help reduce handwriting problem.

5.3.6 Avoiding ordering drug by telephone

There were 112 of 413 responding hospitals (27.12%) reporting implementing not ordering drug by telephone successfully. The respondents informed 7 LASA drug pairs that were solved successfully. (Table 5.19).

Table 5.19 Drug pairs successfully solved by not ordering drug by telephone.

Drug name 1	Drug name 2	Number of hospitals
cefoxitin	Ceftazidime	1
furosemide injection	potassium chloride injection	1
Losec®	Lasix®	1
metronidazole	metoclopramide	1
morphine injection	magnesium sulfate injection	1
Voltaren®	Ventolin®	1
warfarin 2 mg	warfarin 3 mg	1

There were 163 hospitals (39.47%) implementing this method with no success. The reasons for the failure were 1) no cooperation from physicians (24 hospitals), 2) urgent cases requiring phone order (urgent requests for laboratory order or results, and drugs for urgency) (18 hospitals), 3) no physicians in the setting after the office hours (14 hospitals), and 4) insufficient number of physicians (13 hospitals).

There were 138 hospitals (33.41%) never applying this activity. The reasons for not implementing were 1) the hospital policy allowing for prescribing by telephone (24 hospitals), 2) limited number of physicians (14 hospitals), 3) no cooperation from physicians (14 hospitals), 4) the need for phone order after office hours (7 hospitals), 5) convenience (5 hospitals), 6) urgent cases (4 hospitals), and 7) experiencing very few problems with phone order (3 hospitals).

From interview with hospital pharmacists, phone orders were somewhat common in many hospitals. Circumstances that allowed physician's phone orders included 1) having the guideline to practice such order, 2) having limitation by not allowing phone order for high-alert drugs, 3) having limitation by not allowing in outpatient services, 4) having physicians sign on Doctor's order sheet as soon as possible after the phone order, and 5) having nurses opening phone speaker so that fellow nurses could help listen to the order.

From interview with both physicians and nurses, the practice of phone order were allowed only in cases which the physician knew signs and symptoms of the patient, and the patient was not in critical stage. For emergency case, physicians would order by phone then the patient must be seen by the prescribing physician as soon as possible. In phone order, after physicians order drug name to the nurse, they usually asked the nurse to repeat the drug name back to them. In addition, as a recheck, the physicians would also repeat the drug names back to the nurse.

5.3.7 Dispensing with unit dose or one-day dose and pharmacists seeing the physician's handwriting directly

There were 352 of 435 responding hospitals (80.92%) successfully implementing the method of dispensing with unit dose or one-day dose and pharmacists seeing the physician's handwriting directly. The respondents informed a total 50 LASA drug pairs (43 unique pair) solved successfully. The examples of top 2 drug pairs are shown in table 5.20.

Table 5.20 Examples of top 2 drug pairs successfully solved by dispensing with unit dose or one-day dose and pharmacists seeing the physician's handwriting directly.

Order	Drug name 1	Drug name 2	Number of hospitals
1	Losec®	Lasix®	3
2	Aldomet®	Aldactone®	2
	Atarax®	Ativan®	2
	diclofenac	dicloxacillin	2
	enalapril 5 mg	enalapril 20 mg	2
	Voltaren®	Ventolin®	2

From interview with hospital pharmacists and nurses, they reported that if pharmacists had the chance to look at copy of doctor's order sheet, it helped double check the order after nurses' first inspection. Dispensing with one-day dose helped reduce risk of drug errors from drugs with continuous order. The unit dose helped reduce nurse error in the nurse's drug preparing since pharmacist would have prepared the drug for each dose.

There were 39 hospitals (8.97%) implementing the method with no success. The reasons for such failure were 1) having difficulty in reading physician's handwriting (10 hospitals), 2) pharmacist or pharmacy staffs copying wrong drug (4 hospitals), 3) no pharmacist working beyond the office hours (3 hospitals), and 4) dispensing wrong drugs (2 hospitals).

There were 44 hospitals (10.11%) never applying dispensing with unit dose or one-day dose and pharmacists seeing the physician's handwriting directly. The reasons for not doing so were 1) insufficient pharmacy staff (10 hospitals), 2) not many inpatients, and 3) physician ordering drug through computerized system.

5.3.8 Printing drug history on prescription pad before physicians prescribing

There were 117 of 411 respond hospitals (28.47 printing drug history on prescription before physicians prescribed to solve LASA drug problems as successfully. The respondents informed a total of 10 LASA drug pairs (9 unique pairs) successfully solved by this method (table 5.21).

Table 5.21 Drug pairs successfully solved by printing drug history on prescription pad before physicians prescribing to solve LASA drug problems.

Drug name 1	Drug name 2	Number of hospitals
Aldomet®	Aldactone®	2
amlodipine	atenolol	1
Cardura® XL	Cordarone®	1
diclofenac	dicloxacillin	1
glibenclmide	glipizide	1
glibenclamide	gliclazide	1
lorazepam	loratadine	1
Isordil®	Inderal®	1

There were 25 hospitals (6.08%) applying this measure with no success. The reasons for the failure were 1) lack of concern among physicians, 2) not reviewing drug list before ordering, or prescribing without number, and 3) wrongly placing the patient's medication history from clinic visit for other illnesses.

There were 29 hospitals (65.45%) never applying this activity. The reasons for never printing drug history on prescription pad before physician prescribing were 1) being able to see patient's drug history in computer system (45 hospitals), 2) computer program unable to print patient's drug history (22 hospitals), 3) no hospital policy to mandate such practice (15 hospitals), 4) using OPD card (10 hospitals), 5) insufficient staff (4 hospitals), 6) inconvenience to do (3 hospitals), and 7) no person assigned to the task (2 hospitals).

In summary, there were pros and cons in the solutions to be implemented in steps of drug ordering, prescribing and transcribing the orders. Such pros and cons are shown in table 5.22.

Table 5.22 Pros and cons in each activity in steps of drug ordering and prescribing and transcribing medication orders.

Activity in drug ordering and prescribing including transcribing medication step	**Pros**	**Cons**
Asking for cooperation from the physicians not to use abbreviations in prescribing.	Solving the look-alike drug name problems	- Physicians did not cooperate - Overload of work with limited time on physician side - Physicians handwriting was hard to read. - High turnover rate of physicians
Asking for clear writing for LASA drug names from physicians.	Solving the LASA drug name problems	
Asking for written drug strength for LASA drugs from physicians.	Solving the look-alike drug name problems	
Asking physicians to write medical diagnosis on prescriptions.	Solving the look-alike drug name problems	- Poor computer system was poor. - Physicians denied prescribing drug via computer.
Encouraging prescribing drug via computerized system to reduce physician handwriting problem.	Solving the look-alike drug name problems	- Physicians did not cooperate. - Diagnosis could not be written for many diagnoses in a given patient.
Avoiding ordering drug by telephone.	Solving the sound-alike drug name problems	- Physicians did not cooperate. - urgent case (laboratory report, urgent drugs) - Insufficient physician staff off the office hours.
Dispensing with unit dose or one-day dose, pharmacists being able to see physician's handwriting directly.	- Solving the look-alike drug names and the look-alike labeling, packaging, tablets or capsules problems - reducing need for copies of doctor's order	- Physician's handwriting was hard to read. - Pharmacists misreading the drug order.
Printing drug history on prescription pad for physicians prescribing.	Solving the look-alike drug name problems	- Physicians lack of concern, not reviewing drug list before prescribing.

5.4 Drug preparing and dispensing

In this step, many solutions to solve LASA drug problems were listed as the followings: 1) using Tall-man letter on the label to help drug preparing and dispensing, 2) checking drugs prescribed with physician's diagnosis, 3) using signs to warn drug pairs with often errors, 4) allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour, 5) showing both generic and brand names of drugs in computer database.

The activity that was applied to solve the LASA problems successfully was checking whether prescribed drugs were pertinent to physician's diagnosis (83.41%). Unsuccessful activity was the allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour (29.88%). It was found that 33.49% of hospitals never applied showing both generic and brand names of in a computer database. Details of all activities are shown in table 5.23.

Table 5.23 Number and percentage of hospitals applying activities in drug preparing and dispensing step.

Activities in drug preparing and dispensing step	Applied to solve the problem (n, %)		
	successfully	unsuccessfully	Never applied
Using tall-man letter on the label to help drug preparing and dispensing. (n = 432)	279 (64.58%)	31 (7.18%)	122 (28.24%)
Checking drugs prescribed with physician's diagnosis. (n =428)	**357 (83.41%)**	39 (9.11%)	32 (7.48%)
Using signs to warn drug pairs with often errors. (n = 415)	245 (59.04%)	52 (12.53%)	118 (28.43%)
Allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour. (n = 425)	204 (48.00%)	**127 (29.88%)**	94 (22.11%)
Showing both generic and brand names of drug in computer database. (n = 415)	230 (55.42%)	46 (11.08%)	**139 (33.49%)**

5.4.1 Using tall-man letter on the label to help drug preparing and dispensing.

There were 279 of 411 responding hospitals (64.58%) successfully using Tall-man letter on the label to help drug preparing and dispensing to solve LASA drug problems. The respondents informed 259 LASA drug pairs (109 unique pairs) were solved successfully using this method. Examples of top 5 drug pairs are shown in table 5.24.

Table 5.24 Examples of 5 drug pairs successfully solved using tall-man letter on the label to help drug preparing and dispensing to solve LASA problems.

Order	Drug name 1	Drug name 2	Number of hospitals
1	diclofenac	dicloxacillin	24
	dopamine	dobutamine	24
3	lorazepam	loratadine	15
4	hydralazine	hydroxyzine	14
5	enalapril 5 mg	enalapril 20 mg	12

From interview with hospital pharmacists, it was found that tall-man letter was used in computer system in 7 of 16 hospitals (hospital pharmacists IV, V, VI, IX, XI, XIV and XVI). See also figure 5.5 for the use of tall-man letter in computer system.

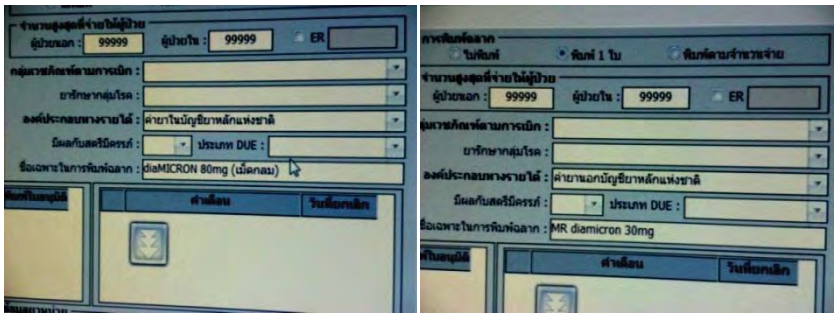


Figure 5.4 Example of Tall-man letter in the computer program of a hospital (reported by pharmacist number XIV).

There were 31 hospitals (7.18%) implementing this measure with no success. The reasons for using Tall-man letter on the label unsuccessfully were 1) human error (being careless, not concentrated, or hasty) (7 hospitals), 2) errors in the drug preparing process (7 hospitals), and 3) confusing Tall-man letters (2 hospitals).

There were 122 hospitals (28.24%) never implementing the measure. The reasons for never using Tall-man letter on the label were 1) limited capacity of the computer program to set Tall-man letter (24 hospitals), 2) being in computer program development state (14 hospitals), 3) using other measures to solve LASA problems (4 hospitals), and 4) lack of knowledge to make Tall-man letter (3 hospitals).

In case of limited computer program ability to make Tall-man letters, other techniques mentioned included 1) changing drug name by initializing with strength of drug or dosage form instead of generic name, for example “ORS ผู้ใหญ่” and “เด็ก ORS”, and 2) filling symbol (*, #, @) in front of or after the drug name.

5.4.2 Checking drugs prescribed with physician’s diagnosis.

There were 357 of 428 responding hospitals successfully implementing checking prescribed drugs for pertinence with physician’s diagnosis. They informed 99 drug pairs (61 unique pairs) were solved successfully. Examples of top 5 drug pairs are shown in table 5.25.

Table 5.25 Examples of 5 drug pairs successfully solved by checking prescribed drugs for pertinence with physician's diagnosis.

Drug name 1	Drug name 2	Number of hospitals
diclofenac	Dicloxacillin	5
flunarizine	Fluconazole	5
hydralazine	Hydroxyzine	5
hyoscine	Hydroxyzine	5
lorazepam	Loratadine	5

There were 39 hospitals unsuccessfully applying this measure. The reasons for such failure were 1) physicians not writing diagnosis on prescription (12 hospitals), and 2) no time to read the diagnosis (4 hospitals).

There were 32 hospitals never applying this activity. The reasons for not implementing were 1) physicians not writing diagnosis on prescription (9 hospitals), and 2) pharmacist unable to find physician's diagnosis in the computer system (3 hospitals).

5.4.3 Using signs to warn drug pairs with often errors.

There were 245 of 415 responding hospitals successfully applying using signs to warn drug pairs with often errors. They informed 110 drug pairs (85 unique pairs) were solved successfully. Examples of top 5 drug pairs are shown in table 5.26.

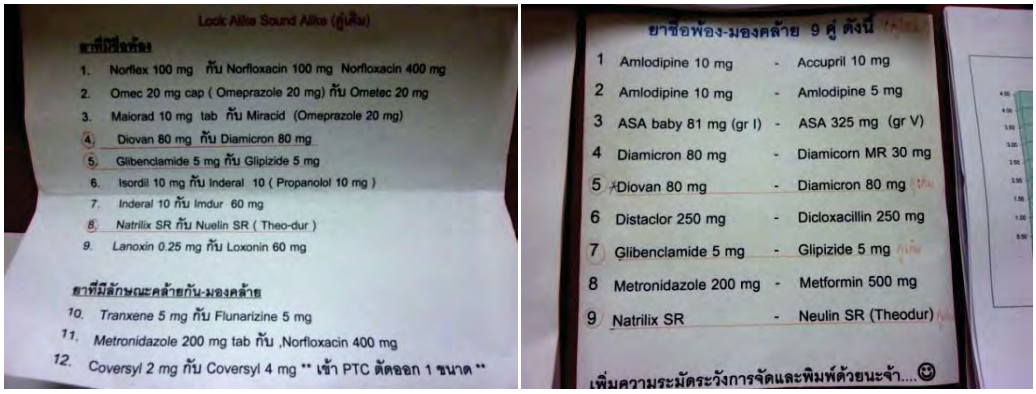
Table 5.26 Examples of 5 drug pairs successfully solved by showing warning signs for pairs with frequent errors.

Order	Drug name 1	Drug name 2	Number of hospitals
1	enlapril 5 mg	enlapril 20 mg	6
2	glibenclamide	Glipizide	5
3	Lorazepam	Loratadine	4
4	amoxicillin 250 mg	amoxicillin 500 mg	3
	diazepam 2 mg	diazepam 5 mg	3

From interview with hospital pharmacist XII, it was informed that each dispensing room and ward would make LASA drug warning labels in their setting monthly (see also figure 5.6).

Figure 5.5 LASA drug pair warnings in various dispensing rooms and wards in a hospital as reported by hospital pharmacist number XIII.

The hospital pharmacist number XIV informed that there made list of LASA drug pairs to be posted for warning all healthcare staff. Data of errors were collected year-round and analyzed annually. See also figure 5.7.



old data new data

Figure 5.6 LASA drug pairs posted in a hospital to warn healthcare staff, as reported in hospital pharmacist number XIV.

There were 52 hospitals unsuccessfully applying this activity. The reasons for the failure were 1) human error (unaware of warning sign existence) (15 hospitals), and 2) disrupted posting of warning signs (4 hospitals).

There were 118 hospitals never applying this activity. The reasons for not implementing the warning signs of pairs with frequent errors were 1) unable to make warning signs (11 hospitals), 2) using other activities to solve the problems (9 hospitals), 3) no space to place warning labels (2 hospitals), and 4) errors based on 5-S method must be removed when found by 5-S checking.

5.4.4 Allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour.

There were 204 of 425 responding hospitals successfully applying the allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour. They informed 12 drug pairs successfully solved. Examples of 12 drug pairs are seen in table 5.27.

Table 5.27 Examples of 12 drug pairs successfully solved by allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour.

Drug name 1	Drug name 2	Number of hospitals
amlodipine 5 mg	amlodipine 10 mg	1
aspirin 81 mg	simvastatin 20 mg	1
Atarax®	Air-X®	1
calcium carbonate tab	colchicines 0.6 mg	1
chloroquine	cinnarizine	1
fluphenazine injection	haloperidol injection	1
glibenclamide	ketoconazole	1
haloperidol 0.5 mg	haloperidol 5 mg	1
hydrochlorothiazide	propylthiouracil	1
methotrexate	Isorem®	1
propranolol 10 mg	nifedipine 20 mg	1
warfarin 3 mg	warfarin 5 mg	1

The techniques that hospital used to allocation of adequate personnel were 1) setting an adequate minimum number of staff in rush hour, 2) allocation of work in both the pharmacy department and outside the pharmacy department to help in rush hour, 3) organizing the vacation day, and 4) discontinuing other tasks to allocate workforce to preparing prescribed drugs during rush hour.

