SAFE MEDICATION ADMINISTRATION FOR INPATIENT SERVICE: PROBLEM ANALYSIS

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A THEMATIC PAPER SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF MANAGEMENT
(NURSING MANAGEMENT)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2008

Thematic Paper
Entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Management (Nursing Management)
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ACKNOWLEDGEMENTS

This thematic paper has completely been succeeded owing to the kindness of advisor --Associate Professor Rachanee Sujijantararat, major advisor, and Associate Professor Prangtip Ucharattana, co-advisor who sincerely advised as well as encouragement. I would like to give special thanks to both of them.

Special thanks are owed to Associate Professor Dr. Yajai Sittimongkol, thematic paper examination committee who gave valuable advice in correcting this thematic paper.

I would like to thank Dr. Somchai Chansawang who supported and devoted time to give valuable advice for this study.

I would like to thank all nursing staffs of the patient unit of the studied hospital for their kind support.

Finally, I express my infinite gratitude to my beloved family for their constant love, care and continuous support, these inspired me to succeed in my master degree.

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ABSTRACT

The objectives of this study were to analyze medication administration errors in inpatient departments at private hospitals in terms of types, rate, causes and contributing factors for the medication errors. During January 1, 2007 to October 31, 2007 the study revealed that there were 28 incident reports sent to the quality center. The most frequent types of the medication administration errors were - wrong dose (25%), wrong time (17.86 %), and omission (14.28 %). The obstetric-gynecology and pediatric ward reported medication errors in a higher proportion (46%) than the surgery ward (25%), medical ward (17.8%), and intensive care units (7%), and OR (3.6%). There were not any error reports from the nursery and labor units. For overall errors, the most common causes of errors were - lack of drug knowledge, ineffective communication, and lack of or unclear policies/ procedure relevant to medication administration.

Safe medication administration of inpatient service needs intensive support from top administrators and multidisciplinary teams in order to promote and enrich the knowledge and skill of all nursing staff in medication administration, drug knowledge, including positive attitude, and increasing awareness in reporting case of errors. Creating effective communication and promoting a safe working environment to reduce stress require collaboration from health care professionals.

KEY WORDS: MEDICATION ADMINISTRATION / PATIENT SAFETY
INPATIENT DEPARTMENT / MEDICATION ERROR

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การบริหารยาอย่างปลอดภัยสำหรับการให้การบริการผู้ป่วยใน : การวิเคราะห์ปัญหา
(SAFE MEDICATION ADMINISTRATION FOR INPATIENT SERVICE: PROBLEM ANALYSIS)

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บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์ความคลาดเคลื่อนในการบริหารยาในฝ่ายบริการผู้ป่วยใน ของโรงพยาบาลเอกชนแห่งหนึ่ง ชนิดของความคลาดเคลื่อน อัตรา และสาเหตุและปัจจัยที่ทำให้เกิดความคลาดเคลื่อนในการบริหารยา ระหว่างวันที่ 1 มกราคม พ.ศ. 2550 ถึง 31 ตุลาคม พ.ศ. 2550 พบว่า มีการรายงานอุบัติการณ์ความคลาดเคลื่อนการบริหารยาในฝ่ายบริการผู้ป่วยในที่ส่งศูนย์คุณภาพ จำนวน 28 ครั้ง ชนิดของความคลาดเคลื่อนที่พบมากที่สุดคือ การได้รับยาผิดขนาด การได้รับยาผิดเวลา และ ความละเลยในการให้ยา คิดเป็นร้อยละ 25, 17.86 และ 14.28 ตามลำดับ หอผู้ป่วยที่มีอุบัติการณ์มากที่สุด ได้แก่หอผู้ป่วยสูติ-นรีเวชและเด็ก (ร้อยละ 46) หอผู้ป่วยศัลยกรรม (ร้อยละ 25) หอผู้ป่วยอายุรกรรม (ร้อยละ 17.8) หอผู้ป่วยวิกฤต (ร้อยละ 7) แผนกห้องผ่าตัด (ร้อยละ 3.6) ไม่มีการรายงานอุบัติการณ์ความคลาดเคลื่อนในแผนกทารกแรกเกิด และแผนกห้องคลอด ปัจจัยที่ก่อให้เกิดความคลาดเคลื่อนในการบริหารยา ได้แก่ เจ้าหน้าที่ขาดความรู้ การสื่อสารที่ไม่มีประสิทธิภาพ และระบบการบริหารยาที่ยังไม่ชัดเจน

ความปลอดภัยในการบริหารยาในฝ่ายบริการผู้ป่วยใน จำเป็นต้องได้รับการสนับสนุนจากผู้บริหารระดับสูงและทีมสหสาขาวิชาชีพ ส่งเสริมพยาบาลให้มีความรู้และทักษะในเรื่องของยา การบริหารยา ส่งเสริมทัศนคติที่ดีในการรายงานอุบัติการณ์ความคลาดเคลื่อนทางยา การสื่อสารที่มีประสิทธิภาพ การสร้างสภาพแวดล้อมในการทำงานให้เอื้อต่อการปฏิบัติงาน เพื่อลดความเครียดหรือสิ่งรบกวน

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CHAPTER I
INTRODUCTION

1.1 Background and Significance of the Study

Patient Safety is one of the most important issues and concerns for all healthcare professionals. There are large numbers of medications used every day in the hospital, such as, diagnostic tests for pain control, different treatments for specific diseases, etc. However, incidents of medication error can occur at any time in the hospital caused by physicians, nurses, pharmacists, and patients or relatives. Medication Administration is a time-consuming and complex task that usually occupies one third of nurse's time (Pepper, 1995 cited in Chilton, 2006). There is much potential for medication error by a nurse who is playing a major role in the administration of drugs to his/ her assigned patients. In 2000, the United States Pharmacopoeia (USP) studied the total number of medication errors and found that the significant majority of errors occurred in the actual administration mode, administration 40%, documenting 21%, dispensing 17%, prescribing 11%, and monitoring 1% (Davidhizar, 2003 cited in Fry and Dacey, 2007). Medication errors have an impact on patients, health care professions and organization.

Patient Harm

In the United States, medical error was one of the eight-leading causes of death. Approximately 44,000-98,000 patient deaths reported each year because of medical errors, 7,000 were attributed to medication errors (Institute of Medicine, 1999). The US Food and Drug Administration: FDA (2001) reported that 10-18% of hospital injuries derived from medication error and 5 % of this error resulted in patient death. The FDA stated that there was at least one death per day and 1.3 million people were injured each year due to medication errors (FDA, 2005). In 1998, there was an article printed about a young boy who received an injection of adrenaline from his surgeon, who thought it was lidocaine. As a result of wrong drug, the child died (ISMP, 2004). In 2004 the death of a woman who was injected with chlorhexidine, an

antiseptic skin preparation solution instead of contrast media during a radiological procedure, both solutions were clear and had been placed on the same table in unlabeled containers during the procedure. In 2005, the Institute for Safe Medication Practices described an incident where a patient's caregiver placed the fentanyl patch, pain-relieving transdermal patch containing fentanyl, such as Duragesic, on the patient's buttock, which was the site of her pain. When the patient went to bed, she also used a heating pad at the same place. Exposing the patch to heating pads can also increase absorption of the drug. As the result, the patient was discovered dead two days later (FDA Patient Safety News, 2005). MSNBC NEWS (2006) reported three premature infants died in Neonatal Intensive Care Unit after being given over doses of heparin. The errors were made when pharmacists stock the drugs improperly, nurses did not double-check to make sure they are dispensing the proper medication, resulting in the wrong dose being administered.

Health care professional harm

Medication errors can affect all health care professional such as physicians, pharmacists and nurses. Medication management is a part of everyday nursing practice. Nurses are subject to a range of practices and procedures, which are dictated through legal, management, and medical requirements to ensure safe administration of medications. The nurse’s role as final check or gate-keeping role, monitoring not only her own performance, but is also held accountable for the performance of others. Medication administration is part of the main responsibility of nursing practice (Cobb, 1986 cited in Kanghae, 2003). Nurses must follow professional standards, no matter that a doctor’s orders are wrong, nurses must take responsibility for their practices according to the law (Senadisai, 2000 cited in Kanghae, 2003). Medication administration error in the hospital ward is still a serious problem and its occurrence is too frequent. Administering medication is probably the highest risk duty that a nurse can perform. Accidents can be harmful to the patients and for the nurse’s career. Medication administration error, for the one-year period of1995-1996, was the fifth most common reason for the removal of nurses from the register nurse in the United Kingdom (Carlisle, 1996 cited in Anderson and Webster, 2001). In 2006, in Wisconsin in the United States, it was the first time that a nurse had been criminally charged with

a felony (serious crime) in the death of 16-year old patient for an unintentional error. The error was an overdose of medication. Hospitals and nurses are concerned that this could make it more difficult to recruit and retain nurses (MSSPNexus Blog, 2006). Furthermore, the potential of medication administration error on wards makes this a problem of concern for nursing staffs everywhere (Gladestone, 1995 cited in Anderson and Webster, 2001). In addition, in the UK, doctors and pharmacists were charged with manslaughter as a result of medication error (McDowell et al, 2006). In the United States of America, medication errors were the second cause for lawsuits involving nurses (Clayton, 1987, Wolf, 1989 cited in Anderson and Webster, 2001).

Healthcare Cost

In the United States, it has been estimated that in 1993 alone, medication error in hospitals accounted for US$ 2 billion in increased hospital costs (Kohn et al., 1999). Annual costs of drug-related morbidity and mortality reached $ 177 billion in the United States (Tipton DJ, 2003). In the UK, drug related injuries occurring in hospitals cost an estimate $ 3.5 billion (£1.9 billion) a year (Institute of Medication Preventing Medication Error, 2007). The personal costs of medication errors for patients may include suffering, the need for additional treatment, loss of income, and death. Family members also experience emotional trauma as a result of seeing a loved one suffer. For the estimated 1.5 million people who are injured by medication errors each year, health care facilities incur a conservative estimate of $3.5 billion in additional expense for treatment their injuries. If this amount were extended to lost wages, lost productivity, and other additional expense, the costs associated with medication errors might increase to as much as 29 $ billion (Aspden, 2007).

In addition to three majors impacts described above, medication error may affect the reputation of the hospital and the health care profession. Any time a medication error occurs, whether it is reported by the media or whether the information simply is spread by word of mouth, the public loses confidence in the quality of health care.

Hospital A is a private hospital located in Bangkok. The hospital's goals are; complying with international standards concerning patient safety, and increasing customer satisfaction. The hospital has an average admission census rate of 2% of

outpatient visits per day. However, occupancy rates of in-patient beds were 50-60%. Factors for the operation of this ward are;

- Consisting of 23 patient-beds.
- Average numbers of IPD patients are 12-19 cases.
- Nursing care teams consists of 2-4 registered nurses (including head of ward), 2-3 nurse assistants, and one ward clerk.
- Nurse / Patient ratio is 1: 3-5, depending on different types (Medicine, Surgery, OB-GYN, and Pediatrics).

Applied nursing care system is the hybrid of functional method and nursing team method. There is a medication nurse who is in charge of preparing and administering medication to all patients on ward. If there are high numbers of admitted patients on ward, the medication nurse might have to carry an overload of medication orders. Under this circumstance, she/he could not commit to the medication schedule of all patients.

In 2002, the hospital set a target to decrease transcribing errors. The steering group was assigned to redesign processes by implementing medication administration record (MAR) instead for administering medication. There were medication cabinets in front of every patient's room that can reduce drug errors. The studied hospital applied distribution system of 24 hrs unit dose of medication. At the beginning of 2007, reducing waiting time of IPD dispensing process is challenged to nursing team. The pilot project was that copy order sheet was replaced by paper scanner. By digital technology, pharmacist could have physician's first order on line. This implementation could shorten waiting time and also could reduce redundant paper work that used to create medication errors.

At the studied hospital, incident reports of medication errors are recorded by the person involved in the incident. These forms of incident reports are returned to the Quality Center for collection. There were significant increases in the numbers of medication administration error that were reported from the previous year (n = 27 year 2006, n = 74 year 2007) (Quality center, 2007). These data indicated the trend of increasing number of medication administration error, one of negative outcome indicators.

1.2 Main Issue

Hospital A, a private hospital in Bangkok, places itself as a first class hospital to serve high-end customers for both international and local clients. The hospital's policy is to provide high quality international standards to the patients, any defect is unacceptable. On the other hand, the incident of medication errors in the studied hospital seems to be increased. Whereas the patients and their families expect the high quality of medical service provided. Accordingly, incidents of medication errors may affect the standard of care required by the administrator, the reputation of the hospital, health care profession and its members. Any time a medication error occurs, whether the word was spread by the media, or whether the information was simply spread by word of mouth, the public would doubt and gradually loose confidence in the quality of the hospital. Therefore**,** it is necessary for the investigator as a nurse manager in the hospital to study and analyze medication administration errors for improving quality of care for the patients in the studied hospital.

1.3 Purpose of the Study

To analyze problems of medication administration of inpatient department in a private hospital.

1.4 Expected Benefits/ Outcomes

The findings and results of this study will be used to develop 1) Protocol for safety drug administration to reduce medication errors in inpatient department; 2) Motivate interested groups to have more recognition in medication errors.

CHAPTER II
LITERATURE REVIEW

In this study, the investigator reviews concepts, theories, literature and research studies that relate to medication administration, and patient safety published in both Thailand and aboard, the research library at Nursing Science Faculty library of Mahidol University and electronic database can be detailed as the following:

1. Searching from the website www.li.mahidol.ac.th from Cinahl, and Ovid.
2. Searching by hand search in Faculty of nursing science library index card,
3. Searching keyword

   English: medication error, medication administration, drug administration and nurse, incident report, nursing role, patient safety

Inclusion Criteria

The inclusion criteria used for selecting the research papers and documents involved with this study are:

1. Text, document and academic paper concerning medication administration in both Thailand and aboard published during 1999 - 2008
2. Thesis, researching papers, and every level of researching study concerning medication administration in both Thailand and aboard published during 2000 - 2007
3. The documents must be available in full text.

2.1 Review of Existing Literature Related to Issues of Concern

Medication errors can be the cause of great harm to the patient, which may or may not result in death. There are many ways of conducting safety medication administration to reduce medication errors. The best method of medication administration means to protect health care providers as well as for the safety of patients. The reviews of literature are comprised of 2 sections.

Section I. Concept of Medication Administration

1.1 Definition

1.2 Medication Administration Process

1.3 The Principle of Medication Administration

Section II. Medication Administration Error

2.1 Classification of medication error

2.2 Factors contributing to medication administration errors

2.2.1 Nursing personnel

(1) Nurses lack of knowledge of medications

(2) Nurses lack skill of Mathematical calculation.

(3) Personal experiences and characteristics of the nurse

(4) Failure to follow the policy

(5) Breakdown of communication

2.2.2 Communication

(1) Policy for verbal medication orders/ order by phone

(2) Standardize the abbreviations, acronym and symbols used in the hospital.

(3) Technique for effective communication

(4) Establish and implement medication reconciliation system in the hospital.

2.2.3 Workload and staffing levels

2.2.4 Working environment

2.3 Quality Management

2.3.1 Risk Management

2.3.2 Root Caused Analysis (RCA)

2.3.3 Failure Mode and Effects Analysis (FMEA)

2.4 Medication Errors Reporting System

Section III. Guideline for Safety Medication Administration

Section I. Concept of Medication Administration

1.1 Definition

"Medication" was defined as drugs that are given for therapeutic purposes (Abrams, 1987).

"Medication Administration" is a continual process and goes beyond the task of simply giving medication to a client. The nurse must apply her/ his knowledge about the client and the medication when assessing, planning, administering, evaluating and documenting the process (College of Nurses of Ontario, 2005).

1.2 Medication Administration Process

Medication administration process is a major part of the nurse's role. Medication process consists of 5 steps; prescribing, transcribing, dispensing, administering, and monitoring (Handler et al, 2004, Davidhizar & Lonser, 2003).

1) Prescribing

This stage is the major responsibility of a physician. However, this stage is an important stage which needs to be completely correct and clear. Physicians have to evaluate the patient disease to determine needs for medication and then select appropriate medicine. Poor handwriting of physicians can cause prescription errors.

A study of the incidents and types of medication errors in the largest pediatric hospital in Thailand (2003) reported that over 15 months of the study period, medication errors occurred in 1 percent of admissions (322 errors in 32,105 admissions). The most common type of error was prescription errors (35.4 %). The majority of errors were detected and prevented before the drugs were administered (76.71%) (Sangtawesin et al, 2003 cited in Dubey, Palaian, Shankar, Mishra, Prabhu, Bhandari, & Chhetri, 2006).

2) Transcribing (Documenting)

Physicians write orders in charts to transcribe verbal orders or orders by phone.

Nurse, then transcribes the order to medication administration records (MAR), kardex, medication card or IV profile. The error which occurs within this process is called transcribing error. Transcribing error is an error in the copying process from the original prescribing order. Such errors were not transcribed, and transcribe incorrectly. In some hospitals one preventive method to reduce transcribing errors is the use of self-copying order forms. The physician's order form is designed to make a direct copy (carbon), which is sent to the pharmacy. Another preventive measure is to use a copying machine to produce a copy of the physician's order. If the copy contains blackened or faded areas. It will be misinterpreted or cannot be read correctly. However, all orders must be checked with the original before the medication is dispensed (Cohen MR, 1999). An additional preventive method is the use of a Computerized Physician Order Entry (CPOE), which eliminates the need of transcription. The physician enters orders into a computer which then prints out the order in the pharmacy department (Anusornsangiam, 2002).

In 1991, a study found that transcribing errors occurred 31.90% from 1,280 medication errors, the study in one year there were transcribe incorrectly 17.7% and not transcribed order 14.2% (Hartwig, Denger, Schneider, 1991 cited in Montakantikul, 2004).

A study in Thailand in 1995 showed that 19.3% of medication errors came from transcribing errors or 4.4% of drug administration. However, the most frequent one is the transcribing medication into the kardex (Kuwalailak, 1995 cited in Montakantikul, 2004).

Detdechasunun (2001) studied by observing a medicine ward in Thailand, that medication errors occurred 34.20% (946 from 2,766 times) there were errors of transcribing 13.27% and medication administration 14.46%, type of transcribing errors without transcribed (6.76%), with transcribed errors such as wrong time (5.93%), wrong dose (0.29%), wrong route (0.18%) and wrong drug (0.11%).
(Detdechasunun, 2001cited in Montakantikul, 2004).

3) Dispensing

This stage is the responsibility of the pharmacist. The process involves receiving, reviewing and confirming orders at the pharmacy unit. The main task is

preparing and dispensing medication to the hospital. The error occurring in this stage induces the error in the following stage.

4) Administering

This stage is the major responsibility of nurses especially in inpatient units. Most medication errors, 46%, occur at patient care transition points (Burke, 2005). This stage involves the review of MAR, administering the right medication, right dose, right route, right time, and right patients. Then, the nurses record the administration in MAR. Teach the patients to know and understand the prescribed drug, its dosage, administration route, dosing frequency and times, and duration of therapy (Schull, 2007). In process of administering, nurse has to use the nursing process that has five steps: assessment, nursing diagnosis, planning, implementation and evaluation. Before administering the medication to the patient, it is important for the nurse to assess the patient in relation to drug therapy includes known data about the patient's past medical history includes drug allergies history and assessment of the patient's current physical status. And the first aspect of patient data collection is patient identification by asking the patient to state his or her own name. Do not call a patient by his or her name and then ask for verification. Physical assessment such as the patient's age, weight, height, includes the evaluation of a particular site or route chosen for the administration. Then administering medication and stay with the patient until all drugs are taken. Observe the patient for untoward reactions and document the administration and patient education (Lane, 1992).

5) Monitoring

This process is very important to save a patient's life in case that wrong drugs were given, or that a patient has a drug allergy. In addition, the assessment of a patient's response to medication is done. Monitor the patient to determine drug efficacy and detect signs and symptoms of an adverse reaction or interaction. After that the outcome will be recorded in MAR.

Adverse reactions occur in roughly 30% of hospital patients and can range from mild to life threatening. The reactions may arise immediately and suddenly, or they may take weeks or even months to develop their symptoms. Early detection of

adverse effects or drug inefficacy allows timely adjustments in therapy and may prevent patient injury or avoid a treatment delay.

However monitoring should include every aspect of policies and procedures. Nurses should check documentation to have accurate records on the ordering, receiving administration and disposal of medication and also spot check when medication is being administered to ensure that medication is not left unsupervised (Robbins, 2006).

1.3 The principle of Medication Administration

The five rights of medication administration are the basis of most education on drug administration in the school of nursing and form the core of medication administration policies. The five rights of medication administration were: 1) The Right Drug, 2) In the Right Dose 3) To the Right Patient 4) At the Right Time and 5) In the Right Route (Abrams, 1987; Reiss & Evans, 1993; Shannon & Wilson, 1992).

Nurses are the final checkpoint before medications are administered to the patients. Therefore, it is very important for nurses to strict and followed "the Five Rights", the principle of medication administration. To increase awareness of practicing nurses, some books of nursing theory added two more rights (right documentation and right to refuse) from "Five Rights" to "Seven Rights" (Reiss & Evans, 2002) but "Seven Rights" of another theory was different, added more two rights, they were right technique and right documentation (Lane, 1992).

