อุบัติการณ์ สาเหตุและค่าใช้จ่ายในการจัดการปัญหาจากการใช้ยาของผู้ป่วยใน ณ โรงพยาบาลสมเด็จพระยุพราชเลิงนกทา

นางสาว สุธีรา ทาระพันธ์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาเภสัชศาสตร์สังคมและบริหาร ภาควิชาเภสัชศาสตร์สังคมและบริหาร
คณะเภสัชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2553

INCIDENCE, CAUSES, AND MANAGEMENT COST OF DRUG RELATED PROBLEMS IN HOSPITALIZED PATIENTS AT LOENGNOKTHA CROWN PRINCE HOSPITAL

Miss Sutheera Taraphan

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Social and
Administrative Pharmacy
Department of Social and Administrative Pharmacy
Faculty of Pharmaceutical Science
Chulalongkorn University
Academic Year 2010

Thesis Title	INCIDENCE, CAUSES, AND MANAGEMENT COST OF DRUG RELATED PROBLEMS IN HOSPITALIZED PATIENTS AT LOENGNOKTHA CROWN PRINCE HOSPITAL
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สุธีรา ทาระพันธ์ : อุบัติการณ์ สาเหตุและค่าใช้จ่ายในการจัดการปัญหาจากการใช้ยาของผู้ป่วยใน ณ โรงพยาบาลสมเด็จพระยุพราชเลิงนกทา. (INCIDENCE, CAUSES, AND MANAGEMENT COST OF DRUG RELATED PROBLEMS IN HOSPITALIZED PATIENTS AT LOENGNOKTHA CROWN PRINCE HOSPITAL) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : ผู้ช่วยศาสตราจารย์ ดร.ภูรี อนันตโชติ, 66 หน้า.

ปัญหาจากการใช้ยาเป็นปัญหาสำคัญทั้งในระดับองค์กร ระดับประเทศและระดับนานาชาติ การค้นหาและแก้ไขปัญหาจากการใช้ยาเพื่อให้การดูแลรักษาผู้ป่วยมีประสิทธิภาพอิงตามแนวทางการรักษาโรคที่ได้มาตรฐานจึงควรทำโดยอาศัยการทำงานร่วมกันของทีมสหสาขาวิชาชีพ เภสัชกรมีบทบาทในการค้นหาและจัดการปัญหาจากการใช้ยา เพื่อให้ผู้ป่วยมีการใช้ยาที่ถูกต้องและลดปัญหาจากการใช้ยาลง การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาอุบัติการณ์ จำแนกชนิดของปัญหาจากการใช้ยา สาเหตุและวิธีการจัดการปัญหาจากการใช้ยาในเชิงระบบ วิธีการศึกษาเป็นแบบภาคตัดขวางในกลุ่มผู้ป่วยในของโรงพยาบาลสมเด็จพระยุพราชเลิงนกทา การแบ่งชนิดของปัญหาจะใช้เกณฑ์ของ Hepler CD และ Strand LM การจัดระดับความรุนแรงของปัญหาจะใช้เกณฑ์ของ Hartwig SC และ Schneider PJ ผลการศึกษาพบว่ามีปัญหาจากการใช้ยา 98 ปัญหา (จาก 6,262 ครั้งของการรับผู้ป่วยเข้ารับการรักษาในโรงพยาบาล) คิดเป็นอุบัติการณ์ร้อยละ 1.56 พบว่าปัญหาจากการใช้ยาที่พบมากที่สุด คือ การเกิดอันตรกิริยาระหว่างยา คิดเป็นร้อยละ 32.7 รองลงมาได้แก่ การเลือกใช้ยาไม่เหมาะสมสำหรับผู้ป่วย คิดเป็นร้อยละ 17.3 อันดับที่สาม ได้แก่ การใช้ยาต่ำกว่าขนาดของการรักษา คิดเป็นร้อยละ 14.3 จากปัญหาจากการใช้ยาทั้งหมดพบว่ามีสาเหตุมาจากทั้งความผิดพลาดเชิงระบบ เช่น ระบบสารสนเทศไม่ครบวงจร การสั่งยาในผู้ป่วยในไม่มีระบบคัดกรองการเกิดอันตรกิริยาระหว่างยา ปัญหาการหมุนเวียนแพทย์จบใหม่ และความผิดพลาดเชิงบุคคล เช่น ข้อมูลที่มีจำนวนมาก และข้อมูลยาใหม่ที่ยังไม่แพร่หลาย ปัญหาเรื่องทัศนคติของแพทย์ต่อคุณภาพยาที่ผลิตในประเทศ ปัญหาทัศนคติของผู้ป่วยต่อความร่วมมือในการใช้ยา เป็นต้น ซึ่งปัญหาเหล่านี้สามารถแก้ไขได้ด้วยวิธีเชิงระบบ เมื่อคำนวนค่าใช้จ่ายที่เกิดขึ้นจากการแก้ไขปัญหาที่เกี่ยวข้องกับการใช้ยา 98 ปัญหา โดยคำนวณจากต้นทุนทางตรงทางการแพทย์ซึ่งประกอบด้วยค่าแรงของแพทย์ เภสัชกรและพยาบาล ค่ายาและค่าตรวจทางห้องปฏิบัติการ พบว่ามีค่าเท่ากับ 18,688.85 บาท

ภาควิชา เภสัชศาสตร์สังคมและบริหาร ลายมือชื่อนิสิต.....

สาขาวิชา เภสัชศาสตร์สังคมและบริหาร ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

ปีการศึกษา 2553

5076855233: MAJOR SOCIAL AND ADMINSTRATIVE PHARMACY
KEYWORDS : DRUG RELATED PROBLEMS / INPATIENTS / PRIMARY CARE SETTING

SUTHEERA TARAPHAN: INCIDENCE, CAUSES, AND MANAGEMENT COST OF DRUG RELATED PROBLEMS IN HOSPITALIZED PATIENTS AT LOENGNOKTHA CROWN PRINCE HOSPITAL. ADVISOR: ASST. PROF. PUREE ANANTACHOTI, Ph.D., 66 pp.

Drug related problems (DRPs) are important issues among organization, country, and national level. Detecting and solving DRPs are important procedures to reach patient safety goal, which can be achieved by collaboration of healthcare team including physician, pharmacist and nurse. Pharmacists play important role to detect and propose solution to eliminate drug related problems. This study aimed to determine incidence of drug related problems, causes, types of drug related problems, and cost to manage drug related problems. This study was a cross-sectional study. All patients admitted to two wards at Loengnoktha Crown Prince Hospital were observed, monitored and detected for DRPs. Type of DRPs were categorized by Hepler C.D. and Strand L.M.'s DRPs classification algorithm, while severity of DRPs were categorized by Hartwig S.C. and Schneider P.J.'s criteria. The result from this study showed that there were 98 DRPs identified from 6,262 patients. The incidence of DRPs among hospitalized patient during 10 month period at Loengnoktha Crown Prince Hospital was 1.56 %. The most frequently DRPs found was drug-drug interaction (32.7%), followed by improper drug selection (17.3%), subtherapeutic dosage (14.3%).It was found that 54.1% of DRPs were in category B (DRPs did not reach patient), 25.5% were in category A (potential to cause DRPs) and 12.3% were in category E (DRPs cause temporary harm, patient need treatment or intervention). When analyzed causes of DRPs, it was found that some of them were a result of system error e.g. information technology did not reach all hospital systems inclusively, the interchange of physicians among hospitals in province.while some of them were human error e.g. personal attitude of patients and doctors. Cost to manage DRPs was calculated using hospital perspective and included only direct medical costs e.g. wages of physicians, nurses and pharmacists, cost of drug and cost of laboratory test. In this study cost to manage 98 DRPs was 18,688.85 Baht.

Department: Social .and Administrative Pharmacy Student's Signature... Sutheera Taraphan

Field of Study: Social and Administrative Pharmacy Advisor's Signature... Puree Anantachoti

Academic Year: 2010

ACKNOWLEDGEMENTS

The author is greatful to Asst. Prof. Puree Anantachoti, Ph.D., Department of Social and Administrative pharmacy, Faculty of Pharmaceutical Sciences, Chulalongkorn University for her support and valuable comment. Author is also thankful for all encouragements from my family and my friends who are the greatest supporter to cheer me up throughout my life.

CONTENTS

CHAPTER I
INTRODUCTION

Drug related problems (DRPs) lead to substantial morbidity and mortality, as well as increased health care expenditure, which in turn affect clinical outcome, humanistic outcome and also financial outcome. DRPs were defined as adverse drug reactions, potential drug interactions, unnecessary drug therapy, inappropriate choice of drugs and untreated conditions. It has been shown to be prevail among hospitalized patients, with reported incidence rates as high as 3.3%-97.1%.[1, 2] Many factors can contribute to the high incidence rate of DRPs. DRPs have been studied internationally and most of them are avoidable. Pharmacists are assuming an active role in preventing and solving DRPs.[3]

One study of Ramathibodi Hospital aimed to identify incidence of DRPs in hospitalized HIV patients. The study was conducted in 3 medical wards at Ramathibodi Hospital. Among 35 admissions of the HIV infected patients, DRPs were identified in 34 admissions (incidence rate = 97.1%).[1] The results raised awareness among health care provider team to care for HIV patients' safety issue. This result led to initiation of routine clinical pharmacist monitoring activity for this special patient group.

Many studies showed that pharmacists effectively identified and prevented clinically significant DRPs, and many of them showed that physicians acknowledged and acted upon the clinical pharmacists' proposed suggestions to solve and prevent DRPs. In 2006, Kaboli et.al published a review about clinical pharmacist services and inpatient medical care. A total of 36 studies including more than 17,000 patients were evaluated in the review. They found that services provided by clinical pharmacist reduced adverse drug reactions or medication errors, and lessened length of hospital stay. Moreover, it helped improve medication adherence, knowledge and appropriateness of drug use. None of the studies included in the review showed negative health outcomes, but 1 of the studies showed increased higher clinical outcomes. Kaboli concluded that, in general, clinical pharmacists service improved care in hospitalized patients and there was no evidence of harm to patients.[4]

In 2004 the World Health Organization launched the World Alliance for Patient Safety which emphasis members to pay the closest possible attention to the problem of patient safety. The alliance members raised awareness and state unanimous commitment to improve patients' safety. They all agreed to facilitate the development policy and working procedure among all WHO member states.[5] In Thailand pharmacists played important role in pharmaceutical care. They searched for DRPs and provided suggestion to other health care professions to prevent and solve DRPs.

Despite the importance of DRPs, very little has been done in the in-patient department at Loengnoktha Crown Prince Hospital. This study was aimed to investigate incidence of DRPs, causes of DRPs and cost of DRPs management. The findings from this study can be used to improve drug safety system for Loengnoktha Crown Prince Hospital in the future.

1.1 Objective of the study

This study aimed to

1. Determine the incidence of DRPs in the in-patient department, Loengnoktha Crown Prince Hospital.
2. Classify DRPs according to their type and severity level.
3. Study the causes of DRPs.
4. Estimate the cost of DRPs management.

1.2 Expected contributions

1. The incidence of DRPs would help indicate the magnitude of the patient safety problems in the in-patient department, Loengnoktha Crown Prince Hospital system.
2. Causes of DRPs would help identified drug system weak point and lead to risk management system improvement.
3. Cost of DRPs management would help the board of organization realized that DRPs is importance problems found in organization and system of protecting DRPs is needed.

1.3 Hospital background

Loengnoktha Crown Prince Hospital is a 60 beds community hospital located in north-eastern of Thailand, 65 km. away from Yasothorn Province. The average numbers of patients admitted to the in-patient department are 40 patients per day in 2 wards, male and female. An average number of patient visited an out-patient department are 250 patients per day. The hospital has 4 physicians, 8 pharmacists, 108 nurses and 4 pharmacist assistances. Hospital formulary contained 319 drug items. The pharmacy department opens 24 hours every day. Loengnoktha Crown Prince Hospital has developed DRPs detecting system by the direct responsibility of the pharmacy department. There are 2 pharmacists working in the in-patient department to detect and summarize DRPs, discuss DRPs with other health care professions, and propose solution to solve DRPs.