From interview with hospital pharmacist number XIV, staff in dispensing room discontinued other tasks to help preparing prescribed drugs. This pharmacist informed that in rush hour the other pharmacist from drug information service, pharmaceutical compounding, and medical supplies storehouse department would join and help to dispensing staff. However, differences regarding errors between regular staffing and additional staffing were not studied.

There were 127 hospitals unsuccessfully applying this activity. The reasons for not implementing were 1) inadequate staff (71 hospitals), 2) human error (lack of concentration, haste) (7 hospitals), 3) executives not approving adding staff

members in dispensing room (4 hospitals), and 4) assistant personnel other than pharmacist from other department not having adequate expertise for dispensing job.

There were 94 hospitals never applying this activity. The reasons for not allocating adequate personnel to reduce the pressure and stress of the operation in rush hour were 1) limited workforce (42 hospitals); 2) not increase personnel or no budget to increase personnel (12 hospitals); and 3) enough staffs (2 hospitals).

5.4.5 Showing both generic and brand names of drugs in computer database.

There were 230 of 415 responding hospitals successfully applying showing both generic and brand names of drugs in computer database and the system could show the both kind of drug names simultaneously. They informed 68 drug pairs (47 unique pairs) were solved successfully by this method. Examples of top 5 drug pairs are shown in table 5.28.

Table 5.28 Examples of 5 drug pairs successfully solved by showing both generic and brand names of drugs in computer database.

Order	Drug name 1	Drug name 2	Number of hospitals
1	hydralazine (Apressoline®)	hydroxyzine (Atarax®)	5
	simvastatin (Zocor®)	simethicone (Air-X®)	5
3	hyoscine (Buscopan®)	hydroxyzine (Atarax®)	4
4	lorazepam (Ativan®)	loratadine (Clarityne®)	3
	Cardura® (doxazocin)	Cordarone® (amiodarone)	3

From interview with hospital pharmacist number II, the use of generic and brand name of furosemide (Lasix®) because the computer system did not print Tall-man letter.

There were 46 hospitals unsuccessfully applying this measure. The reasons for the failure were 1) long drug name (8 hospitals), 2) computer program not supporting the function (7 hospitals), and 3) error of the worker (6 hospitals).

There were 139 hospitals never implementing this measure. The reasons for not implementing were 1) using only the generic name or brand name either (23 hospitals), 2) long drug name not suitable for printing (14 hospitals), 3) computer program not supporting the function (7 hospitals), 4) using other activities to solve LASA problem (4 hospitals), 5) no computer system (2 hospitals), 6) being unaware of this activity, and 7) perceiving the system as too complicate to use.

Moreover, from interview with hospital pharmacist, in addition to using both generic and brand names of a given drug, other ways to solve the problem were implemented including 1) printing as a different name (budesonide inhaler and Rhinocort nasal spray), 2) switching position between strength and drug name, and specifying color of drug tablet on the label, for example, warfarin 3 mg (เม็ดสีฟ้า) and 5 mg warfarin (เม็ดสีชมพู), 3) filling the symbols in drug name especially high-alert drug, for example, “*” and “#”, and 4) separating a given drug name by syllables.

In summary, there were pros and cons in the solutions to be implemented in steps of drug preparing and dispensing. Such pros and cons are shown in table 5.29.

Table 5.29 Pros and cons in each activity in steps of drug preparing and dispensing.

Activity in drug preparing and dispensing step	Pros	Cons
Using tall-man letter on the label to help drug preparing and dispensing.	Solving the look-alike drug name problems	-Human error (not careful, unconscious, hasty) -Confusing Tallman letter -Computer program cannot make Tallman letter.
Checking drugs prescribed with physician's diagnosis.	Solving the look-alike drug name problems	-Physicians did not write diagnosis.
Using signs to warn drug pairs with often errors.	Solving the look-alike drug name and labeling, packaging, tablets or capsules problems	-Human error (not aware and see warning sign)
Allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour.		-The personal was not enough. -Human error
Showing both generic and brand names of drug in computer database.		-Drug name was too long over space on label. -Computer program was not supported.

5.5. Drug administration

In this step, activities to solve LASA drug problems were as follows: 1) always having at least two nurses to check the drug before administering to the patient, and 2) having pharmacists in wards to check drug before administering to the patient.

The activity most reported to successfully solve LASA problems was having at least two nurses to check the drugs before administering to the patient (52.10%); while this method was also the most unsuccessful way (27.29%). It was found that 76.74% of hospitals never having pharmacists in ward to check drug before administering to the patient. Details are shown in table 5.30).

Table 5.30 Numbers and percentages of hospitals that applied activities in drug administration step.

Activities in medication selection and procurement step	Applied to solve the problem (n,%)		
	successfully	unsuccessfully	Never applied
Always having at least two nurses to check the drug before administering to the patient. (n = 403)	**210 (52.10%)**	**110 (27.29%)**	83 (20.60%)
Having pharmacists in wards to check drug before administering to the patient. (n =417)	69 (16.55%)	28 (6.71%)	**320 (76.74%)**

5.5.1 Always having at least two nurses to check the drug before administering to the patient.

There were 210 of 403 responding hospitals successfully applying at least two nurses to check the drug before administering to the patient to solve LASA drug problems. They informed 15 drug pairs (14 unique pairs) were solved successfully. The most common drug pair solved by this method was dopamine injection and dobutamine injection, as reported by 2 hospitals.

From interview with hospital pharmacists, the techniques that nurses used to check the drug before administering to the patient were 1) preparing drug in evening shift and checking it in the night shift, and 2) two nurses checking drugs especially high-alert drugs.

There were 110 hospitals unsuccessfully applying this activity. The reasons for the failure were 1) insufficient nursing staff (31 hospitals), 2) non-fulfillment in guideline (15 hospitals), 3) inconsistent practice in given individuals (8 hospitals), 4) too much workload (6 hospitals), 5) errors by individual providers (5 hospitals), and 6) different practice among wards (4 hospitals).

There were 83 hospitals never applying this activity. The reasons for not implementing were 1) insufficient nursing staff (19 hospitals), and 2) too much workload and patients.

From interview with nurses, regardless of the existence of the guideline, some practice depended on individual providers. In addition, errors

occurred even with the required practice performed. Time constraint was also a limiting factor for completing the implemented tasks. Furthermore, some errors occurred before the step of drug administration, for example, transcribing error.

5.5.2 Having pharmacist in ward to check the drug before administering to the patient.

There were 69 of 417 responding hospitals successfully implementing having pharmacist in ward to check the drug before administering to the patient. Seven drug pairs were solved successfully with this method (Table 5.31).

Table 5.31 Examples drug pairs successfully solved by having pharmacist in ward to check the drug before administering to the patient.

Drug name 1	Drug name 2	Number of hospitals
amitriptylline 10 mg	vitamin Bcomplex	1
aspirin 300 mg	potassium chloride 500 mg	1
amoxicillin + clavulonic acid	omeprazole	1
diclofenac	dicloxacillin	1
efavirenz	lopinavir + ritronavir	1
metronidazole	metformin	1
phenytoin	clindamycin	1

There were 110 hospitals unsuccessfully applying this method. The reasons for such failure were 1) insufficient number of pharmacists (16 hospitals), 2) having no regular pharmacists resident in ward full-time, and 3) pharmacist not performing drug checking, only copying list of prescribed rugs.

There were 320 hospitals never applying this method. The reason for not having pharmacist in ward to check the drug before administering to the patient were 1) insufficient number of pharmacists (145 hospitals), and 2) never having pharmacist in wards (18 hospitals), 3) using other method e.g. checking drug from dispensing room (10 hospitals), 4) unable to allow pharmacist resident work in ward

full-time (7 hospitals), 5) dispensing drugs by one-day dose (5 hospitals), 6) perceiving that pharmacists should have other roles (4 hospitals), and 7) too much workload (3 hospitals).

In summary, there were pros and cons in the solutions to be implemented in steps of drug administration. Such pros and cons are shown in table 5.32.

Table 5.32 Pros and cons in each activity in steps of drug administration.

Activity in drug administration step	Pros	Cons
Always having at least two nurses to check the drug before administering to the patient.	Solving the LASA drug name and look-alike labeling, packaging, tablets or capsules problems	-Insufficient nursing staff -Human error -Some did not follow practice guideline.
Having pharmacists in wards to check drug before administering to the patient.	Solving the LASA drug name and look-alike labeling, packaging, tablets or capsules problems	-Insufficient number of pharmacists.

5.6 Drug monitoring

In this step, activities to solve LASA drug problems were as follows: 1) monitoring pertinence of drug use to the purposes of medical treatment, and 2) Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history.

The activity applied to solve the LASA problems successfully was verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history. If any adverse reaction, pharmacist must verify whether the drug was dispensed as prescribed (76.51%). Unsuccessful activity used to solve the LASA problems was verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history (5.81%). It was found that 53.96% of hospitals never applied the monitoring pertinence of drug use to the purposes of medical treatment. Details are shown in table 5.33.

Table 5.33 Numbers and percentages of hospitals applying activities in drug monitoring step.

Activities in drug monitoring step.	Applied to solve the problem (n,%)		
	successfully	unsuccessfully	Never applied
Monitoring pertinence of drug use to the purposes of medical treatment. (n = 404)	164 (40.59%)	22 (5.45%)	**218 (53.96%)**
Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history. (n = 413)	**316 (76.51%)**	**24 (5.81%)**	73 (17.63%)

5.6.1 Monitoring pertinence of drug use to the purposes of medical treatment.

There were 164 of 404 responding hospitals successfully applying monitoring pertinence of drug use to the purposes of medical treatment to solve LASA drug problems. They informed a total of 14 drug pairs (12 unique pairs) successfully solved. The most common drug pair successfully solved was hydralazine and hydroxyzine, as reported by 3 hospitals.

There were 22 hospitals unsuccessfully applying this activity. The reasons for the failure were 1) insufficient workforce (2 hospitals), and 2) disrupted monitoring (3 hospitals).

There were 218 hospitals never applying this activity with the reasons including 1) not having drug monitoring (19 hospitals), 2) insufficient personnel (10 hospitals), 3) being unaware of the problem (6 hospitals), and 4) checking pertinence of prescribed drugs to diagnosis before prescribing (4 hospitals).

5.6.2 Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history

There were 316 of 413 responding hospitals successfully applying Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history. They reported a total number of 15 drug pairs (14 unique pairs) successfully solved. The most common drug pair successfully solved by this method was clozapine and chlorpromazine, as reported by 2 hospitals.

From interview with hospital pharmacist number II, in monitoring adverse drug reaction, medical record was sent to dispensing room to be determined whether the causative drug was prescribed and given to the patient with allergy history. Another pharmacist (number IV) stated similar practice in his own hospital. An example of a patient taking allopurinol a long time but presented with allergy. Upon inspection, it was found that propylthiouracil was dispensed to the patient instead of allopurinol. Reviewed pharmacists stated that pharmacists should always review drug history. Physician's order and dispensed drugs should be checked. Such practice was similar among these interviewed pharmacists (number IX and XIV).

There were 24 hospitals unsuccessfully applying this activity. The reasons for the failure were 1) the patients taking drugs with allergy (3 hospitals), and 2) insufficient staff.

There were 73 hospitals never implementing this activity. The reasons for never implementing were 1) ADR not found among LASA drug problems (9 hospitals), and 2) being unable to link between LASA drug problems and ADR (5 hospitals).

From interview with hospital pharmacists, drug monitoring was not of their concern, but rather a random post-dispensing drug check by nurses or pharmacy staff. In some hospitals, monitoring activity was entirely discontinued due to time waste and insufficient staff.

In summary, there were pros and cons in the solutions to be implemented in steps of drug monitoring. Such pros and cons are shown in table 5.32.

Table 5.34 Pros and cons in each activity in steps of drug monitoring.

Activity in drug monitoring step	Pros	Cons
Monitoring pertinence of drug use to the purposes of medical treatment.	Solving the LASA drug name and look-alike labeling, packaging, tablets or capsules problems	Insufficient personnel
Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history.	Solving the LASA drug name and look-alike labeling, packaging, tablets or capsules problems	Insufficient personnel

5.7 The summary

Based on the survey, using medication management system (MMS) help solve LASA drug problems. The top 5 actions applied to solve LASA drug problems successfully included 1) separating look-alike drug name or package apart to avoid the confusion, 2) checking pertinence of prescribed drugs with physician's diagnosis, 3) dispensing with unit dose or one-day dose and having pharmacists see the physician's handwriting directly, 4) Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history, and 5) informing staff the list of LASA drug names for caution.

The top 5 actions successfully implemented to solve LASA drug problems included 1) asking for cooperation from the physicians not to use the abbreviations in prescribing, 2) avoiding ordering prescription by telephone, 3) allocating personnel to dispensing task in rush hour, 4) asking for clear writing for LASA drug names from physicians, and 5) always having at least two nurses to check the dispensed drugs before administering to the patients.

The top 5 actions never implemented to solve LASA drug problems included 1) having pharmacist in wards to check dispensed drugs before administering to the patient, 2) avoiding LASA drugs name in the hospital formulary, 3) printing drug history on prescription pad before physician prescribing, 4) considering LASA drug problems in the drug purchase at provincial or regional level, and 5) monitoring pertinence of drug use to the purposes of medical treatment.

The steps in MMS mostly likely to succeed when implementing measures to solve the LASA drug problems were 1) drug storage, followed by 2) drug preparing and dispensing, 3) drug ordering, prescribing and transcribing medication order, 4) drug monitoring, 5) medication selection and procurement, and 6) drug administration, respectively.

CHAPTER 6

SOLVING LOOK-ALIKE/SOUND-ALIKE DRUG PROBLEMS

This chapter presents information from expert panel. The expert panel consisted of 5 hospital pharmacists, 2 internal medicine physicians, 1 hospital nurse, 1 pharmacist representing the Association of Hospital Pharmacy (Thailand), 4 pharmacists representing pharmaceutical companies, 1 pharmacist representing the Bureau of Drug Control, the Food and Drug Administration and 1 professor from a pharmacy school.

The solutions to solve LASA drug problems were divided to 2 levels namely national and hospital level.

6.1 The solution to solve LASA drug problems at national level

The solutions to solve LASA drug problems at national level were further divided to 3 measures as follows:

1. Prevention of LASA drug problems at drug registration and pre-marketing phase;
2. Monitoring LASA drug problems at post-marketing phase; and
3. Developing database of drug monographs and LASA drugs problems.

6.1.1 Prevention of LASA drug problem at drug registration and pre-marketing phase

Prevention of LASA drug problems at drug registration and pre-marketing phase composed of two major stakeholders including 1) the Bureau of Drug Control, the Food and Drug Administration, and 2) the pharmaceutical companies.

6.1.1.1 The roles of the Bureau of Drug Control, the Food and Drug Administration

In the brainstorming of expert, the information about the drug registration was firstly presented to experts. Thereafter experts gave opinions on the drug registration which should be used to solve the LASA drug problems. The roles of the Bureau of Drug Control, the Food and Drug Administration to solve LASA drug problem about drug registration included the followings:

a. In drug registration process, both brand name and generic name of the submitted drug with all existing drug names should be checked to prevent duplicate or similar drug name.

b. Since drug name is considered by Thai - FDA only on the alphabet having similar sound (for example, c and z), not similar drug names. To be more effective, drug names should be considered for similar pronunciation such as hydralazine and hydrazine. In addition look-alike drug name (i.e. losec and lodoz) should be considered too.

c. In drug registration phase, there should be clear criteria for judging. A committee to establish the criteria in order to reduce the use of discretion of the Thai – FDA officers should be formed. Experts in language and pronunciation should be included in the committee to examine similar reading and pronunciation of drug names.

d. In the registration process, Thai FDA reported that since no packaging image of registered drugs are not available at the FDA, comparing package of submitted drugs to ones of the existing drugs to avoid package confusion was not possible. However, since package image of all drugs were available from every drug company, the FDA should call for all images from all companies so that the comparisons should be done conveniently. Confusion due to similar package could be prevented at the national level.

6.1.1.2 The roles of the pharmaceutical companies

From the meeting, the experts suggested the roles of the pharmaceutical companies in solving LASA drug problems as follows:

a. For their products, the pharmaceutical companies should avoid similar drug label and similar drug packaging design.

b. The design for brand name or packaging should be allowed for identity the name of drug and companies. Drug tablet and capsule originally packed in foil or blister, there should be identity that helps identify the name and company when it was taken from its foil or blister or box. This could be useful not only for the patient, but caregivers and healthcare providers as well.

c. The design of drug tablets or capsules with specific code or color could also help identify the drug product.

d. The letters or symbols on drug products and packages should allow for easy communication to the public. Language on these materials should not limit to only English since a large number of Thais do not know English.

e. Clear labeling must be used. This includes Tall-man letter, particularly for various drugs from the same company, and a given drug with many strengths from the same company.

