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Effect of a Simulation Course on Medication Administration Safety of Malaysian Nursing Student

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Effect of a Simulation Course on Medication Administration Safety of Malaysian Nursing Students

by

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Each person whose signature appears below certifies that this dissertation in his/her opinion is adequate, in scope and quality, as a dissertation for the degree Doctor of Philosophy.

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ABBREVIATIONS

AACN	American Association of of Colleges of Nursing
ACNHS	Adventist College of Nursing and Health Sciences
ANOVA	Analysis of Variance
ARF	Acute Renal Failure
CI	Clinical Instructors
CINAHL	Cumulative Index to Nursing and Allied Health Literature
df	Degree of Freedom
GPA	Grade Point Average
HPS	Human Patient Simulators
ICU	Intensive Care Unit
ID	Identification
IOM	Institute of Medicine
IRB	International Review Board
IM	Intramuscular
IV	Intravascular/Intravenous
IQR	Interquartile Range
ISMP	Institute for Safe Medication Practice
KELT	Kolb's Experiential Learning Theory
MA	Medication Administration
MAR	Medication Administration Record
MAE	Medication Administration Error
MASAT	Medication Administration Safety Assessment Tool

MCH	Maternal Child Health
M	Mean
MEDLINE	Medical Information from the U.S. National Library of Medicine
MOHE	Ministry of Higher Education
MRM	Modeling and Role Modeling
N and *n*	Number of Subjects
NBM	Nursing Board Malaysia
NCCMERP	National Coordinating Council for Medication Error Reporting and Prevention
NHMRC	National Health and Medical Research Council
NICU	Neonatal Intensive Care Unit
OSCE	Objective Structured Clinical Examination
p	Probability Value
PAH	Penang Adventist Hospital
PO	Per Oral
PR	Per Rectum
PubMed	Public Medicine (Biomedical citations)
QSEN	Quality and Safety Education for Nurses
RN	Registered Nurse
SAM	Safe Administration of Medication
SD	Standard Deviations
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SPSS	Statistical Package for the Social Sciences

SQ	Subcutaneous
t	Student's *t*,(a statistical hypothesis test)
UKMMC	University Kebangsaan Malaysia Medical Centre
α	alpha
$\bar{x}$	Mean

ABSTRACT OF THE DISSERTATION

Effect of a Simulation Course on Medication Administration Safety of Malaysian Nursing Students

by

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Dr. Patricia Pothier, Chairperson

Improving safety during medication administration has been a goal of today's healthcare environment. The complexity of both medication use and the medication management process, especially in the in-patient setting, creates a significant risk for hospitalized clients. Medication administration errors have harmed millions of people and cost millions of dollars worldwide, including Malaysia. Patient safety is dependent on nurses (including student nurses), who must consistently demonstrate behaviour fundamental to the safe administration of medication. Therefore, nursing education must provide teaching and foster learning in students to prepare them to be a safe nurse. Literature has shown that deficiencies of knowledge and performance were the most common cause of medication errors apart from system errors. Literature has also shown that a simulation refresher course is an effective tool to increase and improve knowledge. This study describes the effectiveness of a simulation refresher course on nursing student knowledge and performance in medication administration using the SAM Scale.

A pre-test using the SAM Scale was administered to 83 student participants who were divided randomly into two groups: an intervention group and a control group. Both groups underwent a pre-test with the SAM Scale. Then the intervention group underwent

a simulation refresher course after a pre-test, whereas the control group followed their 'program as usual'. It was hypothesized that the simulation refresher course would result in higher SAM Scale scores in the intervention group versus the control group on follow-up testing. One month after the pre-test, both groups underwent a post-test # 1 using the same SAM scale and one month later (after post-test #1) a second post-test was administered to all participants.

The findings of the study were not what was hypothesized. Even though there were statistically significant differences in the scores before and after the simulation in the intervention group, the control group also shows the same statistically significant increase in scores. Therefore, the study concluded that in this instance the simulation refresher course did not show any benefit over use of the SAM Scale in improving medication administration scores. The study indicates that the use of SAM Scale itself can be an excellent tool to enhance knowledge and performance in medication administration among nursing students.

Key words: nursing students, medication administration error, simulation, refresher course, barrier to safe MA.

CHAPTER ONE

INTRODUCTION

Medication administration errors (MAE) are a significant issue affecting patient safety and costs in hospitals, and they often pose dangerous consequences for patients. This is a worldwide problem. Although medication error rates are not well known in all countries in the world, the incidence reported by The Joint Commission of the United States (2010) showed 6,782 serious adverse events with 67 percent resulting in death for the years of 1995 through 2013. The Institute of Medicine (2006) also reported that medication errors harm at least 1.5 million people in the United States each year, resulting in an estimated increase in medical costs of 5.3 million dollars per year to treat adverse events. In England, the Department of Health reported that medication errors occur frequently and account for 10 to 20 % of all adverse events in National Health Service (NHS) hospitals, costing an estimated of £200 to £400 million per year (Department of Health, 2004). In Australia, an estimated 350 million U.S. dollars were spent per year to cover the cost of adverse events resulting from medication errors that could have been prevented (Hodgkinson, Nay, Koch & Nichols, 2006).