CHAPTER II

LITERATURE REVIEW

In 2004, The World Health Organization launched the World Alliance for Patient Safety which emphasis members to pay the closest possible attention to the problem of patient safety. DRP is important problem which in turn affect both clinical outcome, economical outcome. Preventing and solving DRPs by coordination of physicians, pharmacists and nurses is important process of effective patient care.[5]

From reviewed literatures, since DRPs were defined and classified for the first time in 1990, there were several different definitions and classifications of DRPs used in pharmaceutical care eg. Hepler C.D. and Strand L.M.'s DRPs definition and classification, The American Society of Health System Pharmacists (ASHP) DRPs definition and classification, The Pharmaceutical Care Network Europe (PCNE) DRPs definition and classification.[6, 7, 8, 9]

In 1990, Strand L.M. and other definited DRPs as "an event or circumstance involving drug treatment that actually or potentially interfered with the patient experiencing an optimum outcome of medical care."[6] And classification of DRPs were created by various groups, Hepler C.D. and Strand L.M. classified DRPs as 8 types, describe as following table.[7]

Table I: DRPs classified by Hepler C.D. and Strand L.M.[7]

DRPs	DESCRIPTION
Adverse drug reaction	The patient has a medical problem that is the result of an adverse drug reaction.
Drug interactions	The patient has a medical problem that is the result of a drug-drug, drug-food interaction.
Subtherapeutic dosage	The patient has a medical problem that is being treated with too little of the correct drug.
Over dosage	The patient has a medical problem that is being treated with too much of the correct drug.

Table I: DRPs classified by Hepler C.D. and Strand L.M. (continue)[7]

DRPs	DESCRIPTION
Untreated indications	The patient has a medical problem that requires drug therapy (an indication for drug use) but is not receiving a drug for that indication.
Improper drug selection	The patient receive drug which improper for condition of patient
Patient not receiving prescribing drug	The patient is not taking a drug for medically valid indication.
Drugs use without indication	The patient is taking a drug no valid indication.

In 1996, The American Society of Health System Pharmacists change the word "drug related problems" into "medication therapy problems" and classified 13 types of medication therapy as described in Table II.[8]

Table II: Medication therapy problems classified by ASHP [8]

Type	**Drug related problems**
1	Medications with no medical indication
2	Medical conditions for which there is no medication prescribed
3	Medications prescribed inappropriately for a particular medical condition
4	Inappropriate medication dose, dosage form, schedule, route of administration, or method of administration
5	Therapeutic duplication
6	Prescribing of medications to which the patient is allergic
7	Actual and potential adverse drug events
8	Actual and potential clinically significant drug–drug, drug–disease, drug–nutrient, and drug–laboratory test interactions
9	Interference with medical therapy by social or recreational drug use
10	Failure to receive the full benefit of prescribed medication therapy
11	Problems arising from the financial impact of medication therapy on the patient
12	Lack of understanding of the medication therapy by the patient
13	Failure of the patient to adhere to the medication regimen

The definition of DRPs provided by the Pharmaceutical Care Network Europe is "an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes, a potential problem means a condition that may cause drug-related morbidity or death if no action is undertaken; an actual problem is manifested with signs and symptoms".[9] The Pharmaceutical Care Network Europe divided DRPs into six main categories and 12 subcategories describe in Table III.

Table III: DRPs classified by the Pharmaceutical Care Network Europe [9]

Category	**Definition**
1. Drug choice	One or more drugs are missing according to established national/international guidelines. Deviations from guidelines that are based on the patient's individual treatment goals and risk factors are not
1a Need for additional drug	
1b Unnecessary drug	A drug that is seen as unnecessary if the indication is no longer present, with lack of discontinuation or double prescription of two or more drugs from the same therapeutic group
1c Inappropriate drug	Not given reason for deviation from concordance between drug and diagnosis/indication or absolute/relative contraindication because of for example age or comorbidity. Deviations that are based on the patient's individual treatment goal and risk factors are not considered to be DRPs.
2 Dosing	Suboptimal dosing (including dosing time and formulation) according to established national/international guidelines. Deviations that are based on the patient's individual treatment goal and risk factors are not considered to be DRPs.
2a Too high dose	
2b Too low dose	
2c Sub-optimal dosing scheme	
3. Adverse drug reaction	Any noxious, unintended, and undesired effect of a drug, which occurs at doses in humans for prophylaxis, diagnosis, or therapy (WHO)
4. Interaction	An interaction is occurring when the effect of a drug is changed by the presence of another drug, food, drink or some environmental chemical agent. Drug combinations with intended overall effect are not considered to be DRPs.

Table II: DRPs classified by the Pharmaceutical Care Network Europe (continue)[9]

Category	Definition
5. Drug use 5a Drugs administered by health personnel	Patients' real drug use deviate from the doctor's prescription with respect to type of drug, dose or scheme. It is a prerequisite that prescriptions are based on a common understanding (concordance) between prescriber and patient (exception: patient with dementia, emergency situation etc.) Problems with logistics are not considered to be DRPs.
5b Drugs administered by the patient	
6.Other 6a Need for/lack of monitoring of effect	Monitoring with respect to effect and toxicity of drugs is not done or does not adhere to guidelines.
6b Lack of or unclear documentation of the drug chart/prescription	Monitoring with respect to effect and toxicity of drugs is not done or does not adhere to guidelines.
6c Other	In general therapy discussions that include several problems and do not belong in any other category.

In Stafford A.C. study, DRPs were classified as 7 types which were similar to DRPs classified by Hepler C.D. and Strand L.M. include drug selection, over or underdose prescribed, compliance, untreated indications, monitoring required, education and information, toxicity or adverse reaction.[7, 10]

Maring J.G. classified DRPs according to the BEDNURS study, the Bergen District Nursing Home Study which categorized DRPs into 4 categories, indication, effectiveness, safety and NA (no drug related problems) describe in Table IV.[11, 12]

Table IV: Drug-related problems categorized according to BEDNURS [12]

DRPs' group	DRPs items
Indications	Need for additional drug: undertreatment for diagnosis
	Unclear or not confirmed indication, need for review
	Unnecessary treatment: no appropriate medical indication, therapeutic or pharmacological duplication, drugs used for the treatment of avoidable adverse drug reactions
Effectiveness	Choice of drug: drug not indicated for condition, more effective drug available, contraindication present
Safety	Risk for adverse drug reactions: unfavourable safety profile
	Drug-Drug interaction
	Dosage too high
NA	No drug related problems

BEDNURS, The Bergen District Nursing Home Study is one study in Bergen, Norway. This study aimed to identify the most frequent clinically relevant medication problems and to analyse them according to the drugs involved and types of problems.[12]

Haley M. classified DRPs into 3 categories, problems related to a home medication, problems related to a postoperative medication and problems related to a potential indication for drug therapy. The prespecified DRPs were drug-allergy interactions, therapeutic duplication, non formulary drug, incorrect formulation, inappropriate dose or strength, inappropriate route of

administration, inappropriate frequency, illegible order, omission of a medication, contraindication and incorrect drug.[13]

The study of Bates D.W. studied incidence of adverse drug event. They defined adverse drug event as an injury from a drug-related intervention, which can include prescribing errors, dispensing errors and medication administration errors.[14]

Nascimento Y.A. adopted the definition and classification of DRPs professed by Second Consensus of Granada respecting Drug Related Problems 2002, describe in Table V.[15]

Table V: Classification of DRPs professed by Second Consensus of Granada respecting Drug Related Problems 2002.[15]

Necessity	Problem
Necessity	DRP 1: The patient suffers from a health problem as a result of not taking the medicine that he needs.
	DRP 2: The patient suffers from a health problem as a result of taking a medicine that he does not need.
Effectiveness	DRP 3: The patient has a health problem resulting from a non-quantitative ineffectiveness of a medicine.
	DRP 4: The patient has a health problem resulting from a quantitative ineffectiveness of a medicine.
Safety	DRP 5: The patient suffers from a health problem as a consequence of a non-quantitative safety problem of a medicine.
	DRP 6: The patient suffers from a health problem as a consequence of a quantitative safety problem of a medicine.

Cipolle R.J. and Morley P.C. classified DRPs in categories with regard to indication, effectiveness, and safety according to the "pharmaceutical care" concept for appropriate prescribing.[16]

Lertsinudom S. classified DRPs as 10 groups, adapted from study of Cipolle R.J.. There are 4 mainly types of DRPs, non compliance, adverse drug reaction, improper dosage regimen, failure to received drug, describe in Table VI. [16, 17]

Table VI: Ten groups of drug related problems adapted from study of Cipolle [16]

DRPs type and DRPs subtype
1.Non-compliance
1.1 Incorrect technique
1.2 Over dosage
1.3 Under dosage
2. Adverse drug reactions
2.1 Oral candidiasis
2.2 Hoarsiness
2.3 Sore throat
2.4 Palpitation
2.5 Etc.
3. Improper dosage regimen
4. Failure to received drug

The most fovourite classification of DRPs is Hepler C.D. and Strand L.M.'s DRPs classification because easily for understanding, cover all DRPs and user friendly in operational workers' opinion.[7]

Type of DRPs study

From reviewed literatures, there were several studies of DRPs in many countries e.g. Brazil, Saudi Arabia, India, The Netherlands, Australia, Canada and Thailand. Most of them

focus on patients at emergency department of hospital and minority focus on patients at out-patient department. Most of studies tried to estimate incidence of DRPs, cause of DRPs, process of prevent and solving DRPs, lesser parts tried to estimate cost of them. DRPs always described into two types, DRPs causing admissions and DRPs during admissions.

DRPs causing admissions

Many studies tried to identify DRPs that caused admission through all departments of hospital or other health care service. Yosef H. aimed to determine incidence of admissions through emergency department due to DRPs, type of DRPs, length of stay in hospital after admissions due to DRPs and assessment of preventability of admission due to DRPs.[2]

Harminder S. aimed to determine the incidence and nature of drug related hospital admission. Patients were prospectively observed include on admission and were followed up until discharge during a six month period.[18]

Chan M. assessed the frequency, severity and preventability of DRPs causing emergency admissions to medical units, in patients ages 75 years and over.[19]

DRPs during admissions

Many studies tried to identifine DRPs occur during patients admitted in health care service. Nascimento Y.A. aimed to study DRPs in patients admitted to hospital due to DRPs.[15] Furthermore Lertsinudom S. aimed to study DRPs in out-patient department.[17] And Blix H.S. and Maring J.G. aimed to describe the frequency and type of DRPs in hospitalized patients and in nursing home patients.[9, 12]

From the studies of DRPs causing admission to wards, Harminder S. and Vial J.H. and DRPs causing admission to emergency department, Korakotchamat S. show incidence of DRPs as 3.3%, 30.4% and 36.9 respectively.[18, 19, 20] From the studies of DRPs during admission, Chanatepaporn P., Bantao K., San-aree R. and Chanthasopeephan S., show incidence of DRPs as 23.5%, 33.0%, 91.3% and 5.5% respectively.[21, 22, 23, 24]

From all DRPs studies, the incidence of DRPs varied from 3.3%-91.3%. Factors that contributed to vary incidence can be described as the study population, the size of hospital, the methodology for DRPs detecting. The studies of Vial J.H., Chongwiriyanurak C. and San-Aree R. collected DRPs in elderly, but the studies of Bantao K. collected DRPs in diabetes mellitus patient, Chanthasopeephan S. collected DRPs data in chronic obstructive pulmonary disease.[19, 22, 23, 24, 25] Furthermore the size of hospital was an important factor which contributed to different incidence of DRPs, Bantao K. and Chongwiriyanurak C. studied DRPs in primary hospital but Vial J.H., San-Aree R., Y.A.Nascimento, Harminder S. studied in tertiary or university hospital[15, 18, 19, 22, 23, 25]. Methodology of DRPs detecting were variety, the study of Yosef H. detected and collected DRPs by 3 committees included physicians and pharmacists who had minimum 8-years experience in work , the study of Harminder S. detected and collected DRPs by physicians, the study of Chanatepaporn P. detected and collected DRPs by a pharmacist.[2, 18, 21] The study of Maring J.G., there are 3 hospital pharmacists and 12 nursing home physicians with 2-years specialist training participated in DRPs detecting.[12] The study of Haley M., there were 2 licensed pharmacists involved in medical records reviewing and identifying DRPs from assessment form which were completed by a preadmission nurse.[13]

Severity of DRPs

There were several categories of DRPs severity create by various researchers. In 1988 Hatoum H.T. tried to estimate severity of DRPs as 6 types of effect of suggestion (Intervention Ranking System)[26] describe as following.