6.1.2 Monitoring LASA drug problems at post-marketing phase

After informing the background of LASA drug problems in post-marketing phase to expert panels discussion, the experts gave their opinions on monitoring LASA drug problems in post-marketing phase. The opinions were as follows:

a. Once an incident associating with LASA problem occurred, the measure should readily in place to direct how to proceed, for example, when to invite the company exchange the information regarding the problems.

b. When LASA drug problem was detected and reported to responsible body, all stakeholders should be informed especially pharmaceutical companies with the problematic LASA drugs. In this LASA medication problem, the responsible body should be the Bureau of Drug Control of the Thai FDA.

For the issues related to the procedure of changing drug name or packaging, the Thai FDA informed that the panel that:

- At present, the Thai FDA provides call number 1566 for reporting pharmaceutical and health product problems. If pharmaceutical companies request for changing drug name, they can request a form at this One-Stop Service Center of the Thai FDA.
- The changing of color of the labels or the boxes which does not affect the text on the label can be done by the pharmaceutical companies without a request for change to the Thai FDA.

6.1.3 Developing database of drug monographs and LASA drugs problems

From the expert meeting, developing database at national level was encouraged. The database should contain two types of information:

1. The database of drug monographs
2. The database of LASA drug problems

6.1.3.1 The database of drug monographs

a. For the registration of a given drug with several strengths, the Bureau of Drug Control should have data of all existing drugs including packaging, labeling, tablet or capsule, and strength. Every strengths of the new submitted drug should not look or sound like any of all existing registered products.

b. In drug name database, one should be able to search any drug name that look or sound alike as many possible ways as possible. It should have images of products dosing unit and packages of product selection by the hospital and drug registration by the company.

c. In developing the database, cooperation from pharmaceutical companies will be needed. The Bureau of Drug Control should take responsibility on this activity to avoid accusation from the pharmaceutical company.

6.1.3.2 The database of LASA drug problems

a. It is necessary to have responsible body to collect the LASA drug problems in order to deal with the problems at national level. The policies to achieve this goal should be pushed at the Thai FDA.

b. LASA drug problems might be collected by sharing the experience from hospitals in a web board forum. This could be a place of knowledge sharing on the issue.

c. The Thai FDA, the Association of Hospital Pharmacy (Thailand) and the Community Pharmacy Association (Thailand) may jointly establish a network to report the problems in order to collect the problem from the hospitals and drugstores.

d. The database should publicize the incidence of LASA drug problems through the media to raise awareness among healthcare professionals. There has been no information of LASA incidents in Thailand. But abroad, it could be noticed in the academic journals.

The experts also gave comments on policy relating to LASA drug problems including that of the Thai FDA, policy of the Office of Permanent Secretary of the Ministry of Public Health, and policy of the National Health Security Office (NHSO), Thailand.

1. The Bureau of Drug Control, Thai FDA, should have a clear policy on solving the LASA drug problems. The critical aspect to be concerned is the channel for LASA drug problem reporting.

2. The Office of Permanent Secretary should set a clear policy about patient safety. In each year, it should provide the goal and focused point of activities related to patient safety for hospitals.

3. The LASA drug problem should be added into the drug policy of the National Health Security Office (NHSO), Thailand. It could be successful like other policies that were added to NHSO, such as adverse drug reaction monitoring, drug use evaluation, antibiotic smart use. These successful policies used pay-for-performance concept to motivate reporting.

6.2 The solution to solve LASA drug problems in hospital level

To solve LASA drug problems at hospital level, the medical management system (MMS) should be fully applied. In this present study, the questionnaire survey and interview with hospital pharmacists, physicians and nurses offered information to provide to the expert panel meeting. The experts then suggested the solution to solve LASA problem as follows:

6.2.1 Using medication selection and procurement to solve the LASA drug problems

The medication selection and procurement could be applied to solve the LASA drug problems by the system for detecting and collecting information as follows:

6.2.1.1 The LASA drug list

The hospital should have a LASA drug list and should update the list to the drug items in hospitals. PTC should consider and find the solution when many LASA drug problems are found. Furthermore, surveillance and regular review of LASA drug problem should be conducted.

6.2.1.2 The selection of drug item in hospital

In an annual update of the hospital drug list, LASA medication should be brought into consideration. If a LASA drug was not critical in the hospital formulary, it should be taken out from the formulary. However, if it is a critical drug, LASA problem might be less of concern. It might be easier to prevent or solve the problem by selecting appropriate drug package.

One cause of LASA drug problems is having to many strengths of a given drug with similar or identical package, label, tablet or capsule. The hospital should select not too many strengths of a given drugs. For tablets, different strengths should be differentiated by different colors such as the pink 5 mg warfarin tablet and the blue 2 mg warfarin tablet.

6.2.1.3 The selection of pharmaceutical company in the procurement of drugs

In a circumstance that buying a given drug with several strengths for a hospital with similar label, package, tablet or capsule from a company would lead to confusion, buying some drug strengths from other companies might alleviate the LASA problem. In doing so, having images of products from alternative companies available for viewing before placing the order would be of great benefit for the hospital.

In addition to images of the products provided by the companies, the experts recommended drug monograph to be provided from pharmaceutical company. The monograph will help the hospital not only see tablets and package of drug before buying but also input the data into computer system for future comparisons with other drugs. However, if too frequent changes in drug products purchased, it will be difficult to do so. Preventing LASA drug problem at drug procurement is suitable for purchasing drug by a deal. For bidding or E-auction, this measure will not be achieved.

In terms of the largest drug providers, GPO should be open for notification on LASA medication problems. As a governmental organization, GPO should take into account the LASA problems seriously. Changing products looks and patterns should be welcome by the GPO than other companies. If problems are not responded by the GPO, the solution is not buying drugs from GPO and using record of problem certified by the PTC. Chief parcel of the hospital will be responsible.

Most of drugs used in hospital are forced by rule to purchase from GPO. So if the hospital did not purchase drugs with LASA problems from GPO, the purchase will be considered breaking the rule, and cannot be done although using the PTC body.

6.2.1.4 Considering LASA drug problems in the drug purchasing at provincial or regional level

Bringing the problem of similarity of labeling, packaging, tablets and capsules into consideration in the drug purchasing at provincial or regional level

should be conducted. It might help reduce LASA drug problem from similar labeling, packaging, capsules, and tablets. If "Preventing LASA drug" was added to be one of the criteria in drug purchasing at provincial or regional level, specification of drug in this criterion should cover drugs from at least 3 companies.

6.2.1.5 Informing the pharmaceutical companies about LASA drug problems of their own product and packaging

When the hospitals found the LASA drug problems of labeling, packaging, tablet or capsule, the hospitals should notify the company by informing pharmaceutical representatives, or reporting directly to the company. Working this as a group of pharmacists might pressure and push the drug company to respond to LASA drug problem better than individual pharmacist's pursuit. An example of an successful effort was a northern pharmacist group requesting one company to change the foil of enalapril 5 mg and 20 mg tablets of which finally the company changed the color printed on foil of 20 mg tablet. Furthermore, it was recommended that pharmacists in a province/region should collect LASA drug problem as a network and altogether report these problems to the pharmaceutical companies. After companies have investigated the problems, whether to resolve the problems or not, they should inform the hospitals about the decision.

The Thai FDA should decimate the criteria to the hospitals. With this, the hospitals could be able to negotiate or inform the manufacturer/distributor to modify packaging of products with LASA drug problems.

6.2.2 Using drug storage to solve the LASA drug problems

At drug storage step, to solve the LASA drug problems in hospitals, information system to detect and collect LASA drug problems is necessary. The activity could be applied as follows:

6.2.2.1 Separating the look-alike drug apart to avoid confusion

In many hospitals, the drugs are sorted by pharmacology drug group or alphabetically drug name. If there were drugs which look-alike labeling or neighboring packaging placed or the pre-pack of drug tablets or capsules are similar

and might be causing drugs errors. Separating dugs apart to avoid confusion should be performed.

6.2.2.2 Making remarkable symbols for the LASA drugs

Making remarkable symbols or using different color of the label of LASA drugs might be useful to the staff. Making the symbol should have enough space of each unit. When some problems are resolved, these symbols should be removed since LASA drug problem are always dynamically ever-changing.

6.2.2.3 Informing the list of LASA drug names to all staff

The staff should be informed about LASA drug pairs in order to understand and aware of the problem from making drug error. Motivation of this awareness should be done periodically.

6.2.3 Using drug ordering, prescribing and transcribing medication orders to solve the LASA drug problems

The drug ordering, prescribing and transcribing medication orders was applied to solve the LASA drug problems by using computerized system and requiring cooperation from physicians. A clear policy on writing prescription for physician should include many aspects as follows:

6.2.3.1 The orientation to new physicians how to write good prescription

The pharmacists should participate in an orientation to new physicians on how to write a good prescription. Showing the incidence of LASA drug problems and disagreeable abbreviations in prescribing should be demonstrated.

6.2.3.2 The certain policy about ordering drugs of physicians with a clear prescription

The certain policy about prescribing should be disseminated at national level from the Ministry of Public Health to all hospitals, especially to public

hospitals. The policy should include abbreviation of drug, defining strength of drug and diagnosis showing for prescribing and dispensing. Moreover, the computerized system should be used in prescribing drugs with the medication reconciliation helping in prescribing process.

6.2.3.3 The cooperation from physicians to write a unmistakable prescription

The physicians should not prescribe drugs with abbreviations and had to write drug strength of every drug item with readable handwriting. If physicians could not respond to these requirements, pharmacists should return their prescription routinely.

If the diagnosis is provided in the prescription, pharmacists should learn to understand the physician's diagnosis.

6.2.3.4 Using computer system to prescribe drugs

The computerized system should be used to prescribe drugs to solve problems associating with poor physician handwriting, prescribing drug with the brand name, not writing drug strength, and unclear drug use and dosing. It might be better to make a warning alert to the physician to be careful about LASA drug pairs via the computerized system when prescribing drug.

Drug names causing LASA drug problem should be communicated with Tall-man letter, color text or remarkable symbol, to be easily observed in order to protect physicians selecting wrong drugs. If there is no limitation of the computerized system, name of a drug which looks like others may be shown with both its generic and brand names. Moreover, if the physicians prescribe drugs via computer, they should print prescription in order to recheck and sign their name.

If the hospitals do not yet implement prescribing drug via computerized system, patient history should be printed on prescription pad to reduce the handwriting problem, using abbreviations and not defining the drug strength. On

the other hand, the physicians may not review medical records repeatedly because they do believed in the printed history of patient's drugs.

6.2.3.5 Prescription is not ordered by telephone

Physicians should avoid prescribing by telephone. But if there is an urgent medical need to order by the telephone, physicians should sign their order as soon as possible. It was necessary to set certain rules for practicing. The high-alert drugs should not be prescribed by telephone.

6.2.3.6 The doctor's order sheet is sent to dispensing room and dispensing with unit dose or one-day dose

If the doctor's order sheet is sent to dispensing room by copy or fax, pharmacists could see physician handwriting and reduce transcribing error by ward nurses. It is the mutual authentication between pharmacists and nurses to prevent medication errors to patients.

6.2.4 Using drug preparing and dispensing to solve the LASA drug problems

Solving LASA drug problems by using computerized system and information system could be applied at drug preparing and dispensing step as follows:

6.2.4.1 Making dissimilarity of LASA drug name in computerized database and on printed drug label

The LASA drug names could be made dissimilar in the computerized database and printed drug label by using Tall-man letter, showing both generic name and brand name, adding symbol, separating syllables of drug name apart, etc.

a. Tall-man letter

Tall-man letter should be used in computerized database and printed drug labels. The standard guideline to write Tall-man letters should be set as the standard of Thailand. This may be firstly guided by the formats in the Drug

Information Handbook. The Tall-man letter style must be used with a certain drug pairs, not to be applied to every pairs. It may be started with a drug pair which could not be solved effectively for LASA problem by other methods or activities. Since some pharmacists did not know “Tall-man letter”, so this issue should be taught in pharmacy school and hospital pharmacists should seek more knowledge by themselves.

b. Using both generic name and brand name

The LASA drug names in computerized database and printed drug label could be presented or printed with both generic name and brand name. If space in computerized database or on printed label had no limit, using both generic name and brand name would greatly reduce drug name confusion. The format of the two-names arrangement could be generic name followed by brand name with bracket.

c. Other techniques to create clear drug name in computerized database and printed label

Other techniques have been used to reduce drug name confusion such as separating syllables, changing item name by initializing with strength or dosage form instead of initializing with generic name as usual. Moreover the symbols are filled in front of or after drug name such as *, #, @, etc. These actions would reduce errors in reading the drug names, preparing and dispensing the drug.

Printing the word “LASA” on the drug labels could help identifying drug pair with LASA problem and reminding the pharmacists who check the drugs.

6.2.4.2 Reading diagnosis or asking Prime question before dispensing drugs to patient

If diagnosis is provided in the prescription, pharmacists should learn to understand the physician's diagnosis. Pharmacists sometimes do not understand physician written diagnosis either in full or abbreviated words. Creating the names of shunned diseases to use in hospital might be a better way to protect the patient's confidentiality. In addition, in standard practice before dispensing, pharmacists must ask patient by prime questions to know the symptoms that brought the patient to the hospital.

Knowing diagnosis would be difficult to be encouraged, national policy could put it into practice within hospitals.

6.2.4.3 Allocation of adequate personnel to reduce the pressure and stress of the operation in rush hour

Adequately allocating pharmacy staff in each period of day might help the pharmacy service unit in rush hour. Fatigue on the body and brain of staff might be reduced by rotating a person to work in a certain period. Adding a staff member to help working in a rush hour might be fit too. The medication error data should be collected during each period in order to obtain all necessary information for managing staff to prevent LASA problem from fatigue and stress.

6.2.4.4 Informing LASA drug problems to healthcare personnel

The activities to inform the staff in pharmacy department and other agencies (physicians and nurses) to know about the LASA drug problems in hospital were done by using notice board or circulating letter. A list of LASA drugs including images of drug package, label, tablet and capsule could be useful. Demonstration of LASA drug pairs on a notice board for the staff or other techniques should be performed to notify the LASA drug problems to all healthcare personnel.

6.2.5 Using drug administration to solve the LASA drug problems

In drug administration step, we could apply two activities to solve the LASA drug problems as follows:

6.2.5.1 Always checking drug before administering to the patient by at least two nurses

There is a nurse's procedure for the drugs administration to the patient and nurse supervisors should be strict on this. If a nurse double-checks drugs by her own, it may allow for high chance of errors. Furthermore, exhaustion from working with nonstop shifts with inadequate rest could lead to the nurse making mistakes more easily during their work on ward. So checking drug before administering to the patient by at least two nurses must be mandated. In addition, the pharmacist should regularly inform any change of the drugs and appearance of the drugs in hospital to ward nurses.

6.2.5.2 Having pharmacist at ward to check drug before administering to the patient

If there is sufficient number of pharmacists to practice at ward, a ward pharmacist should help checking medications for the patient to prevent drug administration errors.

6.2.6 Using drug monitoring to solve the LASA drug problems

The drug monitoring step was applied to solve the LASA drug problems by information system as follows:

6.2.6.1 Monitoring pertinence of prescribed drugs to the purposes of medical treatment

The pharmacist or nurses visiting the patient home, they should check the drugs whether they are right and suitable for the disease. For the inpatient care unit, the pharmacists and nurses should monitor the signs and symptoms of patient after taking drugs too.

6.2.6.2 Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history

In monitoring adverse drug reactions or drug allergy, pharmacist should check drugs the patient takes if it was the intended or prescribed drugs. The problems of product identity are also of concern for pharmacists.

6.3 The summary

The MMS are used to solve the LASA drug problems in hospital level with several techniques. The summary is shown in table 6.1.

Table 6.1 Summary of medication management systems help to solve the LASA drug problems in hospital level

Steps in MMS	The actions	Look-alike drug name	Sound-alike drug name	Look-alike packaging, tablet or capsule
Medication selection and procurement	The LASA drug list	✓	✓	✓
	The selection of drug items in hospital	✓	✓	
	The selection of pharmaceutical company for procurement of drug	✓	✓	✓
	Considering LASA drug problems in the drug purchasing at provincial or regional level	✓	✓	✓
	Informing the pharmaceutical companies about LASA drug problems of their own product and packaging	✓	✓	✓

Table 6.1 Summary of medication management systems help to solve the LASA drug problems in hospital level (continued).