Right patient

Right patient defines as "essential component of the rights of safe medication administration based on correct identification of medication recipient" (Reiss & Evans, 2002, p. 919).

To identify patients correctly before giving medications, the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) requires at least the use of two identifiers to identify a patient such as the patient's name, identification number, birth date, a bar-coded wrist band, or other ways. The patient's room number or location cannot be used for identification (JCAHO, 2008). Ideally, match the ordered treatment to the patient using the patient's name and ID number, comparing it to the

drug order transcribed in MAR. Be especially cautious when patients are confused because they may make mistakenly answer to the wrong name or even answer to the wrong name on purpose.

Right drug

Right drug defines as "essential component of the rights of safe medication administration that involves making sure the correct medication is ordered and administered" (Reiss & Evans, 2002, p. 919).

Giving the wrong drug is the most common type of medication error. It typically results from many factors such as look-alike and sound-alike drug names, similar drug labels and packaging, and poor communication. Example is insulin I.V. administration, it requires regular insulin. No other type of insulin can be administered by I.V. route. Because multiple types of insulin are usually stocked in ward. The chance for using the wrong type of insulin is very high. Furthermore, medication labeling is also an important tool for giving the right drugs. In the operating room (OR), medications are removed from manufacturers' identifying containers; so the OR nurse should label medication placed on the sterile field. Unlabeled medication and solutions on the sterile field have caused many errors. There were some studies of medication safety self assessment of operating room practices in the part of the Institute for Safe Medication Practice (ISMP), revealed that, only 41% of operating room personals in 1,600 hospital labeled all their containers, including syringes, basins, and other containers.

The ISMP (2004) recommended medication labeling to prevent medication administration error as the following: 1) Safe labeling policies and procedures should be implemented in the perioperative setting. 2) Labels should be provided and required on all containers and syringes. 3) Each medication was labeled properly when it is added to the sterile field and before any other medication is dispensed.

In 2006, the JCAHO added a new National Patient Safety Goal in which health care workers are instructed to label all medication, medication containers (e.g. syringes, medicine cups, basins) or other solutions on and off the sterile field in perioperative and other procedure settings (The Joint Commission, 2006). Furthermore, in 2007 the JCAHO added specific requirements to this goal by stating

that all labels should include the medication's name; strength; amount; and expiration date (when a medication is not used within 24 hours) or expiration time (when a medication expired in less than 24 hours) and including the recommendation that "no more than one medication or solution is labeled at one time". However labeling is not required if a medication is removed from its original container and immediately administered by the individual who removed it (The Joint Commission., 2007).

Some recent study was tested in the OR at a Houston, Texas, to identify and implement the best methods of promoting medication labeling in the operative setting with the use of both blank and preprinted labels and found that scrub nurses were more likely to label medications and medication-delivery devices when preprinted medication labels were provided. From this project, the result of the study stimulated the hospital's management team to supply pre-printed labels for all procedures to improve safety for surgical patients (Jennings, 2007).

Right dose

Right dose defines as "essential component of the rights of safe medication administration based on making sure the ordered dose to be administered is safe for the client and is the dose administered" (Reiss & Evans, 2002, p. 919).

Check the dosage against the order in the MAR is to ensure that medication is administering with the right dose. Nurse must determine if the dosage is appropriate based on the patient's age, size, vital signs, and condition. If the dose needs to be measured, use appropriate equipment for instance, an oral syringe rather than a parenteral syringe to measure an oral liquid drug. Be careful for misinterpretation of orders, incorrect calculation of volumes and infusion rates, misreading of decimal points, and labeling errors. Nurse should listen to the patients if they question a dose. When administering a high-alert drug, such as insulin, heparin, morphine, lidocaine, nitroprusside, or potassium chloride, which can cause serious harm if given incorrectly, or when giving an IV drug to a pediatric patient, nurses must double-check the dosage and pump settings; then verify these with a colleague (Schull, 2007). The example of infusion pump used were to check right drug for right patient, check pump set correctly at start of infusion for ordered rate, check all subsequent when rate changes and check at change of shift or handover time (Grasha, 2000).

Right route

Right route defines as "essential component of the rights of safe medication administration that involves making sure the route ordered is safe and that the route ordered is administered" (Reiss & Evans, 2002, p. 919).

Many drugs can be given by multiple routes. The physician chooses the route to administer medication based on two factors, 1) the patient's condition and 2) the desired onset of action. In turn, the prescribed dosage is based on the administration route. The most serious medication errors outcomes are the IV route of administration for medications because many of high-risk medications such as heparin, insulin, morphine, fentanyl, propofol, and midazolam can be delivered intravenously (NCCMERP, 1998 cited in Fields, 2005). The intravenous medications are used in all patient care areas and are used more frequently in acutely ill patients, who are less able to compensate for medication error. Even a minor over or under dose can result in serious adverse effects. The intravenous medications have been associated with 54% of potential adverse drug events (ADE) and 56% of medication errors (Fields, 2005).

Right time

Right time defines as "essential component of the rights of safe medication administration based on assuring that the medication is administered at the correct time" (Reiss & Evans, 2002, p. 919).

Incorrect timing of drug administration accounted for 43% of drug errors reported (the Archives of Internal Medicine, 2002). Although many medications are not time-sensitive, timing of doses can be critical to maintain a specific blood-drug level or to ensure accurate laboratory test values, or avoid interactions with other drugs. Usually, a dose should be given within 30 minutes before or after the time specified in the order, in accordance with the hospital's protocols. Always administer a dose as it's prepared. To maximize the drug's therapeutic efficacy, nurses should check whether the drugs should be given with or without food and whether it could interact with the absorption of administered drugs at the same time. If the patient is scheduled for diagnostic testing, determine whether to withhold the dose until after the test (Schull, 2007).

Nursing responsibilities do not stop with these five rights. In some theory the principles of drug administration were seven rights by adding more two rights, those were right documentation and right to refuse.

Right Documentation

Right Documentation defines as "essential component of the rights of safe medication administration that involves the accurate recording of medication administration, including client response" (Reiss & Evans, 2002, p. 919).

Right Documentation is the primary method used to communicate medication administration from one nurse to the next nurse caring for a special patient. It is a legal and a safety responsibility of nurse. The basic principle of document is "if it isn't documented, it wasn't done" (Bonita, 2002). Therefore, if the nurse does not document the medication was given, another nurse may administered the medication and might cause adverse drug reaction or harm to the patient.

Right Documentation includes document the drug, the dosage, the time administered, the route and site if given parenterally, and the patient's response. Most hospital use medication administration record (MAR) for documenting this information. When documenting, nurses must use only accepted abbreviations and avoid those that are used rarely or that could be misread or misinterpreted. If a patient refuses a medication, report this to the physician immediately. The problems of documentation may come from not recorded or poorly recorded. Adequate recording at every stage of management of medication is needed.

Right to refuse

Right to refuse defines as "essential component of the rights of safe medication administration that involves assuring that the client's right to refuse is preserved; this usually involves a lack of knowledge on the part of the client and requires client education" (Reiss & Evans, 2002, p. 920).

The patient has the right to refuse to take medication without his/her permission. The patients refuse because they lack knowledge about what the medication is, adverse effect of medication that the patient experienced, feel powerless and so on. Nurse should assess the reason why the patient refused. If they refuse

because of knowledge deficit, nurse should give appropriate explanation why medication is ordered, what the medication does and the purpose of the medication. Document if the patient refuses medication, the patient's reason and reporting of refusal to the physician.

Right Technique

Right technique defines as "essential component of the rights of safe medication administration based on assuring that the medication is administered at the correct technique".

If nurses administer medication with the wrong technique there is a risk of an adverse event. An examples, of this error, is that if a chemo drug that is to be administered in the procedure of y-site or two syringe technique, not permit to inject intravenous directly because it may damage out of the vessel and make necrosis or damage the tissue, break, cut some medication that delayed-release tablets and give via oral, administer the drugs which physically incompatibility, include the lack of heart rate or blood pressure measurement before giving a dose.

Concerning with "Five Rights", different hospitals have different policies, there are "Six Rights", "Seven Rights", "Nine Rights", or "Eleven Rights". Additional rights are right technique, right document, right reason, etc. However, Cook (2006) had implemented "The Six Rights for Nurses Administering Medications" to be guidelines for nurses who pertain nursing care to patients. Those "Rights" are;

1) To complete and to clarify written order.
2) To have the correct drug route and dose dispensed.
3) To have access to information.
4) To have policies on medication administration.
5) To administer medication safety and to identify problems in the system.
6) To stop, think, and be cautious when administer medications.

However, in the 25th Annual Meeting of the National Conference of Gerontological Nurse Practitioners, Dr. Pepper noted that teaching medication error prevention according to "The Five Rights" in nursing school should be focused on the system rather than on the individual because "The Five Rights" are goals, not procedures (Chilton, 2006).

Section II. Medication Administration Error

Definition

Medication Administration Error was defined as "mistakes associated with drugs and intravenous solutions that are made during the prescription, transcription, dispensing, and administration phases of drug preparation and distribution" (Wolf, 1989, cited in Henry, 2006).

Medication Administration Error was defined as any deviation from the physician's written order (Flynn, 1999 cited in Anusornsangiam, 2002).

Model of Error

For understanding how error occurs easily, Swiss Cheese Model is a model that defined an error occurs when natural holes in the cheese join up to form a channel which permits an error to happen. In this model everyday error results from both active and latent failures, these form the holes in the cheese that join up at a specific point leading to an error (Reason, 2000 cited in Fry & Dacey, 2007).

Incident of Medication Errors

In 2000, MedMARx, the national database for medication error associated with the United States Pharmacopeia (U.S. Pharmacopeia), reported that it received 6,224 medication error reports between July, 1998 and November, 1999 the majority of medication errors occurred during the medication administration phase (40%), documenting (transcribing) phase 21%, and dispensing phase (17%) (U.S. Pharmacopoeia, 2000 cited in Brown, 2001).

Incident of Medication Errors in Thailand

In Thailand, the studied of medication errors in Buddhachinaraj Phitsanulok Hospital found that 5,040 medication error (7.94%) from 63,455 drug prescriptions. From these medication errors, 2,868 episodes (4.52%) were medication administration errors. The most common errors were medication administration error that did not comply with drug prescriptions (77.82%). These errors derived from human errors (64.98%). Most of these errors (71.92%) were corrected by clinical pharmacists and nurses at wards before administering to patients, and the rest of medication error

(28.08%) still occurred. However, these errors did not affect the patients (Eumkep, Boonchoo & Theanchairoj**,** 2003).

2.1 Classification of Medication Error

The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) is an independent body composed of 24 organizations and agencies in the United States of America such as American Hospital Association, American Medical Association, American Pharmaceutical Association, Food and Drug Administration (FDA), The Institute for Safe Medication Practices (ISMP), The Joint Commission on Accreditation of Healthcare Organizations (JCAHO), National Council of State Boards of Nursing, US Pharmacopoeia and etc.(NCC MERP, 2008).

NCC MERP defined medication error as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use" (NCC MERP, 2000; Davidhizar & Lonser, 2003; Anusornsangiam, 2002). Because the definition of medication error came from multidisciplinary group of many national organizations, therefore in my opinion the definition of medication error should use this definition as the international standard.

Medication errors can be classified in many ways. Some research in Nepal classified medication errors into 4 groups. There were 1) based on the onset 2) based on the underlying cause 3) based on medication error index and 4) based on the severity (Dubey, Palaian, Shankar, Mishra, Prabhu, Bhandari & Chhetri, 2006).

1) Based on the onset (Jackson & Reines, 2003 cited in Dubey et al, 2006). Medication errors can be classified as: (1) active errors and (2) latent errors

(1) Active errors occur at the point of contact between a human and some aspect of a larger system. They are generally readily apparent, for example pushing an incorrect button, ignoring a warning light and almost always involves someone at the frontline.

(2) Latent errors (or latent conditions) refer to less apparent failures of organization or design that contributed to the occurrence of errors or allowed them to cause harm to patients. Latent errors based on the onset and have delayed effects. Latent errors are identified and can be corrected before it recurs. For example if the nurse misread the prescription because it was poorly written, one strategy to prevent this error is to analyze future prescriptions more carefully and verify the medication with the prescriber when there is doubt.

2) Based on the underlying cause

Allan & Barker (1990) (cited in Dubey et al, 2006) classified medication errors into 11 categories as the following.

(1) Omission error: This error occurs when a patient has not received his or her medication by the time the next dose is due.

(2) Wrong dose error: This type of error takes place when the patient receives an amount of medicine that is greater than or less than the amount ordered.

(3) Unordered error: This error occurs when a patient receives a medication for which the physician did not write an order.

(4) Wrong dosage form error: It involves the administration of a drug in a dosage form different from the one that was ordered.

(5) Wrong time error: It occurs when the patient does not receive his/ her medication within a predefined interval.

(6) Wrong route error: They occur when the correct dosage form is administered, but in the incorrect site on the patient's body.

(7) Deteriorated drug error: It is reported when the physical or chemical integrity of a medication dosage form has been compromised, as with expired drugs or intravenous medications requiring refrigeration that are stored at room temperature.

(8) Wrong rate of administration errors: These errors can occur with infusions of intravenous fluids or liquid enteral fluids.

(9) Wrong administration technique errors: It involves the use of an inappropriate procedure during administration of a drug.

(10) Wrong dose preparation error: It occurs when a product is incorrectly made or manipulated before administration.

(11) Extra dose error: It occurs when the patient receives one or more dosage units in addition to those authorized, such as the dose administered after the dose was cancelled.

American Society of Hospital Pharmacists (1993) added prescribing error, compliance error (inappropriate patient behavior regarding adherence to a prescribed medication regimen) and changed wording from unordered error to unauthorized drug error that in the same meaning, changed from wrong dose preparation error to wrong drug preparation error (drug product incorrectly formulated or manipulated before administration) (JCAHO, 2001).

However, Flynn (1999) (cited in Anusornsangiam, 2002) classified medication errors from the underlying cause into 9 categories as the following: (1) Omission error (2) Unauthorized drug errors (3) Wrong dose error (4) Wrong route error (5) Wrong rate error (6) Wrong dosage form error (7) Wrong time error (8) Wrong drug preparation error (9) Deteriorated drug error.

The elements of each type of medication errors were compared (in table 1). According to the principle of medication administration (5 Rights: Right patient, Right drug, Right dose, Right route and Right time), NCC MERP (1998) identified types of medication errors covered more than the others.

Table 1 Comparing the Element Used to Clarify Types of Medication Error

no.	Type of errors	Allan & Barker, 1990 cited in Dubey et al, 2006	Flynn, 1999 cited in Anusornsangiam, 2002	ASHP, 1993 Cited in JCAHO, 2001, p.18	NCC MERP, 1998 cited in JCAHO, 2001, p.19
1	Omission error	√	√	√	√
2	**Wrong dose error**	√	√		
3	Unordered error	√	√	√	
4	Wrong dosage form error	√	√	√	√
5	**Wrong time error**	√	√	√	√
6	**Wrong route error**	√	√		√
7	Deteriorated drug error	√	√	√	√

Table 1 Comparing the Element Used to Clarify Types of Medication Error (continue)

no.	Type of errors	Allan & Barker, 1990 cited in Dubey et al, 2006	Flynn, 1999 cited in Anusornsangiam, 2002	ASHP, 1993 Cited in JCAHO, 2001, p.18	NCC MERP, 1998 cited in JCAHO, 2001, p.19
1	Omission error	√	√	√	√
8	Wrong rate of administration errors	√	√		√
9	Wrong administration technique errors	√		√	√
10	Wrong dose preparation error	√	√	√	
11	Extra dose error	√			
12	Improper dose error			√	√
13	Wrong strength/ concentration				√
14	**Wrong drug error**				√
15	Wrong duration error				√
16	**Wrong patient error**				√
17	Monitoring error			√	√
18	Other error			√	√
19	Prescribing error			√	
20	Compliance error			√	

The U.S. Pharmacopoeia (2000), studied the type of medication errors in the United States and revealed that the three most frequently reported were omission errors accounted for 1,689 errors (27%), 1,313 improper dose or quantity (21%), and 751 unauthorized drugs (12%) (Davidhizar & Lonser, 2003).

During the year 2001-2003, the study of the Partnership for Health and Accountability, a voluntary and peer-review protected statewide hospital patient safety program in Georgia which focused on safe medication use in acute care hospitals showed that more than 90% of participating hospital, the most common error type was dose omission (year 2001, 63.2%; year 2002, 62 %; year 2003, 67.7 %) (Rask, Hawley, Davis, Naylor and Thorpe, 2006).

3) Based on medication error index

The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) developed medication error divided into 9 categories which ranging in severity from A to I. Category A is potential error **(**Hartwig et al, 1991 cited in Dubey et al, 2006). These are circumstances or even that have potential to cause incident. Category B, C, and D are errors that cause no harm to patient. Category E, F, G, H and I are errors that cause harm to patients and the most severe error is category I that results in patient death (NCC MERP, 2001). The details are listed in table 2.

Table 2 Medication Error Categorization Index (NCC MERP, 2001)

Category	**Result**	**Error**
A	Circumstance or events that have the capacity to cause error	No error
B	An error occurred, but the medication did not reach the patient	Error, no harm
C	An error occurred that reached the patient but did not cause patient harm	Error, no harm
D	An error occurred that resulted in the need for increased patient monitoring, but no patient harm	Error, no harm
E	An error occurred that resulted in the need for treatment or intervention and caused temporary patient harm	Error, harm
F	An error occurred that resulted in initial or prolonged hospitalization and caused temporary patient harm	Error, harm
G	An error occurred that resulted in permanent patient harm	Error, harm
H	An error occurred that resulted in near-death event	Error, harm
I	An error occurred that resulted in patient death	Error, death

4) Based on the severity

Medication Errors may be classified based on the severity into 3 degrees such as degree A, B and C (Lustig, 2000 cited in Dubey et al, 2006) as shown in table 3.

Table 3 Medication Error Classified by Severity

Degree of severity	Definition
A	Potentially serious error that can cause permanent harm to patient, may increase hospitalization or need of additional treatment
B	Clinically significant error can increase need for patient monitoring
C	Clinically non-significant error that does not harm the patient

2.2 Factors contributing to medication administration errors

Many research studies found that there were many factors contributing to medication errors: 1) knowledge deficit (IOM, 1999), 2) interruptions by others while passing medications (Tang, Sheu, Yu, Wei & Chen, 2007 cited in Madogowda, Hill and Anderson, 2007), 3) lack of sleep and shift work (Clissold, Smith, Accutt, & DiMilia, 2002 cited in Madogowda et al, 2007). Furthermore, 4) seasonality in winter months when daylight is the least (Roseman & Booker, 1995 cited in Madogowda et al, 2007), 5) personal, employment-related, and 6) environment stressors also are sources of medication errors (Tang et al, 2007 cited in Madogowda et al, 2007).

The recent research in Georgia (Rask, Hawley, Davis, Naylor, & Thorpe, 2006) revealed that the common contributing factors that leading to medication errors in Acute Care Hospital were 1) frequent interruptions, 2) communication system, 3) training, 4) staffing, 5) policies and procedures, 6) assignment of provider or inexperienced personnel, 7) noise level, 8) lack of availability of health care professional, and 9) floor stock and preprinted medication orders.

The investigator reviewed factors contributing to medication errors and divided into 4 groups as the followings:

1) Nursing Personnel such as knowledge, skill and attitude or perception of nurses.

(1) Nurses lack of knowledge of medications
(2) Nurses lack skill of mathematical calculation
(3) Personal experiences and characteristics of the nurse
(4) Failure to follow the policy
(5) Breakdown of communication

2) Workload and Staffing Level
3) Communication
4) Working Environment

2.2.1 Nursing Personnel

Medication administration was more than just giving pills to patients. It was perceived as a way to get an interpersonal contact with the patients. One part of the contact is explaining information about the medicines. Lack of an interpersonal contact during medication administration can cause frustration for patients and nurses. Nurses must have the knowledge, skill, and judgment to assess the appropriateness of the medication for a particular patient and know patient drug allergies. Nurses need to assess the developmental stage of the patient, any alterations in the patient's condition or functional status, which interferes with the physical capacity to take oral medications and the patient and family's level of understanding, knowledge of each medication and their readiness to assume self medication administration. O'Shea (1999) reported seven common nurse characteristics contributing factors of medication administration errors were nurses 1) lack of knowledge of medications, 2) lack skill of Mathematical calculation, 3) workload and staffing levels, 4) failure to follow the policy, 5) breakdown of communication, 6) personal experiences and characteristics of nurse and environment involving nurses contribute to medication errors.

(1) Nurses lack of knowledge of medications

When nurses administer the drug and therefore require knowledge of the action, side effects, and correct dosage of any drug they administer. Whereas the numbers of drugs are increasing in hospitals, it's nurse's responsibility to update their knowledge of drugs which increased.

The study of Leape et al (1999) identified the systems failures that underlie medication errors. In the nurse administration stage, lack of knowledge of drug was also the most common cause (15%) of the problems in this stage (Anusornsangiam, 2002). The nurses' knowledge about effects and side effects of the medicines made it easier for the patients to trust the nurses.