1. Adverse significance = the suggestion lead to terrible clinical.
2. No significance = the suggestion can not solve DRPs but can help to prevent other DRPs.
3. Somewhat significance = the suggestion can completely solve DRPs.
4. Significance = the suggestion lead to practice guideline drug using.
5. Very significance = the suggestion can help to prevent adverse reaction which lead to organ failure or permanently disability.
6. Extremely significance = the suggestion can safe patients' life.

Hartwig S.C. and Schneider P.J. classified the severity of DRPs as 9 types [27], describe in Table VII.

Table VII: Definitions and Severity Level created by Hartwig and Schneider [27]

Severity	Definition
type A	Potential to cause error
type B	Error did not reach patient
type C	no patient harm
type D	no patient harm; increase monitoring
type E	caused temporary harm; treatment or intervention
type F	caused temporary harm; initiated or prolonged hospitalization
type G	caused permanent patient harm
type H	near-death event (cardiac arrest, anaphylaxis)
type I	patient death

The study of Chanatepaporn P. classified the severity of DRPs with regard to potential clinical impact score as 6 level.[21]

- Adverse significance
- No significance
- Somewhat significance
- Significance
- Very significance
- Extremely significance

Pirmohamed M. classified the severity of DRPs as mild, moderate and

severe.[28]

- Mild refer to laboratory abnormality or symptom not requiring treatment
- Moderate refer to laboratory abnormality or symptom requiring treatment or admission to hospital or resulting in non-permanent disability
- Severe refer to laboratory abnormality or symptom that was life-threatening or resulted in permanent disability or fatal.

In Thailand, the famous severity classification is Hartwig S.C. and Schneider P.J. 's severity classification both in medication error and DRPs.[27]

Incidence of DRPs

From the reviewed literatures, many studies found different incidence.

Table VIII: DRPs incidence found in reviewed literatures

Researcher	**Study's site**	**Population of study**	**Incidence rate**
San-Aree R.[23]	Tertiary hospital	All geriatric patients in geriatric clinic	91.3%
Korakotchamat S.[20]	University hospital	All adult patients admitted to ER-department of hospital due to DRPs	36.9%
Chongwiriyanurak C.[25]	At home in Long District, Phrae	All geriatric patients after discharge from Long Hospital, Phrae	74.1%
Vial J.H.[19]	Major public acute care hospital	All 75 years or older patients admitted to ward (240 cases)	30.4%
Maring J.G.[12]	Five Dutch nursing homes	All nursing home patients meeting polypharmacy criterion; patients received	62.0%

		more than 9 drugs (105 cases)	
Chanatepaporn P.[21]	Tertiary hospital	All patients admitted to ward	23.5%
Bantao K.[22]	Primary hospital	DM patients admitted to hospital. (91 cases)	33.0%
Haley M.[13]	Tertiary hospital	Patients undergoing elective joint arthroplasty	79.5%
Nascimento Y.A. [15]	University hospital	All patients submitted to pharmacotherapeutic follow-up	73.6%
Chanthasopeephan S.[24]	Secondary hospital	COPD patients in out-patient department	54.7%
Yosef H. Al-olah.[2]	Tertiary hospital	Patients admitted to ER-department of hospital due to DRPs	14.7%
Kongkathong T.[29]	Two tertiary hospital	Cardio-vascular disease patients admitted to hospital.(23 and 24 cases)	60.9% and 70.8%
Werawathanachai C.[30]	Tertiary hospital	DM patients admitted to hospital (100cases)	0.6%

From reviewed literatures, there were various studies of DRPs. Many factors lead to different incidence of DRPs.

The difference of study site may lead to different incidence of DRPs found. In larger hospital, tertiary hospital, university hospital can contribute to higher DRPs incidence found e.g. the study of San-Aree R. studied in tertiary hospital and found 91.3% of DRPs incidence, the study of Nascimento Y.A. studied in university hospital and found 73.6% of DRPs incidence.[15, 23]

The difference of methodology may lead to different incidence of DRPs found. Mainly, there are 2 types of methodology in collecting incidence of DRPs, DRPs cause admission and DRPs during admission. The study of Yosef H. and Korakotchamat S. collected the incidence of patients who admitted to ER department due to DRPs, when the study of Nascimento Y.A. and Bantao K. collected the incidence of DRPs during patient stayed in hospital.[2, 15, 20, 22] Furthermore there are some studies collected incidence of DRPs in out-patient department e.g. the study of Chanthasopeephan S. collected incidence of DRPs in chronic pulmonary obstructive disease patients in out-patient department.[24] The process of DRPs detecting are difference among reviewed literatures e.g. the study of Yosef H. detected DRPs by 3 committees include minimum 8-years experience physicians and pharmacists, the study of Harminder S. detected DRPs by physicians, the study of Chanatepaporn P. detected DRPs by a license pharmacist.[2, 18, 21]

The difference of population may lead to difference incidence of DRPs found. In some DRPs studies, the researchers focused on patient with special disease e.g. the study of Haley M. collected DRPs in patients undergoing elective joint arthroplasty, the study of Bantao K. collected DRPs in diabetes mellitus patients admitted to hospital.[13, 22] And there are some studies collected DRPs in all patients e.g. the study of Chanatepaporn P. and Nascimento Y.A. collected DRPs in all patients during study period.[15, 21]

Inconclusion there were several DRPs studies especially in large size hospitals e.g. secondary hospital, tertiary hospital, university hospital. But the studies were limited in primary hospital, which was huge amount in Thailand. Loengnoktha Crown Prince Hospital is primary hospital beneath to the Ministry of Public Health, focus on quality of patient care and patient safety. Loengnoktha Crown Prince Hospital specified risk management policy for patient safety

and supported the research which help clarify DRPs, cause of DRPs for development of hospital.

CHAPTER III
METHODOLOGY

This study aimed to determine the incidence of DRPs during patients were hospitalized. Cause and type of DRPs, severity of DRPs were identified. Cost of DRPs management were also calculated. The researcher defined DRPs as an event or circumstance that involves a patient's drug treatment that actually, or potentially, interferes with the achievement of an optimal outcome. The DRPs were detected and collected by pharmacist. All admissions during study period were included in the study with no exclusions. The study was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University with the protocol review number 10-33-005.

3.1 Study design

This study was a cross-sectional study. Data was collected during 1th March, 2010 to 31th Dececember, 2010 (10 months).

3.2 Population

All patients admitted to 2 wards; male and female wards, of Loennoktha Crown Prince Hospital.

3.3 Sample size

Sample size calculation is based on 2 objectives which use different formula.

- sample size for estimating DRPs incidence can be calculated according to the following formula

$$n = ((Z_{(\infty/2)})^2 \times P \times Q) / M^2$$

n = required sample size

P = estimated prevalence of DRPs in study area

(from study of Werawathanachai C.[30] , the prevalence of DRPs = 10% = 0.10)

$(Z_{\infty/2})$ = confidence level at 95% (standard value of 1.96)

Q = (1-P) = 0.90

M^2 = margin of error at 5% (standard value of 0.05)

the magnitude of problem will be calculated the sample size by

$$n = \frac{Z^2 \times P \times Q}{M^2}$$

when substitute formular by data, show

$$n = \frac{1.96^2 \times 0.10 \times 0.90}{0.05^2}$$

$$n = 138$$

- Sample size for the cost associated with DRPs can be calculated according to the following formula

$$n = ((Z_{(\infty/2)})^2 \times \sigma^2) / e^2$$

n = required sample size

$(Z_{\infty/2})$ = confidence level at 95% (standard value of 1.96)

σ = standard deviation

e = the proportion of error we are prepared to accept

(unknown σ can estimate e in term of percentage of σ)

(e = 10% of σ : e = 0.10 σ)

$$n = ((1.96)^2 \times \sigma^2) / (0.10\,\sigma)^2$$

$$n = 384.16$$

In order to estimate cost to manage DRPs, the researcher needed 384 DRPs. Therefore all sample size which enough for this study is 384/10% = 3840

3.4 Measurement

In this study, the 2 registered pharmacists reviewed doctor order sheet every day. The data from doctor order sheet was secondary data. Two pharmacists used the definition and classification of DRPs from Handbook of Pharmacy in Primary Healthcare Service. Before the data collection start, this 2 pharmacists agreed how to detect DRPs. The data collection form were composed with 3 parts including:

1. Patient's demographic data e.g. name of patient, age, hospital number (HN), admission number (AN), underlying disease, length of stay (LOS).
2. DRPs's detail e.g. type of DRPs, description of DRPs, severity of DRPs.proposed intervention to solve/prevent DRPs
3. Conclusion of DRPs after consulting with physicians or nurses, and the final decision from health care team of how to solve DRPs.

3.6 Statistical Analysis

Descriptive statistic was used to describe the incidence of DRPs, cost of DRPs management. Data was described in term of percentage, mean, min-max and standard deviation.