Steps in MMS	The actions	Look-alike drug name	Sound-alike drug name	Look-alike packaging, tablet or capsule
Drug storage	Separating the look-alike drug apart to avoid confusion	✓		✓
	Making symbols as observation point for the LASA drug	✓		✓
	Notifying of the list of LASA drug name to officer	✓	✓	✓
Drug ordering and prescribing including transcribing medication orders	The orientation to new physician how to write good prescription	✓		
	The clear policy about ordering drugs of physicians with a clear prescription	✓		
	The cooperation from physicians to write a clear prescription	✓		
	The computer system is used to prescribe drugs	✓	✓	
	Prescription is not order by telephone		✓	
	The doctor's order sheet is sent to dispensing room	✓		

Table 6.1 Summary of medication management systems help to solve the LASA drug problems in hospital level (continued).

Steps in MMS	The actions	Look-alike drug name	Sound-alike drug name	Look-alike packaging, tablet or capsule
Drug preparing and dispensing	Using the LASA drug name in computer database and on printed label to see differently	✓		
	Reading diagnosis or asking prime question before dispensing drugs to patient	✓		
	The human resource management to reduce the pressure and stress in rush hour	✓		✓
	The activities or informing the news to healthcare personal to know about the LASA drug problems	✓	✓	✓
Drug administration	Having at least two nurses who checking the drug before administered to the patients at all time	✓	✓	✓
	There is a pharmacist at ward in order to check drug before administered to the patients	✓	✓	✓
Drug monitoring	Monitoring pertinence of prescribed drugs to the purpose of medical treatment	✓	✓	✓
	Verifying the actual dispensed drugs if any allergy occurrence in patients with no allergy history	✓	✓	✓

CHAPTER 7

CASE STUDIES OF SOLVING LOOK-ALIKE/SOUND-ALIKE DRUG PROBLEMS

This chapter shows the results of case studies of solving look-alike/sound-alike (LASA) drug problems in three public hospitals. The objective of this phase was to study processes and methods of solving LASA drug problems in three public hospitals using medication management system (MMS). The activities in MMS used to solve the LASA problems in three hospitals particularly focused on drug storage and drug preparing and dispensing steps. The reasons for focusing on these two steps were information received from questionnaire survey and interviews demonstrating that solving LASA drug problem in many hospitals could be successfully achieved in drug storage and drug preparing and dispensing step (about 50%).

Three hospitals were purposively selected to be the case studies as follows: 1) a community hospital in Petchaburi province; 2) a community hospital in Nakhon Pathom province; and 3) a general hospital in Ratchaburi province. All hospitals were under the Office of Permanent Secretary of the Ministry of Public Health. Head of pharmacy department of all three hospitals were willing to be case studies.

7.1 Case study I: a community hospital in Petchaburi province

The data of this hospital was collected between 2nd February and 22nd May 2012. This hospital had 30 beds. There were 313 items of drug available in this hospital. There were 4 pharmacists, 4 pharmacy assistants, and 4 general assistants, working under the pharmacy department. There are about 180 outpatient prescriptions and 30 inpatient prescriptions per day.

In monitoring medication errors in this hospital, they include LASA drug problems in medication errors detection system. Data of medication errors were collected by manually separating drug prescriptions with errors identified. The head of pharmacy department entered medication errors data into a computerized system. Unfortunately, data in computerized system could not be retrieved for causes of each error.

Solving LASA drug problems in this hospital is performed in drug storage and drug preparing and dispensing steps as follows:

1. The first action used was separating look-alike drugs apart to avoid preparing wrong drugs.

2. Using different color of the label of LASA drugs helped distinguish them from general drugs. Pink labels were used for LASA drug while yellow labels were used for general drugs (figure 7.1)

Figure 7.1 Using pink color label instead of yellow label for drug with similar name

3. The Tall-man letter fonts had been used successfully at the beginning, but over a long period, the success could not maintain, for example, diclofenac and dicloxacillin. Finally, they shortened the name diclofenac into “Fenac.” (see also figure 7.2).

Figure 7.2 Changing name diclofenac to Fenac and using pink paper to make label.

4. Changing generic name to brand name, for example, for a pair of "hydroxyzine and hyoscine", hyoscine was changed to Buscopan®, and a pair of "simvastatin and simethicone" pf which simethicone was changed to Air-X®. They also used different color of drug label on the shelf. (see figure 7.3).

Figure 7.3 The name hyoscine was changed to Buscopan® in order to avoid a similar name of hydroxyzine.

5. For the senior staff members with impaired eyesight, they have made errors when preparing drug more often than their younger fellow staff members. This problem was solved by allocating the person to a less visually demanding job, for example, placing prescription label stickers on the plastic prescription bags.

6. During data collection, they found a problem of confusion between salbutamol 2 mg tablet and furosemide 40 mg tablet. Since the two drugs were pre-packed in the brown color zipper bag, the workers often confused one with another. Errors occurred with both drugs where pre-packed “salbutamol” was mistakenly picked for “furosemide” and vice versa. In solving the problem, the labels of ‘salbutamol” was changed to “salbutamol (Ventolin®) and “furosemide” to “furosemide (Lasix®).” This seemed to prevent errors in preparing drug step.

7. Another episode of error was that second year pharmacy students who were trained in preparing prescribed drug had made error of preparing cinnarizine instead of the prescribed cetirizine. The error was caught by fourth year pharmacy students in the screening step before dispensing to the patient.

8. Two other drug pair errors found during data collection were losartan and lorazepam (drug name confusion), and calcium carbonate 1,000 mg (GPO) and mefenemic acid 500 mg (Community Pharmacy), with similar yellow tablets (see also figure 7.4). These two problems were solved by informing these errors to all staffs during working, not individually informing.

Figure 7.4 Calcium carbonate (GPO) and mefenamic acid (Community Pharmacy)

9. A fourth year apprentice pharmacy student found the prescribed serratiopeptidase tablet was wrongly prepared with prazosin (figure 7.5). It was found that the error was attributable to the blister packs with similar size and color, and tablets with similar color and size. After investigating this problem, the cause of the problem was however from returning a drug to the wrong box. They informed that

when picking drugs from the shelf, the staff, and in this case, pharmacy students, often look only at the tablets, but did not read the drug name on the box.

Figure 7.5 Blister packs of serratiopeptidase and prazosin tablets.

From the discussion with pharmacists and all pharmacy staff, most problems in preparing drug were due to missed matching. When the staff read one drug name, they may recall the image of a look-alike drug and pick it accordingly. During our observation, problems frequently found were associated with preparing the right generic drug with wrong strength.

In summary, this hospital used several techniques to solve LASA problems. These included printing drug name paper with different colors to put on the drug box, using brand name instead of generic name, changing job for staff members with poor eyesight, and adding brand name on to the generic name in the label. During data collection, a total number of four drug pairs of LASA problems were found. These included 1) cinnarizine and cetirizine (look-alike/sound-alike generic name), 2) losartan and lorazepam (look-alike/sound-alike generic name), 3) cacium carbonaote and mefenamic acid (look-alike tablet) and 4) serratiopeptidase and prazocin (look-alike tablet).

7.2 Case study II: A community hospital in Nakhon Pathom province

The data of this hospital were collected between 26th January and 31rd May 2012. This hospital had 60 beds. There were 346 drug items available. There were 4 pharmacists, 2 pharmacy assistants, and 1 general assistant. There were 4 persons (3 pharmacists, 1 pharmacy assistant) working in dispensing unit under the pharmacy department. There were about 240 outpatient and 50 inpatient prescriptions per day.

During observation, a LASA drug list was compiled by pharmacists and staff in the pharmacy department. They finalized a list of LASA drugs then announced to all pharmacy staff to aware in drug preparing (figure 7.6).

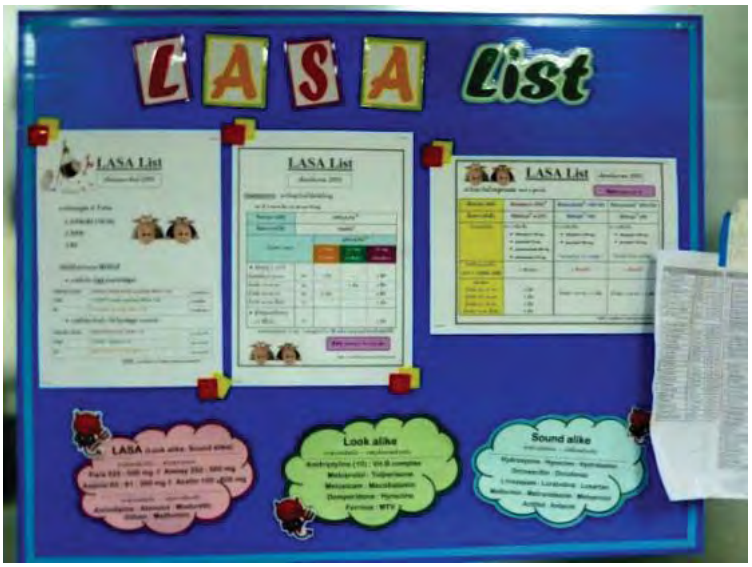


Figure 7.6 LASA drug list

There was also a demonstration display about similar drugs in pharmacy department that were easy to see by the staff to prevent preparing drug error (figure 7.7).

Figure 7.7 Demonstration of similar drugs displayed in in pharmacy department.

In data collection, pharmacists and staff members retrieved six-months retrospective LASA drug problems from the log book for the researcher. However, this information was out-dated since some drugs had been changed in their appearances including package, capsule or tablet. To help the researcher obtain more present data on errors, pharmacists and staff members prospectively collected new LASA drug problems in the next two weeks (6nd – 20th February 2012). Three LASA problems found were as follows:

1. Methydopa and Madopar® (look-alike generic name and brand name) (figure 7.8).

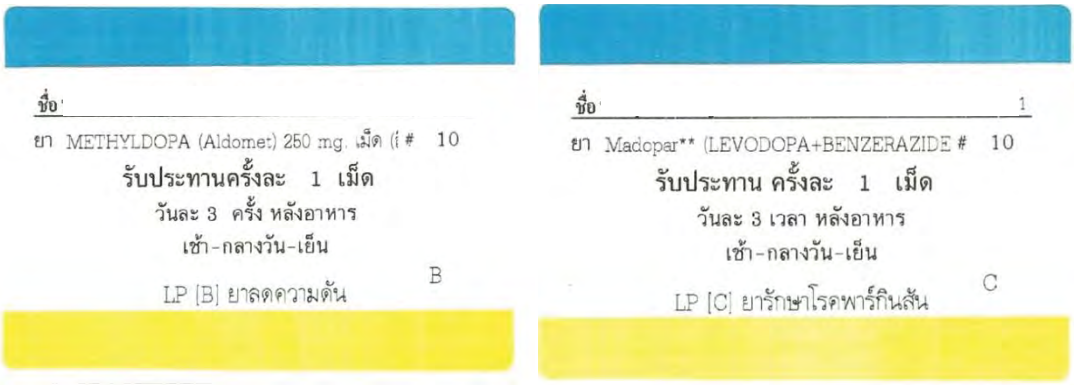


Figure 7.8 Look-alike labels of methydopa and Madopar® printed from the computer.

This problem was solved by changing drug brand name Madopar® to LEVODOPA+BENSERAZIDE on the label and in computer database (figure 7.9).). After this change, the problem of this drug pair had not been found.

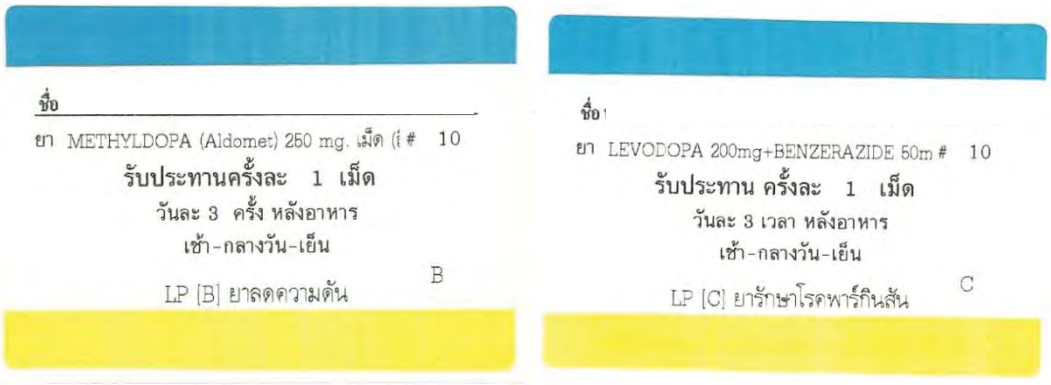


Figure 7.9 Changing drug brand name Madopar® to LEVODOPA+BENSERAZIDE.

2. amlodipine and hydrochlorothiazide (HCTZ) (similar pre-packed brown zipper bag with unclear label on pre-packed box) (figure 7.10).

Figure 7.10 Pre-packed amlodipine and hydrochlorothiazide (HCTZ) tablets.

To solve a problem of amlodipine and HCTZ confusion, they applied 2 actions. Firstly, they separated the pre-packed boxes of these two drugs apart, but later it was found ineffective. As a consequence, they made a noticeable drug label

on pre-packed boxes and encouraged the staff to repeat reading drug name when picking the drugs (figure 7.11 and 7.12).). After this change, the problem of this drug pair had not been found.

Figure 7.11 Old labels on the boxes of of pre-packed amlodipine and hydrochlorothiazide tablets.

Figure 7.12 New labels on the boxes of pre-packed amlodipine and hydrochlorothiazide tablets.

3. amlodipine and atenolol with look-alike generic name in similar pre-packed brown zipper bag was found. With 1 error episode as a dispensing error, pharmacist urgently visited the patient's home and averted the risk of such error by giving the right drug (figure 7.13).

Figure 7.13 Pre-packed bags of of atenolol and amlodipine tablets.

In an attempt to prevent repeating error, they solved this problem by using tall-man letter with symbols on the label, i.e., “AMLodipine**5**mg” and “ATenolol 50 mg” (figure 7.14).). After this change, the problem of this drug pair had not been found.

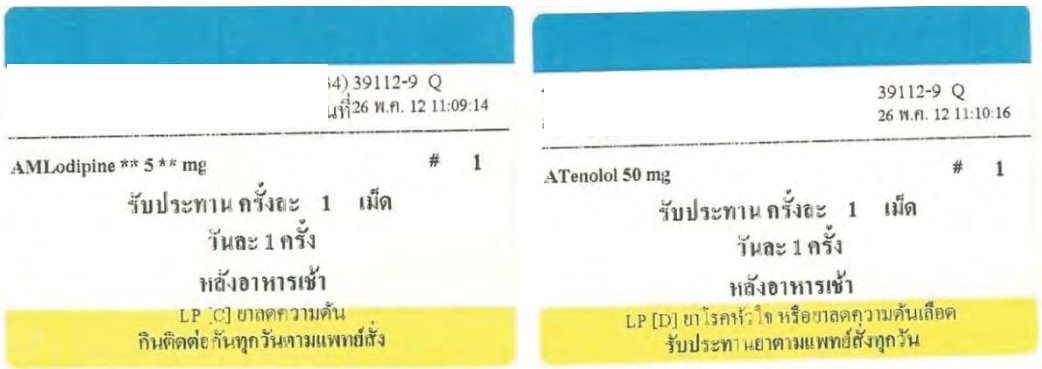


Figure 7.14 New labels of amlodipine and atenolol tablets from computer printing.

In summary, this hospital used several techniques to solve LASA problems. These included using generic name instead of brand name, changing labelt of pre-pack box to clear, using Tall man letter to print drug name, and using symbol in the printed label.

7.3 Case study III: A general hospital in Ratchaburi province

The data collection in this hospital was conducted between 19th January and 31rd May 2012. This hospital had 300 beds and 592 drug items available. There were 28 staff members working in dispensing pharmacy service. Dispensing room was divided into services for outpatient department (OPD) and inpatient department (IPD). For OPD service, there were 5 pharmacists, 3 pharmacy assistants, and 7 general assistants; while 6 pharmacists, 2 pharmacy assistants and 5 general assistants were serving IPD patients. There were about 500 outpatient prescriptions and 300 inpatient prescriptions per day.

The medication errors in this hospital were detected and recorded in record form during pharmacist checking drugs. But they usually forgot to record the incidents during the rush hour. Later, they noted medication errors on the copy of drug item lists of each prescription during pharmacist drug checking. All noted medication error incidents were recorded to computer system later. Lately the hospital began Pay-for-Performance (P4P) system. Pharmacy staff members preparing drugs would also collect the copy of drug items to file for their own workloads. Finally, pharmacists had to note in small note papers then enter such data into the computer system. Since some pharmacists may not record or forget to record, medication errors were still under-reported.