The study in the United Arab Emirate (2007), the clinical pharmacist designed and implemented an educational program for raising the awareness of inpatient nursing staff about medication errors by using pre-post self reported questionnaire (twenty closed questions) examined knowledge about fundamental aspects of medication errors and other relevant medication safety issues, in-house training, and educational material. There were statistically significant differences in the knowledge of nurses about the causes and reporting of medication errors, and were also differences in response by year's experience, educational qualification and the current clinical working area of participant nurses that consistent with the results of the study of Mayo and Duncan (2004). Furthermore, nurses believed CPOE (Computerized Physician Order Entry), bar code system, and independent double check system when administer high alert drugs will decrease medication errors (Elnour, Ellahham, & Qassas, 2007, p.186).

(2) Nurses lack skill of mathematical calculation

The medication calculations literature identified three main areas where errors may be made. The first is a result of not understand the logic of a problem or how to construct a calculations formula, the second is arithmetical, which nurses cannot add, subtract, divide and multiply correctly. The last are linguistic errors where nurses have little or no knowledge of mathematical language such as an inability to understand the words in the instruction.

The very high risk and dangerous areas in medication calculation are infants and children patients. The accurate doses are very important even small discrepancies. The two methods using in calculate pediatric dosages are based on child weight (mg per kg) and body surface area (BSA). The nurse must know if the ordered dosage is safe before administering a drug and responsible for recognizing incorrect dosage and must notify the physician if a prescribed medication is out of safe range. The purpose

of learning how to calculate pediatric drug doses is to ensure that the child receives the correct dose within the normal therapeutic range (Kee, 1992 cited in Sredl, 2006).

The study of Bindler and Bayne (1991) reported that 81% of the nurses were unable to calculate medication correctly 90% of the time and 43.6 % of test scores required calculation received grades below 70% accuracy (Davidhizar & Lonser, 2003).

A study of Ashby (1997) indicated that 56.4% of nurses could not calculate medication doses correctly in 90% of the problems (Britner, Kreamer, Frownfelter, Helmuth, Lutter, Schafer, & Wilson, 2006).

The study of Brown (2002) administered a computational arithmetic test to a national sample of 850 associate degree students and obtained an average score of 75%. The study concluded that nursing students are under prepared in mathematics (Britner et al, 2006).

Some quasi-experimental research aimed to assess the medication calculation skills of nurses and nursing students showed the result that medication calculation was a weakness among nurses and nursing students, 41.6% of students and 54.8% of nurses could not calculate IV. Medication or IV flow rates with 90% accuracy (Britner et al, 2006). The NCC MERP had also reported that 7% of medication error reports were related to miscalculation (Thomas, Holquist, & Phillips, 2001 cited in Britner et al, 2006). As a result, one study recommended “The Triangle Technique”, the new tool for teaching mathematic calculations and increase mathematical comprehension among nursing students and practicing nurses (Sredl, 2006).

(3) Personal experiences and characteristics of the nurse

Mental health status, family and personal stress, distraction during medication preparation, and other experiences may be correlated with drug administration errors.

Distraction defines as “anything that draws away diverts, or disturbs attention from achieving a goal” (Pape, 2002 cited in Pape, Bryant, & Sharp, 2005, p.109). Excessive input (information overload) and distractions compete for the individual’s attention and fill the working memory where information is temporarily stored, thus affecting the ability to concentrate. Slips occur when an interruption prevents an

intended action during information overload (Reason, 1991 cited in Pape, Bryant, & Sharp, 2005).

The other contributing factors to errors include hurriedness, fatigue (United States Pharmacopoeia, 2000 cited in Pape, Bryant, & Sharp, 2005).

The recent study of Pape et al. (2005) reported the innovative approaches for reducing nurse's distraction during medication administration by using protocol checklists to be used during medication administration and used signage for reminding the staffs and increasing more awareness such as "Do Not Disturb" during administering drugs. The results showed that most of the nurses (81%) avoided distractions, interruptions and conversation. However, overall nurses did not follow the protocol 30% which indicates improvement is needed. These tools were the very simple and inexpensive tools for medication safety (Pape, Bryant, & Sharp, 2005).

(4) Failure to follow the policy

Failure to follow the policy is a significant factor in medication administration errors. Although nurses are highly motivated to administer drugs accurately, there is less motivation to follow policy to improve medication administration. It comes from routines practices.

5) Breakdown of communication

Breakdown of communication is another major in medication administration errors such as poor physician handwriting, oral orders, and transcription of orders contributing to errors. More detail will be discussed in the topic of communication.

2.2.2 Communication

Communication is "the exchange of information or opinions. It is most often an interactive process that is a means to an end and is influenced by the context in which it occurs. Communication typically involves a sender, a message, a receiver, and feedback" (Bernat, 2003). Medication errors occur because there is a lack of communication or coordination between providers or providers and patients.

Nurse's role is to communicate the patients and their families knowing and understanding their responsibilities and the process for managing medications.

Communication problems are a common cause of medication errors. It occurred because of inadequate communication among nurses, physicians, and pharmacists as well as patients and families.

The Joint Commission on Accreditation of Healthcare Organizations reported that the most common root cause of sentinel event is communication (60%) between the years 2001-2006. More than 350 medication errors resulting in death or major injury and 63% of sentinel event database were related to failed communication (Shannon, 2007).

Tools to Reduce Medication Error

These are the tools to help reducing medication errors from communication errors.

1. Policy for Verbal Medication Orders/Order by phone

Verbal communication relies on speaking words to convey a message. It involves the use of the auditory channel previously discussed. The accuracy of the message is dependent on the sender's vocabulary and the receiver's ability to make sense of the words used to send the message (Bernat, 2003). Verbal orders are spoken orders delivered in person. Telephone orders are spoken order delivered by telephone. There have been errors associated with verbal and telephone orders when doctor who prescribe is not clear or nurses don't understand the order.

For prevent medication error, Massachusetts Coalition (2001) recommended the policy for verbal medication order or order by phone as the following: 1) limit verbal and telephone orders to emergency situations only 2) enunciate verbal and telephone orders slowly and distinctly 3) follow verbal orders, delivered either in person or via telephone, with a request that the person receiving the order repeats it 4) accompany verbal and telephone orders with backup documentation and signature 5) fax prescriptions as an alternative to verbal communications.

NCC MERP (2002) has the same recommendation of verbal medication orders/ order by phone and added more recommendations such as the hospital should establish policies and procedures that describe limitations or prohibitions on use of verbal orders, list the elements required in a complete verbal order, list and define the individuals who may send and receive verbal orders, provide guidelines for clear and effective

communication of verbal orders. Furthermore, the leaders of hospital should promote a positive culture that encouraged staff to question physicians when there are any questions or disagreements about verbal orders. The chemotherapeutic drugs are very dangerous, should not be permitted by verbal orders and should not permit to administer in emergency or urgent situations.

The elements of verbal order include: name of patient, age and weight of patient, drug name, dosage form (e.g., tablets, capsules, inhalants), strength or concentration, dose, frequency, and route, quantity and/or duration, purpose or indication (unless disclosure is considered inappropriate by the physician), specific instructions for use, name of physician, and telephone number when appropriate).

The content of verbal orders should be clear, such as, spelling, use both brand name and generic name, the indication of use. Also, to avoid confusion with spoken numbers, a dose such as 50 mg should be spoken as "five zero milligrams" do not use fifty milligrams to distinguish from "fifteen milligrams" The instructions for use should be provided without abbreviations. For example, "1 tab bid" should be communicated as "take/give one tablet two times daily." The complete verbal order should be repeated back to the physician. All verbal orders should be reduced immediately to writing and signed by the individual receiving the order. And verbal orders should be documented in the patient's medical record, reviewed, and countersigned by the physician as soon as possible.

Furthermore, to improve effective communication, The Joint Commission on Accreditation of Healthcare Organization (JCAHO), recommended International Patient Safety Goal 2 (IPSG 2) as the following: 1) a collaborative process is used to develop policies and/ or procedures that address the accuracy of verbal and telephone communications. 2) The complete verbal and telephone order or test result is written down by the receiver of the orders or test result. 3) The complete verbal and telephone order or test result is read back by the receiver of the order or test result. 4) The order or test result is confirmed by the individual who gave the order or test result (JCAHO, 2008).

In 2007, Hendrickson studied of verbal medication orders in the OR, and found that verbal orders in OR were usually come from surgeons and anesthesiologist. They are not communicated clearly for many reasons, such as, wearing masks that cover a

surgical team member mouths make the team members voice unclear. This leads to confusion about a medication's name, strength, or dose. Noise clutter, such as, ringing telephones, music, and alarms of medical equipment in the OR may cause distraction. The appropriate communication techniques should be used including a read-back system in which verbal orders are written on a dry-erase board and verified by the ordering physician, requesting clarification of questionable orders, and reducing distractions in the OR (Hendrickson, 2007).

2. Standardize the abbreviations, acronym and symbols used in the Hospital

Abbreviation of drug names can lead to significant errors. The study in a Midwestern, urban teaching hospital for the purpose of measuring prescribing errors, revealed that from reviewing 1,422 prescribing orders, there were 1,979 errors (1.3 errors per order), 29% of orders contained a dangerous abbreviation and 18% were illegible, 18% of orders were ambiguous (Garbutt, Milligan, McNaughton, Waterman, Dunagan and Fraser, 2005).

In each hospital, abbreviations may have a different meaning. An example commonly reported is the misinterpretation of the letter "U" intended to represent the word "units" being frequently interpreted as a "0" (that is, "10U" is misread as "100" units). If not caught, this error would occur as an inappropriate dose, and harm the patients (Beyea, 2004).

3. Technique for effective communication

A "Hand-Off" occurs when we transfer responsibility for a patient's care from one physician to another, one nurse to another, among other personnel, or when a patient is discharged from hospital. There is a high risk for medication error to occur. We need to provide complete and accurate verbal communication about the patient's status and care. The "Hand-Off" communication is used to provide accurate information about a patient's, resident's care, treatment and services, current condition and any recent or anticipated changes. The examples of patient hand off, are nursing shift changes, patient transfer to other care settings etc (JACHO, 2006).

An easy-to-remember, format for communicating with other caregivers is a technique called "S-B-A-R". SBAR stands for**:** 1) Situation: Identify yourself and your unit: give the patient's name, identifying information, and the patient's current status include medications, allergies, intravenous fluids, and recent lab results 2) Background: give the admission diagnosis, the date of admission, the pertinent medical history, brief summary of treatment to date. 3) Assessment: provide the most recent vital signs-BP., pulse, respirators, temperature and other information such as mental status, skin color, pain level, respiratory rate/ quality, rhythm, changes, etc 4) Recommend to say what you would like to see such as asking for the physician to see the patient now, asking for a consult, ordering lab test (Menzoian, 2006). The SBAR technique is an easy way for nurses to remember and focused way to set expectations for what will be communicated and how between team members.

One study of using SBAR in Medication Reconciliation Process of Saint Joseph Medical Center in year 2004- 2005 showed that the use of SBAR in Admission Reconciliation Process increased from 72% to 88% and the used of SBAR in Discharge Reconciliation Process increased from 53% to 89%. It increased nurse's satisfaction (Haig, 2006)**.**

4. Establish and Implement Medication Reconciliation System in the hospital

While some hospitals use technologies such as CPOE, bed side bar coding system to make sure that the patients receive the appropriate medication and dosages on admission, during transfer and at discharge. But medication reconciliation can reduce risk of medication error without the use of technology or equipment (Ketchum, Grass, & Padwojski, 2005).

Medication Reconciliation is defined as "a process of identifying the most accurate list of all medications a patient is taking including name, dosage, frequency, and route and using this list to provide correct medications for patients anywhere within the health care system" (Midelfort, 2006). Reconciliation involves comparing the patient's current list of medications against the physician's admission, transfer, and/or discharge orders.

The Institute for Healthcare Improvement (IHI) defines medication Reconciliation as **"**creating the most accurate list possible of all medications a patient is taking including drug name, dosage, frequency, and route and comparing that list against the physician's admission, transfer, and/ or discharge orders with the goal of providing correct medications to the patient at all transition points within the hospital" (Ketchum et al, 2005). Medication reconciliation is the process of comparing a patient's medication orders to all of the medications that the patient has been taking. This reconciliation is done to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions. It should be done at every transition of care in which new medications are ordered or existing orders are rewritten. Transitions in care include changes in setting, service, practitioner or level of care. This process comprises five steps: 1) develop a list of current medications; 2) develop a list of medications to be prescribed; 3) compare the medications on the two lists; 4) make clinical decisions based on the comparison; and 5) communicate the new list to appropriate caregivers and to the patient (The Joint Commission on Accreditation of Healthcare Organization (JCAHO, 2006).

However, Department of Health Western Australia (2007) defines Medication Reconciliation as "the formal process of obtaining a complete and accurate list of a patient's current home medications and comparing the medical officer's admission, transfer or discharge orders to that list".

There are four-steps of the medication reconciliation process for all patients:

1. Medication history - obtain a complete and accurate medication history of each patient's current home medications (details to include generic medication name, dosage, frequency and route).
2. Confirmation – confirm with the patient and (where possible) a second source of information that the details obtained in the medication history are correct.
3. Reconciliation – compare the clinician's admission, transfer of discharge orders to the medication history and ensuring that any discrepancies are brought to the attention of the prescriber and, if appropriate, changes are made to the orders.

4. Medication information provider – make sure that frequent and accurate communication about the patient's medications occurs between all clinicians involved in the patient's care and is also communicated to the patient and/or care.

Ketchum et al, (2005) stated that communication could be improved by using medication reconciliation system at three areas of transition: admission, during transfer between units and at discharge

The following of 4 components of medication reconciliation were:

(1) Develop policies and procedure that assign primary responsibility for reconciliation at admission, transfer and discharge.
(2) Identifying time frame for completion of medication reconciliation
(3) Using standardized forms that are easily accessible and visible at all times during transfer and place home medication lists in the form so that they are highly visible in patient charts.
(4) Clarifying all medication discrepancies with the physician's order (Ketchum et al, 2005).

There was a study in 1998 of a health care system in Wisconsin demonstrated that the reconciliation system can improve patient safety and reduce medication errors. Including, time used more appropriately on admission, transfer and discharge period by using a form consisting of the details of all medications at the front of the patient's chart. This form decreased the time spent from 30 minutes to 5-10 minutes on admission. The transfer from the coronary care unit decreased from 60-90 minutes to 30-45 minutes, and discharge time decreased from 45-60 minutes to 10 minutes. Furthermore, in seven months (January - July, 1998), medication errors decreased from 213 to 63 per 100 admissions. A follow-up study showed that after implementing medication reconciliation during transfer and at discharge, errors decreased fewer than 50 per 100 admissions monthly.

However, there are some problems, which are difficult to solve. Problems, such as, patients forgot medication taken at home, many physicians are caring for one patient, incomplete medication lists, patients not taking medication as prescribed, clinicians interview patients quickly, staff are unfamiliar with medications and errors are made in recording (Ketchum et al, 2005).

2.2.3 Workload and staffing levels

"Workload for nursing" was defined as those working double shifts therefore increasing fatigue versus new graduates with limited experience and knowledge base (Leape LL, 1996). Some research indicated that workload and staffing levels could contribute to medication errors. All hospitals and nursing departments have faced the problem of staff shortages. Shortages of nursing personnel increase the number of medication administrations per nurse and thus may increase the possibility of error. Staff shortages are responsible for restricted time to do physical assessment, to monitor medication outcomes, or failure to detect sub-therapeutic toxic levels of medication.

A study of 30 mixed patient care units (ICU, medicine, surgical, obstetric, and skilled nursing units) of 11 hospitals investigated the impact of total nurse staffing worked hour per patient day (WHPPD) and the proportion of those hours provided by registered nurses (RN) on the outcomes of medication errors, patient falls and cardiopulmonary arrests. It revealed that units with higher proportions of RN, up to an 85% skill mix, had lower rates of medication errors per 10,000 doses and across all units, lower WHPPD resulted in more medication errors (Blegan and Vaughn, 1998 cited in Whitman, Kim, Davidson, Wolf and Wang, 2002).

In a survey study of more than 600 hospital nurses, nearly one in four nurses indicated that patients regularly miss routine assessments due to lack of nurses (Analysis of American Nurses Association Staffing Survey, 2001 cited in Brown, 2001).

The United States Department of Health and Human Services and the Harvard School of Public Health (2001) reported that higher nurses staffing with a 3-12% reduced the rates of outcomes potentially sensitivity to nurse staffing (OPSN). Examples of OPSN were pressure sore, length of stay, urinary tract infections, pneumonia, upper gastrointestinal bleeding, and shock (Needleman, Buerhaus & Mattke, 2001 cited in Brown, 2001).

However, the studies of the impact of staffing on patient outcomes across special units from 95 patients care units across 10 adult acute care hospitals in the United States. The results from this study showed contrast from the other studies that staffing is consistently inversely and significantly associated with medication errors in

the cardiac, non-cardiac ICU and the cardiac intermediate care unit. These findings suggest that environments with higher acuity patients and most likely greater number and more complex medication regimens per patient are sensitive to staffing alterations (Whitman et al, 2002).

However, the studies of the relationship between nurse staffing and patient outcomes or the impact of nurse staffing on patient outcomes had not been previously examed in Thailand (Akkadechanunt, Thitinut, Cynthia and Abbas, 2003).

A study in 19 teaching hospitals in Ontario, Canada, was to evaluate the effect of different nurse staffing models on costs and the patient outcomes of medication errors. The results revealed the relationship between medication error and staffing, the lower proportion of professional nurses in the staff mix on a unit, the higher number of medication errors (Hall et al, 2004).

2.2.4 Working Environment

Environment is the aggregate of the conditions, influences, forces, and cultural values that influence or modify an individual's life in a community such as a clinic or clinic unit (Schmalenberg & Kramer, 2008). The following eight elements were essential to a productive work environment: (1) nurse manager support, (2) support for education, (3) perception of adequate staffing, (4) clinically competent peers, (5) clinical autonomy, (6) collaborative nurse-physician relationships, (7) control of nursing practice, and 8) patient-centered cultural values (Schmalenberg & Kramer, 2008). For example, a working environment for nurses that emphasizes safety depends on the supportive of management team. The lack of a safety culture safety is a major barrier to safe medication administration. Lack of reporting of medication errors and near misses are examples of a deficient culture of safety. It may come from nurses are afraid of reprisal if they report errors or nurses, physicians, and pharmacists do not work well together. Lack of productive, healthy work environment has been related to nursing shortage, poor quality of nurses'work lives, nurse job dissatisfaction, low productivity, and poor-quality unsafe patient care (American Hospital Association, 2002; American Organization of Nurse Executives, 2006; Hall, 2005; Institute of Medicine, 2004 cited in Schmalenberg & Kramer, 2008).

However, for external environmental factors such as poor lighting, cluttered workspaces, noise interruptions, high patient acuity, and non-stop unit activity often contribute to medication administration errors as well. Standard of working environment recommended light in the patient's room should not less than 200 LUX (Standard of engineer science, Thailand, 2007).

2.3 Medication Errors Reporting System

There are many data sources to identify and monitor medication errors such as incident reports, medication administration record (MAR) review, pharmacy records, medical record review and automated or computer-generated reports (Rask et al, 2006). The goal of reporting medication errors is to identify and document the cause of the error in order to develop systems that minimize recurrence. However, because of the blame culture still in health care system, there is generally under reporting. Reporting errors is step one in the process of reducing errors and continuous quality improvement. Feedback of information can create awareness of errors that occur in the system and improve system design to reduce medication errors. Most hospital use voluntary reporting to identify errors. This reporting depends on the perception of nurses, if a nurse does not think the medication error is a mistake, they will not make a report. Only 5% of significant errors are actually reported (Low & Belcher, 2002). Reporting of medication errors is a problem because nurses frequently assume that not making an error is good nursing, and they may fail to report medication errors if no harm to the patient resulted (Stetina, Groves, & Pafford, 2005).

In 1999, by the statistic of the Ministry of Public Health of Thailand, there were 4,663,946 IPD patients in public hospitals (excluded Bangkok). Refer to the criteria of the Institute for Safe Medication Practice (ISMP, U.S.A.), the average number of medication administration for one IPD patient were 16 times a day or 74,623,136 times per year (1999). Assuming the lowest rate of missing drug administration at 2%, there might be at least 1,492,463 medication errors in 1999. According to the statistic of one private hospital that had been accredited by the Institute of Hospital Improvement and Accreditation (HA), there was a discrepancy of the reported numbers. Only 200 medication errors were actually reported per year instead of 10,070 as calculated by the same criteria of ISMP (Ningsanon et al, 2004).

Some study of medication error reporting in 126-bed long term care, community- based hospital in Pennsylvania of the United State of America between the year 2002-2003, revealed that there were average 4.7 medication error reports per month. Staff felt that 50% of all medication errors were identified and communicated informally through change of shift reports rather than through medication error reports. Most staff (85%) believed that disciplinary action was taken against the person who committed an error (Handler, Nace, Studenski and Fridsma, 2004).