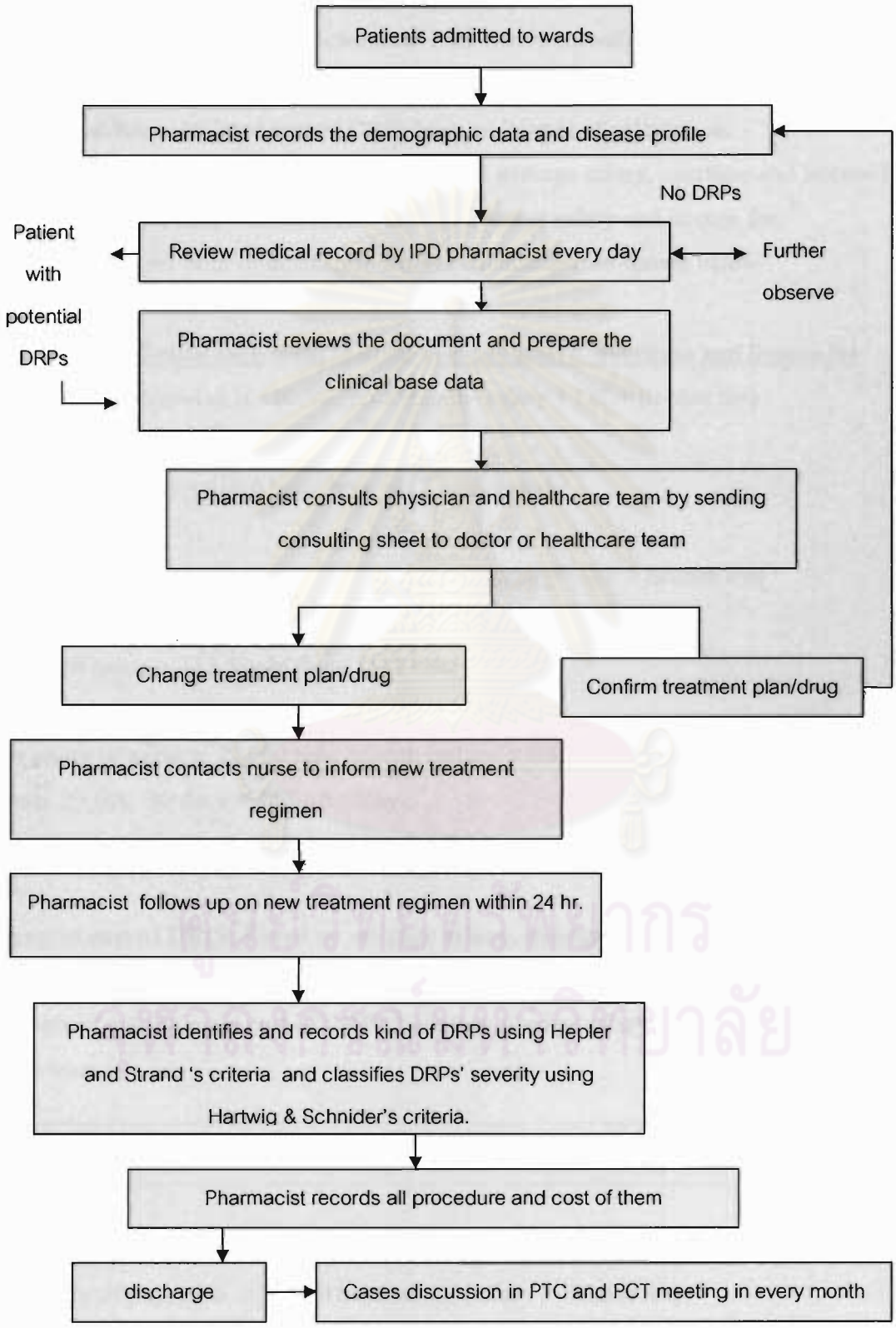
3.7 Process to detect DRPs

In this study the researcher categorized the type of DRPs base on Hepler C.D. and Strand L.M. criteria.[7] The severity of DRPs were categorized base on Hartwig S.C. and Schneider P.J.criteria.[27] All patients admitted to two wards, male and female ward of Loengnoktha Crown Prince Hospital during 1th March, 2010 - 31th Dec, 2010 were observed. Patients' medical record and patients' drug profile will be reviewed by in-patient department pharmacists every day. The review took about 10 - 15 minutes per patient per day. When DRPs or potential DRPs in pharmacist's opinion is identified, pharmacist prepare clinical base data and send consulting sheet/clinical base data to the physician. If physician confirm to continue drug regimen, pharmacist will classify case as **patient with potential DRPs** and need closely observed. If physician confirm to change or stop drug regimen, pharmacist classify case as **patient with DRPs** then contact nurse and healthcare team to inform new drug regimen. Pharmacist follow up on new treatment regimen at ward, start within 24 hours after new treatment regimen is ordered.

In every month, pharmacist conclude all DRPs detected and process of solving DRPs and bring them into The Patient Care Team (PCT) meeting and Pharmaco-Therapeutic Committee (PTC) meeting. The healthcare team in both meeting discuss all DRPs found in the month and find out the way to protect them. The causes of DRPs in this study were categorized into two types of error, system error and human error. An in-patient department pharmacist analysed causes of DRPs and recorded them.

Pharmacist collect general demographic data of **patient with DRPs or potential DRPs**, cause and type of DRPs, severity of DRPs, detail of the event, time and procedure of solving DRPs from the first step until finish. Then calculate cost of DRPs management, in hospital perspective. The same type of DRPs may need same time period to manage them, in this study the researcher collect cost of DRPs management base on algorithm of wages of healthcare team (physician, nurse and pharmacist), cost of drug and cost of required laboratory test. And then pharmacist calculate incidence of DRPs. Process of study describe in diagram I.

Diagram I: Process in Identifying, Confirming DRPs, Adjusting drug regimen



3.8 Management cost estimation

When the process of DRPs solving finished. The researcher recorded time period spent in DRPs solving (since DRPs were detected until DRPs were solved) and calculated cost by multiply time period spent in DRPs solving with wage per hour of healthcare worker. In this study, the researcher calculated cost of DRPs base on 2 types of calculation.

1. Wage per hour of health care worker include average salary, overtime and license fee
2. Wage per hour of health care team include average salary and license fee

The detail of wage per hour of healthcare worker calculation are shown below

Wage per hour of health care team include average salary, overtime and license fee

Average salary of physician is 100,000 baht/month (salary + OT.+ license fee)
In a month 100,000/30days =3,333 baht /day
In a day 3,333 /8 hours = 416.6 baht /hour (417 baht /hour)

Average salary of pharmacist is 27,000 baht /month (salary + OT.+ license fee)
In a month 27,000 /30 days = 900 baht /day
In a day 900/8 hours = 112.5 baht /hour (113 baht /hour)

Average salary of nurse is 23,000 baht /month (salary + OT.+ license fee)
In a month 23,000 /30 days = 767 baht /day
In a day 767/8 hours = 95.8 baht /hour (96 baht /hour)

Management cost of DRPs, based on average salary, overtime and license fee of healthcare team

Formula of management cost of DRPs, based on average salary, overtime and license fee of healthcare team is

(number of cases patient with DRPs) ×(total time spend) ×(wage/hour of healthcare team)

Wage per hour of health care team include average salary and license fee

Average salary of physician is 70,000 baht/month (salary + license fee)

In a month 70,000/30days =2,333 baht /day

In a day 2,333 /8 hours = 291.6 baht /hour (292 baht /hour)

Average salary of pharmacist is 19,000 baht /month (salary + license fee)

In a month 19,000 /30 days = 633 baht /day

In a day 633/8 hours = 79.1 baht /hour (79 baht /hour)

Average salary of nurse is 15,000 baht /month (salary + license fee)

In a month 15,000 /30 days = 500 baht /day

In a day 500/8 hours = 62.5 baht /hour (63 baht /hour)

Management cost of DRPs, based on average salary and license fee of healthcare team

Formula of management cost of DRPs, based on average salary and license fee of healthcare team is

(number of cases patient with DRPs) × (total time spend) × (wage/hour of healthcare team)

** wage = salary and license fee

Other cost included cost of drug use in solving DRPs and cost of required laboratory test when DRPs were detected. The researcher adds all cost together and record into data collecting form. (see appendix B)

3.9 Operational definition

Incidence: is the number of new cases of a condition, symptom, death, or injury that arise during a specific period of time, such as in a year. It is often expressed as a percentage of a population. Incidence shows the likelihood that a person in that population will be affected by the condition. In this study incidence of DRPs is number of new cases of patient with DRPs during 10 months, March-December 2010.

Incidence of DRPs can be calculated by following formula

$$\text{Incidence of DRPs} = \frac{\text{number of cases with DRPs identified}}{\text{number of patients admission during the study period}}$$

incidence of DRPs from each item of drug can be calculated by following formula

$$\text{Incidence of DRPs from each drug} = \frac{\text{a new case of DRPs from each item of drug during study period}}{\text{all patients use each item of drug during study period}}$$

Drug Related Problems (DRPs): In this study, the researcher will categorize the DRPs by using criteria created by Hepler C.D. and Strand L.M. criteria.[7] which categorized DRPs to 8 types, adverse drug reaction, drug interactions, drug use without indication, patients not receive prescribing drug, improper drug selection, over dosage, subtherapeutic dosage, patient require drug therapy but not receiving.

Cost: in this study the researcher collect the direct medical cost include salary of physician, nurse, pharmacist (wages per time period spending to solve DRPs), cost of drug and cost of required laboratory test in hospital perspective.

CHAPTER IV
RESULT

This study aimed to determine the incidence of DRPs during patients were hospitalized. Cause and type of DRPs, severity of DRPs were identified. Cost of DRPs management were also calculated. Loengnoktha Crown Prince Hospital is a primary hospital in Yasothon province. Generally, there are four physicians, eight pharmacists, one hundred and eight nurses on duty. The hospital has sixty beds available. On average the hospital provides outpatient service to three hundreds patients per day, and provides inpatient service to fifty patients per day. Data was collected during 1th March, 2010 to 31th Dec, 2010. The findings were devided into 4 parts

1. Patients' characteristic
2. DRPs among hospitalized patient
3. Causes of DRPs found
4. Management cost regarding DRPs

4.1 Patients' characteristic

During the study period, there were 6,262 admissions with a total of 5,051 patients hospitalized at the Loengnoktha Crown Prince Hospital. Most of the patients (86.1%) were admitted once, however, 13.1% of the patients hospitalized 2-5 times and 0.7 % hospitalized more than 5 times.

Among those hospitalized cases, 42.7% were male and 57.3% were female. The average age of hospitalized cases was 38.0±27.1 year (0-99 years). It was found that patients in 0–10 age group were the most prevalent group (23.1%), followed by those in 61-70 and 51-60 age group (12.4% and 11.9%), respectively. An average length of stay for these patients was 3.7±2.4 days with the range between 1–34 days. One of all patients stayed in hospital longer than 65 days with economic problems, was not include into the study. For each admission, it was found that an average drug items prescribed was 8.6±4.8 with the range between 1-42 items.

Table IX: Patients' Characteristics

Patient's characteristics		**n (%)**
Gender		
Male		2,675 (42.7)
Female		3,587 (57.3)
Age	*mean ± SD (min, max)*	*38.0 ± 27.1 (0-99)*
0-10		1,449 (23.1)
11-20		638 (10.2)
21-30		573 (9.2)
31-40		582 (9.3)
41-50		602 (9.6)
51-60		746 (11.9)
61-70		774 (12.4)
71-80		651 (10.4)
80 up		247 (3.9)
Length of stay	*mean ± SD (min, max)*	*3.7± 2.4 (1-34)*
Number of drug items	*mean ± SD (min, max)*	*8.6 ± 4.8 (1- 42)*
4-6		1,299 (20.7)
7-10		2,016 (32.2)
11-20		1,844 (29.4)
> 21		127 (2)
Number of admission		
1 admission		4,351 (86.1)
2-5 admission		664 (13.1)
≥ 5 admission		36 (0.7)
Top 5 Primary diagnosis		
Diarrhoea and gastroenteritis of presumed infectious origin		598 (9.5)
Spontaneous vertex delivery		396 (6.3)
Singleton, born in hospital		372 (5.9)
Fever, unspecified		210 (3.4)
Non-insulin-dependent diabetes mellitus, without complications		170 (2.7)

Note: The number shown in table is number of admission cases, not number of patients.

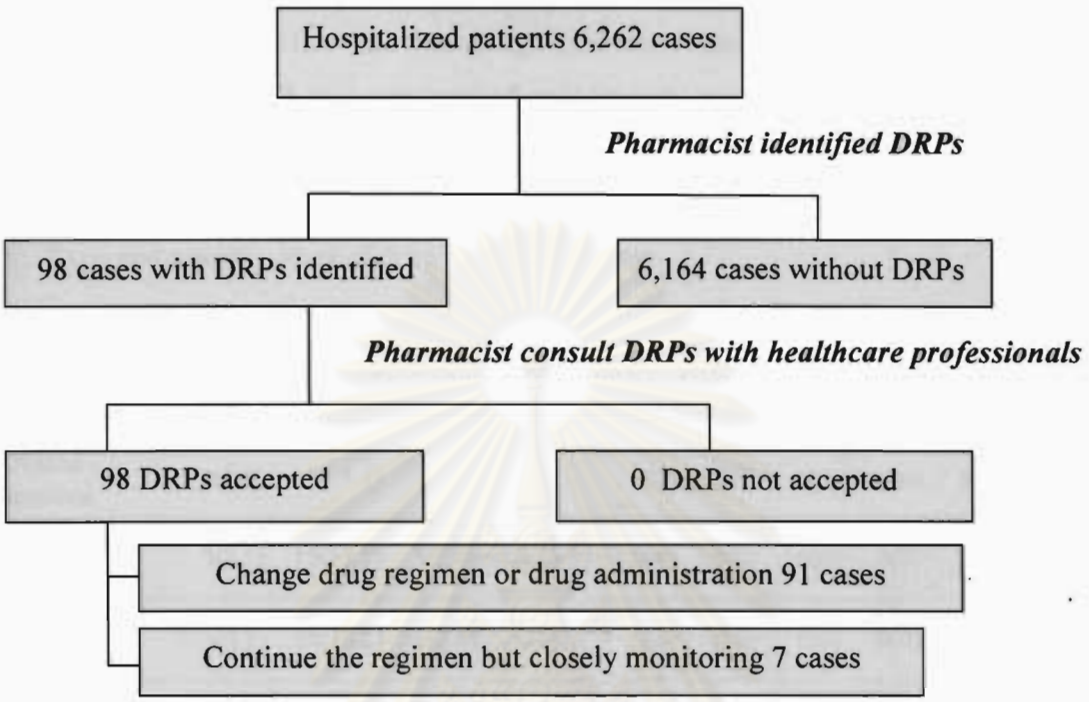
The top 5 primary diagnosis of these hospitalized patients were diarrhea and gastroenteritis of presumed infectious origin (9.5%), spontaneous vertex delivery (6.3%), singleton born in hospital (5.9%), fever unspecified (3.4%), and non-insulin dependent diabetes mellitus, without complications (2.7%).