This hospital provided information of medication errors for the researcher to study LASA drug problems. The researcher and a hospital pharmacist together solved drug pair problems which were found in retrospective data of October 2011 to December 2011. Four drug pairs of LASA were selected to be solved:

1. folic acid and vitamin Bcomplex and multivitamin (LASA three drugs)

The problem of folic acid and vitamin B complex tablets were due to similar yellow color, similar size and pre-packed in brown zipper bag. It had been confusing in picking the two drugs. Multivitamin tablet was also pre-packed in brown zipper bag like vitamin B complex tablet. Among the 3 drugs, one was often wrongly picked for another. The pre-packed boxes of these 3 drugs were already separated apart, but errors were still repeated.

In correcting the errors, labels on the pre-packed boxes were planned to offer a warning sign to the staff. However, during April - May 2012, the service pharmacy planned to renovate a dispensing room both for OPD and IPD services. Pharmacists and other staff members all agreed that new drug shelves should be finished first and LASA drug problems could be solved later. But during that time, they found that medication errors of folic acid and vitamin B complex decreased. This might due to the fact that folic acid tablet was purchased from another pharmaceutical company. The tablet of this new folic acid tablet was much smaller than that of vitamin B complex. This helped differentiating one from another.

2. Xanax® and Ativan® (confusing drug name).

The staffs were often confused when they prepared Xanax® and Ativan® drugs. This was complicated by the confusing generic names of the two drugs (alprazolam and lorazepam). This problem was solved by using the Tall-man letter and bracket with their brand name or generic name of the drug on drug labels, i.e., “XANAX-ALPRAZOLAM” and “loraZePAM (Ativan).”

After this changing, some pharmacists commented that loraZePAM (Ativan) may cause medication error between lorazepam and loratadine. This could have caused more harm than medication error between Xanax® VS Ativan®. So, they changed the name of drug back to the previous label, i.e., ALPRAZOLAM and LORAZEPAM.

3. diltiazem 30 mg and Isordil®30 mg (look-alike foil)

The problem of this drug pair was due to similar blister leading to dispensing error. The blisters of these drugs are in figure 7.15. This problem had been solved by separating two drugs apart, but medication errors remained. The action taken was changing the name of the drug in computer database by initializing with the drug strength instead of drug name, i.e., 30 mg Isodil® and diltiazem 30 mg (figure 7.16). After this change, the problem of this drug pair had not been found.

Figure 7.15 Blister packs of of diltiazem 30 mg and isosorbide dinitrate 30 mg tablets.

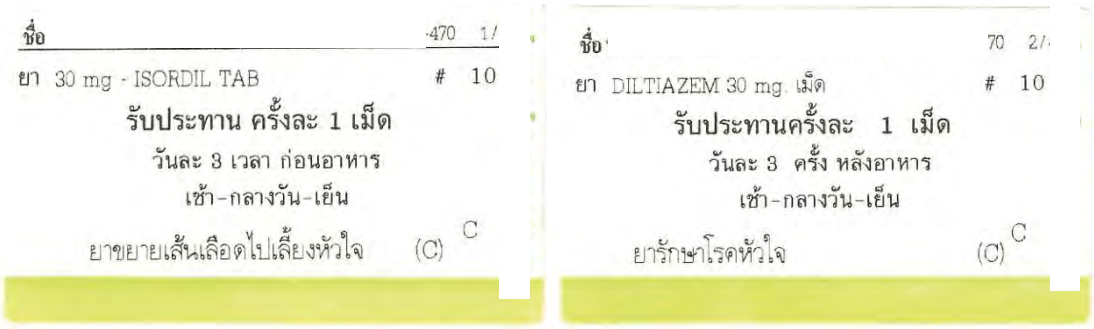


Figure 7.16 Change of the name of Isodil® on printed label.

4. Motilium® and Mydocalm® (look-alike brand name).

This drug pair problem was found frequently with look-alike drug names. The problem was solved by using tall- man letter, using brand name and bracket with their generic name, and using generic name and bracket with their brand name on label. For example, “MOtilium (DOMPERIDONE)” and “TOLPERISONE (MYDocalm).” (see also figure 7.17) After the action, errors of this drug pair had not been found.

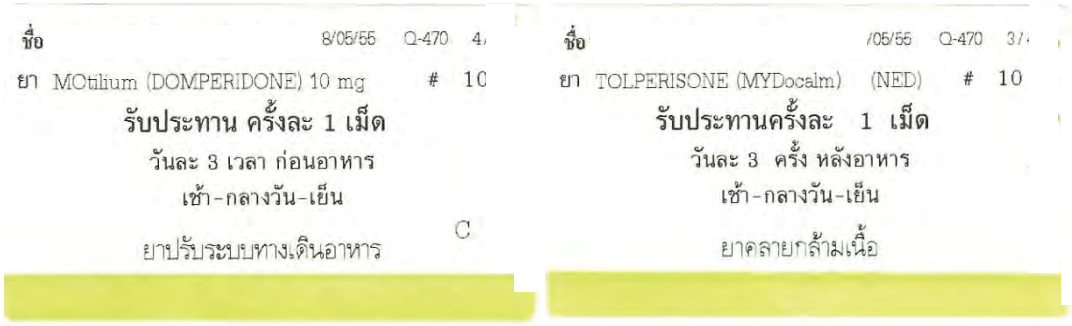


Figure 7.17 Printed labels of tolperisone and domperidone tablets.

In summary, this hospital used several techniques to solve LASA problems. These included initializing with the drug strength instead of drug name, using Tall man letter to print drug name, and bracket with their generic name, and using generic name and bracket with their brand name on label.

7.4 The summary

From three these case studies, it was found that there were different techniques to solve LASA problems in each hospital due to different contexts, working system, location and human factors. But LASA drug problems are ever-changing, so an effective monitoring system in each hospital may be a key success factor. The summary solution showed in table 7.1

Table 7.1 The activities in three hospitals used to solve the LASA drug problems.

The actions to solve the LASA drug problems	the community hospital in Petchaburi province	the community hospital in Nakhon Pathom province	the general hospital in Ratchaburi province
Changing the pharmaceutical company to buy drugs			The tablet of folic acid was smaller to reduce confusion with vitamin Bcomplex.
Drug labeling on the drug shelves is clear.	Changing the label at box of “salbutamol” and “furosemide” to “salbutamol (Ventolin®) and “furosemide (Lasix®) to reduce confusion of pre-pack.	Writing label of pre-pack box pre-pack of amlodipine and HCTZ to clear up.	
	Using different color of the label of LASA drugs help to distinguish from general drugs		
Using brand names instead of generic name when look-alike drug name.	hyoscine→ Buscopan® diclofenac → Fenac®		
Using generic name on the label.	Inderal® → propranolol	Madopa® → LEVODOPA+ BENSERAZIDE	
Using Tallman letter		atenolol 50 mg and amlodipine 5 mg changed to ATenolol 50 mg and AMLodipine**5**mg	Mydocalm and Motilium changed to TOLPERISONE (MYDocalm) and MOtilium (DOMPERIDONE)

Table 7.1 The activities in three hospitals used to solve the LASA drug problems. (continued).

The actions to solve the LASA drug problems	the community hospital in Petchaburi province	the community hospital in Nakhon Pathom province	the general hospital in Ratchaburi province
Using generic name and brand name on the label			Mydocalm and Motilium change to TOLPERISONE (MYDocalm) and MOtilium (DOMPERIDONE)
Initializing with the drug strength instead drug name			diltiazem 30 mg and Isodil 30 mg changed to Diltiazem 30 mg and 30 mg Isodil
Informing the errors to all staffs during work, provided not individually.	When finding wrong drug prepared, pharmacists will notify the staff immediately.		
Changing jobs to staffs.	Changing the job of staffs under state of health.		

CHAPTER 8
CONCLUSIONS, DISCUSSIONS AND RECOMMENDATIONS

This chapter contains conclusions, discussions, recommendations and limitations of this thesis. The research conducted in three phases: 1) **phase I** was to study look-alike/sound-alike (LASA) drug situation in public hospital including pairs and types of LASA medications with safety measures the hospitals had implemented to solve such problems. Recognition on national medication safety policy was also determined, 2) **phase II** was selecting LASA medication errors with specific safety measures obtained from phase I presented to the panel of experts to gain more insight and information necessary for proposing a national guideline to solve LASA medication error problem for all levels in Thai healthcare system, and 3) **phase III** was an observational study conducted to gain more information on problems during real time pharmacy practice in 3 selected hospitals as cases for study.

8.1 Conclusion

Most hospitals recognized medication safety policy through Thai National Patient Safety policy and implemented such policy to prevent medication errors from LASA drugs, HAD and severe ADR and repeated drug allergy. Medication errors attributable to LASA drug names with several drug pairs were found. The reported LASA drug pairs, generic drug name LASA errors were the most frequently reported type of LASA drug problems. The steps in MMS mostly likely to succeed when implementing measures to solve the LASA drug problems were 1) drug storage, followed by 2) drug preparing and dispensing, 3) drug ordering, prescribing and transcribing medication order, 4) drug monitoring, 5) medication selection and procurement, and 6) drug administration, respectively. The solutions to solve LASA drug problems at national level were further divided to 3 measures as follows: 1) prevention of LASA drug problems at drug registration and pre-marketing

phase; 2) monitoring LASA drug problems at post-marketing phase; and 3) developing database of drug monographs and LASA drugs problems. Solving LASA drug problems in national level, if possible, can help prevent problems before the LASA drugs reach a hospital.

8.2 Discussions

8.2.1 The recognition on the national medication safety policy

In this survey on the recognition on national patient safety policy and look-alike/sound-alike medication errors among public hospitals, we found that the national policy was recognized by most hospitals (88.52%), expectedly through the National Patient Safety Goal 2007 – 2008 announcement. This recognition rate seems acceptable; however, since the announcement was carried out by an authoritative agent, a 100% recognition rate should be aimed for an effective implementation. As the matter of fact, in September 2009, the Ministry of Public Health announced the National Patient Safety Goal 2007 – 2008 policy to all public hospitals, specifically to the pharmacy department head to inform their staff to execute accordingly. Thus this disparity on policy recognition might have happened from a lack of communication among healthcare providers in the hospital especially in the pharmacy department, and neither official request for performance report nor systematic performance assessment tools by the Ministry of Public Health. Thus there is a room for improvement for an effective means in communication both at national and local setting levels. Staff pharmacists should be able to learn such policy from their department head through the department meeting or information circulation. An official measure for hospital performance evaluation should be initiated from the Ministry of Public Health.

With 76.62% of the hospitals having implemented the safety measures, this however indicates a relatively high awareness on patient safety among public hospitals and their active role in such a burdensome responsibility. The measures which most hospitals already implemented were for detection and prevention of errors associating with HADs, followed by LASA medications and severe ADR and repeated drug allergy, respectively. The possible reason for HAD related errors preventive measure to be

the most implemented policy was that it had been introduced more than 6 years along with the nation-wide trend of hospital accreditations[77]. With its narrow range of list of suspect drugs and clear detection and prevention measures, safety policy on HAD related errors have been widely implemented.

Given the safety measure on HAD related errors to be the most implemented policy, it was reported that LASA medications were the number-one troublesome cause of medication errors by most hospitals (82.46%). This could be attributable to the fact that LASA errors could happen among almost all drug items while HAD errors were limited to a smaller number of high-risk drugs. This discrepancy on perceived priority of problem between LASA and HAD errors, as expected, was large since the majority of responding hospitals were community hospitals where an even fewer number of HADs are included in their hospital formulary. Regarding severe ADR and repeated drug allergy measure, it was found the least among the three policies. This might be in part because we aimed specifically at those severe in nature and those with repeated incidents, not general ones which have long been recognized and continuously reported by almost all public hospitals to the Food and Drug Administration, the Ministry of Public Health, for more than 20 years[78]. In short, all of the perceptions found in our study is in accordance with the statement *"the existence of confusing drug names is one of the most common causes of medication error and is of concern worldwide"* endorsed by WHO and JCAHO[58].

8.2.2 The situation of LASA drug problem in public hospitals

In terms of LASA drug problems, we found various drug pairs from 476 public hospitals, while 3 hospitals did not report LASA drug pairs. The least number of drug pair reported from hospitals was 1 drug pair and the highest number of drug pair was 59 drug pairs. From the total drug pairs, it was found that 40.24% were the unique drug pairs. This means that several public hospitals found common specific problem, especially generic drug name LASA problems as the most frequently reported type of problems with the largest reduction of number of all pairs to unique pairs. Several drug name pairs reported were similar to those reported in other

countries. Some drug pairs had been reported for medication error and harm in patient such as Lasix® and Losec®, Aldactone® and Aldomet®, Norflex® and norfloxacin, hydroxyzine and hydralazine, and lorazepam and loratadine [25, 54, 73]. Some drug pairs had not been reported as medication error in other countries such as Ventolin® and Voltaren®, Prenolol® and propranolol, diclofenac and dicloxacillin, etc. The drug name pairs had been reported in other counties with LASA brand names. Some brand names were originally brand names that have been routinely used, while some drug names were of those locally made brand name products.

The look-alike packaging could be found in various forms of containers including ampoule and vial for injectable drug, bottles for tablets or liquid drug, and pill box, foil or blister for tablets or capsules. The look-alike tablets or capsules were more likely to be from given drug with different strengths, although different drug could also have look-alike tablet or capsule. These problems must be found in the drug from the same company more than different companies because the company concept of making a given drug with different strengths look similar for the product identity purpose.

8.2.3 Solving LASA drug problems in hospital and national level

Form the mail questionnaire, in-person interviews, and experts brainstorming, information for solving the LASA drug problem in hospital and national level was obtained. To solve the problem, the risk management could be applied to identify, assess the problem and select a solution.

8.2.3.1 The roles of risk management in solving LASA drug problem

Risk management has been defined as "*the process of making and carrying out decisions that will minimize the adverse effects of accidental lasses upon an organization*"[70]. In health care, the principles of risk management are applied to protect the safety and welfare of patient, visitors and staff. To prevent or minimize the effects of loss, risk are identified, analyzed, treated, evaluated, and communicated.

In LASA error context, risk management process that could be applied to solve LASA drug problem are as follows. (see also figure 8.1).

1. Established context

To begin solving LASA drug problems, pharmacists should know the context of their hospital. Aspects of the hospital context include policy of the director of the hospital, the cooperation of all healthcare personnel in hospital, supporting equipment and budget, and number of personal in the hospital.

2. Identify Risks

The LASA drug problems in hospital should be collected by recording the medication errors (prescribing error, transcription error, dispensing error, and administration error). LASA drug problems should be selected from their medication error records in order to identify type of LASA drug problems (LASA drug names or look-alike labeling, packaging, tablet or capsule).

3. Analyze Risks

The LASA drug problems must be analyzed for the cause of the problem using root-cause analysis. If the pharmacists or healthcare professionals know the cause of LASA drug problems, they will select the appropriate activities in MMS to solve those LASA drug problems.

4. Evaluate Risks

In a hospital, a given LASA drug problem might occur repeatedly with different characteristics. Solving all problems at once might demand too much time and staff. Pharmacists or other healthcare professionals should prioritize urgency of LASA drug problems. The severity and frequency of incidents are usually used to prioritize LASA drug problems and to select appropriate solving activities. For problems prioritized as not serious these medication errors should be monitored periodically. For those serious, urgent solving should be carried out.

5. Treat Risks

For LASA drug problems that need to be solved, pharmacists or other healthcare professionals should identify the solving activity. These activities could be from one or more steps of MMS. However, look-alike from labeling, packaging,

tablets or capsules could not be solved using steps of drug ordering, prescribing, and transcribing. (Table 6.1 in chapter 6)

Based on the survey, the steps in MMS mostly likely to succeed to solve the LASA drug problems were 1) drug storage, followed by 2) drug preparing and dispensing, 3) drug ordering, prescribing and transcribing medication order, 4) drug monitoring, 5) medication selection and procurement, and 6) drug administration, respectively. In other countries, drug storage was suggested to solve LASA drug problems such as Health Canada, a good practice to manage LASA drugs of HA-MSC of Hong Kong and Adrienne Berman's study [59-60, 64].

In drug preparing and dispensing, some activities were suggested to solve LASA drug problems. These include using Tall-man letter and making dissimilarity of LASA drug name in computer database and on printed drug label as suggested by Adrienne Berman' study, a good practice to manage LASA drugs of HA-MSC of Hong Kong and the guidelines of medication safety. In Thailand, medication safety in National Patient Safety Goal 2007 – 2008 also suggested the similar activities [12, 60, 64].

For drug ordering, prescribing and transcribing medication order step, writing a clear prescription was suggested by Health Canada, and Adrienne Berman' study[59, 64]. Spelling out the name of the drug name when giving verbal prescription orders was also suggested by Health Canada, and Adrienne Berman' study[59, 64]. In Thailand, the guidelines of medication safety suggested avoiding verbal drug ordering.