Delnor-Community Hospital found that the problems of staffs not reporting medication errors were caused by fear of punishment and shame. This hospital formed the medication event team (METs team) which consists of staff nurses, quality department staff, public relation representative, and pharmacists and developed program "Life Savers: Report Medication Events" to build a non punitive culture and increase medication error reporting by staffs. A non-punitive culture is the culture that promotes patient safety, requiring staff members to be trusted, valued and supported by administration and colleagues. It must be a lived experience and integral to every clinical activity and decision in healthcare (Force, Deering, Hubbe, Andersen, Hagemann, Cooper-Hahn, & Peters, 2006). For more understanding a non-punitive culture, the definition of culture defines as "the invisible force behind the tangibles and observables in any organization, a social energy that moves people to act. Culture is to an organization what personality is to the individual- a hidden, yet unifying theme that providing meaning, direction and mobilization." (Ruchlin, Dubbs, & Callahan, 2004 cited in (Force et al, 2006).

To learn how medication errors occurred, The METs met staff asking why medication errors were unreported. The example of results from focus groups that consisted of nurses and pharmacists are shown in the table 4. Furthermore, they created the new form of the "near-miss" that was a half-page form. It is easy, fast and simple, encouraged staff to report their opinions about medication processes and how to improve the system. For managers, in the past, because when they received the files of medication errors reports, they did not act to solve these problems. So this program encouraged managers to send any medication errors reports to the METs' chairpersons immediately after recording the staff follow-up on the report. Medication error reports were not allowed to be filed, copied, or placed into employee records. Therefore, when

staff understood how medication errors reporting used to analyze system failures and not for punishment, only one year the reporting increased from average 14 to 72 reports per month (Force et al, 2006).

Table 4 Some example of results from focus groups with nurses and pharmacists at Delnor-Community Hospital (Force et al, 2006, p.36)

Staff reported issue/ concerns	Solutions
1. Do not feel completely safe reporting errors.	1. Communication efforts by hospital administration that reassured blame-free culture of safety.
2. The word "error" has negative connotations.	2. "Error" changed to "event" on all reports and communications.
3. Forms are too complicated and require too much time to complete.	3. New user-friendly forms designed and tested by staff nurses before implementation.
4. Responses reflect attitudes of fear and a punitive reporting culture.	4. Highly visible communications from administration supporting replacing a culture of fear with a culture of safety.
5. Staff do not receive feedback regarding actions related to solving problems	5. Daily rounding to reports from each unit and provider feedback on reports.
6. Staff do not want to take the time or recognize the priority of reporting	6. Thank-you notes sent to staff for all reporting with gift cards/ lunch passes

2.4 Quality Management

2.4.1 Risk Management

Risk Management is a strategy to reduce or prevent loss and legal action. Risk management consists of identify risk, analyze risk, evaluate risk, develop plans for the reduction of risk inclusive of decreasing frequency of occurrence and severity of occurrence, and implement change that should lead to quality improvement**.**

Everyone needs to work in the safe area. So everyone should reduce the risk in all areas. The system needs to change to allow clinicians and nurses at the frontline to influence management decisions effectively. The hospital should address high-risk areas, which contribute significantly to medication error such as high alert drugs, intravenous medication administration, administering medication for pediatric, elderly patients, chemotherapy, etc.

Near miss has potential for harm and is the most common type of error. The hospital should encourage staff to report near miss occurrences to learn and improve the quality of patient care. The example of a near-miss form of Delnor-Community hospital that can help increasing medication error reports and preventing medication errors in the future as described in the topic of medication errors reporting system.

2.4.2 Root Cause Analysis (RCA)

Root Cause Analysis defines as “a process for identifying the basic or causal factors that underlying variation in performance, including the occurrence or possible occurrence of a sentinel event.” (The Joint Commission on Accreditation of Healthcare Organizations, 2001, p.114).

Steps involved in root cause analysis consist of:

(1) Organize a team
(2) Define the problem
(3) Study the problem
(4) Determine what happened
(5) Identify contributing process factors
(6) Identify other contributing factors
(7) Measure: collect and assess data on proximate and underlying causes

(8) Design and implement interim changes

(9) Identify which systems are involved in the root causes

(10) Prune the list of root causes

(11) Confirm root causes

(12) Explore and identify risk-reduction strategies.

(13) Formulate improvement actions

(14) Evaluate proposed improvement actions

(15) Design improvement

(16) Ensure acceptability of the action plan

(17) Implement the improvement plan

(18) Develop measures of effectiveness and ensure their success.

(19) Evaluate implementation of improvement efforts

(20) Take additional action

(21) Communicate the results (JCAHO, 2001, p.114)

A sentinel event is defined as an "any unexpected occurrence or variation involving death or serious physical or psychological injury, or the risk thereof." The phrase, "or the risk thereof" includes any process variation for which a recurrence would carry a significant chance of a serious adverse outcome (The Joint Commission on Accreditation of Healthcare Organizations, 2001, p.16). Such events are called "sentinel" because they need immediate investigate and response. When a sentinel event occurs, most staffs are focused on the direct causes that have led to the event. For example, many staffs will claim that the cause of medication error is a failure to check label against the patient's wristband. But this is just the direct cause. To get the real reasons, one should ask why the clinician did not check the label against the wristband. The purpose of root cause analysis is to go direct, find what causes and figure out the reasons for the event. The objective is to force one to think harder about the source of the problem. It is possible that the label was not checked against the wristband because the label was missing. Furthermore it is also possible that the label was missing because the computer was not printing. Then the root cause is computer malfunction and the direct cause is the failure to check the label against the wristband. A focus on direct causes may prevent the sentinel event for a while, but later the root cause will lead to a sentinel event. The process of "getting to the root of the problem"

can be applied to any systems-related error. A root cause analysis requires a multidisciplinary team of individuals who understand the process, diagrams to map the process, and identification of weaknesses in the system. The goal is to identify what actually went wrong in the process. An effective root caused analysis consists of 1) involves team members knowledgeable in the processes associated with the event; 2) identifies causes; 3) analyzes all systems associated with the cause; 4) considers relevant literature; 5) identifies possible improvements; 6) outlines the plan for implementation of improvements; 7) assigns responsibility for auditing performance after implementation of improvements.

JACHO (2001) suggested that the hospital should have a core of the healthcare team (represent of nursing, physician, pharmacist, information technology staff or management) to analyzed medication errors that occurred in hospital. The minimum scope of root cause analysis for medication errors should cover as the following areas.

1) Patient identification process
2) Staffing levels
3) Orientation and training of staff
4) Competency assessment and credentialing
5) Supervision of staff
6) Communication among staff members
7) Availability of information
8) Adequacy of technological support
9) Equipment maintenance and management
10) Physical environment
11) Control of medications: storage and access
12) Labeling of medications

Many tools can be used such as flow charts and diagrams offering presentations of the steps in a process. A cause-and-effect diagram can be useful in showing how different processes are related, and how changing one process can adversely affect the outcome of another process. "Brainstorming" is the discussion of all team members to identify causes of error.

2.4.3 Failure Mode and Effects Analysis (FMEA)

Failure Mode Effective Analysis (FMEA) is "a systematic approach for proactively identifying the ways that a process can fail, why it might fail, and how it can be made safer" (JCAHO, 2005).

FMEA is a proactive process used to look more carefully and systematically at sensitive areas or processes. FMEA can be employed before purchase and implementation of new services, processes or products to identify potential failure modes so that steps can be taken to avoid errors before they occur.

A study was done at a children's hospital on administering chemotherapy to cancer in children. This administration process is a complex and carries a very high risk. A health care team used FMEA to identify the elements of risk in three areas—prescribing, dispensing, and administration and implementing appropriate strategies. For each area, potential failures within sub-processes were assigned risk priority numbers (RPN), reflecting their frequency, severity, and detection. Three strategies for risk reduction: 1) the team prescribed and administered the drugs, 2) the areas with the highest RPN were concentrated on more fully, and 3) the focus of most of its strategies, were introduced to their staffs and implemented in 2002. Post implementation Results showed that the potential prescribing error rate decreased from 23% to 14%; use of preprinted standard order sets increased from 22% to 45% in 2003 (one year after the FMEA was conducted) and 76% in 2005. Actual dispensing errors decreased from 3% to 1%, and the actual administration errors from 4% to 3% (Robinson, 2006).

Section III. Guideline for Safety Medication Administration

The National Conference in Philadelphia, U.S.A. in 2004 was conducted for the purpose of analyzing safe medication administration and to develop recommendations for research, practice, education, and public policy. Most nurses who attended the event were extremely aware of methods to prevent medication administration errors.

While physicians, pharmacists, sociologists and psychologists have conducted and published extensive research on medication safety, nurses may lately turn their attention toward these problems. Concerning medication safety, nurses need to put

more effort into identifying root causes of medication errors and to define ways to reduce these errors (Burke, Alexander, & Rich, 2005).

Guidelines and recommendations were collected for the purpose of improving the safety of medication administration. Five guidelines from national institutions from various countries were chosen as follows:

1) Safe Medication Administration Practices for Hospitals (South Florida Hospital and Healthcare Association, 2001)

2) Recommendations to Reduce Errors Related to Administration of Drugs (National Coordinating Council for Medication Error, 2002)

3) Practice Standard Medication: Administering medications (College of Nurses of Ontario, 2005)

4) Medication Administration: Guidelines for Registered Nurses **(**College and Association of Registered Nurses of Alberta, 2005)

5) Medication Management Guideline for Nurses and Midwives (Nurse Board of Western Australia, 2006).

The investigator has summarized the elements of safety medication administration of each institution as shown (in table 5). And these data will be analyzed and synthesized at the end of chapter three to be the guidelines of safety medication administration for IPD nurses.

Table 5 Summarized Elements of Safety Medication Administration of Each Institution

No.	Institution/ Hospital/ Healthcare Association Elements	South Florida, 2001	NCC_MERP, 2002	Ontario, 2005	Alberta, 2005	Western Australia, 2006
1	Patient information	√	√	√		
2	Drug references available	√	√		√	√
3	Nurse's knowledge about medication	√				√
4	Clarify any order that is not clear and legible	√	√	√	√	√
5	Check dispensed medication with physician's	√			√	
	first order					
6	Require reconciliation process	√				
7	Note both brand name and generic name in MAR	√				
8	Administering medication only full, clear label	√	√		√	
9	Create work environment that minimizes distractions,	√	√			
	and interruptions, appropriate lighting, safe noise level					
10	Utilize standard medication administration time schedule	√		√	√	
11	Maintain unit dose package until the point of	√				
	actual administration					
12	Use two nurses in drug calculation	√				
13	Nurse's skill for device	√	√			
14	Double check by two nurses when administering	√		√	√	
	in case of critical drugs, HAD and infusion pump					
15	Strict to the principle of drug administration (Rights)	√ (9 Rights)	√ (5 Rights)	√		√ (6 Rights)
16	Educate patient and relative about their role in	√	√	√		√
	taking medication					
17	Multiple dosage must be double check for accuracy	√				
18	Document immediately after administering medication	√		√	√	√
19	Never borrow drugs from the another's patient cabinet	√			√	
20	Establish policy for double checking	√				

Table 5 Summarized Elements of Safety Medication Administration of Each Institution (Excel) (continue)

No.	Institution/ Hospital/ Healthcare Association Elements	South Florida, 2001	NCC_MERP, 2002	Ontario, 2005	Alberta, 2005	Western Australia, 2006
21	Use infusion pump only those that prevent free-flow		√			
22	Encourage the use of automated system		√			
23	Monitoring patients for desired outcome and/or expected medication effects		√	√		√
24	Data be collected if errors occurred, for CQI		√			
25	Require Verbal order/ Telephone order		√		√	√
26	Adhere to procedure of hospital					√
27	Check the patient's drug allergy			√		√
28	Consider to teach self-medication used to the patient (depend on hospital's policy)					√
29	Report to the prescriber if any side effect or adverse reactions occurs to the patient			√		√
30	Reports all errors			√		
31	Verified inform consent from the patients or relatives before administering the first dose or changing drug therapy			√		
32	Ensuring drugs are stable, stored and labeled appropriately			√		
33	Prepare adequate staffs			√		
34	Read the label three times and check medication order before administering the medication				√	
35	A change in order requires re-labeling of drugs				√	
36	Clarified any abbreviation drug name, dose frequency, encourage using of Latin abbreviation				√	
37	Promote the use of zero before the decimal point				√	
38	Identified the patient by two methods (e.g. ID brand and names as stated by patient)				√	

From 38 element of the guidelines for safety medication administration (in table 5), more than one institution that stated were 17 elements as the followings:

1. Patient information: ensure that essential patient information, including allergies, age, weight, current diagnoses, relevant lab values and current medication regimen, is available.
2. Drug references available: ensure the immediate availability of appropriateand current drug reference texts and/ or online resources to those who administer medication.
3. Clarify any order that is not clear and legible: require that any order that is ncomplete, illegible, or otherwise questionable be clarified using an established process for resolving questions prior to administration of the medication.
4. Check dispensed medication with physician's first order: verify the dispensed medication for any new medication order with the original prescriber’s order and medication administration record (MAR) to ensure that it is the correct medication for administration.
5. Administering medication only full, clear label: administer only medications that have been fully labeled with medication name, dose to be administered, dosage form, route, special storage requirements, expiration date, and all other applicable warnings.
6. Create work environment that minimizes distractions, and interruptions, appropriate lighting, safe noise level
7. Utilize standard medication administration time schedule, if appropriate. Educate nursing staff on how and when to incorporate newly started medication orders safety into the standardized schedule.
8. Increase nurse's skill for medical device such as infusion pump
9. Double check by two nurses when administering in case of critical drugs, HAD and infusion pump
10. Strict to the principle of medication administration (Rights)
11. Educate patient and relative about their role in taking medication and question they should ask. Develop and document patient education.

12. Document immediately after administering medication Never borrow drugs from the another's patient cabinet
13. Monitoring patients for desired outcome and/ or expected medication effects
14. Require verbal order/ telephone order
15. Check the patient's drug allergy
16. Report to the prescriber if any side effect or adverse reactions occurs to the patient

However, the investigator considered the elements that presented only one institution but it is necessary if lack of these elements, medication errors would be occur. These elements were:

1. Require reconciliation process
2. Note both brand name and generic name in MAR
3. Verified inform consent from the patients or relatives before administering the first dose or changing drug therapy.
4. Maintain unit dose package until the point of actual administration
5. Use two nurses in drug calculation
6. Multiple dosage must be double check for accuracy
7. Establish policy for double checking
8. Use infusion pump only those that prevent free-flow
9. Data be collected if errors occurred, for CQI
10. Adhere to procedure of hospital
11. Reports all errors
12. Verified inform consent from the patients or relatives before administering the first dose or changing drug therapy
13. Ensuring drugs are stable, stored and labeled appropriately
14. Prepare adequate staffs
15. Read the label three times and check medication order before administering the medication
16. A change in order requires re-labeling of drugs
17. Clarified any abbreviation drug name, dose frequency, encourage using of Latin abbreviation

18. Promote the use of zero before the decimal point
19. Identified the patient by two methods (e.g. ID brand and names as stated by patient)

The elements lists that the investigator would consider in the future were:

1) Encourage the use of automated system because high cost comparing the size of hospital and the average number of IPD patients rather low. The hospital should study more about automated system for preparing in case of extension of the hospital.

2) Teaching self-medication used to the patient, this depend on hospital's policies and for preventing medication error, at the present the hospital are not allowed self-medication used in the studied hospital.

Some elements that were not presented in the guidelines of safe medication administration because it seems like those had been written in the nursing theory. Therefore, every nurse should know at the time of being nursing students. However for reminding nurses, the principle should be written in the procedure or work instruction of medication administration and training all nurses before working in the unit. Therefore, orientation is very important, should add as mandatory course of training that every nurse must pass.

Table 6 The Elements of Medication Administration Arranged by Responsibility

No.	Element	Nurse	Physician	Pharmacist	Hospital / Policies
1	Patient information				√
2	Create work environment that minimizes distractions, and interruptions				√
3	Utilize standard medication administration time schedule				√
4	Require reconciliation process				√
5	Require verbal order/ telephone order system				√
6	Establish policy for double checking				√
7	Use infusion pump only those that prevent free-flow				√
8	Clarified any abbreviation drug name, dose frequency, encourage using of Latin abbreviation				√
9	Promote the use of zero before the decimal point				√
10	Consider to teach self-medication used to the patient* (depend on hospital's policy)				√
11	Encourage the use of automated system**				√
12	Ensuring drugs are stable, stored and labeled appropriately	√		√	
13	A change in order requires re-labeling of drugs			√	
14	Drug references available			√	
15	Increase nurse's skill for medical device such as infusion pump	√			
16	Prepare adequate staffs	√			
17	Verified inform consent from the patients or relatives before administering the first dose or changing drug therapy.	√			
18	Adhere to procedure of hospital	√			
19	Check the patient's drug allergy	√	√		
20	Clarify any order that is not clear and legible	√	√		
21	Note both brand name and generic name in MAR	√			

Table 6 The Elements of Medication Administration Arranged by Responsibility (continued)

No.	Element	Nurse	Physician	Pharmacist	Hospital / Policies
22	Check dispensed medication with physician's first order	√			
23	Never borrow drugs from the another's patient cabinet	√			
24	Read the label three times and check medication order before administering the medication	√			
25	Multiple dosage must be double check for accuracy	√			
26	Use two nurses in drug calculation	√			
27	Strict to the principle of medication administration (Rights)	√			
28	Identified the patient by two methods (e.g. ID brand and names as stated by patient)	√			√
29	Administering medication only full, clear label	√			
30	Maintain unit dose package until the point of actual administration	√			
31	Double check by two nurses when administering in case of critical drugs, HAD and infusion pump	√			
32	Document immediately after administering medication	√			
32	Educate patient and relative about their role in taking medication	√			
33	Monitoring patients for desired outcome and / or expected medication effects	√			
34	Report to the prescriber if any side effect or adverse reactions occurs to the patient	√			
35	Reports all errors, data be collected if errors occurred, for CQI	√			

From table 6, the elements for reducing medication administration that relevant about nurses were selected to be “Recommended Safety Medication Administration” in chapter 4.

Literature review has helped in learning about the definition, types of medication errors, the severity level of medication error, the principle of medication administration such as right patient require the use of two identifiers (patient’s name and date of birth); right drug using safe label policies and procedures and pre-printed labels for medications and medication-delivery devices; right dose the nurses must know patient’s age, size, weight and body surface area in children including vital sign, condition, use appropriate equipment, double-check the dosage and etc. Factors contributing to medication error such as nurse’s knowledge, skill, nurse staffing, communication and working environment. There are tools to reduce or prevent medication errors, such as the hospital should establish policies for verbal medication orders/ order by phone, using the standardize of abbreviation, acronym and symbols used in the hospital, promoting effective communication between health care team by using SBAR when notify the physician, and using reconciliation system at transition period. Preventing over workload, the hospital has to prepare qualified and adequate nursing staffs for medication administration and promoting good work environment by reducing stress and distraction. And the important thing is to build a non-punitive culture and increase medication error reporting by staffs. Incident report will be analyzed to find the root cause and improve the process or system that will be presented in the next chapter.

CHAPTER III
PROBLEM ANALYSIS

In the literature review in chapter 2, the investigator focused on crucial issues of analyzing the medication administration system in inpatient department of the studied hospital as the following.

3.1 Analysis of IPD Medication Administration Process

3.2 Analysis of Incident Report

3.1 Analysis of IPD Medication Administration Process

The process of medication administration for nurses in inpatient department (IPD) can be broken down and analyzed into 13 steps. From this analysis, many healthcare professionals and other staffs have been involved in this process as shown in table 7.

Table 7 IPD Medication Administration Process and Responsibility Analysis

No.	Activities	Responsible person						Phase
		Doctor	In-charge	Med. Nurse	Secret. Unit	Pharm	Pharm. Assist.	
1	Drugs are prescribed by physicians	①						1
2	Orders are received, transcribed to pharmacy (key in computer) and to MAR		②					
3	Copy order sheet is sent to pharmacy department				③			2
4	Drugs are prepared						④	
5	Drugs are re-checked					⑤		
6	Drugs are dispensed to patient unit				⑥			
7	Drugs are received from pharmacy and checked			⑦				
8	Drugs are kept to each patient's medicine box			⑧				
9	Drugs are checked and compared with MAR			⑨				3
10	Drugs are prepared			⑩				
11	Administering drug to the patient			⑪				4
12	Evaluating and monitoring the patient		⑫					5
13	Document med. administration in MAR			⑬				

Note: MAR = Medication Administration Record

The 13 steps of the IPD medication administration process, can be organized into 5 phases, as the following:

Phase 1 Taking physician's order

Phase 2 Medication requisition

Phase 3 Medication prepared by nurses

Phase 4 Administering medication

Phase 5 Monitoring patients

Phase 1: Taking physician's order

Before a physician orders the prescription on the order sheet for a patient's chart, a nurse must ensure that the order sheet is identified with the patient's name, hospital number and room number. And when the INCHARGE nurse receives the order, the nurse must make sure that the physician's orders have the essential information (date, time of order, the medication name, dosage, strength and direction for administration, route and time interval or frequency including the physician signature (Wilson & Shannon, 1991, p.79). INCHARGE nurse must:

1. Take the physician's order by transcribing ordered into MAR sheet.
2. Assess the patient by asking the patient's past history, age, weight and height and medication site contraindications.
3. Sign her/ his name with date and time at the end of the signage of physician's signage.