For patients that admitted to the hospital more than 5 times during the study period, they were diagnosed with non-insulin dependent diabetes mellitus, without complication, chronic ischaemic heart disease, unspecified, and diarrhea and gastroenteritis of presumed infectious origin.

4.2 Identifying DRPs

Generally, when patients were admitted to the hospital, pharmacist would check for any DRPs from doctor order sheet. If DRPs arose, pharmacist would prepare the consulting sheet by clearly identify problems and provide adequate references. Reference frequently use e.g. Drug Information Handbook 14th edition, Handbook of Injectable Drugs, MIMs, Drug Interaction Fact and internet. Complete consulting sheet composed with name of patient, hospital number, admission number, DRPs which are detected from pharmacist's opinion, proposed solution and reference. Complete consulting sheet were then sent to physician. Pharmacist followed up on consulting sheet with physician by phone or met for discussion and sent additional document to physician as requested. When the physician made decision on drug regimen and sent the consulting sheet back. Pharmacist rechecked order and contacted nurse to inform any changes. Pharmacist followed up on new drug regimen which would start within 24 hours after new regimen issued. There were some cases that DRPs would be solved by special pharmacist advice to the patients e.g. patients reject Budesonide inhaler, pharmacist gave special advice about important of drug for protect acute exacerbation. In this case the pharmacist would talk directly to patients and their care givers. The result of the study was showed in diagram II.

Diagram II : Drug Related Problems and Physicians' response



From this study, 98 cases with DRPs were identified. All of them were resolved. Physician respond to consulting procedure with standard guideline 91 cases and no response to consulting procedure 7 cases with giving special reason by physician. These 7 cases were closely observed by healthcare workers. Each reported problem came from a single admission case. Among 98 cases, 54 were female. Age of those patients identified with DRPs range between 7 month to 88 years. It can be said that during ten months period, the incidence rate of DRPs among hospitalized patients in Loengnoktha Crown Prince Hospital was 1.56%. Calculation of incident rate was showed below

$$= \frac{98}{6{,}262}$$

$$= 0.0156$$

$$= 1.56\%$$

DRPs were classified by type and severity. It was found that the most type of DRPs frequently found was resulting from drug-drug interaction (32.7%), followed by improper drug

selection (17.3%), and sub-therapeutic dosage (14.3%), accordingly. In this study, there was no case of drug use without indication.

Most of DRPs identified case was categorized into A and B severity level (25.5% and 54.1%). However 12 cases (12.2%) were ranked as E severity level. More detail was shown in Table IX.

Table X: Type and severity level of drug related problems

DRPs	**Severity n (%)**									**Total**
	A	B	C	D	E	F	G	H	I	
Untreated indications	2(2.0)	5(5.1)	0(0)	0 (0)	0(0)	0(0)	0(0)	0(0)	0(0)	7(7.1)
Improper drug selection	3(3.1)	12(12.2)	2(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	17(17.3)
Subtherapeutic dosage	3(3.1)	10(10.2)	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	14(14.3)
Over dosage	2(2.0)	9(9.2)	2(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	13(13.3)
Adverse drug reaction	1(1.0)	1(1.0)	0(0)	0(0)	11(11.2)	0(0)	0(0)	0(0)	0(0)	13(13.3)
Drug-drug interaction	14(14.3)	16(16.3)	2(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	32(32.7)
Patient not receiving prescribing drug	0(0)	0(0)	1(1.0)	0(0)	1(1.0)	0(0)	0(0)	0(0)	0(0)	2(2.0)
Drug use without indication	0(0)	0(0)	0(0)	0 (0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Total	25(25.5)	53(54.1)	8(8.2)	0(0)	12(12.2)	0(0)	0(0)	0(0)	0(0)	98(100)

Incidence of DRPs from each drug were calculated by the following formula

$$= \frac{\text{A new case of drug related problems from each drug during study period}}{\text{Patient use each drug during study period}}$$

The results were showed in table XI

selection (17.3%), and sub-therapeutic dosage (14.3%), accordingly. In this study, there was no case of drug use without indication.

Most of DRPs identified case was categorized into A and B severity level (25.5% and 54.1%). However 12 cases (12.2%) were ranked as E severity level. More detail was shown in Table IX.

Table X: Type and severity level of drug related problems

DRPs	**Severity n (%)**									**Total**
	A	B	C	D	E	F	G	H	I	
Untreated indications	2(2.0)	5(5.1)	0(0)	0 (0)	0(0)	0(0)	0(0)	0(0)	0(0)	7(7.1)
Improper drug selection	3(3.1)	12(12.2)	2(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	17(17.3)
Subtherapeutic dosage	3(3.1)	10(10.2)	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	14(14.3)
Over dosage	2(2.0)	9(9.2)	2(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	13(13.3)
Adverse drug reaction	1(1.0)	1(1.0)	0(0)	0(0)	11(11.2)	0(0)	0(0)	0(0)	0(0)	13(13.3)
Drug-drug interaction	14(14.3)	16(16.3)	2(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	32(32.7)
Patient not receiving prescribing drug	0(0)	0(0)	1(1.0)	0(0)	1(1.0)	0(0)	0(0)	0(0)	0(0)	2(2.0)
Drug use without indication	0(0)	0(0)	0(0)	0 (0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Total	25(25.5)	53(54.1)	8(8.2)	0(0)	12(12.2)	0(0)	0(0)	0(0)	0(0)	98(100)

Incidence of DRPs from each drug were calculated by the following formula

$$= \frac{\text{A new case of drug related problems from each drug during study period}}{\text{Patient use each drug during study period}}$$

The results were showed in table XI

Table XI: Incidence of drug which caused DRPs

no	Drug which caused DRPs	case	total	% incidence	Group of drug
1	Ethambutol	5	81	6.2	Anti-TB drug
2	Aluminium Hydroxide gel	30	520	5.8	Antacid
3	Rifampicin	5	86	5.8	Anti-TB drug
4	Vit B6	5	86	5.8	Anti-TB drug
5	PZA	4	69	5.8	Anti-TB drug
6	Digoxin	3	72	4.2	Cardiac glycoside
7	Norfloxacin	20	567	3.5	Antibiotic(fluoroquinolone)
8	Oseltamivir	9	308	2.9	Antiviral
9	Ranitidine	6	224	2.7	H2-blocker
10	Isoniazid	2	80	2.5	Anti-TB drug
11	Cloxacillin	3	124	2.4	Antibiotic (penicillin)
12	Ofloxacin	4	237	1.7	Antibiotic(fluoroquinolone)
13	Furosemide	6	382	1.6	Diuretic
14	Amlodipine	8	615	1.3	Calcium antagonist
15	Cefazolin	2	168	1.2	Antibiotic (cephalosporin)
16	Clindamycin	2	184	1.1	Antibiotic
17	Prazocin	1	94	1.1	Alpha 1-antagonist
18	Isosorbide dinitrate	2	243	0.8	Nitrate
19	Aspirin	4	586	0.7	Antiplatelet
20	Metformin	2	271	0.7	Biguanides
21	Budesonide	1	167	0.6	Inhale corticosteroid
22	Salbutamol	1	175	0.6	Bronchodilator
23	Gemfibrozil	1	193	0.5	Fibrates
24	Metronidazole	1	266	0.4	Antibiotic
25	Ceftriaxone	6	1,613	0.4	Antibiotic (cephalosporin)

Table XI: Incidence of drug which caused DRPs (continue)

no	Drug which caused DRPs	case	total	% incidence	Group of drug
26	Ampicillin	2	469	0.4	Antibiotic (penicillin)
27	Roxithromycin	1	273	0.4	Antibiotic (macrolides)
28	Lorazepam	1	395	0.2	Benzodiazepine
29	Enalapril	1	560	0.2	ACEs inhibitor
30	Ferrous fumarate	2	1,077	0.2	Vitamin supplement
31	DN/2	1	1,673	0.1	IV fluid
32	Folic acid	1	974	0.1	Vitamin supplement

From this table, drug which frequently caused DRPs were Ethambutol, Aluminium Hydroxide gel, Rifampicin, Vit B6 and Pyrazinamide. Four of five drugs which frequently caused DRPs in Loengnoktha Crown Prince Hospital were anti-tuberculous drug.

There are several kinds of DRPs found in Loengnoktha Crown Prince Hospital. The problems describing, identifying and solving are importance process for reducing and preventing DRPs.

I. Untreated indications

There were 7 cases of patients identified as untreated indication, classified into two types of errors. First type of error is patients require drug therapy but not receiving in case of physician forget to review medication record of patients and second type of error is patients who admitted to ward, can not give the information about patient's health history e.g. patients who received drug for treat chronic disease from another hospital and admitted to ward of Loennoktha Crown Prince Hospital with accidental. During staying in ward, patients and healthcare givers can not give the information about patient's health history to healthcare workers.

The causes of these DRPs are system error and human error. System error arose from there were no standard procedure for communicate about patients' medical history among hospitals and human error arose from urgency in office hours.

From these DRPs, pharmacist initiated medical reconciliation to solve problems. Medical reconciliation is a tool for patients' medical history communication among hospital.

And followed patient's drug using from another hospitals by phone or suggest relative of patients to bring patients' chronic disease drug to Loengnoktha Crown Prince Hospital.

II. Improper Drug Selection

There were 17 cases identified as improper drug selection e.g. patients with relapse pulmonary tuberculosis, physician ordered anti-tuberculosis drug category I (2HRZE/4HR) which is not proper to relapse case. Pharmacist suggested to change drug regimen in to anti-tuberculosis drug category II (2HRZES/1HRZE/5HRE). The difference of anti-tuberculous drug category I and catgory II are type of drug and time period of using drug. The cause of this error is human error. Because tuberculosis is the disease which not frequently found in site of this study, therefore physicians are inexperience and contribute to errors occur.

Patients were diagnosed as diabetes mellitus (DM), physician ordered 5%DN/2 1000 ml as intravenous fluid. Pharmacist suggested to change in to 0.9%NSS 1000 ml to reduce risk of hyperglycemia in DM patient. The cause of this DRPs is human error, because large amount of patients and urgency in office hours can cause confusion and contribute to this DRPs.

Patient age 24 days and 10 months were prescribed Oseltamivir for prevent influenza during breakout period, information from Thai Food and Drug Administration show that Oseltamivir have no clinical data using in neonatal and WHO suggest using in children age more than 1 year, in these cases pharmacist suggested to discontinue Oseltamivir and changed therapeutic plan into supportive treatment. The cause of these DRPs is system error, lacking of source of new drug information can contribute to these DRPs.