In every step of risk management process, one should communicate LASA drug risk to all stakeholders in hospital (i.e., pharmacist, assistant pharmacist, pharmacy staff, physicians, and nurses). Some of the LASA drug problems may be sent to the other stakeholders outside hospital, i.e., the Thai – FDA, and pharmaceutical companies, to solve LASA drug problems at national level. For example, many hospitals informed the GPO about the LASA errors of the GPO drugs (i.e., blister and capsule of amoxicillin 250 mg look-alike with 500 mg; labeling of fursosemide injection 20 mg/2ml look-alike with diazepam injection 10 mg/2ml); the

northern pharmacist group requested a company to change foil of enalapril 20 mg to avoid confusion with that of 5 mg enalapril tablet.

Moreover, close monitoring at in every step of risk management should be should done to reduce the chance of LASA drug problem reoccurring. (See also figure 8.1)

There are examples of applying risk management to solve and prevent LASA drug problems. The first example, the Joint Commission published "National Patient Safety Goal" which suggested that one must "identify and, at a minimum, annually review a list of look-alike/sound-alike drugs used in the organization, and take action to prevent errors involving the interchange of these drugs". In this document of the Joint Commission, the most problematic look-alike and sound-alike drug names for specific health care settings are provided. In addition, examples of potential errors and safety strategies specific to each of the problem drug names are also provided, when applicable. It also included potential problematic drug names, brand names & generic names, potential errors and consequence, and specific safety strategies [72]. The second example is the Medmarx® Report which contains processes of reporting drug names and medication errors form healthcare professionals. In its system Medmarx Report® collects and analyzes type and severity of problem, and later publishes such information as a guide to prevent the problem[25].

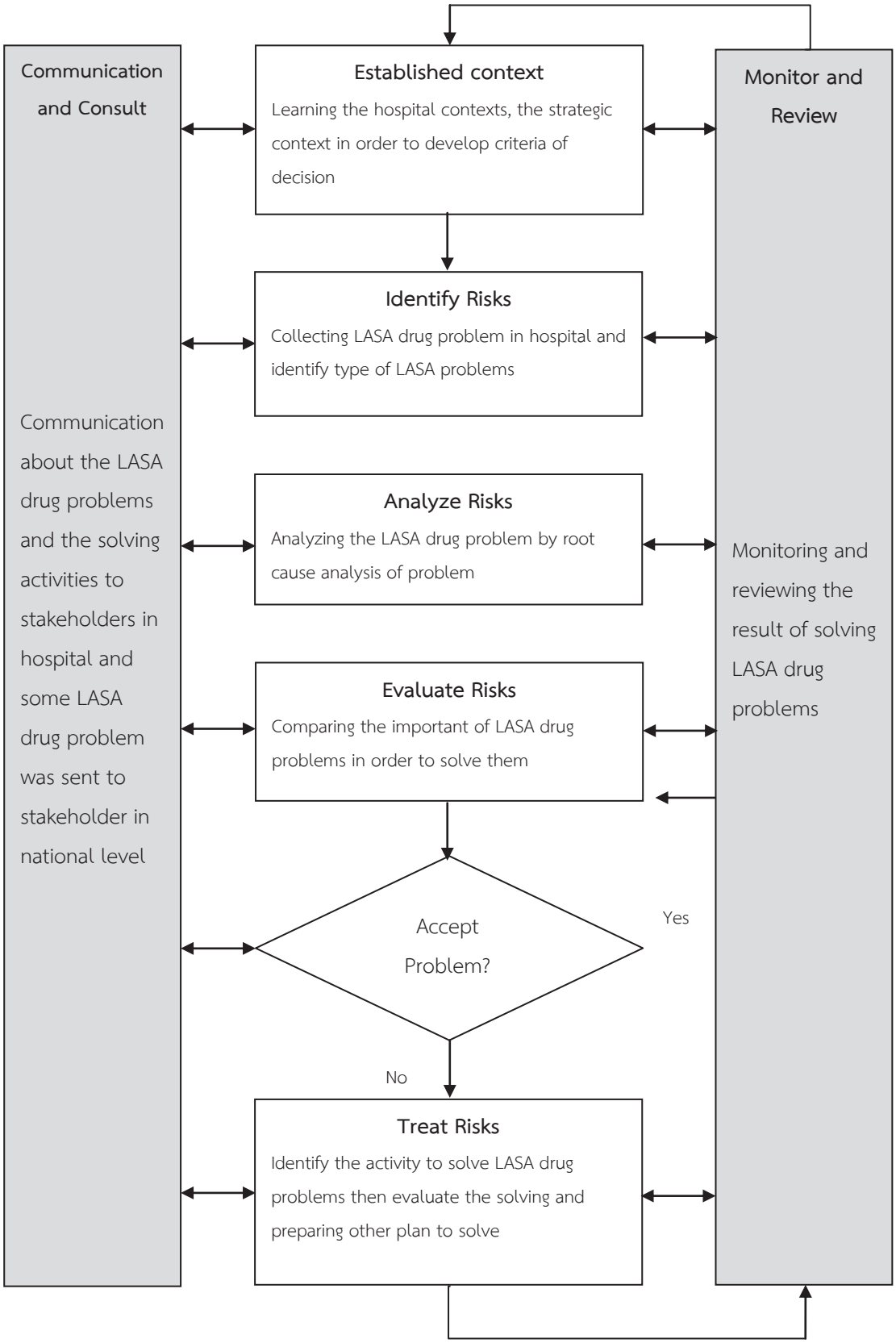


Figure 8.1 roles of risk management in solving LASA drug problem

8.2.3.2 The established database of LASA drug problems

A database for collecting LASA drug problems is critical because national level problems could make awareness among professionals and trend of problems can be figured. It was necessary to have responsible body to collect the LASA drug problems in order to deal with the problems at national level. LASA drug problems may be collected by sharing the experience from hospitals in web board forum. This could be a place of knowledge sharing in solving LASA drug problems. The database should be publicized for the incidence of LASA drug problems through the media to raise awareness among healthcare professional. It could adapt the concept of the US Pharmacopeia (USP) which publishes medication errors with a specific focus drawn from analyses of medication errors involving drug nomenclature as voluntarily reported to either MEDMARX® or the USP-ISMP Medication Errors Reporting Program[25]. One could also adapt the concept of the ISMP which have published all incidences in the ISMP Medication Safety Alert!, and in the ISMP's List of Confused Drug Names. One could also learn how events involving these medications were reported to ISMP through the ISMP National Medication Error Reporting Program (ISMP MERP)[79]. Pushing the policies to achieve this goal should be performed at the Thai FDA. With the Association of Hospital Pharmacy (Thailand) and the Community Pharmacy Association (Thailand) collaboration, the Thai FDA could be able to establish a network of reporting system to collect problems from the hospitals and drugstores.

8.2.3.3 The suggestion to solve LASA drug problem in healthcare provider.

Solving LASA drug problems is responsibility of all healthcare providers. Each professional has specific roles as follows.

1. Pharmacists

a. Pharmacist is responsible for compiling and updating LASA drug list in the hospital.

b. Once a LASA medication is detected, the problematic drugs should be separated apart to avoid confusion. Pharmacist should make remarkable

symbols or use different colors of the label on the LASA drugs to help staff to differentiate. Moreover, the staff should be informed about LASA drug pairs to understand and be aware of the problem.

c. Not buying drugs from companies that have a similar appearance to the labeling, packaging tablets or capsules. If change at hospital level is not possible, pharmacist should inform the pharmaceutical company about LASA drug problems of their own product and packaging. Collective effort among pharmacist from various hospitals helps put more pressure on the drug company to respond to the problem than individual pharmacist's pursuit.

d. Pharmacist is responsible for designing dissimilarity of LASA drug names in computerized database and on printed drug label. The methods include using Tall-man letter, using both generic name and brand name, separating syllables, changing item name by initializing with strength or dosage form instead of initializing with generic name as usual, filling symbols in front of or after drug name such as *, #, @, etc.

e. Pharmacist should be able to read diagnosis or ask prime question before dispensing drugs to the patient. If diagnosis is provided in the prescription, pharmacists should be able to understand the physician's diagnosis. In accordance with standard practice, before dispensing, pharmacists must ask the patient the prime questions to know the symptoms that brought the patient to the hospital.

f. For in-patient dispensing, if the doctor's order sheet is sent to dispensing room by copy or fax, pharmacists must see physician handwriting directly. This could help reduce transcribing error by ward nurses. It is the mutual authentication between pharmacists and nurses to prevent medication errors to patients.

g. Pharmacists are responsible to inform the staff in pharmacy department and other agencies (physicians and nurses) to know about the LASA drug problems in the hospital. This could be done by using notice board or circulating letter. A list of LASA drugs including images of drug package, label, tablet and capsule should be displayed. Demonstration of LASA drug pairs on a notice board

for the staff or other techniques should be performed to notify the LASA drug problems to all healthcare personnel.

h. Pharmacists must monitor pertinence of prescribed drugs to the purposes of medical treatment. In home visit, pharmacists or nurses should check the drugs whether they are right and suitable for the disease. For in-patient care unit, pharmacists and nurses should monitor the signs and symptoms of patient after taking drugs.

i. Pharmacists must monitor adverse drug reactions or drug allergy. This is to check whether the drugs the patient takes was the intended or prescribed ones. Identification of suspected drug is the direct responsibility of pharmacists.

2. Physicians

a. Physicians should not prescribe drugs with abbreviations and had to write drug strength of every drug item with readable handwriting. If physicians could not respond to these requirements, pharmacists should return their prescriptions.

b. Physicians should prescribe drugs via computerized system to solve problems associating with poor physician handwriting, prescribing drug with the brand name, not writing drug strength, and unclear drug use and dosing. It might be better to make a warning alert to the physician to be careful about LASA drug pairs via the computerized system when prescribing drug.

c. Physicians should avoid prescribing by telephone. But if there is an urgent medical need for verbal order, physicians should sign their order as soon as possible. It is necessary to set certain rules for practicing, specifically, high-alert drugs should not be prescribed by telephone.

3. Nurses

a. There is a nurse's procedure for the drugs administration to the patient and nurse supervisors should be strict on it. If a nurse double-checks drugs by her own, it may allow for high chance of errors. Furthermore, exhaustion

from working with nonstop shifts with inadequate rest could lead to the nurse making mistakes more easily during their work on ward. So checking drug before administering to the patient by at least two nurses must be mandated. In addition, the pharmacist should regularly inform any change of the drugs and appearance of the drugs in hospital to ward nurses.

b. Nurses should cooperate with pharmacists to check the doctor's order sheet as a mutual authentication between the two professions to prevent medication errors to patients.

c. For the inpatient care unit, nurses should cooperate with pharmacists to monitor the signs and symptoms of patient after taking drugs.

8.3 Recommendations

8.3.1 Recommendations for Action

1. Based on the result, the Thai FDA should be concerned more on the LASA drug problems, especially at drug registration process and monitoring LASA drug problems in post-marketing phase.

2. Establishing responsible body for collecting LASA drug problems in order to deal with the problems at national level is needed for Thailand. Experience from hospitals could be shared in web board forum and the database should be publicized for the incidence of LASA drug problems through the media to raise awareness among healthcare professionals.

3. Pharmaceutical companies should avoid similar drug labels and similar drug packaging designs. They should cooperate with hospitals to monitor and solve LASA drug problems.

4. Pharmacists and other healthcare professionals should review and monitor the LASA drug problems in their hospital regularly. This is because new LASA drug problems always occur.

5. Collecting data on frequency and the severity of LASA drug problems would be useful to prioritize problems for solving. Risk management matrix should be used for analysis.

8.3.2 Recommendations for further study

In a near future, there will be a LASA database developing at hospital and nation level. There is therefore a need to study for effectiveness of implementing such database. Various aspects of LASA drug problems could be analyzed and problems with high priority could be figured using risk management matrix.

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APPENDICES

APPENDIX A: Questionnaire

เลขที่แบบสอบถาม.....

แบบสอบถามเรื่อง มาตรการความปลอดภัยด้านยาและการจัดการเกี่ยวกับยาที่มีรูปคล้าย เสียงพ้องในโรงพยาบาลของรัฐ

คำชี้แจงแบบสอบถาม

1.แบบสอบถามนี้เป็นแบบสอบถาม เพื่อศึกษาเกี่ยวกับมาตรการความปลอดภัยด้านยาและการจัดการเกี่ยวกับยาที่มีรูปคล้าย เสียงพ้องในโรงพยาบาลของรัฐ ซึ่งเป็นการวิจัยเกี่ยวกับยาที่มีรูปคล้าย เสียงพ้องของประเทศไทย เพื่อนำไปสู่การแก้ไขในระดับประเทศต่อไป

2. แบบสอบถามจะแบ่งออกเป็น 4 ตอน ดังนี้

ตอนที่ 1 ข้อมูลทั่วไป

ตอนที่ 2 ข้อมูลเกี่ยวกับมาตรการความปลอดภัยด้านยา

ตอนที่ 3 ข้อมูลการดำเนินการเกี่ยวกับยาที่มีรูปคล้ายเสียงพ้อง

ตอนที่ 4 ความคิดเห็นเพิ่มเติม และข้อเสนอแนะเกี่ยวกับปัญหายาที่มีรูปคล้ายเสียงพ้อง

3. การตอบแบบสอบถามในแต่ละตอนให้ใส่เครื่องหมาย ✓ ลงในช่อง ❑ หรือ ❍ และตอบคำถามที่ตรงกับสภาพความเป็นจริงหรือความคิดเห็นของท่านมากที่สุด

ผู้วิจัยขอขอบคุณเภสัชกรทุกท่านที่ให้ความร่วมมือไว้ ณ ที่นี้

ผู้วิจัย ภญ.ฉัตราภรณ์ ชุ่มจิต

กลุ่มงานเภสัชกรรม โรงพยาบาลดำเนินสะดวก จ.ราชบุรี

นักศึกษาปริญญาเอก สาขาเภสัชศาสตร์สังคมและการบริหาร

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อาจารย์ที่ปรึกษา ภญ.อ.ดร.เยาวลักษณ์ อ่ำรำไพ

ภาควิชาเภสัชกรรมชุมชน คณะเภสัชศาสตร์

มหาวิทยาลัยศิลปากร

หมายเหตุ

หากท่านไม่ประสงค์ที่จะตอบคำถามในแบบสอบถามฉบับนี้ ทางผู้วิจัยยินดีที่จะรับแบบสอบถามคืน โดยที่ไม่มีการตอบแบบสอบถาม

กรุณาส่งกลับมาภายในวันที่ .....

เลขที่แบบสอบถาม.....

<u>ตอนที่ 1</u> ข้อมูลทั่วไป

กรุณาทำเครื่องหมาย ✓ลงในช่อง ❑ และเติมข้อมูลลงในช่องว่างที่ตรงกับความเป็นจริงเกี่ยวกับโรงพยาบาลของท่าน

1. ตำแหน่งงานของผู้ตอบแบบสอบถาม

   (กรณีผู้ตอบแบบสอบถามมากกว่า 1 คน หรือปฏิบัติงานมากกว่า 1 ตำแหน่ง สามารถเลือกได้มากกว่า 1 ข้อ)

   - ❑ หัวหน้าฝ่าย/กลุ่มงานเภสัชกรรม
   - ❑ เภสัชกรผู้รับผิดชอบงานพัฒนาระบบยา
   - ❑ เภสัชกรทำหน้าที่ปฏิบัติงาน (ระบุงาน) .....
   - ❑ ตำแหน่งอื่น ๆ (ระบุตำแหน่ง) .....

2. โรงพยาบาลของท่านสังกัดหน่วยงานราชการใด และมีจำนวนเตียงเท่าใด

   - ❑ สำนักงานปลัดกระทรวงสาธารณสุข
     - ❍ โรงพยาบาลศูนย์ ขนาด.....เตียง
     - ❍ โรงพยาบาลทั่วไป ขนาด .....เตียง
     - ❍ โรงพยาบาลชุมชน ขนาด .....เตียง
   - ❑ กรมการแพทย์ ขนาด .....เตียง
   - ❑ กรมสุขภาพจิต ขนาด .....เตียง
   - ❑ กรมควบคุมโรค ขนาด.....เตียง
   - ❑ กรมอนามัย ขนาด .....เตียง
   - ❑ กระทรวงกลาโหม ขนาด .....เตียง
   - ❑ มหาวิทยาลัย ขนาด .....เตียง
   - ❑ อื่น ๆ (ระบุสังกัด) ..... ขนาด.....เตียง

3. ปัจจุบันโรงพยาบาลของท่าน**มีเภสัชกร**จำนวนทั้งหมด.....คน

4. ปริมาณใบสั่งยาที่มารับยา<u>โดยเฉลี่ย</u>วันละเท่าไร

   จำนวนใบสั่งยาผู้ป่วยนอก ประมาณวันละ .....ใบ

   จำนวนใบสั่งยาผู้ป่วยใน ประมาณวันละ .....ใบ

<u>ตอนที่ 2.</u> ข้อมูลเกี่ยวกับมาตรการความปลอดภัยด้านยา

กรุณาทำเครื่องหมาย ✓ ลงในช่อง ❑ แต่ละข้อที่ตรงกับความเป็นจริงและความคิดเห็นของท่านมากที่สุด

1. ท่านทราบหรือไม่ว่าในขณะนี้ทางกระทรวงสาธารณสุขได้ประกาศนโยบายด้านความปลอดภัยของผู้ป่วยระดับชาติปี พ.ศ. 2550 - 2551 โดยมีมาตรการความปลอดภัยด้านยา เป็นประเด็นหลักประเด็นหนึ่งด้วย

   ❑ ทราบ (ตอบคำถามต่อข้อ 2) ❑ ไม่ทราบ (ข้ามไปตอบคำถามต่อข้อ 3)

2. ท่านทราบนโยบายนี้จากแหล่งข้อมูลใด

   - ❑ การจัดประชุมชี้แจงหัวหน้าฝ่าย/กลุ่มงานเภสัชกรรม และ/หรือหัวหน้ามาแจ้งให้ทราบ
   - ❑ ทราบด้วยตนเองจากแหล่งข้อมูลอื่น โปรดระบุแหล่งข้อมูล.....