Analysis

Potential Risk

1) Reading & writing or typing: there were some risk points for errors that can occur by an incorrect reading from illegible or poor handwriting, when nurse read physician's order incorrectly. Consequently the orders may be transcribed incorrectly into a computer. Possible causes why a nurse could have an incorrect reading are that seldom used abbreviations were used, or use of dangerous abbreviations.

Recommendation:

(1) The hospital should identify staff authorized to transcribe medication orders.

(2) The hospital should establish standards of abbreviation policies and used only approved abbreviations as specified.

2) Telephone order: the unclear policy of verbal and telephone orders

When nurse take verbal orders, nurse write the order in the note instead of order's sheet and transcribe again on order's sheet that may made to error, another reason came from nurse did not read back and confirm back to the physician while take the order.

Recommendation:

The hospital should establish the policy of verbal order or telephone order in the process or guideline (add read back, hear back and confirm back).

(1) If verbal orders are used, the nurse should repeat the order to confirm understanding.
(2) The nurse who accept verbal orders, record the verbal order directly into order's sheet, write the name of the physician who prescribed and signs her name with designation.
(3) The physician should verify the verbal/ telephone order in the patient's chart and sign such order within the timeframe as defined by the hospital (24 hours or the next time visit of the physician).

3) Allergy: due to the high workload of nurses, sometimes complete evaluation of a patient's history or recognizing drug allergies is overlooked. This may lead to error.

Recommendation:

(1) For preventing errors, a nurse must read a patients history before taking the physician's orders. In case the physician prescribes medication that the patient has an allergy to. The nurse must notify physician to prevent this error.
(2) List allergies in plain view.
(3) Pop up of drug allergy in the computer system will be helpful for warning healthcare team.

4) Unclear Writing: in case the physician's order is unclear or because of a physician's handwriting, the nurse does not understand but is afraid to ask the physician, does it with a clue.

***Recommendation*:**

Nurse should not hesitate to question an order, for instance, if it is suspected that the dosage ordered is not within normal dosage limits, consult with the physician (Lane, 1992).

5) Calculation: to prevent calculation errors and wrong dose errors in case of high alert drugs, pediatric small dose, dangerous medication such as chemotherapeutic drugs

***Recommendation*:**

(1) The hospital should establish the policy that medications such as injections, oral liquid medicine and specially prepared doses for pediatric patients are prepared doses from pharmacy department and use two nurses to double check when administering medication.

(2) The checking system must be independent and double checked then co-signed by two nurses for safety of the patient, starting at the phase of taking the physician's order.

Phase 2: Medication Requisition

After taking the physicians order the, INCHARGE nurse must:

1. Transcribe lists of medication to the pharmacy department by key in the computer. A risk point can be when nurses help each other, for example, the medication nurse help the INCHARGE nurse by typing data into computer. It consists of name, amount, strengths and dosages of medication, if typed incorrectly, this may lead to errors.

2. Send the physician's first order (copy order sheet) to pharmacy department by unit secretary. Pharmacist reviews the order for appropriateness and enters the data into the pharmacy database for dispensing. The pharmacist's assistant prepares the daily dose of medication for each patient. Then the pharmacist re-checked again.

3. Unit secretary receives the medication from the pharmacy department and sends it to patient unit. The medication will be separated and kept in the medicine box in front of the patient's room, refrigerate any medicine that needs to be kept at a low temperature. Narcotic drugs must be kept in a locked cabinet at the nurse's counter.

Analysis

1) The copy order sheet system takes a long time in processing; it increases the workload of the unit secretary especially when the physician prescribes many orders. Fax or scanning systems might reduce waiting time for this process and the

unit secretary has time to help nurses receiving phone calls, providing service to visitors and the other tasks for reducing nurse's distraction.

2) Wrong time errors may occur because the unit secretary is too busy. This will result in delay for the dispensing of medication from the pharmacy department to the patient unit. It can be helpful if pharmacist's staff could deliver the medication to the patient unit.

***Recommendation*:**

(1) Medication order sheets should have the patient's name, and other identification such as hospital number, and room number.

(2) Copy order sheet must be clear written for reading before sending to pharmacy department.

Phase 3: Medication Preparation

Medication Preparation can be divided into 2 steps:

3.1 Checking the dispensed medication by the medication nurse

3.2 Medication preparation by the medication nurse

3.1 Checking the dispensed medication

The medication nurse is responsible for checking medication after it has been received from the pharmacy department. Following the work instructions of medication administration for IPD nurse, check medication against (1) IPD prescription (prescription sheet that printed out from computer), (2) the physician's order, and (3) medication administration record (MAR).

Analysis

Potential Risk:

The investigator found that in this step, there were some risk points as the followings.

1) Nurses did not check or checked incompletely, in case of dispensing errors from the pharmacy, this may lead to medication administration errors.

2) Nurses checked the dispensed medication with IPD prescription and medication administration record (MAR) only, not checked with the physician's order. If the INCHARGE nurse transcribed order incorrectly into MAR, they checked with data that contains errors.

***Recommendation*:**

For preventing these errors, nurses must:

(1) Strict to work instruction for medication administration in IPD by checking dispensed medication to the physician's first order, IPD prescription and medication administration record (MAR).

(2) In case of high alert drug, every process (taking the physician's order, calculation, medication checked, preparing and administering the medication including documenting) should have independent double check by another nurse.

3.2 Medication preparation by medication nurse

In the process of preparing medication, nurse must:

1. Prepare and give drugs in well-lighted areas, as free of interruptions and distractions as possible (Abrams, 1987; Lane, 1992; & Peanpijan, 1997).
2. Wash hands before preparing medications
3. Use sterile technique in preparing injections
4. Read medication administration record carefully and repeatedly. Read the label on the drug container and compare with the medication sheet in terms of drug, dosage or concentration, and route of administration (Abrams, 1987).

Nurses must follow the principle of **three medication checks**, checking the accuracy of drugs **three times** when:

(1) Taking the medication from storage

(2) While preparing the medication and

(3) When replacing the medication in storage (Lane, 1992; & Peanpijan, 1997).

5. Do not leave medications unattended (Abrams, 1987).

Analysis

Potential Risks:

1) Inadequate lighting and materials.
2) Medication nurse is disturbed by distraction, loud noise or over workload while preparing medication. Distraction may come from telephone calls, physician's rounds, patients call for emergency, visitors, heavy workload that make nurses confused, exhausted, and forgetful. All of these distractions or fatigue may lead to medication administration errors. This

finding is consistent with the reason that nurses had to hurry at work. Understaffing, results in reduced attention in working details, promoting errors and decreasing the quality of care (Worthington 2001, Beyea et al, 2003 cited in Tang et al, 2007).

3) Nurses did not follow the principle of three medication checks when preparing the medication.

4) It would not be safe to perform the third check after administering the medication. Medications should be replaced in storage before administration to patients.

***Recommendation*:**

(1) Work with adequate lighting and materials.

(2) Prepare drugs in quiet area. Do not converse with others when preparing drugs.

(3) Pay attention to the procedure and think through each step, do not become automatic and routine.

(4) Nurse should not hesitate to question an order, if suspect that the dosage is not normal dosage limits. Consult with the physician.

(5) Nurse should strict to the principle of three medication checks.

(6) Return drugs to storage immediately after use. Drug should not be left out unattended.

(7) Administer only medications that nurse, herself prepared.

Phase 4: Administering medication

4.1 Administering medication

In the process of administering medication, the medicine nurse must:

1. Check the medication with MAR accurately
2. Wash hands before administering drugs
3. Use sterile techniques in administering injections
4. Identify the patient by comparing the identification wristband to the medication sheet.
5. Identify the nurse who is administering the medication to the patient, and state the reason for approaching the patient.
6. Position the patient appropriately for the intended route of administration.

7. Provide water or other supplies or medical device as needed.

8. Do not leave medications at the bedside.

9. Do not give a drug when signs and symptoms of toxicity are present. Notify the physician and record the reason the drug was omitted and why (Abrams, 1987).

Analysis

Potential Risk:

1) In identifying the patient, wrong patient errors might occur because no signage of patient's name is in front of the patient's room. This would not be according to the hospital policy. Another cause of error would be that the assignment from the INCHARGE nurse is delivered to the medication nurse verbally, using a room number instead of the patient's name in identification number. For example, the INCHARGE nurse assigns a medication nurse to give paracetamol to the patient at room number instead of using the patient's name. Unfortunately, this patient was transferred to another room for some reason. As a result, the nurse gives the medication to the wrong patient.

2) According to the principle of medication administration, that nurses should adhere when administer medication, the errors occurred when nurses bypassed these rights. Not only nurses, but also all personnel including the head nurse, nurse manager, nurse educator and the Nursing Committee of the hospital should participate and make discussion for improving safety of medication administration in IPD. The investigator suggest to add more two rights in the principle of medication administration to be seven rights (right patient, right drug, right dose, right route, right time, right technique and right document) to increase nurses' awareness and focus on training and monitoring.

3) Wrong dose errors will occur for the lack of recheck or double check in the administration process, especially high alert drug, or when the label provides directions but the number of pills given must be calculated. This may contribute to confusion in administering. For reducing wrong time errors or wrong dose errors, the hospital should add the system of independent double check and co-sign by two nurses, focusing on medication that is given via intravenous, including high alert drug. The hospital's policy should establish the policy of using infusion pump for all I.V.

drugs and increasing safety by checking accurately the infusion pump and maintenance regularly (The JCAHO, 2004). Moreover, nurses must follow the work instruction of checklist infusion pump strictly.

4) Administer to the wrong patient, wrong drug, wrong dose, wrong route, wrong time or omission, because of distraction, interruption or workload of nurses.

5) Unsafe medical device such as infusion pump that no prevention for free-flow, valve connector.

***Recommendation*:**

(1) Reduce distraction by adding signage for medication nurse such as “Do not disturb” or create checklist protocol for IPD medication administration procedure to remind nurses.
(2) Always adhere to the 5 Rights of Medication Administration
(3) Follow the procedure of IPD Medication Administration
(4) Administering medication only full, clear label: administer only medications that have been fully labeled with medication name, dose to be administered, dosage form, route, special storage requirements, expiration date, and all other applicable warnings.

4.2 Documenting and patient education

1. Nurses must record every medication with a routine that will prevent duplication or omission.

2. Sign nurse’s name in MAR sheet and nurse’s note to document the symptom of the patient and outcome of medication on time and at the point of administration.

Analysis

Potential Risk:

1) Normally, documentation of medication administration time and location should take place at the point of administration. But MAR was not available because in a ward all of MARs sheet of each patient were gathered in one file that each of them separated by index. Errors can occur at several points, for example while INCHARGE_nurse transcribe the orders to MAR, medication nurse needs them in

administration process. As a result nurse documented after giving the medication that caused nurse forgot to document.

2) MAR form in the studied hospital is not convenience for filling because there are 2 pages, front and back. Nurses have to turn the page to record which made confusion.
3) In case of patient education, error may be caused by miscommunication, if the patients cannot speak Thai or English, it is necessary to use interpreter in translation for understanding the problems of the patient. But sometimes an interpreter is not available.

***Recommendation*:**

(1) The hospital should review protocol or work instruction clearly and cover all essential steps for nurses can follow easily.
(2) The Human Resource Development and Nurse Educator should have set training as mandatory program and on the job training for new nurses and existing nurses to refresh their knowledge, skill including attitude for report the medication errors.
(3) Nurse should take the MAR to the patient's room on process of administering medication, then fill the document immediately to prevent repeat dose from other nurse.
(4) Head nurse, supervisor and in-charge nurse should supervise and monitor nursing staffs to ensure they follow the step of medication administration process.
(5) Revise MAR form by using only one page to prevent confusion.

Phase 5: Monitoring the patient

Nurse should monitor the result from drug, notify adverse drug events such as side effects and drug allergies if occurred to the physician, monitor the laboratory results and the other treatments results, assess the problem when medication errors occur, coordinate with multidisciplinary team for providing proper medication administration for each patient and record in nurses' notes and ensuring that patients and families instructed about drug knowledge and side effects.

Analysis

Potential Risk:

1) There are many potential risks in this phase such as nurses forget to monitor the patient, nurse neglect, over workload, inadequate knowledge of drug action.

2) Patients lack of knowledge about the drugs

***Recommendation*:**

(1) Provide nurses and other staffs involved in the medication administration process with orientation and education on monitoring medications.

(2) Educate patients during hospital stay, at discharge about the safe and accurate use of their medication.

The investigator summarized possible risk points from the IPD medication administration process analysis as shown in table 8.

Table 8 Summarized Possible Risk and Recommendation from the Medication Administration Process Analysis

Phase of medication administration	**Possible risks**	**Recommendation**
1. Take physician's order (transcribing)	-Phone order not clarified/ verbal order not clarified. -Written on wrong chart -Physician's hand written, cannot read. -Fear to ask the physician	-The hospital should establish the policy of verbal order or telephone order in the process or guideline - Checking system every shift - The hospital should establish the policy for physician ordering in capital letter and using standard abbreviation**.** - Promote relationship between health care team
2. Medication Requisition	-Unclear of copy order sheet -Delay in process	- Copy order sheet should be clearly written before sending to pharmacy department. - Use FAX or CPOE instead

Table 8 Summarized Possible Risk and Recommendation from the Medication Administration Process Analysis (continue)

Phase of medication administration	**Possible risks**	**Recommendation**
3. Medication Preparation	-Nursed did not follow the principle of 3 checks when preparing medications, did not verified medication with the physician's order -Lack of knowledge/ skill of medicine, Unfamiliar drug -Interrupted during preparation -No drug information in the ward	-Training Medication Administration Procedure and short brief every morning or when change shift. - Training - Signage for medication nurse "Do not Disturb" - Pharmacists & IT staffs provide drug references (text or on line) for staffs in the ward.
4. Administering medication and document medication	-Use room number identified the patient -Nurse did not take the MAR in patient's room -Nurse did not check ID brand or allergies brand before administered medication - Not follow the principle of 5 Rights - Not document immediately after administered medication	- Use two identifiers in identification such as patient's name and date of birth -Take MAR in the patient's room when administering drugs - Follow the procedure of IPD medication administration - System can prevent by pop-up system or show warning in the computer system - Always adhere to the 5 Rights of medication administration - Mandatory training, on the job training

Table 8 Summarized Possible Risk and Recommendation from the Medication Administration Process Analysis (continue)

Phase of medication administration	Possible risks	Recommendation
5. Monitoring the patient	-Forget/ lack of knowledge or experience in monitoring the patient - Over workload	- Orientation and education on monitoring medication - Educate patients during hospital stay, at discharge about the safe and accurate use of their medication. - Prepare qualified and adequate nursing staffs.
6. Other risks	- Unclear communication between professional - No policy of verbal/ telephone order - Language barrier with foreigner patients	- Use "SBAR" for hand-off communication or when report the physician - Establish reconciliation system and implement reconciliation form at transition point. - Establish policy of verbal/ telephone order - Language training/ using interpreter

3.2 Analysis of Incident Report

In inpatient department (IPD) of the studied hospital during January 1, 2007 to October 31, 2007, there were 28 medication administration error reports (Quality Center of the studied hospital, 2007).

3.2.1 Type of Errors

The investigator analyzed these data and found that the most types of medication administration errors are wrong dose errors 25% (n = 7), wrong time errors 17.86% (n = 5), omission errors 14.28% (n = 4). The other types of errors were wrong drug errors 10.71% (n = 3), wrong route errors 10.71% (n = 3), wrong patient errors

7.14% (n = 2), unauthorized drug errors 3.57% (n = 1) and other errors 10.71 % (n = 3) that cannot put in any groups (see table 9). For example of the other errors were the ward nurse sent medication that was not labeled on the syringe to the OR, history of allergy administered high alert drug on ward and the patient received the medication that he has.

Pediatric and obstetric & gynecology ward had the highest occurrence reports (46% of errors). This finding is consistent with a research study indicated that pediatric nurses reported medication errors (67%) higher proportion than adult nurses (56%) (Stratton, Blegan, Pepper, & Vaughn, 2004). In the medicine ward, the types of medication administration errors occurred are wrong dose errors (n = 3) and the surgery ward are wrong time errors (n = 2). The high-risk areas are obstetric-gynecology and pediatrics ward, labor room and nursery. The obstetric-gynecology & pediatrics ward is high risk for the reason that almost half of medication errors (46%) occur in this ward. Another reason the labor room and nursery are high risk is that nurses may fear punishment or the system of reporting medication errors is not easy to use. Some research indicates that the reasons nurses do not report medication errors is that the errors are not recognized, the errors are recognized but harmless, nurses fear to be punished and the system does not encourage reporting of medication errors (Wakefield et al, 1996, 1998, 2001 cited in Stratton, Blegen, Pepper, & Vaughn, 2004). However, in nursery and labor department, it can be interpreted as underreporting. Causes of errors may come from the policy of the hospital that placed the pediatric patients with the obstetric and gynecologist patients in one ward because pediatric patients were very few. However, some research indicates that hospital policy of reducing working staff to improve economics in the short term can cause poor quality patient care (Arndt, 1994 cited in Tang et al, 2007). The contributing factors of obstetric-gynecology & pediatrics ward might come from work environment, high stress from the sick pediatric patient’s parents or physicians. The leading cause for higher stress of nurses, than in the other wards, was increased turn over rate of nurses. In the studied hospital, turn over rate of all nurses was 4.89 % (2007) has increased from the previous year, 4.08 % (2004), 3.78% (2005), and 4.77% (2006) (Human Resource Management Department of the studied hospital, 2007). As a result, more than half of nurses that work in this ward are newly graduated nurses

and their average work experience is only 1-3 years. Some of the contributing factors are inadequate training, because nurses could not attend the orientation classes because of staff shortages or heavy workloads. An interested finding in this section of the study is similar with some reported studies, that high job stress leads to low job performance (Jamal, 1984, Leveck & Jones, 1996, Motowidlo, Manning & Packard, 1986, Westman & Eden, 1996 Cited in AbuAlRub, 2004).

Table 9 Number of Medication Administration Errors in Each Department by Types of Errors between Jan-Oct, 2007 (Quality Center, 2007)

Type of errors	Department								
	MED	SUR	OB-GYN & PED	ICU	LR	NS	OR	Total	%
Omission errors		1	3					4	14.28
Wrong Patient errors			2					2	7.14
Wrong drug errors	1	1	1					3	10.71
Wrong dose errors	3	1	1	2				7	25.00
Wrong route errors	1		2					3	10.71
Wrong time errors		2	2				1	5	17.86
Unauthorized errors			1					1	3.57
Other errors		2	1					3	10.71
Total	5	7	13	2	0	0	1	28	100
% of errors	17.8	25	46	7			3.6	100	

3.2.2 Severity level of medication error

The severity level of medication errors which occur has shown in table 10, most of them were in D level (13 case reports) that require monitoring, but cause no harm, level C has10 case reports that are actual errors, no harm. There are 4 medication administration error case reports in B level that is actual harm but not reach to the patient. There is one case of medication error in medicine ward, in E level that is the most sever level of the total cases that reported in the study period from wrong dose errors. It caused temporary harm; the patient was transferred to the

intensive care unit, and recovered in a few days. No near miss of medication error reports to Quality Center, it may indicate that most of staffs are not aware or concerned about preventing medication errors.

Table 10 The Severity of Medication Errors in IPD (Quality Center, 2007)

Dept.	**number of medication error**	**Severity level of medication error**								
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Ob-Gyn & Ped	13		1	5	7					
Surgery	7		2	2	3					
Medicine	5		1	1	2	1				
ICU	2			1	1					
LR	0									
Nursery	0									
OR	1			1						
Total	**28**		**4**	**10**	**13**	**1**				

Case Study of Medication Administration Error

From 28 medication error reports in the studied hospital, 8 incidents were selected to be analyzed as examples for 8 types of medication errors as described in the followings.

Case One: Wrong Drug Error

A Thai female, mid thirty years of age was diagnoses of cervical spondylosis. The physician prescribed methycobalt 1 x 3 oral p.c., nurse transcribed in computer methyldopa (aldomet®) 1 x 3 oral p.c. The patient was discharged with methyldopa (aldomet®) 1 x 3 oral p.c. # 180 tablets. In this case the patient called back to report her symptom of dizziness. The nurse and pharmacist found out that she received the wrong medication (methyldopa: aldomet®) at home. The hospital stopped the medication and changed to the correct medication. The pharmacist improved the

system by adding the trade name and the generic name of the medication in the computer. Users, who key in, can see both the trade name and the generic name.

For example: METHYLDOPA (ALDOMET).

Analysis

Cause of errors:

This case showed that the direct causes of error come from many factors.

The errors occurred every phase of medication administration. Starting with in-charge nurse (transcribing error), pharmacy and pharmacy assistant (dispensing error), and at the final step, medicine nurse who prepare and administer medication.

1) At ward, on the process of transcribing, nurse made an error by key in medication item which list of medication METHYLCOBALT and METHYLDOPA are nearby. The reasons may come from distraction at that moment or over workload.
2) On dispensing process, pharmacist assistance who prepared the medication according to IPD prescribed that printed from the computer and pharmacist that have to check the IPD prescribe with the physician's order. Why they could not see and correct the error. The reason may come from they did not check with the physician's order or check incompletely.
3) On the medicine nurse responsible to check dispensed medication from pharmacy. He/ She checked it or not?
4) The name list in the computer system has been set up alphabetically without putting some technique to distinguish such terms from each other similar.