Patient having respiratory tuberculosis were prescribed vitamin B complex for treat Isoniazid induced neuritis which composed with 1.2 mg of vitamin B6, in this case pharmacist suggested to change in to vitamin B6 100-200 mg. per day. The cause of these DRPs is human error, because healthcare worker did not know usual dose of drug.

III. Subtherapeutic dosage

There were 14 cases identified as subtherapeutic dosage. From this study, fifty kilogram body weight's patient who having pulmonary tuberculosis, was prescribed Ethambutol

800 mg once daily. Data base on Drug Information Handbook 10th Anniversary Edition show that usual dose for patients who have received previous antituberculous drug is Ethambutol 25 mg per kilogram of body weight, as a single dose once daily. Pharmacist suggested to change in to 1200 mg once daily. The cause of these DRPs is human error, because healthcare worker did not know usual dose of drug.

Patient who having chronic ischaemic heart disease, was prescribed isosorbide dinitrate 5 mg three times daily. Data base on Drug Information Handbook 10th Anniversary Edition show that initial dose of isosorbide dinitrate for chronic heart failure is 10-20 mg., 3-4 times daily. In this case pharmacist suggested to change dose of isosorbide dinitrate into optimal dose. The cause of this DRP is human error, because healthcare worker did not know usual dose of drug.

Patient weigh 20 kilogram was prescribed Ceftriaxone injection 400 mg IV once daily. Data base on Drug Information Handbook 10th Anniversary Edition show that usual dosage of Ceftriaxone is 50-75 mg. per kilogram per day. In this case physician changed dose of Ceftriaxone into 1 gm. per day. The cause of this DRP is human error, because healthcare worker did not know usual dose of drug.

IV. Over dosage

There were 13 cases identified as over dosage. Patients having primary hypertension were prescribed Amlodipine 5 mg. 2 tablets twice daily. Data base on Drug Information Handbook 10th Anniversary Edition show that maximum dosage of Amlodipine is 10 mg. per day. Pharmacist suggested to change dose of Amlodipine into 10 mg. per day. In these case physician confirmed the order, because physician did not believe that quality of locally made drug make equal with patent drug. Cause of these DRPs is human error, physician has negative attitude to quality of locally made drug.

Patient who having pulmonary tuberculosis was prescribed vitamin B6 100 mg three times daily, Data base on Drug Information Handbook 10th Anniversary Edition show that maximum dose of vitamin B6 for treat drug-induced neuritis is 200 mg once daily. Pharmacist

suggested to change dose of vitamin B6 into 200 mg. per day and physician accepted. The cause of this DRP is human error, because healthcare worker did not know maximum dose of drug.

V. **Resulting from adverse drug reaction**

There were 13 cases of patients with adverse drug reaction problems. Four cases of DRPs are resulted from Ceftriaxone adverse reaction e.g. skin reaction (erythrematous rash, urticaria, angioedema), respiratory reaction (airway obstruction). In this case pharmacist suggested to discontinue suspected drug and gave the drug allergy alert card and special advice to patients.

Patient had adverse drug reaction from Enalapril, with chronic cough. Pharmacist suggested to change anti-hypertensive drug (ACEs inhibitor) into drug in calcium channel blocker group to reduce side effect of them.

Patient had adverse drug reaction from Furosemide, have to frequently wake up at night to urinate. Pharmacist suggested to adjust time of diuretic drugs in to after breakfast and lunch especially in elderly, to decrease effect of incontinence.

Patient has adverse drug reaction from Aspirin, GI irritate after take 81 mg. once daily for treat ischaemic heart disease. Pharmacist suggested to adjust time of Aspirin to with meal and add H2-blocker or proton pump inhibitor to reduce effect of Aspirin.

The cause of these DRPs is human error, most of adverse drug reaction is reaction which unpredictable but healthcare worker can prevent them.

VI. **Resulting from drug-drug interaction**

Patient who have DRPs resulting from drug-drug interaction (32 cases), most of them resulted from Aluminium Hydroxide gel and Norfloxacin (19 cases). Aluminium Hydroxide gel may decrease the absorption of quinolone antibiotics with significance level 2, rapid onset and severity level is moderate. In these cases pharmacist suggested to separate time of each drug atleast 2 hours to decrease interaction.

A case is resulted from Digoxin and Furosemide, drug- drug interaction with significance level I, delayed onset and severity level is major. Data from Drug Interaction Fact 2006 show that this interaction can cause hypokalemia (Hypo K^+). In this case physician confirmed order but followed up serum potassium (K^+).

Drug-Drug interaction in Loengnoktha Crown Prince Hospital can solve in various ways. In some cases, pharmacist suggested nurse to separate time of drug administration to reduce effect but in some cases, change drug regimen or discontinue couples of drug which cause interaction is needed. The cause of these DRPs is system error, process of patients' admission to ward is not allow physician to meet drug-interaction pop up alert.

V. **Patient not receiving prescribing drug**

Patient was diagnosed as asthma with acute exacerbation, refused Budesonide inhaler because irritation of throat. Other one was diagnosed as gastritis, refused Aluminium Hydroxide gel because distasteful flavour. Cause of these DRPs is human errors, patients has negative attitude to drug.

These DRPs can solve by pharmacist give suggestion about drug using and realized patients about how essential of drugs. After pharmaceutical care process, patients accept these drugs.

4.3 Causes of DRPs

In this study the researcher classified cause of DRPs into 2 types of error, system error and human error. The system error is error which happen from any causes in hospital except human e.g. information technology, communication among healthcare worker, process of drug distribution. Human error is error which happen from human e.g. human attitude, some human characteristics.

From 98 DRPs found in Loengnoktha Crown Prince Hospital, causes of them can be classified as appendix C. The system error found in this study include

1. **The process of patients' admission to ward.**

There was a problem in process of patients' admission to wards of Loengnoktha Crown Prince Hospital. Physician order drugs by write the name of drug in doctor order sheet and send its to pharmacist and nurse. Pharmacist and pharmacist's assistance record the drug use information into HosXP program, the computer program use in hospital. HosXP program is composed with the pop-up blocking program which help healthcare worker to detect drug interaction, drug allergy alert. In this process physician can not meet HosXP program, this topic is a factor which contribute to DRPs occur.

2. **The communication among healthcare worker**

There were 2 problems occur during the communication. The deliverer did not send information or the receiver did not receive information. The main procedure of communication among healthcare worker in Loengnoktha Prince Crown Hospital is prepare the meeting include patient care team (PCT) meeting and pharmaco-therapeutic committee (PTC) meeting. The audiences of meeting are pressed for time, can not attend to the meeting and can not receive any information, this is a factor which contribute to DRPs occur.

Because of economic problems, the updating clinical guideline from sources of information such as clinical conference, clinical workshop was limited among small group of healthcare workers. The communication between trained healthcare workers and other healthcare workers was not fluency, because of limitation of time. Therefore the deliverer can not send information to receiver, this is other factor which contribute to DRPs occur.

Another communication problem is the communication about patients' drug use history especially patients with chronic disease who have never admitted to Loengnoktha Crown Prince Hospital before and can not give information about their drug use history to healthcare worker. This is a factor which contributes to untreated indication, one of important DRPs.

3. **The drug storing**

Because of economic problems, the stock of Loengnoktha Crown Prince Hospital can store limited amount of drug especially new drug during breakout period such as H1N1-influza, tuberculosis. During breakout period demand of drug increase rapidly therefore stock can not prepare enough drug.

The human error found in this study include

1. **The attitude of physician**

The physician has negative attitude to quality of locally made drug. The attitude of healthcare worker about quality of drug can contribute to DRPs occur especially prescribing drug overdose.

2. **The attitude of patients**

The patient has negative attitude to quality of drug can contribute to DRPs occur especially drug use overdose or reject prescribing drug.

3. **The special characteristic of patients**

Some characteristics of patient can cause DRPs such as adverse drug reaction which unpreventable and unpredictable.

4. **Others**

Human error can contribute to DRPs occur in all points of system e.g. mass of information, overworked can cause confusion and lead to errors.

4.4 Cost of DRPs management

In this study, the researcher used direct medical cost as main cost of study because the researcher tried to identify cost in hospital perspective. Other cost e.g. non-direct medical cost and indirect medical cost were poorly related to cost in hospital perspective.

Because the same type of DRPs usually took same length of time to manage. This study the researcher calculated the cost of DRPs management by setting 5 algorithms. Each algorithm include wage of healthcare worker (physician, pharmacist, nurse) describe in difference calculation, base on type of DRPs. Cost of DRPs management in this study also include drug cost and laboratory testing cost e.g. complete blood count test, serum potassium test, serum glucose test, serum digoxin test.

Untreated indications (new case and old case)

	A	B	C	D	E	F	G	Total time (mins)
Nurse	20					15		35
Pharmacist		40	5	5			10	60
Physician				5	5			10

The meaning of alphabet in this algorithm are described below

A = Nurse contacted patient's care giver and interview about patient medication use history.

B = Pharmacist reviewed all medications patient take (both at home and in hospital) especially patient with chronic disease and prepare consulting sheet.

C = Pharmacist send consulting sheet to physician.

D = Pharmacist & physician discuss about patients' drugs.

E = Physician ordered drug for chronic disease and other drugs.

F = Nurse accepted drug regimen & start treatment plan within 24 hr.

G = Pharmacist collected data of DRPs & follow upon additional drug regimen.

Drug-drug interaction (need order reviewing by physician) / subtherapeutic or over dosage / improper drug selection

	A	B	C	D	E	F	Total time (mins)
Nurse					15		15
Pharmacist	45	5	5			10	65
Physician			5	15			20

The meaning of alphabet in this algorithm are described below

A = Pharmacist review DI and confirm with believable reference and prepare consulting sheet.

B = Pharmacist send consulting sheet to physician.

C = Pharmacist & physician discuss case.

D = Physician review order and make decision.

E = Nurse received order and take action.

F = Pharmacist follow up on DRP management.

Drug-drug interaction (need adjusting administration by nurse)

	A	B	C	D	E	Total time (mins)
Nurse			5	15		20
Pharmacist	10	5	5		10	30
Physician						0

The meaning of alphabet in this algorithm are described below

A = Pharmacist review DI and confirm with believable reference and prepare consulting sheet.

B = Pharmacist send consulting sheet to nurse.

C = Nurse & physician discuss case.

D = Nurse received order and take action.

E = Pharmacist follow up on DRP management

Adverse drug reaction

	A	B	C	D	E	F	G	Total time (mins)
Nurse	30					15		45
Pharmacist	15	45	5	5			10	80
Physician				5	15			20

The meaning of alphabet in this algorithm are described below

A = Pharmacist or nurse fine out ADRs sign in patients every day.

B = Pharmacist review ADRs and confirm with believable reference and prepare consulting sheet.

C = Pharmacist send consulting sheet to physician.

D = Pharmacist & physician discuss case.

E = Physician review order and make decision.

F = Nurse received order and take action.

G = Pharmacist follow up on DRP management.

Patient not receive prescribing drug

	A	B	C	D	E	Total time (mins)
Nurse	30		5	15		50
Pharmacist	30	30	5		10	75
Physician						0

The meaning of alphabet in this algorithm are described below

A = Pharmacist or nurse find out patient who reject drugs every day.

B = Pharmacist review patients' medical record and meet patients for advice about how essential of drug or how to use drug.

C = Pharmacist & nurse discuss case.

D = Nurse observe for patients' reaction after receiving information from pharmacist and inform pharmacist.

E = Pharmacist follow up on DRP management.

Due to 2 type of wage per hour of healthcare worker calculation, the detail showed as following table.

Table XII: Wage per hour of healthcare worker

Wage per hour of healthcare worker (Baht)		
worker	Average salary + OT.+ License fee	Average salary + License fee
Physician	417	292
Pharmacist	113	79
Nurse	96	63

Then the researcher calculated the management cost of DRPs, detail showed as following table.