3. โรงพยาบาลของท่านได้เริ่มดำเนินการเกี่ยวกับมาตรการความปลอดภัยด้านยาแล้วหรือไม่

   - ❑ ดำเนินการแล้ว (ทำต่อข้อที่ 4)
   - ❑ กำลังจะเริ่มดำเนินการ เรื่องใดเรื่องหนึ่ง (ทำต่อข้อที่ 4)

❑ ยังไม่ได้ดำเนินการใด ๆ เลย (ข้ามไปทำข้อที่ 5)

4. ในมาตรการความปลอดภัยด้านยา โรงพยาบาลของท่านได้ดำเนินการหรือจะเริ่มดำเนินการเรื่องใดไปแล้วบ้าง (ตอบได้มากกว่า 1 ข้อ)

❑ ยาที่มีรูปคล้ายเสียงพ้อง (Look – Alike, Sound – Alike medication, LASA)

❑ ยาที่ต้องระมัดระวังสูง (High alert drugs)

❑ ยาที่มีอาการไม่พึงประสงค์ที่รุนแรง และการแพ้ยาซ้ำ

5. ท่านคิดว่าโรงพยาบาลของท่านมีปัญหาความคลาดเคลื่อนทางยาจากสาเหตุใดมากที่สุด(เรียงลำดับที่ 1, 2, 3)

..... ยาที่มีรูปคล้ายเสียงพ้อง (Look – Alike, Sound – Alike medication, LASA)

..... ยาที่ต้องระมัดระวังสูง (High alert drugs)

..... ยาที่มีอาการไม่พึงประสงค์ที่รุนแรง และการแพ้ยาซ้ำ

<u>ตอนที่ 3.</u> ข้อมูลการดำเนินการเกี่ยวกับยาที่มีรูปคล้าย เสียงพ้อง

1. โรงพยาบาลของท่านพบปัญหายาที่มีรูปคล้ายเสียงพ้องรูปแบบใดบ้าง

*กรุณายกตัวอย่างชื่อยาที่พบว่า**มีปัญหา**ในแต่ละข้อย่อยๆ ปัญหาละ 3 ตัวอย่าง*

ปัญหา	คู่ยาที่มีปัญหา	
	ชื่อยาตัวที่ 1	ชื่อยาตัวที่ 2
ปัญหาเกี่ยวกับชื่อยาพ้องกัน		
1.1 ชื่อ**การค้า**กับชื่อ**การค้า**ของยาคล้ายกัน		
1.2 ชื่อ**การค้า**กับชื่อ**สามัญทางยา**คล้ายกัน		
1.3 ชื่อ**สามัญทางยา**กับชื่อ**สามัญทางยา**คล้ายกัน		

ปัญหา	ชื่อยาตัวที่1	บริษัท	ชื่อยาตัวที่ 2	บริษัท
ปัญหาเกี่ยวกับฉลากยาคล้ายกัน				
1.4 ฉลากยาคล้ายกัน โดยเป็น**ยาบริษัทเดียวกัน**				
1.5 ฉลากยาคล้ายกัน โดยเป็น**ยาต่างบริษัทกัน**				

ปัญหา	คู่ยาที่มีปัญหา			
	ชื่อยาตัวที่1	**บริษัท**	**ชื่อยาตัวที่ 2**	**บริษัท**
ปัญหาเกี่ยวกับบรรจุภัณฑ์ยาคล้ายกัน				
1.6 ampoule หรือ Vial บรรจุยาฉีดคล้ายกัน โดยเป็น**ยาบริษัทเดียวกัน**				
1.7 ampoule หรือ Vial บรรจุยาฉีดคล้ายกัน โดยเป็น**ยาต่างบริษัทกัน**				
1.8 ขวดบรรจุยาเม็ด/ยาน้ำคล้ายกันโดยเป็น**ยาบริษัทเดียวกัน**				
1.9 ขวดบรรจุยาเม็ด/ยาน้ำคล้ายกันโดยเป็น**ยาต่างบริษัทกัน**				
1.10 กล่องบรรจุยาคล้ายกัน โดยเป็น**ยาบริษัทเดียวกัน**				
1.11 กล่องบรรจุยาคล้ายกัน โดยเป็น**ยาต่างบริษัทกัน**				
1.12 แผงบรรจุยาคล้ายกัน โดยเป็น**ยาบริษัทเดียวกัน**				
1.13 แผงบรรจุยาคล้ายกัน โดยเป็น**ยาต่างบริษัทกัน**				
ปัญหาเกี่ยวกับลักษณะเม็ดยา				
1.14 เม็ดยาคล้ายกัน โดยเป็น**ยาบริษัทเดียวกัน**				
1.15 เม็ดยาคล้ายกัน โดยเป็น**ยาต่างบริษัทกัน**				

2. โรงพยาบาลของท่านได้นำการจัดการระบบยามาดำเนินการเพื่อช่วยแก้ปัญหายาที่มีรูปคล้าย เสียงพ้อง ในแต่ละขั้นตอนอย่างไรบ้าง

<u>วิธีการตอบแบบสอบถามข้อนี้</u>

กรุณาทำเครื่องหมาย ✓ ลงในช่อง ❍ ในผลการแก้ไขปัญหาด้วยวิธีการต่าง ๆ ที่โรงพยาบาลของท่านใช้แก้ไขปัญหาในแต่ละขั้นตอน โดย

- หากเลือก **ใช้แก้ไขปัญหาแล้วประสบผลสำเร็จ** โปรดยกตัวอย่างคู่ยาที่แก้ไขปัญหาสำเร็จ
- หากเลือก **ใช้แก้ไขปัญหาแล้วไม่ประสบผลสำเร็จ** โปรดระบุสาเหตุที่แก้ไขไม่สำเร็จ
- หากเลือก **ไม่เคยนำมาใช้แก้ไขปัญหา** โปรดระบุเหตุผลที่ยังไม่ใช้วิธีการนั้นในการแก้ไขปัญหา

วิธีการที่ท่านใช้ในการแก้ไขปัญหายาที่มีรูปคล้าย เสียงพ้อง ในแต่ละขั้นตอน	**ผลการแก้ไขปัญหาด้วยวิธีการต่าง ๆ**		
	ใช้แก้ไขปัญหาแล้วประสบผลสำเร็จ (โปรดยกตัวอย่างคู่ยา)	**ใช้แก้ไขปัญหาแล้วไม่ประสบผลสำเร็จ (โปรดระบุสาเหตุ)**	**ไม่เคยนำมาใช้แก้ไขปัญหา (โปรดระบุเหตุผล)**
การคัดเลือกและจัดหายา			
กำหนดให้แต่ละรายการยาในบัญชียาโรงพยาบาลมีเพียงความแรงเดียว	❍.....	❍.....	❍..... ....
หลีกเลี่ยงการนำยาที่มีเสียงพ้องกันเข้าสู่บัญชียาโรงพยาบาล	❍.....	❍.....	❍..... ....
ไม่ซื้อยาจากบริษัทที่มีรูปลักษณะของผลิตภัณฑ์หรือบรรจุภัณฑ์คล้ายกัน	❍.....	❍.....	❍..... ....
นำปัญหาเข้าพิจารณาในการซื้อยาร่วมระดับจังหวัดหรือเขต	❍.....	❍.....	❍..... ....
แจ้งบริษัทให้ทราบถึงปัญหาบรรจุภัณฑ์	❍.....	❍.....	❍..... ....
อื่น ๆ (ระบุ).....	❍.....	❍.....	❍..... ....
การเก็บรักษายา (คลังยาเวชภัณฑ์ของโรงพยาบาล และคลังย่อยในหน่วยบริการต่าง ๆ)			
แยกสถานที่วางยาที่มีลักษณะคล้ายกัน ให้อยู่ห่างกัน	❍.....	❍.....	❍..... ....

วิธีการที่ท่านใช้ในการแก้ไขปัญหายาที่มีรูปคล้าย เสียงพ้อง ในแต่ละขั้นตอน	ผลการแก้ไขปัญหาด้วยวิธีการต่าง ๆ		
	ใช้แก้ไขปัญหาแล้วประสบผลสำเร็จ (โปรดยกตัวอย่างคู่ยา)	ใช้แก้ไขปัญหาแล้วไม่ประสบผลสำเร็จ (โปรดระบุสาเหตุ)	ไม่เคยนำมาใช้แก้ไขปัญหา (โปรดระบุเหตุผล)
ทำสัญลักษณ์ให้เป็นจุดสังเกตสำหรับยาที่มีรูปคล้าย เสียงพ้อง	❍.....	❍.....	❍..... ....
แจ้งรายการชื่อยาที่มีรูปคล้าย เสียงพ้อง ให้เจ้าหน้าที่ระวังมากขึ้น	❍.....	❍.....	❍..... ....
อื่น ๆ (ระบุ).....	❍.....	❍.....	❍..... ....
การสั่งใช้ยาของแพทย์ และการคัดลอกคำสั่งของพยาบาล			
กำหนดให้แพทย์ไม่ใช้ตัวย่อในการสั่งใช้ยา	❍.....	❍.....	❍..... ....
กำหนดการเขียนชื่อยาที่มีตัวสะกดคล้ายกันหรือมีเสียงพ้องกันให้ชัดเจน	❍.....	❍.....	❍..... ....
กำหนดให้เขียนความแรงในการสั่งยา	❍.....	❍.....	❍..... ....
มีการสั่งใช้ยาผ่านคอมพิวเตอร์ เพื่อลดปัญหาลายมือแพทย์	❍.....	❍.....	❍..... ....
กำหนดให้แพทย์เขียนการวินิจฉัยโรคในใบสั่งยา	❍.....	❍.....	❍..... ....
ไม่รับคำสั่งทางโทรศัพท์ ต้องสั่งจ่ายยาเป็นลายลักษณ์อักษรเท่านั้น	❍.....	❍.....	❍..... ....

วิธีการที่ท่านใช้ในการแก้ไขปัญหายาที่มีรูปคล้าย เสียงพ้อง ในแต่ละขั้นตอน	ผลการแก้ไขปัญหาด้วยวิธีการต่าง ๆ		
	ใช้แก้ไขปัญหาแล้วประสบผลสำเร็จ (โปรดยกตัวอย่างคู่ยา)	ใช้แก้ไขปัญหาแล้วไม่ประสบผลสำเร็จ (โปรดระบุสาเหตุ)	ไม่เคยนำมาใช้แก้ไขปัญหา (โปรดระบุเหตุผล)
มีการจ่ายแบบ unit dose หรือ one-day dose ทำให้เภสัชกรได้เห็นลายมือแพทย์โดยตรง ลดการคัดลอกคำสั่งของพยาบาล	❍.....	❍.....	❍.....
พิมพ์ประวัติยาเดิมบนใบสั่งยาให้แพทย์ก่อนสั่งยา	❍.....	❍.....	❍.....
อื่น ๆ (ระบุ).....	❍.....	❍.....	❍.....
การจัดยาและจ่ายยาของเภสัชกร			
ใช้อักษรตัวเล็กปนตัวใหญ่ (Tall man letter) บนฉลากเพื่อช่วยการจัดและจ่ายยา เช่น hydrALAZINE - hydroOXYzine เป็นต้น	❍.....	❍.....	❍.....
ตรวจสอบรายการยากับข้อมูลการวินิจฉัยของแพทย์ว่าสอดคล้องกันหรือไม่	❍.....	❍.....	❍.....
ติดป้ายเตือนให้ทราบเกี่ยวกับคู่ยาที่เกิดความผิดพลาดบ่อยครั้ง	❍.....	❍.....	❍.....
จัดสรรบุคลากรให้เพียงพอเพื่อลดความเร่งรีบและความเครียดในการปฏิบัติงานในช่วงเวลาเร่งด่วน	❍.....	❍.....	❍.....
ชื่อยาในฐานข้อมูลคอมพิวเตอร์ แสดงทั้งชื่อการค้า และชื่อสามัญทางยาเพื่อหลีกเลี่ยงการพ้องกัน	❍.....	❍.....	❍.....

วิธีการที่ท่านใช้ในการแก้ไขปัญหายาที่มีรูปคล้าย เสียง พ้อง ในแต่ละขั้นตอน	ผลการแก้ไขปัญหาด้วยวิธีการต่าง ๆ		
	ใช้แก้ไขปัญหาแล้วประสบผลสำเร็จ (โปรดยกตัวอย่างคู่ยา)	ใช้แก้ไขปัญหาแล้วไม่ประสบผลสำเร็จ (โปรดระบุสาเหตุ)	ไม่เคยนำมาใช้แก้ไขปัญหา (โปรดระบุเหตุผล)
อื่น ๆ (ระบุ).....	❍.....	❍.....	❍.....
การบริหารยา			
มีพยาบาลอย่างน้อย 2 คน ตรวจสอบการเตรียมยาก่อนให้ยาแก่ผู้ป่วยทุกครั้ง	❍.....	❍.....	❍.....
มีเภสัชกรประจำหอผู้ป่วยเพื่อช่วยตรวจสอบก่อนการให้ยาผู้ป่วย	❍.....	❍.....	❍.....
อื่น ๆ (ระบุ).....	❍.....	❍.....	❍.....
การติดตามผลการใช้ยา			
ติดตามผลการใช้ยาว่าตรงกับวัตถุประสงค์ในการรักษาของแพทย์หรือไม่ เช่น แพทย์สั่งจ่าย Ventolin อาการหอบของผู้ป่วยควรดีขึ้น แต่หากผู้ป่วยได้รับ Voltaren ไป อาการหอบอาจแย่ลง	❍.....	❍.....	❍.....
หากเกิดอาการไม่พึงประสงค์จากการใช้ยา หรือแพ้ยา มีการตรวจสอบยาที่ผู้ป่วยได้รับว่าถูกต้องตามที่แพทย์สั่งจ่ายหรือไม่	❍.....	❍.....	❍.....
อื่น ๆ (ระบุ).....	❍.....	❍.....	❍.....

<u>ตอนที่ 4</u> ความคิดเห็นเพิ่มเติม และข้อเสนอแนะเกี่ยวกับปัญหายาที่มีรูปคล้าย เสียงพ้อง

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ขอขอบพระคุณในความร่วมมือของท่านไว้ ณ โอกาสนี้

กรุณาส่งแบบสอบถามกลับมาที่ ภญ.ฉัตราภรณ์ ชุ่มจิต

กลุ่มงานเภสัชกรรม โรงพยาบาลดำเนินสะดวก

ต.ท่านัด อ.ดำเนินสะดวก จ.ราชบุรี 70130

กรุณาส่งกลับมาภายในวันที่ .....

APPENDIX B

Table appendix B Qualifications of Experts.

Experts	Qualifications
Regional Hospital	- Responsible in management supplies for 18 years. - Head of Department of Pharmacy in the Regional hospital for 3 years. - Committee on performance standardized of hospital pharmacy. - Speaker in "System Management of LASA drugs" in The Association of Hospital Pharmacy (Thailand) Annual Meeting 2008.
General Hospital	- Worked in the Provincial Health Office. - Worked in the Bureau of Primary Health Care, the Ministry of Public Health. - Worked in the Division of Regional hospital, the Ministry of Public Health. - Head of Department of Pharmacy in General hospital.
Community Hospital	- Head of Department of Pharmacy in Community hospital for 19 years.
Hospital under Department of Medical Service	- Pharmacist worked in General hospital. - Head of department of pharmacy in the hospital under Department of Medical Service.
Hospital under the Thai Red Cross Society which be equivalent to Hospital under the University	- Pharmacist worked in service pharmacy unit for 17 years - Responsible in the risk management in Department of Pharmacy for 10 years.
Medicine physician	- Pharmacist worked in Community hospital for 2 years. - Pharmacist worked in General hospital for 1 year - Intern physician worked in General hospital for 3 years. - Resident in medicine worked in University hospital for 3 years. - Medicine physician working in General hospital.