Contributing factors: Communication/ IT system

Recommendation*:*

To prevent this error

(1) The order's sheet should be filled the patient's diagnosis and the physician should write the purpose of medication when he/ she prescribe the order, for staffs who involve in the medication use process could understand why the physician prescribe this medication and if it is not reasonable, they can ask, notify to physician to protect the errors.

(2) Provide both the generic and brand name in communications of drug orders such as in the computer system to prevent the error from the similar situation.

(3) Add the policy that the nurse must note both brand name and generic name in medication administration record (MAR) in the protocol of IPD medication administration.

(4) When receive the medication from pharmacy. Nurse must check the dispensed medication with the physician's order.

(5) Nurse administrator such as head ward, nurse manager, and supervisor should do some spot check or monitor at the frontline practicing regularly.

(6) This occurrence should be sharing in the academic conference, quality meeting or the morning brief as a lesson learned for the other staffs to aware and prevent re-occurrence by focusing at the system more than individual person.

(7) From literature review, some hospitals take the computerized physician order entry (CPOE) system in order to the physician prescribe the physician's order in computer by himself to pharmacy department. It can help reducing prescribing and transcribing error. But CPOE has high cost, comparing with the context of the studied hospital and the low number of inpatient per day. The other reason is CPOE need collaboration and cooperation from physicians that have to be supported from top administrator and Medical Staffing Organization (MSO).

Case Two: Medication Error from Verbal Order/ Telephone Order

The Thai male patient, 76 years old, case cervical spondylosis, the lab result of potassium was 6.2 at 8.00, INCHARGE nurse notified the physician and he prescribed kayexalate 30 ml oral STAT by telephone order but INCHARGE nurse took the order as KCl elixir 30 ml oral. The physician visited the patient and followed the blood test again and saw the result of potassium still high. Therefore, the physician prescribed kayexalate 30 ml oral STAT again in the patient's chart. At that time INCHARGE nurse just knew that she made errors.

Analysis

Cause of error:

1) No hospital's policy about telephone order, it is no guideline for nurses to follow.

2) Insufficiency of drug knowledge of in-charge nurse and never having had experience with kayexalate before.

3) The number one rule to prevent medication errors: when in doubt, clarify, if the nurse cannot understand the medication order clearly, the physician should immediately be contacted for clarification. Nurse should not assume by her own.

Contributing factors:

Lack of verbal order/ telephone order policies

Recommendation:

(1) The hospital should establish the policy of verbal order and telephone order that address the accuracy of verbal and telephone. The complete verbal and telephone order is written down by the nurse who takes the orders, the complete verbal and telephone order is read back by the nurse who receive the order and the order is confirmed back to nurse by the physician who give the order (JCAHO, 2008).

(2) Communicate and implement the guideline or protocol of verbal and telephone order to all staff and follow up by periodic monitoring to ensure that nurses follow this policy.

(3) Nurse should clarify any order that is not clear or ask the physician to clarify the order.

(4) Training and educating nurses about information on new drugs and infrequently used drugs should be made easily accessible to nurses prior to administering medications.

(5) Drug references should available at ward, and easy to access.

(6) The occurrence of medication errors should be reported in “morning brief” for management team, health care team and key person considering and discussing the weak point of the system, correct the problems. It is the fast track of communication and sharing experiences with the other nurses and health care team in the hospital. However, in the investigator’s opinion, the incident that report in morning brief, Quality Center should specific the severity level of medication errors and sensitive of the issues.

(7) The occurrence of medication errors should be sharing as learning lesson during change shift, and ward meeting supportive by administrator and positive culture.

Case Three: Wrong Dose Error

A Thai male patient, 80 years old, case cerebrovascular accident (CVA) with diabetes mellitus, hypertension, and AF came to hospital with chief complaint of left side weakness, his physician prescribed fraxiparin® 0.4 ml. sc. q12 h. Nurse A administered the medication but did not sign her name in medication administration record (MAR), another nurse wanted to help and believed that the medication still had not been injected into the patient, so she injected this medication again, as the result the patients received a double dose of fraxiparin®.

Analysis

Cause of error: This error occurred because nurse did not follow to the procedure of the hospital. The nurse did not take the MAR into the patient's room or at the point of care in the process of medication administration.

Contributing factor: communication between nursing care team

Recommendation:

(1) This error can prevented by nurse adherence to the procedure of the hospital, document immediately after administering medication.

(2) Promoting communication between nursing team, the another nurse who wants to help should ask the medication nurse before giving medicine to the patient that not her job and her responsibility, should not guess although there was no signature of medication nurse in the MAR.

Case Four : Wrong Dose Error

The physician prescribed TYLENOL® 1 tab. oral P.R.N. q 6 h. But nurse gave TYLENOL® 2 tabs the reason being that the usually accustomed dose was 2 tabs.

Analysis

Cause of error:

In this case, the nurse used her decision-making from her own experience and think that the dosage of medication may be not enough for the patient whereas the physician may has some reason for giving this dosage such as the poor of liver function of the patient, age and etc.

Contributing factor: nurse did not verify or follow the physician's order.

Recommendation:

(1) The physician should write the purpose of medication on the physician order's sheet to help the nurse interpret the order accurately.

(2) Nurse should clarify the order with the physician if the medication order is not clear.

Case Five : Wrong Time Error

A 2 year old Thai girl, case acute gastroenteritis, which her doctor treated her with Rocephine® 250 mg IV q 12 h. (order one day). Nurse gave the first dose to the patient at 09.00 and gave the next dose at 14.00. The patient received the medication early than the medication schedule.

Analysis

Cause of error: nurse lack of knowledge

Contributing factor: The standard medication administration time schedule is not written in document/Insufficiency training/Communication

The nurse lacked of knowledge and failed to use critical thinking or decision-making. Usually in taking the order for one day, nurse must count the administering time of the dose such as q 12 h. as 9.00, 21.00, but in this case, the nurse may misunderstand or confused, because she started the first dose at 9.00 and the next dose should be 21.00. This could cause a danger to the patient from a high dose of antibiotic in her blood level. If the order was not clear and nurse did not understand the order, she should ask or consult the physician or supervisor.

Recommendation:

(1) The hospital should utilize the standard medication administration time schedule

(2) Nurse Educator should educate nursing staffs to know and understand the standard medication administration time schedule.

(3) Head of department or in-charge nurse should review and brief during shift change or in the meeting.

Case Six: Omission error

The foreigner female patient, 51 years old, the physician made a diagnosis of hyperthyroidism, she planned to be discharged from the hospital. While she was waiting for her son to take her back home, the cashier informed the nurse at ward's counter that the patient had paid money already. The nurse went to the patient's room for giving medication that would be used at home and found that the patient and relative had left the hospital already.

Analysis

Cause of error:

1) Patient did not get informed by service team about what they waited for, the home medication they were to receive before going home. The patient also did not receive the special instruction or appointment card. This is involved health care team such as the physician, the nurse, even the cahier officer. Everyone understands that the patient should know the step of discharge.
2) Insufficient communication between nurse at ward and cashier

Contributing factor: Communication/ Orientation system when admit the patient

Recommendation:

(1) Nurse must inform the patient and relatives about the step of discharge, give instruction for the medication usage, special instruction, appointment card and etc. that will be given to them after the financial process was finished.
(2) The communication between cashier and patient, cashier and nurse.
(3) Increase awareness by sharing some incident report as a lesson learned in order to prevent the same incident occur in another department.

Case Seven: Wrong Route Error

The physician prescribed valium 5 mg I.V. stat, INCHARGE nurse received the physician's order, transcribed on medication administration record (MAR) and key in computer as valium 5 mg oral stat. Therefore medicine nurse administered valium 5 mg oral stat instead.

Analysis

Cause of error:

This case showed that the causes of error come from many phases, starting at transcribing error, dispensing error and administering error.

1) Transcribing error, at ward, in-charge nurse made an error by key in IV as oral.
2) Dispensing error, the pharmacist check the IPD prescribe with the physician's order or not.
3) Administration error, medicine nurse check dispensed medication from pharmacy or not.

Contributing factor: medicine from ward stock

Medication was kept in the stock ward. It is more convenient for staffs and reducing waiting time of dispensing phase, but it always lead to medication errors.

Recommendation:

(1) Review the transcribing process

(1.1) Nurse should check dispensed medication with physician's first order**.**

(1.2) Copy of physician's order sheet with hand writing order should be sent to pharmacy for re-check.

(1.3) Pharmacist should check the copy of physician's order sheet with the prescribed order form that key in the computer to compare the accuracy for re-check.

(2) Try to minimize medication stock in ward.

Case Eight: Unauthorized drug error

A Thai-female patient, 36 years old, case Bronchitis, her physician discharged her and she was in the waiting to receive home medication, nurse brought the medication "Air-X®" 2 tablets to the patient after lunch, she asked what these medicine for? Then nurse returned to check the home medication, she found that the physician had not prescribed Air-X®. As the result the patient was unsatisfied with the lack of prudence of the nurse.

Analysis

Cause of error:

1) Ward administration, communication among nurse team who bring Air-X 2 tablets to patient, may not know that the patient was discharged already, so she continue giving Air-X as schedule.
2) In this case, nurse prepared the own medication of the patient from the patient's medicine box without checking the physician's order.

3) Slip technique, nurse did not work according to procedure, when discharge patient, the physician's order should be transcribed. Medication left in medicine box should be returned to pharmacy. Some medication is temporary used in ward, may be not ordered to be home medication.
4) Cross-mixing of medication between different medicine box. Sometimes the patient transfer to another room and staff nurses forget to transfer medication to the new one. And when admit the new patient, may cause to error that nurse administer medication that not belonged to the new patient.

Contributing factor: Communication/ Lack of medication reconciliation system

Recommendation:

(1) The hospital should establish medication reconciliation system to be the guideline for staff nurses and health care team
(2) Review work process in ward
(3) Nurse should check medication with MAR before administering medication.
(4) Check and re-check the medication in each patient's medicine box.
(5) Improve communication level among team nurses.

Cause of Medication Error Summary

The causes of medication administration errors in IPD of the studied hospital that has been reported are divided into 4 groups: 1) Human: comes from nurses lack of knowledge/skill, insufficient training, failure to document previous dose and nurses did not strict to the principle of five right. 2) Communication: the causes of communication errors come from verbal/ telephone ordering, nurse identifying patients using a room number and miss communication. 3) Policy/ Procedure, most of medication errors come from transcribing errors, lack of policy of verbal/ telephone order, and 4) Work environment/ System that come from stress, interruption and lack of reconciliation system.

The fish bone diagram (in figure 1) showed the causes and contributing factors of medication errors of inpatient department, its advantage for setting prioritization of the problems and lead to set the target of improvement and the ways to solve these problems according to each causes.

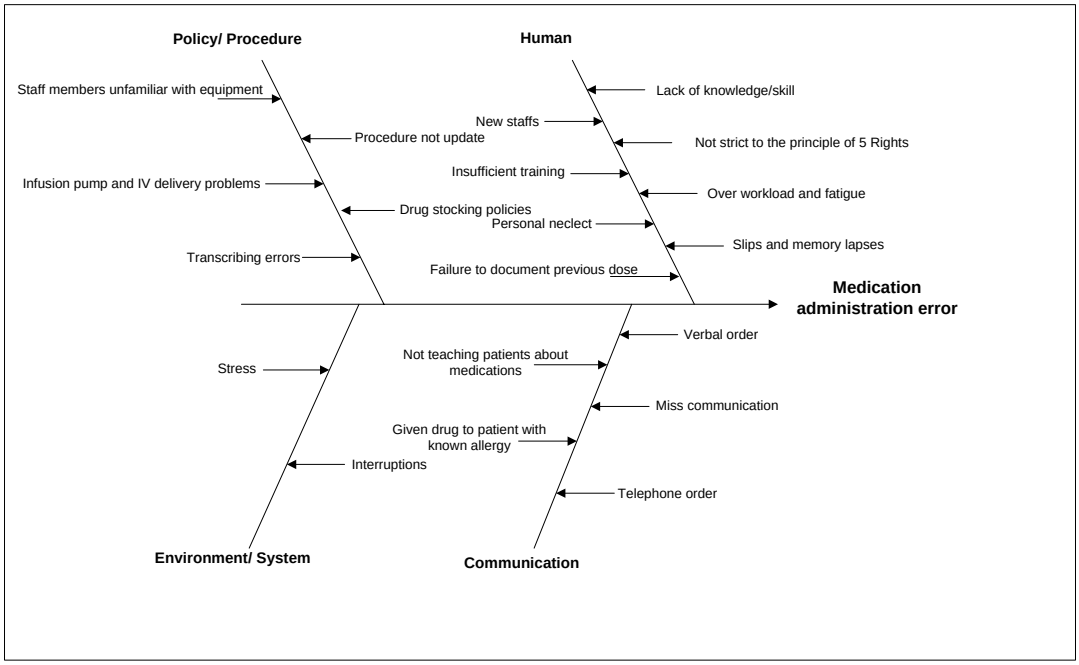

Figure 1 Fish Bone Diagram Cause of IPD Medication Errors in the Studied Hospital

Furthermore, the weak point in the studied hospital was the lack of root cause analysis of the medication errors in inpatient department (Quality center, 2007). Nurses could not identify the problems to do continuous quality improvement (CQI), the nurse's point of view are not clear, they did not really understand how to do certain tasks. The data that showed each month, it was just reported for statistics, and they thought the problems were very difficult to solve. The first priority that the hospital should do first, is training. Reduction of medication errors in this hospital needed support from everyone especially the hospital administrators, physicians, pharmacists and all nurses.

CHAPTER IV
CONCLUSION AND RECOMMENDATION

Conclusion

The objectives of this study were to analyze the medication administration error and propose the safe medication administration of the inpatient department of a private hospital in Bangkok, Thailand. Scope of the study was reviewing literature and relevant research and academic textbooks both in Thailand and abroad. Analysis of medication administration process and incident reports of medication administration error in inpatient department were done by the investigator. Data to be analyzed were situation of medication errors during January 1, 2007 to October 31, 2007. The analysis revealed that there were 28 incident reports sent to quality center. The most frequent types of these errors were wrong dose (25%) wrong time (17.86%) and omission (14.28%). The obstetric-gynecology and pediatric ward has reported medication errors in higher proportion than the other wards (46%), surgery ward (25%), medicine ward (17.8%), intensive care unit (7%), and OR (3.6%), no error reports from nursery and labor unit. Overall errors, the causes of medication administration errors were deficit of knowledge, communication errors from unclear policies of telephone orders, transcribing errors, stress and distraction.

Suggestions for Improve Safety of Medication Administration

The safety of medication administration needs the supportive of top administrator, collaboration of health care team such as the physician, pharmacist and nurses on developing the proper system for safety medication administration to ensure patient safety. The following suggestions can help to minimize medication administration errors in the studied hospital.

I. Role and Responsibility of Top Administrator/Hospital

1.1 Promote the positive culture for reporting medication errors by demonstrating positive responses to staff members for reporting medication errors and commit to a quality management process to improve the patient safety rather than only discovering mistakes.

1.2 Establish and implement the medication reconciliation system.

1.3 Improving an effective communication system such as read back policy for verbal medication orders/ order by phone, using the standardize of abbreviation, acronym and symbols used in the hospital.

1.4 Examine the work environment and design and promote safe working environment at the patient unit to reduce stressors such as noise and lighting.

II. Role and Responsibility of Nurse Administrator/ Nurse Manager

2.1 Prepare adequate and qualified of nurses in medication administration.

2.2 Promote the positive culture for reporting medication errors by demonstrating positive responses to staff members for reporting medication errors and commit to a quality management process to improve the patient safety rather than only discovering mistakes.

2.3 The nursing committee should review procedure of medication administration periodically including the principle of medication administration.

2.4 Providing every nursing meeting discuss about medication error to ensure all nurses aware of improvements as well as areas where incidents occurred. Each error should be use as an education opportunity.

2.5 Medication chart audits should be attended each month.

2.6 Demonstrate positive responses to staff members for reporting medication errors and commit to a quality management process to improve the patient safety than discover mistakes.

2.7 Providing multidisciplinary analysis of medication errors at the patient unit to examine the error from the systems perspective and also reducing individual blame and fear.

III. Role and Responsibility of Nurse Educator

Focused on education or training of medication administration as mandatory course of the hospital that every nurse must pass this training. Education must be brief and cover essentials not only medication administration but also focus on root cause analysis, how to handle the situation when incidents occur.

The following topics of training about medication administration are:

1) Protocol or Guideline of Safety Medication Administration
2) Drug Knowledge, Drug Calculation
3) How to use Medication Advices
4) The hospital's policies such as standard abbreviation, acronyms in the studied hospital, verbal medication order/ telephone orders
5) Reconciliation system
6) Quality Management
   - Definition
   - Types of medication error
   - The severity level of medication errors
   - Analysis root cause of errors
   - Continuous Quality Improvement

IV. Role and Responsibility of Registered Nurse

4.1 Adhere to the 7 Rights of Medication Administration.

4.2 Follow the Recommended Procedure of IPD Medication Administration

The Recommended Procedure of IPD Medication Administration

For reducing medication errors in inpatient department, it is the important role and responsibility of registered nurse. The following guideline should be observed.

1. Verify informed-the consent form with the patients or relatives before administering the first dose or changing drug therapy.
2. Complete and clarify written order
3. Strict to the principle of medication administration (7 rights: right patient, right drug, right dose, right route, right time, right technique and right document).

4. Review the medication administration record (MAR) and/ or changes in medication orders and assessing implications for the overall plan of care. The nurses must communicate the important issues to members of the health care team as appropriate.
5. Maintain unit dose packaging of medications until immediately prior to patient administration.
6. Administer medications within one hour of scheduled administration time and follow the standard dosing times for all medications.
7. Check the initial transcription and verification of the MAR has been completed.
8. Check dispensed medication against: (1) The physician's order, (2) IPD prescription, and (3) Medication administration record (MAR).
9. Review the ordered medication with respect to desired outcome, therapeutic duplication, possible food drug interactions, allergies and adverse effects.
10. Prepare the medication if necessary including reconstituting with the amount and type of solution noted on the package, package insert, or pharmacy label.
11. Read the label on the drug container and compare with the medication administration record in terms of drug, dosage or concentration, and route of administration.
12. Follow the principle of three medication checks, these were checking the accuracy of drugs three times when
    (1) Taking the medication from storage
    (2) While preparing the medication and
    (3) When replacing the medication in storage (Lane, 1992; & Peanpijan, 1997).
13. Never borrow medication from another patient's cabinet.
14. Check the time, dose, and route of the packaged medication against that transcribed on the MAR and check patient's allergies.
15. Check the patient's name band and date of birth of the patient to verify patient identity and names stated by the patient.

16. Oral syringe are to be used when administering oral medications that must be given by syringe.
17. When the following medications are administered the pump settings must be verified and documented on initiation, rate and bag changes by a second nurse:
    (1) IV patient control analgesia (PCA)
    (2) IV heparin
    (3) IV insulin
    (4) IV chemotherapy
    (5) Epidural analgesia
18. Educate patient and relative about their role in taking medication.
19. Using the basic principle of document “If it is not documented, it was not done”.
20. Document medication administered on the MAR after completion of the medication administration procedure
    (1) Use only accepted abbreviation
    (2) Never alter patient records.
    (3) Do not erase, remove or destroy, or attempt to edit notes previously written. (4) Do not use correction fluid or tape.
    (5) Indicate errors by drawing a single line though the error, writing the word “error” above the error, and initialing the error.
    (6) Late entries, entries made out of time sequence should be clearly marked in the record, and properly dated, time and signed.
21. Documentation of the evaluation of the patient response to the medication when appropriate, adverse reaction to the medication administered, explanation of any omitted doses.
22. Medication error should be multidisciplinary analysis of medication errors at the patient unit to examine the error from the systems perspective and also reducing individual blame and fear.
23. Report all errors include near miss and data should be collected for continuous quality improvement (CQI). (See table 11)

Table 11 Medication Administration and Responsibility of Nurses with Different Levels

no.	Activities	Responsible Person			
		Nurse Administrator	Nurse Educator	Incharge nurse	Staff nurses
1	Strict to the principle of medication administration (Rights)	■	■	■	■
2	Adherence to medication administration procedure	■	■	■	■
3	Prepare adequate staffs	■			
4	Increase nurse's skill for medical device such as infusion pump	■	■	■	■
5	Ensuring drugs are stable, stored and labeled appropriately	■		■	■
6	Verified inform consent from the patients or relatives before administering the first dose or changing drug therapy.			■	■
7	Clarify any order that is not clear and legible			■	■
8	Check the patient's drug allergy			■	■
9	Note both brand name and generic name in MAR			■	■
10	Never borrow drugs from the another's patient cabinet			■	■
11	Check dispensed medication with physician's first order and the MAR				■
12	Read the label three times and check medication order before administering the medication				■

Table 11 Medication Administration and Responsibility of Nurses with Different Levels (continue)

no.	Activities	Responsible Person			
		Nurse Administrator	Nurse Educator	Incharge nurse	Staff nurses
13	Double check by two nurses when administering multiple doses, HAD, drug calculation and infusion pump			■	■
14	Administering medication with only full and clear label				■
15	Maintain unit dose package until the point of actual administration				■
16	Identify the patient by two methods e.g. ID brand and names as stated by pt.				■
17	Educate patients and relatives about their role in taking medication			■	■
18	Document immediately after administering medication				■
19	Monitoring patients for desired outcome and/or expected medication effects			■	■
20	Report to the prescriber if any side effect or adverse reactions occur to the patient.			■	■
21	Reports all errors, collect data if errors occur, for CQI	■	■	■	■
22	Review W/I or protocol of medication administration every year	■	■	■	■
23	Sharing knowledge and experience about medication administration regularly at every nursing meeting	■	■	■	■
24	Spot check & monitoring in routine job	■	■	■	

Process of Implementation

The pilot study should be applied before the implementation of the action plan for the guidelines for safety medication administration of inpatient department and evaluate process and results, then develop to be suitable for each hospital's context.