Table XIII: Management cost of DRPs calculated by 2 types of calculation (include and not include OT.)

	Cost of DRPs	
Type of DRPs	salary/OT/license fee	Salary/license fee
untreated indications (new case and old case)	1,669.50	1,150.90
Subtherapeutic dosage	3,995.80	2,781.30
Over dosage	3,710.40	2,582.70
Adverse drug reaction	4,701.70	3,248.90
Patient not receive prescribing drug	442.50	302.50
Patient with drug interaction (need adjusting administration by nurse)	1,770.00	1,210.00
Patient with drug interaction (need order reviewing by physician)	3,425.00	2,384.00
Patient receive improper drug selection.	4,852.10	3,377.30
Total cost of DRPs	24,567.00	17,037.60

Although when include cost of drug and cost of required laboratory into cost of DRPs management into this study, the total cost show

Cost of drug use in 98 DRPs management = 911.25

Cost of required laboratory test in 98 DRPs = 740.00

In conclusion, cost of 98 DRPs management was 17,037.60 + 911.25 + 740.00 = 18,688.85 baht and 24,567.00 + 911.25 + 740.00 = 26,218.25 baht, respectively. Total cost per one DRP was 190.70 Baht and 267.53 Bath.

CHAPTER V
DISCUSSION

From this study, the DRPs incidence was 1.56% which lower than other studies conducted in primary care hospital. Examples were a study of Buntao K. in Warinchamrab Hospital and a study of Chongwiriyanurak C. in Long Hospital. These studies found that incidence of DRPs were 33.0% and 74.1% respectively. The difference incidence rate may contributed to the study population. In this study the researcher collected DRPs from all patients admitted to hospital, while Buntao K. collected DRPs in diabetes mellitus patients, and Chongwiriyanurak C. collected DRPs in geriatric patients.[22, 25]

In this study, each DRP was found in 1 patient. Type of DRPs found in this study was similar to those found in other studies which were improper drug selection, adverse drug reaction and drug interaction. However, when focusing on level of severity of DRPs, it was found that DRPs from other studies were more likely to be in a severity level that harm the patient. Most of detected DRPs in many studies were classified as level E; "DRPs caused temporary harm which resulted in further treatment or intervention". However, in this study severity level of DRPs were mostly level A; "potential to cause DRPs" and B; "DRPs did not reach patient", and some were found to be level E.

Almost 93% of identified DRPs were accepted by the physicians and nurses. When discussing with physicians or nurses, clinical significance of the DRPs and patients' risk factors were major influence leading to physicians' immediate response to solve DRPs. Eventhough many DRPs required physicians to change drug regimen, however, there were DRPs that could be solved by direct contact with nurses or the patients.

The majority of DRPs found in this study were in low severity level which caused trivial economical effect. However, if these DRPs were not detected, they might lead to more serious consequences. One of the examples was the improper selection of anti-tuberculosis drugs selection for patient with recurrent TB. This event may lead to drug resistance, spreading of resistant germs into community and increase time and cost to treatment.

From causes of DRPs found in Loengnoktha Crown Prince Hospital, the researcher found that there were DRPs from system errors and human errors. Examples of system errors included the information technology system were implemented in some department, but not implemented in other departments, ineffective communication among healthcare workers, drug shortage in the hospital. The human errors included the attitude of patients on medicine's efficacy and side effect, attitude of physicians on locally made drug, and lack of new drugs' indication and dosing information.

Furthermore, external factor such as a 3-month rotation of newly graduated physicians in the province to Loengnoktha Crown Prince Hospital led to difficulty in DRPs management. Measures to solved DRPs must take into account these environmental factors and pay more attention not only within the hospitals, but also other hospitals in the same provincial administration.

These DRPs can be solve by system approach including pharmacist and pharmacy department become proactive as a point of drug information, creating the standard guideline for some drugs or some disease to increase patient's safety, applying information technology system into all hospital systems inclusively.

Due to the fact that DRPs related to patients' safety and require intervention of professional health care team. All DRPs found in Loengnoktha Crown Prince Hospital are going to be topic of pharmacotherapeutic committee (PTC) meeting and patient care team (PCT) meeting for find out the way to solving problems among physician, pharmacist, nurse and other healthcare team which influence to reduce DRPs incidence in end phrase of the study.

Eventhough Loengnoktha Crown Prince Hospital is a primary care hospital and show low incidence of DRPs, detecting DRPs is still important activity and cannot be compromised. Most of DRPs studies initiated in larger size of hospital such as university hospital, secondary and tertiary hospital, which are less than 130 hospitals in Thailand. But in small size hospital such as primary hospital which are more than 700 hospitals in Thailand have limited data of DRPs. Therefore the DRPs study in primary hospital is interested and information sharing among

healthcare workers should be result in knowledge distribution lead to safety and quality patient care.

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APPENDICES

APPENDIX A

ใบขอรับคำปรึกษา

กลุ่มงานเภสัชกรรม โรงพยาบาลสมเด็จพระยุพราชเลิงนกทา

หน่วยบริการ ( ) ห้องยานอก ( ) ห้องยาผู้ป่วยใน

วัน/เดือน/ปี……

เรียน……..ทราบ

ห้องจ่ายยาขอเรียนปรึกษาเกี่ยวกับยาดังต่อไปนี้

เนื่องจาก รายการยาที่……

ชื่อยา……

รายการยาที่……

ชื่อยา……

รายละเอียด

จาก……

……

……

……

การแก้ปัญหา

……

……

จึงเรียนมาเพื่อโปรดทราบ

ลงชื่อเภสัชกร……..

โทร……

ความเห็นของแพทย์

( ) เปลี่ยนแปลง

รายละเอียด……

( ) ยืนยันตามคำสั่งเดิม

รายละเอียด……

ลงชื่อ

แพทย์……..

APPENDIX B

บันทึกการติดตามปัญหาที่เกี่ยวเนื่องจากยา (Drug-Related Problems;DRPs)

ชื่อ-สกุล.....
HN.....

sex : ☐ male ☐ female age : .....
admission date .....
discharge date .....
วันที่.....

Classification of Drug Related Problems (DRPs) (Strand, et al.,1990)

Category	Description
1	Requires drug therapy but not receiving
2	The wrong drug is being taken/Improper Drug Selection
3	Too little of the correct drug being taken
4	Too much of correct drug being taken
5	Resulting from an adverse drug reaction
6	Resulting from drug-drug/food/lab. Interaction
7	Patient not receiving prescribing drug
8	Taking a drug which no valid medical indication (accidental and intentional poisoning)

DRPs Categories	บรรยายลักษณะ DRPs/ ประเด็น Consult	ข้อเสนอเพื่อพิจารณา (Interventions)	ผลลัพธ์หรือการตอบสนองจากสหวิชาชีพ	ระดับความรุนแรง (A-I)	ผู้บันทึก

กระบวนการและเวลาที่ใช้ในการแก้ไขปัญหา

กระบวนการ	เวลาที่ใช้
☐แจ้งพยาบาล	
☐แจ้งแพทย์	
☐เปลี่ยนหรือปรับขนาดยา	
☐การรักษาอาการที่เกิดเนื่องจาก drug related problem	
☐อื่นๆ(ค่ายา ค่าแลป).....	
รวม	