Table appendix B Qualifications of Experts (continued).

Experts	Qualifications
Medicine physician	- Intern physician worked in General hospital for 1 year. - Intern physician worked in General hospital for 2 years. - Resident in medicine worked in University hospital for 3 years. - Medicine physician working in General hospital.
A nurse from a general hospital	- Committee on risk management in hospital. - Secretary of patient care team of Medicine - Speaker in risk of administration in hospital.
A pharmacist representative from the Association of Hospital Pharmacy (Thailand)	- Pharmacist worked in inpatient dispensing room of medicine ward - Pharmacist working in Drug information service, responsible in DIS, ADR, HA and warfarin clinic
A pharmacist representative from the Food and Drug Administration	- Pharmacist worked in hospital for 2 years. - Pharmacist worked in the Division of Hazardous Substances Control, the Thai FDA for 1 year - Pharmacist worked in the Division of Technical and Planning for 5 years. - Pharmacist working in the Bureau of Drug Control for 12 year.
Pharmacist representatives from GPO	- Analysis liquid drug - Control of packaging, labeling and leaflet - Control of drug registration - Director of Standard products Division.
Pharmacist representatives from GPO	- Pharmacist working in Pharmacy store of GPO for 11 years.

Table appendix B Qualifications of Experts (continued).

Experts	Qualifications
Pharmacist representatives from original pharmaceutical company	- Medical Scientist (Pharmacist) worked in Division of Drug Analysis, Department of Medical Sciences, the Ministry of Public Health for 2 years. - Quality Control Pharmacist worked in local pharmaceutical company for 1 year - Research and Development Pharmacist worked in local pharmaceutical company for 3 years. - Quality Assurance Manager worked in original pharmaceutical companies for 1 year. - Quality Assurance Manager working in original pharmaceutical companies for 3 year
Pharmacist representatives from local pharmaceutical company	- Sales representation worked in original pharmaceutical company. - Specialist in product worked in original pharmaceutical company. - Sales Manager worked in original pharmaceutical company. - Product manager worked in original pharmaceutical company. - Marketing Director working in local pharmaceutical company.
A professor from a school of pharmacy	- Worked in General hospital for 16 years. - Worked in the Bureau of Primary Health Care, the Ministry of Public Health for 5 months. - Professor from a school of pharmacy for 14 years. - Surveyor of the Healthcare Accreditation Institute (Public Organization)

APPENDIX C

Table C1 Figure of LASA drugs in table 4.11.

Row	Generic name 1	Company name	Generic name 2
1	amoxicillin 500 mg cap	GPO	amoxicillin 250 mg cap
	 Before changed  After changed		
2	propranolol 10 mg tab	GPO	propranolol 40 mg tab
			
3	enalapril 5 mg tab	Berlin	enalapril 20 mg tab
	 Before changed  After changed		
4	furosemide 40 mg tab	GPO	folic acid 5 mg
			

Table C1 Figure of LASA drug in table 4.11(continued).

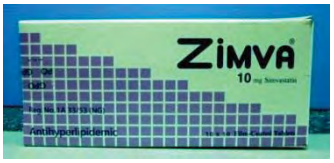
Row	Generic name 1	Company name	Generic name 2
5	amlodipine 5 mg tab	GPO	simvastatin 10 mg tab
			
6	diazepam injection	GPO	furosemide injection
	 Labeling on a box of diazepam และ furosemide injection		
	 Before changed  After changed on March 2011		
7	vitamin K 1 mg injection	Atlantic	vitamin K 10 mg injection
			

Table C1 Figure of LASA drug in table 4.11 (continued).

Row	Generic name 1	Company name	Generic name 2
8	diazepam 2 mg tab	GPO	salbutamol 2 mg tab
			

Table C2 Figure of LASA drug in table 4.13

Row	Generic name 1	Company name	Generic name 2
1	diazepam injection	GPO	furosemide injection
	 Before changed		 After changed on March 2011
2	vitamin K 1 mg injection	Atlantic	vitamin K 10 mg injection
			

Table C2 Figure of LASA drug in table 4.13 (continued).

Row	Generic name 1	Company name	Generic name 2
3	hyoscine injection	GPO	terbutaline injection
			
4	vitamin B1 injection	ANB	vitamin Bcomplex injection
			
5	gentamicin injection	GPO	metoclopramide injection
			
6	ampicillin injection	Modern Manu	penicillin G sodium 1 mu
			

Table C2 Figure of LASA drug in table 4.13 (continued).

Row	Generic name 1	Company name	Generic name 2
7	haloperidol injection	Atlantic	vitamin K 1 mg injection
			
8	vitamin K 1 mg injection	Roche	vitamin K 10 mg injection
	Before changed labeling		
			
	After changed labeling		
			
9	ampicillin injection	Modern Manu	cloxacillin injection
			

Table C2 Figure of LASA drug in table 4.13 (continued).

Row	Generic name 1	Company name	Generic name 2
10	hyoscine injection	GPO	neostigmine injection
			

Table C3 Figure of LASA drug in table 4.14.

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
1	vitamin B complex injection	ANB	vitamin K_1 10 mg injection	Atlantic
				
2	vitamin B1 injection	ANB	vitamin K_1 10 mg injection	Atlantic
				

Table C3 Figure of LASA drug in table 4.14 (continued).

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
3	50 % magnesium sulfate injection	Atlantic	dimenhydrinate injection	LBS
				
4	diclofenac injection	GDH	dimenhydrinate injection	LBS
				
5	ampicillin 1 g injection	GPO	cefazolin 1 g injection	M & H
				
6	dextrose 50% injection	TP Drug	lidocaine injection	GPO
				

Table C4 Figure of LASA drug in table 4.15.

Row	Generic name 1	Company name	Generic name 2
1	furosemide 40 mg tab	GPO	folic acid 5 mg tab
			
2	diazepam 2 mg tab	GPO	salbutamol 2 mg tab
			
3	guaifenesin syrup	GPO	paracetamol syrup
			
4	ammon carb. mixture	GPO	brown mixture
			

Table C4 Figure of LASA drug in table 4.15 (continued).

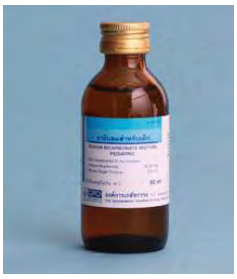
Row	Generic name 1	Company name	Generic name 2
5	sodium bicarbonate syrup	GPO	salbutamol syrup
			
6	propylthiouracil 50 mg tab	GPO	trihexyphenidyl 2 mg tab
			
7	paracetamol syrup	GPO	chlorpheniramine syrup
			
8	vitamin Bcomplex tab	GPO	multivitamin tab
			

Table C4 Figure of LASA drug in table 4.15 (continued).

Row	Generic name 1	Company name	Generic name 2
9	co-trimoxazole suspension	GPO	milk of magnesia 60 ml
			

Table C5 Figure of LASA drug in table 4.16.

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
1	amoxicillin dry syrup	several companies	multivitamin dry syrup	GPO
				
2	paracetamol syrup	Thai Nakorn	ibuprofen suspension	GPO
				

Table C5 Figure of LASA drug in table 4.16 (continued).

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
3	amoxicillin dry syrup	several companies	erythromycin dry syrup	several companies
				
4	dapsone 100 mg tab	Pond's chemical	allopurinol 100 mg tab	GPO
				
5	domperidone suspension	several companies	albendazole suspension	GPO
				

Table C5 Figure of LASA drug in table 4.16 (continued).

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
6	domperidone suspension	several companies	mebendazole suspension	several companies
				
7	erythromycin dry syrup	Osoth Interlab	multivitamin dry syrup	GPO
				

Table C6 Figure of LASA drug in table 4.17.

Row	Generic name 1	Company name	Generic name 2
1	amoxicillin 500 mg cap	GPO	amoxicillin 250 mg cap
	 Before changed  After changed in May 2011		
2	propranolol 40 mg tab	GPO	propranolol 10 mg tab
			
3	rifampicin 300 mg cap	GPO	rifampicin 450 mg cap
			
4	dicloxacillin 250 mg cap	GPO	dicloxacillin 500 mg cap
			
5	enalapril 5 mg tab	Berlin	enalapril 20 mg tab
	 Before changed  After changed		

Table C6 Figure of LASA drug in table 4.17 (continued).

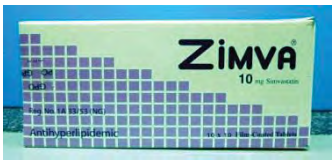
Row	Generic name 1	Company name	Generic name 2
6	amlodipine 5 mg tab	GPO	simvastatin 10 mg tab
			
7	vitamin K1 1 mg injection	Atlantic	vitamin K1 10 mg injection
			
8	budesonide 100 mcg/dose MDI	Cipla	budesonide 200 mcg/dose MDI
			

Table C7 Figure of LASA drug in table 4.18.

No.	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
1	simethicon drop	R.X.	vitamin E drop	Ranbaxy
				
2	finasteride 5 mg tab	T.O. chemical	alfuzosin 10 mg tab	sanofi-aventis
				

Table C8 Figure of LASA drug in table 4.19.

Row	Generic name 1	Company name	Generic name 2
1	propranolol 10 mg tab	GPO	propranolol 40 mg tab
	Before changed  After changed 		
2	amoxicillin 500 mg cap	GPO	amoxicillin 250 mg cap
	Before changed  After changed in May 2011 		

Table C8 Figure of LASA drug in table 4.19 (continued).

Row	Generic name 1	Company name	Generic name 2
3	enalapril 5 mg tab	Berlin	enalapril 20 mg tab
	 Before changed		 After changed
4	amlodipine 5 mg tab	GPO	simvastatin 10 mg tab
	 Before changed		 After changed
5	spironolactone tab	Berlin	atenolol tab
	 Back		 Front
	From: http://www.smhos.com/phar/?name=ddrug		

Table C8 Figure of LASA drug in table 4.19 (continued).

Row	Generic name 1	Company name	Generic name 2
8	amlodipine tab	Berlin	simvastatin tab
			
9	dicloxacillin 250 mg cap	GPO	dicloxacillin 500 mg tab
			
10	metformin 500 mg tab	GPO	metronidazole 200 mg tab
	 After metronidazole first changed		 metronidazole second changed

Table C9 Figure of LASA drug in table 4.20.

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
1	omeprazole 20 mg cap	GPO	amoxicillin + clavulanic acid	several companies
	 Back  Front			
2	simvastatin 20 mg tab	GPO	aspirin 81 mg tab	Osoth inter
				
3	flunarizine 5 mg cap	GPO	clorazepate 2 mb cap	Polipharm
	 Before changed  First changed  Second changed			

Table C9 Figure of LASA drug in table 4.20 (continued).

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
4	ranitidine 150 mg tab	Berlin	simethicone 80 mg tab	R.X.
				
5	ethambutal 400 mg tab	GPO	enalapril 5 mg tab	Berlin
				
6	calcium Carbonate tab	several companies	gemfibrozil 600 mg tab	several companies
	Back  Front 			

Table C9 Figure of LASA drug in table 4.20 (continued).

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
7	ofloxacin 200 mg	Farmaline	enalapril 5 mg tab	Berlin
				
8	fluconazole 200 mg	GPO	Itraconazole	several companies
				

Table C10 Figure of LASA drug in table 4.21.

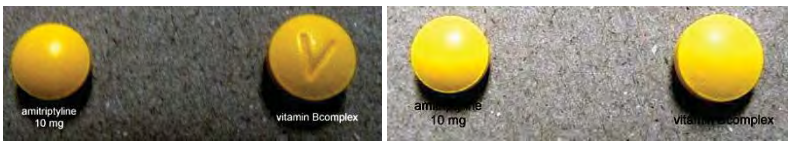
Row	Generic name 1	Company name	Generic name 2
1	dimenhydrinate 50 mg tab	GPO	diazepam 5 mg tab
			
2	amoxicillin 500 mg ca	GPO	amoxicillin 250 mg cap
			 Before changed
			 After changed
3	propylthiouracil 50 mg tab	GPO	phenobarbital 60 mg tab
	 Before changed		
	 After changed		
4	amitriptyline 10 mg tab	GPO	vitamin Bcomplex tab
			

Table C10 Figure of LASA drug in table 4.21 (continued).

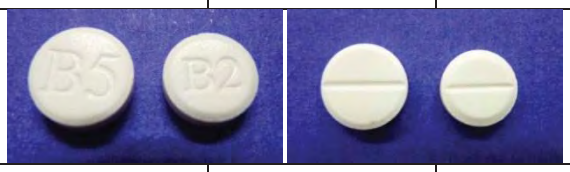
Row	Generic name 1	Company name	Generic name 2
5	trihexyphenidyl 2 mg tab	GPO	diazepam 2 mg tab
			
6	trihexyphenidyl 2 mg tab	GPO	trihexyphenidyl 5 mg tab
			
7	propranolol 10 mg tab	GPO	propranolol 40 mg tab
			
8	propylthiouracil 50 mg tab	GPO	isoniazid 100 mg tab
			
9	paracetamol 500 mg tab	GPO	alumina-Magnesia® GPO
	 From: http://www.smhos.com/phar/?name=ddrug		

Table C10 Figure of LASA drug in table 4.21 (continued).

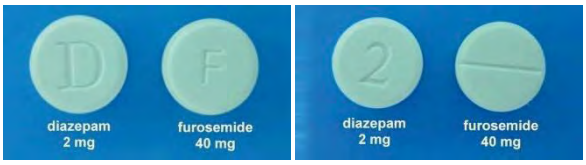
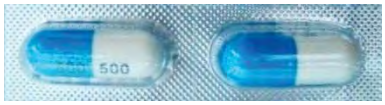
Row	Generic name 1	Company name	Generic name 2
10	diazepam 2 mg tab	GPO	furosemide 40 mg tab
			
	After changed 		
11	dicloxacillin 250 mg cap	GPO	dicloxacillin 500 mg cap
			

Table C11 Figure of LASA drug in table 4.22.

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
1	chlorpheniramine 4 mg tab	GPO	bromhexine 8 mg tab	several companies
	 			
2	stavudine 30 mg cap	GPO	indomethacin 25 mg cap	several companies
				

Table C11 Figure of LASA drug in table 4.22 (continued).

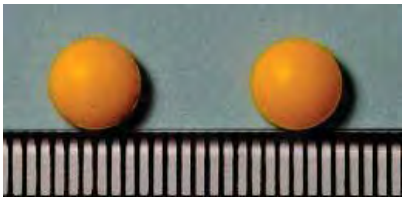
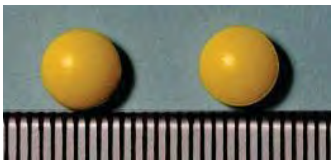
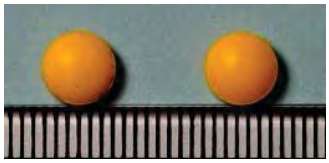
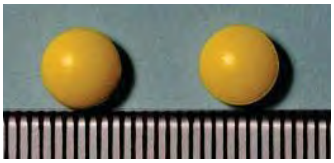
Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
3	aspirin 300 mg tab	several companies	ibuprofen tab	several companies
				
4	vitamin Bcomplex tab	GPO	diclofenac 25 mg tab	several companies
				
5	amitriptyline 10 mg tab	GPO	diclofenac 25 mg tab	several companies
				
6	mefenamic acid 250 mg cap	several companies	indomethacin 25 mg tab	several companies
				

Table C11 Figure of LASA drug in table 4.22 (continued).

Row	Drug name 1		Drug name 2	
	Generic name	Company	Generic name	Company
6	mefenamic acid 250 mg cap	several companies	indomethacin 25 mg tab	several companies
				
7	chlorpheniramine 4 mg tab	GPO	verapramil 40 mg tab	Berlin
				
8	amitriptyline 10 mg tab	GPO	verapramil 40 mg tab	Berlin
				
9	prednisolone 5 mg tab	GPO	metoclopramide 10 mg tab	several companies
				
	allopurinol 100 mg tab	GPO	levothyroxine 0.1 mg tab	GSK
				

BIOGRAPHY

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Education:	
2000	Bachelor of Pharmacy, Silpakorn University
2004	Master of Pharmacy in Community Pharmacy, Naresuan University
2007 – 2013	Doctor of Philosophy, Ph.D. in Social and Administrative Pharmacy, Silpakorn University
Work experience	
2000 – 2001	Pharmacist in Beung Kan hospital, Nong Kai province (Present is in Beung Kan province)
2001 – Present	Pharmacist in Damnoen Saduak hospital, Ratchaburi province 70130, Thailand