1. Collect the best practice guideline of medication administration in inpatient department that analyzed and synthesis already, adapt to be the standard or guideline of medication administration in the studied hospital accordingly with vision, mission, Goal, objective that can actually practice or perform as written document. Design practiced relevant form as the followings.
   (1.1) Review work instruction medication administration of inpatient department
   (1.2) Medication error report sheet for responsible unit
   (1.3) Medication Reconciliation Form
   (1.4) Near-miss medication event reporting form
2. Propose this guideline to top management for approved/ propose project with budgeting to top management
3. Communication to all nursing staff levels
   3.1 Attend as a member of pharmacy committee with the management committee of inpatient department
   3.2 Initiate action plan, target and indicator to all nursing staffs.
   3.3 Starting with the prioritizing implementation issue such as work instruction, identification, high alert drug, and medication reconciliation.
   3.4 Cooperate with human resource department and nurse educator to organize about medication administration training program, work flow, case study of medication errors
4. Implementation
5. Regularly monitor and evaluate the outcome.

Recommendation

Recommendation from this study can be made as follows:

1) Recommendation on the use of the research findings

In addition to the small number of medication administration error reports, it may not be strong enough to support analysis to determine the root cause of the errors.

2) Recommendation on future studies

Further research is needed to identify causes and contributing factors of errors. Further research should be valuable to explore decision-making of nurses to medication administration; the study of using protocol checklist of medication administration procedure and signage in the studied hospital; perception of nurse correlated with incident report. And it would be useful to compare between single check with double check for reducing medication administration error.

One area that was not considered in this study was information technologies preventing medication error; research should be conducted for the cost effectiveness of information technologies to reduce medication administration errors in the studied hospital.

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APPENDIX

APPENDIX A

Medication Safety-Related Internet Links

There are many public agencies and private organization that dedicates to patient and medication safety, all of which are internet accessible (see table12).

Table 12 Medication Safety-Related Internet Links

Agency for Healthcare Research and Quality	www.ahrq.gov
American Hospital Association	www.aha.org
American Nurses Association	www.ana.org
American Society of Health-System Pharmacists	www.ashp.org
American Society for Healthcare Risk Management	www.ashrm.org
Institute for Healthcare Improvement	www.ihi.org
Institute of Medicine	www.national-academies.org
Institute for Safe Medication Practices	www.ismp.org
Joint Commission on Accreditation of Healthcare Organizations	www.jcaho.org
Massachusetts Coalition for the Prevention of Medical Errors	www.mhalink.org/mcpme
MedErrors	www.mederrors.com
National Coordination Council on Medication Error Reporting and Prevention	www.nccmerp.org
U.S.Pharmacopoeia	www.usp.org

APPENDIX B
GLOSSARY

CPOE	Computerized Prescriber Order Entry is a computer-based system of ordering medications and often other tests. Prescribers directly enter orders into a computer system that can have varying levels of sophistication. Also known as "e-prescribing".
Culture	Behaviors, norms, belief sets, values race, traditions, and folkways of a specific group
Drug	pharmacologic agent or medication capable of inter acting with living organisms to produce biological effects.
Drug abuse	self-directed use of a drug for non therapeutic purposes
Drug action	interaction between a drug and cellular components
Drug interactions	relationships between concurrently administered drugs that result in alterations in the therapeutic effects of any or all of the drugs.
Elixir	flavored, sweetened hydroalcoholic (water and alcohol) liquid that contains a medicinal agent.
FMEA	Failure mode and effects analysis is a proactive risk assessment method based on the simultaneous analysis of possible failure modes, their consequences, and associated risk factors.
Harm	Impairment of the physical, emotional, or psychological function or structure of the body and/ or pain resulting thereform.
High alert drug	Medications that have a high risk of causing serious injury or death to a patient if they are misused. Errors with these products are not necessarily more common, but their results can be more devastating. Examples of high-alert medications include warfarin and intravenous (IV) antithrombotics, insulin, chemotherapy, concentrated electrolytes, IV digoxin, opiate

	narcotics, neuromuscular blocking agents, and adrenergic agonists. A complete list can be found at www.ismp.org
Hyperkalemia	excess potassium in the blood
Hypokalemia	insufficient potassium in the blood
Independent Double Check	A procedure in which two individuals, preferably two licensed practitioners, separately check each component of the work process. An example would be one person calculating a medication dose for a specific patient and a second individual independently performing the same calculation (not just verifying the calculation) and matching the results. This would involve for example, checking the accuracy of the dose/kg and the weight being used in the calculation. In the case of receiving a telephone order an INDEPENDENT DOUBLE CHECK means that the order must be read back to the prescriber (in figures and words – e.g. 50mg: fifty milligrams, five 0 mg). As a further check, the prescriber should repeat the order to a second person.
Inhalant	medicinal vapors administered through the nose, trachea, or respiratory system
Injection	introduction of a liquid into the body using a syringe; a solution of a medication suitable for injection.
Inpatient unit	Hospital unit that is able to provide care to patient 24 hours a day, 7 days a week
Intervention	May include change in therapy or active medical/ surgical treatment
Intra-articular route	medication administration instillation or injection into a joint
Intradermal route	medication administration by injection of small amounts of solution, usually antigens, between the epidermal and the dermal (skin) layers.
Intramuscular route	medication administration by injection of a solution into a muscle.

Intrathecal	within a sheath, as in the cerebrospinal fluid within the subarachnoid space.
Intrathecal route	medication administration by direct injection through the theca (enclosing sheath) of the spinal cord into the subarachnoid space.
Intravenous route	medication administration by injection or infusion into a vein
MAR	The Medication Administration Record provides a documentation of record medication administration. In the USA and in many electronic medication management systems, the doctor's prescription is on a separate document or screen and the medications are transferred (either manually or electronically) onto a separate record of medication administration. Currently, in Australia when medications are prescribed manually, the medication chart combines the doctor's prescription and the medication administration record in the one document.
Medication	Medication includes: prescription medications; sample medications; herbal remedies; vitamins; nutraceuticals; over-the-counter medicines; vaccines; diagnostic and contrast agents used on or administered to persons to diagnose, treat, or prevent disease or other abnormal conditions; radioactive medications; respiratory therapy treatments; parenteral nutrition; blood derivatives; intravenous solutions (plain, with electrolytes and/or drugs); and any product designated by the Therapeutic Goods Administration (TGA) as a drug. The definition of medication does not include enteral nutrition solutions (which are considered food products), oxygen, and other medical gases.
Medication Devices	Equipment such as infusion pumps, implantable pumps, syringes, tubing, patient controlled analgesia pumps, automated compounding devices, robotics, and other related devices that are used for medication preparation, dispensing, and administration.

Monitoring	To observe or record relevant physiological signs
Root cause analysis	A retrospective process for identifying the most basic or causal factors that underlie the occurrence or possible occurrence of an adverse event.
Stat	In the context of medication administration "*stat*" is used as an abbreviation to mean *give as a single dose immediately*. The expected time of administration should be specified whenever a stat dose is prescribed.
Unit-dose	Unit dose is a system of packaging whereby each dosage unit is separately packed in a protectively sealed unit and labeled with the name of the medicine, strength, dose contained within the pack, batch number and expiry date. The presentation should minimize or eliminate the preparation required for the medicine to be administered. The advantage of a unit dose system is that each dosage unit is identifiable up to the point of administration. Dosage integrity minimizes wastage as unused doses may be reissued.

APPENDIX C

1. A system approach to the reduction of medication error on the hospital ward

Author: David J. Anderson & Craig S. Webster (2001)

Item	Detail
Objective	To discuss a potentially powerful approach to safer medication administration on the hospital ward, based on principles of safe developed in other high-risks industries, and consistent with recent national reports on safety in health care released in the United Kingdom (UK) and United States of America (USA). To discuss why punitive approaches to safety on the hospital ward and in the nursing literature do not work.
Sample size	-
Variable studied	-
Data Sources	-
Research Design	-
Research Instrument	-
Result	Recommend using the systems-approach, which allows the complete set of contributing factors underlying an accident to be understood and addressed. Feedback and targeted to participants to understand that incident data are being used appropriately, and to maintain high levels of on-going reporting and enthusiasm for the scheme
Data Analysis	Concept of focusing system approach more than individual
Recommendation	Agree

2. Effective Strategies to Increase Reporting of Medication Errors in Hospitals

Author: Mary VanOyen Force, Linda Deering, John Hubbe, Marcy Andersen, Barbara Hagemann, & Michelle Cooper-Hahn and William Peters (2006)

Item	Detail
Objective	To increase medication error reports, analyze the reports and implement action plans to improve medication administration and patient safety
Sample size	Medication reports were collected and aggregated every month for 1 year before and after the LifeSavers program was implemented
Variable studied	medication error reports
Data Sources	Staff nurse and pharmacist in Delnor-Community Hospital
Research Design	The medication event team (METs) team developed the LifeSavers program for training staff nurses and pharmacists to learn more how medication error occurred in the hospital and met staff to ask why medication process failures are unreported and open dialogue about possible solutions to these problems. Emphasis was placed on the medication process and not on the individual errors. Feedback from staff was discussed at METs meeting and strategies to correct the problem of low error reporting were initiated.
Research Instrument	Group discussion, mean rate, A paired-sample *t*-test analysis
Result	After implemented program that build a non-punitive culture for increasing medication error reports, In one year the reports increased from 14 to 72 reports per month
Data Analysis	Analyzed occurrence report 7-10 reports by METs meeting teams every week for cause and possible solutions initiated of the system failure. Look for trending of events and frequency, contributing factors, and solutions to the problems Develop strategies to implement organizational/ departmental changes to solve the problems. Report to Board of Directors. Investigations of every report were thorough, respectful and system-focused without emphasis on personal failures. The METs utilized aggregate data to inform and shape patient safety action plans to reduce medication errors.
Recommendation	Educational programming aimed at changing the way staff perceived medication errors significantly impacted medication error reporting.

3. Impact of a Statewide Reporting System on Medication Error Reduction

Author: Kimberly Rask, Jonathan Hawley, Anne Davis, Dorothy 'Vi' Nayler, & Kenneth Thorpe (2006)

Item	Detail
Objective	To evaluate the effectiveness of the SMU (Safety Medication Use) program
Sample size	150 hospitals
Variable studied	Type of medication error, step in medication process, underlying causes, contributing factors, data source for monitoring error rates, and self-reported change in medication errors.
Data Sources	PHA (Partnership for Health and Accountability) staffs, from the year 2001, 2002, and 2003
Research Design	Participating hospitals performed a self-assessment, developed an improvement plan to address a specific type of medication error, and then reassessed their results after 9 months of implementation. This study reviewed participating hospital surveys from 2001, 2002, and 2003.
Research Instrument	Survey (paper, web-based survey)
Result	Hospital participation rates were high (more than 90% of eligible hospital) in each year. Dose omission (67.7% in 2003) was the most common error type. The most common contributors to errors were human factors, frequent interruptions, and communication. Most hospitals reduced the targeted medication error, with a mean error reduction of 28% (2002) and 34% (2003). Improvement was seen across all types of hospitals, with no statistically significant differences between urban, rural, large, small or academic hospitals. Overall participation in the statewide patient safety program was the only significant predictor of both the likelihood and magnitude of error reduction. Several hospitals found that computerized medication administration records (eMAR) reduced errors by (1) improving legibility, (2) offering drug-specific dosing instructions (e.g.100 mg = 2 tablets), (3) reducing duplicate annual record keeping, and (4) improving the reporting and monitoring capabilities.
Data Analysis	No significant differences were found in hospital demographic subgroup analyses. Focused primarily on whether hospitals were successful in reducing errors rather than on the magnitude of the change
Recommendation	The willingness of hospitals to share negative results and continued participation was create the supportive and non-punitive environment.

4. Medication Error Analysis and implementation of Pharmacist role on Error Reduction at Samut Sakhon Hospital

Author: Warupsorn Anusornsangiam (2002): descriptive and comparative study

Item	Detail
Objective	To analyze medication errors in the medication-use process of hospitalized patients in terms of types, rate, medication class involved in errors, contributing factors, and severity of errors, according to prescribing, transcribing, dispensing, and administration process and to determine the effectiveness of pharmacists' role in medication error reduction
Sample size	The patients admitted to the 36-bed female medical ward II at Samut Sakhon Hospital during April1, 2001 to December 31, 2001 (461 patients, 805 medication error reports in Phase1, and 514 patients, 578 medication error reports in Phase 3)
Variable studied	Number of medication errors
Data Sources	The female medical ward II at Samut Sakhon Hospital
Research Design	The method was divided into three phases. In phase I, the medication-use process was monitored and medication errors were assessed from April 1, 2001 to June 30, 2001. Pharmacists' roles in medication error reduction were established for a 1- month period in phase 2 and evaluated from October 1, 2001 to December 31, 2001 in phase 3.
Research Instrument	Mean (X), Standard deviation (SD)
Result	The majority of errors were medication administration errors. The most common types of errors were omission, administering of unauthorized drugs, and administering of wrong doses. The second most frequent medication error was transcribing error. The error rate of a pharmacist's transcribed drug profile was lower than the error rate of a nurse's transcribed drug profile. The most frequent types of errors were no transcribing in dosage regimen, incorrect transcribing in dosage regimen, and in drug quantity. For overall errors, the most common contributing factors were administered drug was not verified with medication card (39.2%), lack of drug knowledge (12.5%), forgetfulness (11.1%), and illegible order (11.1%). Approximately 42% of all errors caused no patient harm, but patient monitoring should be increased. The most common medication classes involved in all medication errors, were antimicrobial, gastrointestinal, and cardiovascular drugs.
Data Analysis	Contributing factors in each stage of medication-use process
Recommendation	-

5. Medication study supports registered nurses' competence for single checking

Author: Jarma, H., Jacobs, E., & Zielinski, V. (2002): A descriptive study

Item	Detail
Objective	To examined 1) Nurses' level of awareness of their responsibility following the introduction of a single person checking of medications, their level of confidence in their checking technique, their level of satisfaction with the change, 2) Compare the amount of time required for double-person and single-person, The number of incidence of medication errors during period of single-person checking (March to September, 2001) and double-person checking (March to September, 2000) to determine the safety of single-person checking of this designated group of medications.
Sample size	129 nurses from participant unit
Variable studied	Nurses' level of awareness of their responsibility, their level of confidence in their checking technique, their level of satisfaction with the change, and the number of incidence of medication errors during period of study.
Data Sources	In adult inpatient units and specialty and midwifery services of the Geelong Hospital.
Research Design	A descriptive research design 1) Pilot study in two acute care units of The Geelong hospital, a Victorian regional acute care hospital, Australia, monitoring of medication errors for the designated group of medications under a single-person checking protocol for a 7-month period. Number of medication errors reported compared with the number of medication errors reported in a similar time frame which double-person checking was standard practice. 2) Questionnaires to nurses (N= 292) in all adult inpatient unit (excluding the two pilot study), and OR, LR, ER 3) The quantitative data from the nurses' questionnaires, including the values generated from the visual analogue scales, were analyzed using descriptive statistics. This level of analysis allowed comparison with previous findings reported by Nathine.
Research Instrument	Questionnaires contains of 15 questions

5. Medication study supports registered nurses' competence for single checking (continued)

Author: Jarma, H., Jacobs, E., & Zielinski, V. (2002): A descriptive study

Item	Detail
Result	From 129 (44%) that returned the questionnaires 1) The majority of nurses appreciated the increased autonomy the change to single-person checking of medications provided. They also identified benefits for patients, including that they were able to be more responsive to patient needs. 2) The amount of time saved by the change to single-person checking for routine medication rounds was between 3 and 25 min, with the perceived average amount of time saved being 20 min. These time –saving came from cannot find another nurse to double check, interruption, on night duty that don't have another nurse. 3) The number of incident report: during the study period (7 months) 4 medication administration reports in single –person checking, and 5 medication administration reports in double –person checking. They assumed from this result that single –person checking has the same level of safety as double –person checking.
Data Analysis	The key benefits of single-person checking were: 1) nurses having a greater sense of professional responsibility, accountability and personal responsibility for safe medication practice 2) save nurses' time
Recommendation	The majority of nurses in this study had 6 or more years of clinical experience. They believed that they were responsible and accountable for their own practice. Therefore they required for single-person checking of medications. However, assessment of performance and competency of nurses is necessary for single-person checking, if nurses had less experience, the investigator concerns that the single-person checking will lead to increase medication error. The number of the participant nurses in this study is lower than expected (only 44%).

6. Nurses relate the contributing factors Involved in medication errors

Author: Fu-In Tang, Shuh-Jen Sheu, Shu Yu, Ien-Lan Wei and Ching-Huey Chen (2007)

Item	Detail
Objective	To investigate nurses' view on the factors contributing to medication errors in the hope of facilitating improvements to medication administration processes.
Sample size	90 female nurses
Variable studied	Narrative description of the incident, nurse's background and contributing factors (40 possible conditions and eight categories)
Data Sources	Hospitals in Taipei and Taiwan
Research Design	A focus group of nine registered nurse discussed medication errors with which they were familiar as a result of both their own experiences and of literature review. The group, along with other researchers, then developed a semi-structured questionnaire consists of three parts: narrative description of the error, the nurse's background and contributing factors. After the contributing factors had been elicited and verified with eight categories and 34 conditions, additional registered nurses were invited to participate by recalling one of the most significant medication errors that they had experienced and identifying contributing factors from those listed on the questionnaire. Identities of the hospital, patient and participants involved in the study remain confidential.
Research Instrument	Mailing questionnaires, SPSS (for descriptive analysis of the nurses' backgrounds and demographics)
Result	72 female nurses who responded, 55 (76.4%) believed more than one factor contributed to medication errors: personal neglect (86.1%), heavy workload (37.5%), and new staff (37.5%) were the three main factors in the eight categories. The top three of the 34 conditions were: 'need to solve other problem while administering drugs'; 'advanced drug preparation without rechecking'; and 'new graduate'. The two most error-prone places were medical ward (36.1%) and intensive care unit (33.3%). The common types of errors were wrong dose (36.1%) and wrong drug (26.4%). Antibiotics (38.9%) were the most commonly misadministered drugs.
Data Analysis	The contributing factors in this study can be used to develop the occurrence report of medication error form
Recommendation	extending training period for new staff, increasing manpower and promoting good attitude in reporting errors by positive culture

7. Reporting of Medication Errors by Pediatric Nurses

Author: Stratton, K. M., Blegan, M. A., Peper, G., Vaughn, T. (2004)

Item	Detail
Objective	1) To estimate the proportion of medication errors that are actually reported by nurses in pediatric ward, examine the documented medication error rates in light of proportion of medication errors nurses say are reported, nurses' reasons that why medication administration errors occur, and reason for not reporting 2) To specifically compare the pediatric nurse findings with previously reported adult and pediatric nurse findings related to reporting of medication administration errors.
Sample size	284 RNs (227 adult nurses and 57 pediatric nurses)
Variable studied	The reasons medication errors are not reported, estimate the percent of medication errors actually occurring on their units that were reported, estimate the overall proportion of medication error reported on their unit, and demographic information of participated nurses
Data Sources	from 33 acute care units (27 adults and 6 pediatrics units) in 11 hospitals (120-500 beds-hospital) in 2 states (40% response rate), 3 hospitals from a Midwestern rural consortium, 8 hospitals from urban areas in the Rocky mountain region of the United States (October to December, 2000)
Research Design	Questionnaires contained three sections related to medication errors 1) demographic information 2) asked the nurses the reasons medication errors are not reported 3) asked the nurses to estimate the percent of medication errors actually occurring on their units that were reported 4) asked the nurses to estimate the overall proportion of medication error reported on their unit
Research Instrument	Questionnaires & cronbach's alpha interitem

Item	Detail
Result	1) Pediatric nurses estimated that 67% of all medication errors on their patient care units are reported higher proportion than the 56% reported for all medication errors by adult nurse. 2) The medication error rates per 1,000 patient-days computed from actual occurrence reports were also higher on pediatric (14.80) as compared with adult units (5.66). 3) Pediatric nurses selected distraction/ interruption and RN-to-patient ratios were the two most common selected reasons for medication administration errors 4) The primary reasons selected for not reporting medication error were nursing administration's focus on the person rather than the system and the fear of adverse consequences.
Data Analysis	The role of nurse's manager: 1. Examine the work environment and design safe work environments at the patient unit to reduce the stressors such as noise and lighting. 2. Demonstrate positive responses to staff members for reporting medication errors and commit to a quality management process to improve the patient safety than discover mistakes. 3. Providing multidisciplinary analysis of medication errors at the patient unit to examine the error from the systems perspective and also reducing individual blame and fear.
Recommendation	Medication administration error occurrences are underreported. And the need to explore both individual and systematic safeguards to focus on the reported cause and underreporting of medication errors.