APPENDIX C

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
Drug interaction (32 cases)	Physician order Aluminium Hydroxide gel and Norfloxacin in patients who are diagnosed as infective diarrhea ; *Aluminium Hydroxide gel may decrease absorption of Quinolone antibiotic (Norfloxacin).* **(19 cases)**	Separate time of each drugs at least 2 hours.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
	Patients are prescribed Furosemide and Digoxin for ischaemic heart disease at same time.; *Digoxin and Furosemide cause hypomagnesemia, significance I, major severity, delayed type.* **(1 case)**	Should monitor potassium chloride in blood level.	Physician and nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
	Patients are prescribed Ranitidine and Aluminium Hydroxide gel at same time.; *Aluminium Hydroxide gel may decrease absorption of Ranitidine.* **(4 cases)**	Separate time of each drug at least 1-2 hr.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
	Patients are prescribed Ofloxacin and Aluminium Hydroxide gel at same time.; *Aluminium Hydroxide gel may decrease absorption of quinolone antibiotic.* **(4 case)**	Separate time of each drug at least 1-2 hr.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patients are prescribed Ferrous fumarate and Aluminium Hydroxide gel at same time.; *Aluminium Hydroxide gel can precipitate ferrous fumarate, reduce absorption of ferrous fumarate.* **(1 case)**	Separate time of each drug at least 1-2 hr.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
	Patient acute diarrhea are prescribed Folic acid and Aluminium Hydroxide gel.; *Aluminium Hydroxide gel can precipitate Folic acid, reduce absorption of Folic acid.* **(1 case)**	Separate time of each drug at least 1-2 hr.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
	Patient acute diarrhea are prescribed Ofloxacin and Aluminium Hydroxide gel.; *Aluminium Hydroxide gel reduce absorption of quinolone antibiotic.* **(1 case)**	Separate time of each drug at least 1-2 hr.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
	Patient is prescribed Digoxin and Aluminium Hydroxide gel.; *Aluminium Hydroxide gel may reduce absorption of Digoxin.* **(1 case)**	Separate time of each drug at least 1-2 hr.	Nurse accept and start new regimen within 24 hour.	System error; physician cannot meet the drug interaction pop-up blocking in HosXP program. And human error; physician did not know the couple of drug which cause interaction.
Adverse drug reaction (13 cases)	Patient have adverse drug reaction eg. urticaria, erythrematous rash and airway obstruction after receive Ceftriaxone injection 2 gm. IV. ; *Intravenous antibiotic can cause adverse drug reaction eg. skin reaction, respiratory reaction.* **(4 case)**	Discontinue suspected drug. patients are closely observed and give allergy alert card and information about drug allergic to patient.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patient has adverse drug reaction from furosemide, have to frequently waked up at night to urinate. ; *Diuretic can cause frequently urinate as side effect.* **(1case)**	Adjust time of giving drug into after breakfast and lunch for reduce side effect.	Nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
	Patient has adverse drug reaction from Enalapril, with chronic cough.; *Enalapril is ACEs inhibitor which can cause side effect eg. chronic cough.* **(2 case)**	Change anti-hypertensive drug (ACEs inhibitor) in to calcium channel blocker to reduce side effect of them.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
	Patients have adverse reactions from Amlodipine with headache, blurred vision,n/v. **(1case)**	Change anti-hypertensive drug in to another group to reduce side effect of them.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
	Patients have adverse drug reactions from Cloxacillin inj/Clindamycin inj.with urticaira at IV site. **(1case)**	discontinuing suspected drugs, closely observed and give allergy alert card and information about drug allergic to patient.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
	Patient has adverse drug reaction from Gemfibrozil, with chronic diarrhea. **(1case)**	Change dyslipidemic drug (gemfibrozil) in to another group to reduce side effect of them.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
	Patient has adverse drug reaction from Aspirin, GI irritate after take 81 mg. once daily for treat ischaemic heart disease. **(1case)**	Adjust time of aspirin to with meal and add H2-blocker or proton pump inhibitor to reduce effect of aspirin (should not discontinue aspirin).	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patients have adverse drug reactions from Cloxacillin inj.with urticaria. **(1case)**	discontinuing suspected drugs, closely observed and give allergy alert card and information about drug allergic to patient.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
	Patients have adverse drug reactions from Clindamycin inj.with urticaria at IV site. **(1case)**	discontinuing suspected drugs, closely observed and give allergy alert card and information about drug allergic to patient.	Physician and nurse accept and start new regimen within 24 hour.	Human error; adverse drug reaction can occur in all patients and can not predictable but healthcare worker can find and prevent them.
Untreated indication (7 cases)	Patient with chronic disease from other hospital admitted to Loengnoktha Crown Prince Hospital and cannot give the information about their drug use history. ; *Patient has hypoglycemia as effect of diabetes mellitus while staying in ward.* **(1case)**	Review drug use history of patient as soon as possible and initiate the medication reconciliation.	Nurse and pharmacist accept and intiate medication reconciliation.	System error; medical history of patient should be interviewed and recorded as soon as possible when patient admit to hospital.
	Patient with chronic disease from other hospital admitted to Loengnoktha Crown Prince Hospital and cannot give the information about their drug use history. ; *Patient use Prazocin as anti-hypertensive drug from other hospital.* **(1case)**	Review drug use history of patient as soon as possible and initiate the medication reconciliation.	Nurse and pharmacist accept and intiate medication reconciliation.	System error; medical history of patient should be interviewed and recorded as soon as possible when patient admit to hospital.
	Patient with chronic disease from other hospital admitted to Loengnoktha Crown Prince Hospital and cannot give the information about their drug use history. ; *Patient use Amlodipine as anti-hypertensive drug from other hospital.* **(1case)**	Review drug use history of patient as soon as possible and initiate the medication reconciliation.	Nurse and pharmacist accept and intiate medication reconciliation.	System error; medical history of patient should be interviewed and recorded as soon as possible when patient admit to hospital.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patient with chronic disease from other hospital admitted to Loengnoktha Crown Prince Hospital and cannot give the information about their drug use history. ; *Patient use Metformin as DM drug from other hospital.* **(1case)**	Review drug use history of patient as soon as possible and initiate the medication reconciliation.	Nurse and pharmacist accept and intiate medication reconciliation.	System error; medical history of patient should be interviewed and recorded as soon as possible when patient admit to hospital.
	Patients on Oseltamivir during admitted and not complete doses when D/C. **(3 cases)**	Continuing Oseltamivir as home medication until complete doses.	Physician accept and response based on standard guideline.	System error; medical history of patient should be interviewed and recorded as soon as possible when patient admit to hospital.
Improper drug selection (17 cases)	Physician prescribed antituberculous drug category I to patient with relapse TB. ; *Patient with relapse TB should be prescribed antituberculous drug category II.* **(1case)**	Change drug regimen into antituberculous drug category II.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know that antituberculous drug category I should not prescribe to patient with relapse TB.
	Patients diabetes mellitus, was prescribed 5%DN/2 1000 ml as intravenous fluid.**(1case)**	Change into 0.9%NSS 1000 ml to reduce risk of hyperglycemia.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not concern about patient underlying disease.
	Patient age 4 years was prescribed Mist.Scill Ammon. as an expectorant.; *Mist.Scill Ammon. is composed with opium tincture, should not use in children < 6 years.* **(1case)**	Change into Guaifenesin syrup.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know the composition of drug.
	Patient with asthma symptoms was prescribed Budesonide inhaler and Beclomethasone inhaler as an inhale corticosteroids.; *Budesonide inhaler and Beclomethasone inhaler are inhale corticosteroids which should not use in same time.* **(1 case)**	Use one of them, in this case physician prescribed only Budesonide inhaler.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician prescribed the same group of drug in the same time.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Pregnant patient age 24 years was prescribed Diazepam 2 mg. oral twice daily as an muscle relaxant.; *Diazepam is benzodiazepine drug which classified as pregnancy category D, should not use in pregnant.* **(1 case)**	Supportive treatmet and chang into Paracetamol 500 mg. if patient require.	Physician and nurse accept and start new regimen within 24 hour.	System error; physician did not meet the drug in pregnancy alert pop-up in HosXP program. and Human error; physician did not concern about underlying disease of patient.
	Patient was prescribed Ergotamine tartrate as drug for vascular headache 1 tablet oral every 1 hour for headache.; *Maximum dose per attack per day in adults is 6 mg=6 tablets.* **(2 case)**	Suggest nurse and patient, should not use more than 6 tablet per day.	Nurse accept and start new regimen within 24 hour.	Human error; physician did not concern about the overdose of drug.
	Patients are prescribed Vitamin B complex as vitamin B6 supplement for Isoniazid induced neuritis.; *Vitamin B6 in Vitamin B complex is not enough for prevent Isoniazid induced neuritis in TB patient.* **(6 case)**	Change into Vitamin B6 100 mg. tablet.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know the dose and composition of drug. System error; stock of hospital did not store enough drug.
	Patient age 24 days is prescribed Oseltamivir 12 mg oral twice daily for prevent flu .; *Oseltamivir, WHO suggest using in children age > 1 yr* **(1 case)**	Discontinue Oseltamivir and change therapeutic plan into supportive treatment.	Physician and nurse accept and start new regimen within 24 hour.	System error; lack of information about new drug.
	Patient age 10 months is prescribed Oseltamivir 25 mg oral twice daily for prevent flu.; *Oseltamivir, WHO suggest using in children age > 1 yr.* **(1 case)**	Discontinue Oseltamivir and change therapeutic plan into supportive treatment.	Physician and nurse accept and start new regimen within 24 hour.	System error; lack of information about new drug.
	Patient on Aspirin for ischaemic hearth disease, need to meet dentist for tooth decay.; *Aspirin is anti-coagulation drug which can cause bleeding.* **(1 case)**	Discontinuing aspirin atleast 7 days before meet dentist.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know side effect of drug.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patient age 3 yr. start 5%DN/3 1000ml IV drip 80 ml/hr. Physician change in to 5%DN/2 1000ml IV drip 80 ml/hr. **(1 case)**	Change 5%DN/2 to 5%DN/3.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not concern about the overdose of drug.
Drug overdose 13 cases	Patient age 9 years and 17 kg. body weight is prescribed Oseltamivir 30 mg . twice daily.; *Patient weigh 16-23kg. should be prescribed 45 mg. Oseltamivir twice daily.* **(1 case)**	Change dose of Oseltamivir into 45 mg. Twice daily.	Physician and nurse accept and start new regimen within 24 hour.	System error; lack of information about new drug and Human error; physician did not know dose of drug.
	Patients were prescribed Amlodipine 20 mg./ day as an anti-hypertensive drug.; Maximum dose of Amlodipine for anti-hypertensive is 10 mg./day. **(9 cases)**	Change dose of Amlodipine into 10 mg. daily.	Physician confirm to continue Amlodipine 20 mg./day.	Human error; physician have negative attitude to locally made drug.
	Patient age 35 years were prescribed Ceftriaxone inj. 2 gm. Intravenous every 8 hr. for bacterial musculoskeletal infection.; *Maximum dose of Ceftriaxone is 2 gm./day.* **(1 case)**	Change dose of Ceftriaxone into 2 gm.daily.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
	Patient with pulmonary TB is prescribed vitamin B6 100 mg oral tid pc daily.; *Maximum dose of vitamin B6 for treat drug-induced neuritis; 200 mg once daily.* **(2 cases)**	Change dose of vitamin B6 into 100 mg. once daily.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
Subtherapeutic dosage 14 cases	Patient pulmonary tuberculosis, body weight 50 kg. is prescribed ethambutol 800 mg once daily.; *In patients who have received previous antituberculous drug, administer ethambutol 25 mg per kg. of body weight, as a single dose once daily.* **(1 case)**	Change dose of ethambutol into 1200 mg once daily.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patient age 48 years was prescribed Cefazolin inj. 1 gm. IV every 12 hours. as postoperative antibiotic.; *Usual dose of Cefazolin for postoperative is 0.5-1 gm. IV or IM every 6-8 hours for 24 hours after surgery.* **(1 case)**	Change dose of Cefazolin into 1 gm IV every 6 hours.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
	Patient weigh 24 kg. was prescribed Oseltamivir 45 mg. oral twice daily.; *Usual dose of Oseltamivir per body weight 23-40 kg. is 60 mg. oral twice daily.* **(1 case)**	Change dose of Oseltamivir into 60 mg. oral twice daily.	Physician and nurse accept and start new regimen within 24 hour.	System error; lack of information about new drug and Human error; physician did not know dose of drug.
	Patient weigh 20 kg. was prescribed Oseltamivir 30 mg. oral twice daily.; *Usual dose of Oseltamivir per body weight 15-23 kg. is 45 mg. oral twice daily.* **(1 case)**	Change dose of Oseltamivir into 45 mg. oral twice daily.	Physician and nurse accept and start new regimen within 24 hour.	System error; lack of information about new drug and Human error; physician did not know dose of drug.
	Patient weigh 41 kg. was prescribed Oseltamivir 60 mg. oral twice daily.; *Usual dose of Oseltamivir per body weight> 40 kg. is 75 mg. oral twice daily.* **(1 case)**	Change dose of Oseltamivir into 75 mg. oral twice daily.	Physician and nurse accept and start new regimen within 24 hour.	System error; lack of information about new drug and Human error; physician did not know dose of drug.
	Patient weigh 10 kg. was prescribed Co-trimoxazole suspension 1 teaspoonful oral twice daily (80 mg. of Trimethoprim).; *Usual dose of Co-trimoxazole 6-12 mg/kg/day twice daily.* **(1 case)**	Change dose of Co-trimoxazole into 3 teaspoonful oral twice daily (120 mg. of Trimethoprim).;	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
	Patient weigh 20 kg. was prescribed Domperidone ½ teaspoonful oral three times daily (2.5 mg. of Domperidone).; *Usual dose Domperidone is 0.2-0.4 mg./kg./dose every 4-8 hours.* **(1 case)**	Change dose of Domperidone into 8 ml. three times daily (8 mg. of Domperidone)	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.

Type of DRPs	Detail of event	Suggestion	Responsive	DRPs Analytic
	Patient age 23 and 27 years were prescribed Metronidazole 200 mg. three times daily for pelvic absess.; *Usual dose of Metronidazole is 400 mg oral every 8 hours.* **(2 cases)**	Change dose of Metronidazole into 400 mg. three times daily	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
	Patient was prescribed Ceftazidime inj. for pyelonephritis from ***Ps.aeruginosa*** 2 gm. IV every 12 hours for 7 days.; *Usaul dose of Ceftazidime for pyelonephritis from* ***Ps.aeruginosa*** *is 2 gm. IV every 12 hours for 14 days.***(2 cases)**	Change duration of trearment plan into 14 days.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not duration of using drug.
	Patient weigh 40 kg. was prescribed Rifampicin 300 mg. as anti-tuberculous drug.; *Usual dose Rifampicin for patient body weight 40-49 kg. is 450 mg./day.* **(1 case)**	Change dose of Rifampicin into 450 mg./day.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
	Patient chronic ischaemic heart disease is prescribed isosorbide dinitrate 5 mg three times before meal.; *Initial dose of isosorbide dinitrate for chronic heart failure ; 10-20 mg/ 3-4 times daily.* **(1 case)**	Change dose of isosorbide dinitrate into 10 mg. three times daily.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
	Patient body weight 20 kg is prescribed Ceftriaxone inj. 400 mg IV once daily.; *Usual dosage of Ceftriaxone; 50-75 mg/kg/day.* **(1case)**	Change dose of Ceftriaxone inj. into 1 gm once daily.	Physician and nurse accept and start new regimen within 24 hour.	Human error; physician did not know dose of drug.
Patient not receive prescribing drug (2 cases)	Patient with peptic ulcer attack, reject Aluminium Hydroxide gel. **(1 case)**	Advice and realized patient to know importance of using drugs.	Physician and nurse accept and start new regimen within 24 hour.	Human error; patient has negative attitude to drug.
	Patient reject Budesonide inhaler, because not improving symptoms immediately. **(1 case)**	Advice and realized patient to know importance of using drugs.	Physician and nurse accept and start new regimen within 24 hour.	Human error; patient has negative attitude to drug.

BIOGRAPHY

Sutheera Taraphan was born in Ubon-ratchathani, Thailand, on February 24,1982. She graduated from Demonatration school, Khon-Kaen university in 2000 and received her Bachelor of Science degree in Pharmacy from Khon-Kaen university in 2005. Sutheera has worked in Loengnoktha Crown Prince Hospital, Yasothon in the position of pharmacist.