8. Strategies to Decrease Medication Errors

Author: Ruth Davidhizar & Giny Lonser (2003)

Item	Detail
Objective	To discuss strategies to decrease medication errors and increase patient safety during medication administration
Sample size	-
Variable studied	-
Data Sources	The medication error reports from the United States Pharmacopoeia (USP)
Research Design	-
Research Instrument	-
Result	The two main causes of medication errors in the UPS study were performance deficit and failure to follow procedure. The three most frequently types of errors were omission (27%), improper dose (21%), unauthorized drug (12%). The three most common contributing factors were distraction, workload increase and inexperienced staff. The author recommended strategies to prevent medication errors: 1) Report all medication errors regardless of whether there has been actual harm to the patient 2) Analyze medication error data to establish safe care practices 3) Involve a multidisciplinary approach in considering medication errors. 4) Assess for adequate levels and numbers of staff 5) Provide training and retraining in the agency's medication procedure 6) Evaluate medication policies and procedures to ensure optimum efficiency and safety 7) Increase awareness of staff concerning medication errors 8) Increase focus on the patient 9) Relate performance evaluations to competency 10) Consider the negative effects of stress
Data Analysis	- Establish strategies to prevent medication errors in the studied hospital - Arrange preceptors for new staff to monitor for competency and training in the medication administration procedure for the unit - Both training and review medication administration procedure periodically - Training and monitoring medication calculation abilities for nurse
Recommendation	-

9. การดูแลที่เน้นผู้ป่วยเป็นศูนย์กลางในการบริหารยาตามการรับรู้ของพยาบาลและผู้ป่วย

Author: ปรีดา กังแฮ 2546 (Kanghae, 2003)
Descriptive comparative research

หัวข้อ	รายละเอียด
วัตถุประสงค์ของการวิจัย	เพื่อศึกษาระดับการดูแลที่เน้นผู้ป่วยเป็นศูนย์กลาง ในการบริหารยาตามการรับรู้ของพยาบาลและผู้ป่วย และเปรียบเทียบการรับรู้ของพยาบาลและผู้ป่วย
กลุ่มตัวอย่าง	พยาบาลวิชาชีพ จำนวน 40 คน ที่ปฏิบัติงานในหอผู้ป่วยอายุรกรรม 3 แห่งในโรงพยาบาลแห่งหนึ่ง และผู้ป่วยจำนวน 164 คน ที่ 1) พักรักษาตัวในหอผู้ป่วยอายุรกรม ไม่น้อยกว่า 1 วัน 2) มีอายุตั้งแต่ 18 ปีขึ้นไป 3) ได้รับยาทั้ง 2 ชนิดคือยาฉีดเข้าหลอดเลือดดำและยารับประทาน 4) เป็นผู้มีสติสัมปชัญญะสมบูรณ์ อ่าน ออก เขียนภาษาไทยได้ 5) ยินดีให้ความร่วมมือในการตอบแบบสอบถามได้รับการบริหารยาจากพยาบาลวิชาชีพ
ตัวแปรที่ศึกษา	1. การยอมรับในคุณค่า ความพอใจและความต้องการของผู้ป่วยในขณะบริหารยา 2. การประสานงานและบูรณาการการบริหารยา 3. การให้ข้อมูลเกี่ยวกับยา วิธีการให้และการใช้ยา และการติดต่อกับผู้ป่วยในการบริหารยา 4. การดูแลความสุขสบายด้านร่างกายในขณะบริหารยา 5. การสนับสนุนทางด้านจิตใจ การลดความวิตกกังวลและความกลัวที่เกิดจากการบริหารยา 6. การมีส่วนร่วมของญาติและผู้ใกล้ชิดของผู้ป่วยในการบริหารยา 7. ด้านการส่งต่อและความต่อเนื่องในการบริหารยา
แหล่งเก็บข้อมูล	หอผู้ป่วยอายุรกรรม 3 แห่งในโรงพยาบาลแห่งหนึ่ง ในเดือนพฤศจิกายน พ.ศ. 2545
การออกแบบวิจัย	ผู้วิจัยสร้างชุดแบบสอบถามขึ้นมา 2 ชุดสำหรับพยาบาล 1 ชุดและผู้ป่วย 1 ชุด มีการตรวจสอบคุณภาพของเครื่องมือ ความตรงด้านเนื้อหาของข้อมูล (content validity) และการหาความเชื่อมั่นของเครื่องมือ (reliability) วิเคราะห์ข้อมูลโดยใช้ program SPSS
เครื่องมือที่ใช้ในการวิจัย	แบบสอบถาม มี 2 ชุดได้แก่ชุดแบบสอบถามสำหรับพยาบาลวิชาชีพ และชุดแบบสอบถามสำหรับผู้ป่วย การแจกแจงความถี่ หาค่าร้อยละ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน และการเปรียบเทียบค่าเฉลี่ย

หัวข้อ	รายละเอียด
ผลการวิจัย	พยาบาลร้อยละ 68 รับรู้ว่ามีการดูแลที่เน้นผู้ป่วยเป็นศูนย์กลางในการบริหารยาในระดับปานกลาง และร้อยละ 53-70 รับรู้ว่ามีการดูแลรายด้านทั้ง 7ด้าน ในระดับปานกลาง ผู้ป่วยร้อยละ 67 รับรู้ว่ามีการดูแลที่เน้นผู้ป่วยเป็นศูนย์กลางในการบริหารยาในระดับปานกลาง ร้อยละ 59-70 รับรู้ว่ามีการดูแลรายด้านทั้ง 7 ด้านในระดับปานกลาง และค่าเฉลี่ยการรับรู้ของผู้ป่วยน้อยกว่าค่าเฉลี่ยการรับรู้ของพยาบาล ทั้งในภาพรวมและรายด้าน
การสกัดเพื่อการนำไปใช้	ทำอย่างไรจะให้ผู้ป่วยรับรู้ได้อย่างเป็นรูปธรรมว่าเน้นผู้ป่วยเป็นศูนย์กลาง
ข้อคิดเห็นในการนำผลงานวิจัยไปใช้	-

10. ความคลาดเคลื่อนในการใช้ยาในโรงพยาบาลศรีสะเกษ

ผู้วิจัย: สัมมนา มูลสาร, 2536 (Mullasan, S., 1993)

หัวข้อ	รายละเอียด
วัตถุประสงค์ของการวิจัย	เพื่อประเมินถึงลักษณะและสาเหตุที่ก่อให้เกิดความคลาดเคลื่อนในการใช้ยาในหอผู้ป่วย 8 หอของโรงพยาบาลศรีษะเกษ โดยจะเป็นหอที่ใช้ระบบการกระจายยาแบบเดิม 4 หอ ระบบยูนิตโด๊ส 4 หอในระหว่างเดือนมิถุนายน – ธันวาคม 2536
กลุ่มตัวอย่าง	ข้อมูลการสั่งใช้ยาจากใบสั่งยาทุกใบ ขั้นตอนปกติของการจ่ายยาในระยะเวลา 1 เดือน ของหอผู้ป่วยหลัก (สูติกรรม อายุรกรรม ศัลยกรรม กุมารเวชกรรม) ของโรงพยาบาลศรีสะเกษ
ตัวแปรที่ศึกษา	ความคลาดเคลื่อนในการจ่ายยา ความคลาดเคลื่อนในการสั่งใช้ยา และความคลาดเคลื่อนในการบริหารยา
แหล่งเก็บข้อมูล	หอผู้ป่วยหลัก (สูติกรรม อายุรกรรม ศัลยกรรม กุมารเวชกรรม) ของโรงพยาบาลศรีสะเกษ
การออกแบบวิจัย	การสำรวจขบวนการใช้ยา 3 ขั้นตอน คือ การสั่งใช้ยา การจ่ายยา และการบริหารยา จากการรวบรวมข้อมูลการสั่งใช้ยาจากใบสั่งยาทุกใบ ขั้นตอนปกติของการจ่ายยาในระยะเวลา 1 เดือน โดยแบ่งเป็นระยะเวลาเตรียมการ (การออกแบบฟอรม์และทดสอบเอกสารพร้อมทั้งทดลองดูวิธีการเก็บข้อมูล การชี้แจงการดำเนินการแก่พยาบาลประจำหอผู้ป่วย) ระยะเวลาการเก็บข้อมูล และระยะเวลาการสรุปข้อมูล
เครื่องมือที่ใช้ในการวิจัย	การเก็บข้อมูลโดยวิธีการสังเกต (Disguised observation method), UNPAIRED t-test
ผลการวิจัย	ความถี่ในการเกิดความคลาดเคลื่อนในการจ่ายยา พบว่ามีความถี่ใกล้เคียงกันระหว่างระบบเดิม (48 / 1922; 2.5%) และระบบยูนิตโด๊ส (295 / 9977; 2.95%) ความคลาดเคลื่อนในการจ่ายยาที่พบมากที่สุด 3 ลำดับแรก ในระบบเดิมคือ other error (19 / 0.99%), omission error (13 / 0.68%) และ wrong dose error (8 / 0.42%) ขณะที่ในระบบยูนิตโด๊สจะเป็น other error (66 / 0.77%), wrong dose (65 / 0.65%) และ unordered drug error (64 / 0.64%)ซึ่งความคลาดเคลื่อนที่พบทั้งหมดนี้จะได้รับการแก้ไขที่กลุ่มงานเภสัชกรรม สาเหตุหลักที่ก่อให้เกิดความคลาดเคลื่อนในการจ่ายยา คือ ความผิดพลาดส่วนบุคคล ระบบงานที่ไม่เหมาะสม และปริมาณงานที่มากเกินไป พบว่ามีความคลาดเคลื่อนในการสั่งใช้ยา 176 ครั้ง จากขนานยาทั้งหมด 6452 ขนาน (2.7%) ความคลาดเคลื่อนนี้ไม่มีอันตรายร้ายแรงต่อผู้ป่วย

หัวข้อ	รายละเอียด
ผลการวิจัย	พบความคลาดเคลื่อนในการบริหารยา 437 ครั้ง (11.78%) และ 629 ครั้ง (16.74%) ในระบบเดิมและระบบยูนิตโด๊สตามลำดับ ประเภทความคลาดเคลื่อนที่พบมากที่สุดในระบบเดิมจะเป็น wrong dose (234 / 6.31%), omission (123 / 3.31%), และ unordered drug error (46 / 1.24 %) สาเหตุที่ก่อให้เกิดความคลาดเคลื่อนในระบบนี้คือ การขาดความรู้ ความผิดพลาดส่วนบุคคล และการจัดยาผิด ขณะที่ในระบบยูนิตโด๊ส ประเภทความคลาดเคลื่อนที่พบมากที่สุดตามลำดับคือ wrong time (415 / 11.05%), omission (91 / 2.42%) และ wrong dose error (46 / 1.22%) สาเหตุส่วนใหญ่ที่ก่อให้เกิดความคลาดเคลื่อนคือ ระบบงานที่ไม่เหมาะสม ความผิดพลาดส่วนบุคคล และการเตรียม kardex ผิด การศึกษาในครั้งนี้ จะพบว่าระบบยูนิตโด๊สยังมีประสิทธิภาพในการลดความคลาดเคลื่อนในการบริหารยาได้ไม่ดีเท่าที่ควร เมื่อพิจารณาเฉพาะความถี่ของความคลาดเคลื่อน แต่ถ้าเปรียบเทียบโดยไม่นำความคลาดเคลื่อนประเภท wrong time error มาร่วมพิจารณา จะเห็นว่าระบบยูนิตโด๊สจะเหนือกว่าระบบเดิมในการลดความคลาดเคลื่อนในการบริหารยา
การสกัดเพื่อการนำไปใช้	1. การเน้นการตรวจสอบยาซ้ำในระบบยูนิตโด๊ส เป็นขั้นตอนสำคัญในการลดความคลาดเคลื่อนในการบริหารยา 2. การจัดคู่มือการทำงานที่แน่นอนและเป็นขั้นตอนการทำงานในการบริหารยาสำหรับพยาบาลใหม่ที่จะศึกษาแทนที่จะให้พยาบาลถ่ายทอด สอนงานกันเอง อาจเป็นสาเหตุให้เกิดความไม่สมบูรณ์ของการถ่ายทอดความรู้ได้ 3. การจัดระบบงานภายในหอผู้ป่วย เช่นแทนที่รับประทานอาหารพร้อมกัน เปลี่ยนเป็นการผลัดกันลงพักตอนเที่ยง จะช่วยลดการเกิด wrong time error ได้
ข้อคิดเห็นในการนำผลงานวิจัยไปใช้	มีบางประเด็นที่สามารถนำไปปรับใช้ได้ เช่น เพิ่มเติมระบบการตรวจสอบซ้ำยาที่จะให้ผู้ป่วย ซึ่งเป็นระบบยูนิตโด๊สอยู่แล้ว

11. ความสัมพันธ์ระหว่างความคลาดเคลื่อนในการใช้ยากับการเกิดเหตุการณ์ไม่พึงประสงค์จากการใช้ยาในผู้ป่วยในของโรงพยาบาลพหลพลพยุหเสนา

Author: สุชาดา เดชเดชะสุนันท์, 2544 (Detdechasunun, 2001)

การวิจัยเชิงวิเคราะห์แบบตัดขวาง (Cross-sectional Study)

หัวข้อ	รายละเอียด
วัตถุประสงค์	เพื่อหาความสัมพันธ์ระหว่างความคลาดเคลื่อนในการใช้ยากับการเกิดเหตุการ์ไม่พึงประสงค์จากการใช้ยาในผู้ป่วยในของโรงพยาบาลพหลพลพยุหเสนา ในระหว่างวันที่ 1 พฤศจิกายน 2544 ถึงวันที่ 31 มกราคม 2545 โดยศึกษาอัตราและชนิดของการเกิดความคลาดเคลื่อนในการใช้ยา อัตราและลักษณะของการเกิดเหตุการณ์ไม่พึงประสงค์จากการใช้ยา ประเภทของความคลาดเคลื่อนในการใช้ยาที่ทำการศึกษา ได้แก่ ความคลาดเคลื่อนที่เกิดจากการสั่งใช้ยา ความคลาดเคลื่อนที่เกิดจากการคัดลอกรายการยา ความคลาดเคลื่อนที่เกิดจากการจ่ายยา ความคลาดเคลื่อนที่เกิดจากการบริหารยา และศึกษาเหตุการณ์ไม่พึงประสงค์จากการใช้ยาทั้งที่มีความสัมพันธ์และไม่มีความสัมพันธ์กับความคลาดเคลื่อนในการใช้ยา
กลุ่มตัวอย่าง	ผู้ป่วยในหอผู้ป่วยอายุรกรรม 2 หอ ที่เข้ารักษาตัวในโรงพยาบาลพหลพลพยุหเสนา ระหว่างวันที่ 1 พฤศจิกายน พ.ศ. 2544 ถึงวันที่ 31 มกราคม พ.ศ. 2545 ที่มีคุณสมบัติเป็นผู้ป่วยที่รับใหม่เข้ารักษาตัวในหอผู้ป่วย และได้รับการสั่งใช้ยาตั้งแต่ 1 รายการขึ้นไป
ตัวแปรที่ศึกษา	ความคลาดเคลื่อนในการใช้ยา ความคลาดเคลื่อนที่เกิดจากการสั่งใช้ยา ความคลาดเคลื่อนที่เกิดจากการคัดลอกรายการยา ความคลาดเคลื่อนที่เกิดจากการจ่ายยา ความคลาดเคลื่อนที่เกิดจากการบริหารยา และ เหตุการณ์ไม่พึงประสงค์จากการใช้ยา
แหล่งเก็บข้อมูล	หอผู้ป่วยอายุรกรรม 2 หอ ของ โรงพยาบาลพหลพลพยุหเสนา
เครื่องมือที่ใช้ในการวิจัย	การสังเกตการณ์ของผู้ทำวิจัย การตรวจเช็คจากเอกสารแบบบันทึกต่างๆ ร่วมกับการสัมภาษณ์พยาบาลผู้ปฏิบัติงาน และตรวจเช็คจากบันทึกการให้ยาของผู้ป่วย

หัวข้อ	รายละเอียด
ผลการวิจัย	จากการติดตามโดยการสังเกตผู้ป่วยทั้งหมด 225 ราย (2,766 ครั้ง) ของการใช้ยาครั้งแรก บนหอผู้ป่วยอายุรกรรม 2 หอ พบผู้ป่วย 196 ราย (ร้อยละ 87.11) เกิดความคลาดเคลื่อนในการใช้ยา (946 ครั้งจากการใช้ยาครั้งแรก 2,766 ครั้ง คิดเป็นร้อยละ 34.20) โดยเป็น ความคลาดเคลื่อนที่เกิดจากการสั่งใช้ยา 165 ครั้ง (ร้อยละ 5.96) ความคลาดเคลื่อนที่เกิดจากการคัดลอกรายการยา 367 ครั้ง (ร้อยละ 13.27) ความคลาดเคลื่อนที่เกิดจากการจ่ายยา 8 ครั้ง (ร้อยละ 0.29) ความคลาดเคลื่อนที่เกิดจากการบริหารยา 400 ครั้ง (ร้อยละ 14.46) และพบอัตราการเกิดเหตุการณ์ไม่พึงประสงค์จากการใช้ยาโดยคิดวิธีค้นหาในเชิงลึก 60 ครั้ง พบเหตุการณ์ไม่พึงประสงค์จากการใช้ยา 27 ครั้ง (ร้อยละ 45) i)นเหตุการณ์ไม่พึงประสงค์จากการใช้ยาที่มีความสัมพันธ์กับความคลาดเคลื่อนในการใช้ยาคิดเป็นร้อยละ 2.85 ของความคลาดเคลื่อนในการใช้ยาที่เกิดขึ้นทั้งหมด 946 ครั้ง หรือคิดเป็นร้อยละ 0.98 ของการใช้ยาที่สังเกตทั้งหมด จากเหตุการณ์ไม่พึงประสงค์จากการใช้ยา 27 ครั้ง เป็นเหตุการณ์ไม่พึงประสงค์จากการใช้ยาที่สามารถป้องกันได้ 24 ครั้ง ชนิดของความคลาดเคลื่อนจากการบริหารยา ได้แก่ การให้ยาผิดอัตราเร็ว (ร้อยละ 56 ของผู้ป่วย) การให้ยาผิดเวลา(ร้อยละ 26.67 ของผู้ป่วย) และผู้ป่วยไม่ได้รับยา (ร้อยละ 9.78 ของผู้ป่วย)
การสกัดเพื่อการนำไปใช้	ปัญหาของแต่ละโรงพยาบาลขึ้นกับปัจจัยของทรัพยากรที่มีอยู่ ปัญหาการคัดลอกคำสั่งเกิดขึ้น เนื่องจากยังใช้ระบบเดิม (ไม่ได้ใช้ระบบคอมพิวเตอร์ ระบบการกระจายยาเป็นแบบผสมระหว่างสต็อกยาในหอผู้ป่วยกับตามใบสั่งยารายตัวผู้ป่วย หอผู้ป่วยมียาสำรองมากเกินไป ทำให้ยาหมดอายุ ไม่ได้ยึดหลัก FIFO (First in, First out) ในการวางยาบนชั้นวาง การกำหนดเวลาในการบริหารยา โดยให้เป็นการให้ยาผิดเวลา ในกรณีพยาบาลให้ยาผิดไปจากกำหนดเวลามากกว่า 30 นาที ซึ่งถ้าปริมาณงานมาก มีผลทำให้พยาบาลไม่สามารถให้ยาได้ทันเวลา และ ข้อจำกัดในเรื่องงบประมาณ ต้นทุนสูง จึงขาดเครื่องมือควบคุมการไหลอัตโนมัติ
ข้อคิดเห็นในการนำผลงานวิจัยไปใช้	การเตรียมยาของพยาบาล สังเกตพบว่าเตรียมยาพร้อมกันทั้งหมด ทำให้ยาที่จะทราบว่าพยาบาลกำลังเตรียมยาอะไร ให้แก่ผู้ป่วยรายใด ความคลาดเคลื่อนจากการเตรียมยาที่ปริมาตรผิดไป (ร้อยละ 5) เกิดจากพยาบาลไม่ได้คำนวณยาแต่ใช้ความเคยชิน หรือการประมาณ การผสมยาฉีดกับสารละลาย เมื่อผสมไปแล้ว พยาบาลไม่ได้คิดคำนวณปริมาณหลังผสมแต่จะคำนวณจากปริมาณสารละลายที่ใช้ผสม ทำให้ผู้ป่วยได้รับยาที่มีปริมาณน้อยกว่าในคำสั่งแพทย์(ร้อยละ 13)

BIOGRAPHY

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