Malaysia is not immune to the problem of MAE. In 2009, an estimated 2,572 occurrences of medication errors and/or adverse events impacting on patient outcomes was reported in Malaysia (Johari, Shamsuddin, Idris & Hussin, 2013). Chua, Tea & Rahman (2009) stated that the frequency of medication administration errors in Malaysia (as a developing country) is similar to that of developed countries. While there are many reports in the literature available regarding MAEs by registered nurses (RN) in other parts of the world, to date, there is little in the Malaysian nursing literature that addresses

this issue. In general, there is a little research on MAEs in Malaysia (Chua et al. 2009). However, the few studies reported in Malaysia do not imply that the occurrences of MAE are lesser. The Malaysian government is paying attention to the issue of safety by encouraging researchers to conduct studies on medication safety to better understand the issue and find ways to reduce medication errors, thus improving the safety of the patient (Johari et al. 2013).

Although physicians and pharmacists are also involved in the medication administration (MA) process, nurses are the key personnel in the preparation and administration of medications, so they need to accept responsibility for safe administration of medication (Mrayyan, Shishani & Faori, 2007). The role of an RN in achieving safety in MA requires knowledge, skills, and commitment. Therefore, the educational preparation of undergraduate nursing students is an important component to ensure that future RNs have the necessary knowledge, skills, and attitudes to function effectively. To address this issue, Quality and Safety Education for Nurses (QSEN) was formed in 2005 to identify gaps in nursing education related to MA and develop a curriculum that includes how quality and safety can be implemented. QSEN is a project funded by the Robert Wood Johnson Foundation developed in the United States, with the goal to prepare future nurses with the knowledge, skills, and attitudes needed for lifelong commitment to the quality and safety competencies endorsed by the Institute of Medicine (IOM). Their goals have been accepted and used worldwide. Malaysian nursing education has embraced the QSEN's goal that every RN should achieve a higher level of education and training through an improved education system that promotes a seamless academic progression and take their place in the frontline of healthcare. In other words,

each educational institution in Malaysia has the responsibility to prepare student nurses who can provide safe, quality patient care when they become RNs.

Medication administration is part of the education of undergraduate nursing students. The main aim of undergraduate preparation within the context of medication safety is for students to gain an understanding of medications and how to administer them safely following the Five Rights of MA. In today's nursing education, students have varied learning styles, presenting a challenge to faculty as they seek ways to teach students to think critically. Multiple methods are used as teaching strategies to enhance nursing students' knowledge in MA education. An aim of this study is to find a method of teaching that can offer guidance for skills acquisition by producing the features of a real-life situation.

The Problem

The occurrence of MAE has been on the rise in Malaysia despite the health ministry's efforts to control and prevent them. It remains a critical problem in Malaysia, not only for RNs but also for nursing students who also play an important role in the provision of care for patients (Abdullah, Ibrahim, & Ibrahim, 2004). Although there were no studies reporting medication errors or near misses by nursing students in Malaysia, this does not mean that they have never committed an error or near misses. According to the Institute for Safe Medication Practice (ISMP, 2007), a non-profit organization based in Philadelphia devoted entirely to medication error prevention and safe medication use, nursing students can be involved in medication errors, despite the close supervision of their clinical instructors. Errors can occur in any health care organization providing clinical rotation sites for student nurses including in Malaysia. Analysis of medication

errors by Institute for Safe Medication Practice (ISMP) reveals that many of the errors by nursing students arise from a distinct set of error-prone conditions and are similar to that of practicing RNs, such as misinterpreting an abbreviation, misidentifying drugs due to look-alike labels and packages, misprogramming a pump due to pump design flaw, or simply making a mental slip when distracted (ISMP, 2007).

The tremendous annual financial cost as a consequence of medication errors underscores the seriousness of this issue throughout the world. The United States, estimated a loss of approximately US$40 billion per year, and Australia has estimated a cost of between AUD$867 million to over AUD$1 billion annually (David, 2003). In England, 71,000 out of 800,000 adverse events were related to medication errors (Schachter, 2009). The Institute of Medicine (IOM) reported an estimate of 7,000 deaths annually in the US and accounts for nearly one in 20 hospital admissions as a result of medication errors in the UK (IOM, 2007 and Williams, 2007). Abdullah et al. (2004) extrapolated that the cost of medication errors in one of the outpatient pharmacies in Malaysia was RM111,865 during the year of research. Chua et al.'s (2009) study reports that MAEs in Malaysia are common, with 127 errors detected out of 1,118 opportunities. In the same study, 10.4% of the administration errors were considered as potentially life-threatening. In a different study in 2009, 2,572 cases of medication errors were reported in Malaysia and identified as the main adverse event impacting on patient outcomes (Johari et al. 2013). Major consequences to patients included hospitalization, prolonged hospital stay, additional sick leave costs, and lower patient satisfaction as a result of the MAEs plus negative consequences to the nurses who committed the errors (Bates, et al. 1997, Gandhi et al. 2000, and Anderson & Webster, 2001).

In general, there is more information and research being conducted addressing MAEs by RNs in the hospital setting than what is reported associated with nursing education (Bullock & Manias, 2002 and Koohestani & Baghcheghi, 2009). Reid-Searl, Moxham & Happell (2010b) stated that the extent to which nursing students might contribute to errors has not been researched in depth. Valdez, Guzman & Chua (2013) agrees with Reid-Searl at al. (2010b) by stating that literature on medication errors by nursing students remains a blind spot in nursing research. The limited evidence of research addressing medication safety in nursing education suggests that students' involvement in MAEs is not uncommon (Reid-Searl & Happell, 2012). Some literature shows that the rate of nursing students committing medication errors similar to that by experienced staffs (Institute for Safe Medication Practices, 2007; Harding & Petrick, 2008 and Wolf, Hicks, & Serembus, 2006). The MA procedure is one of the highest risk tasks an RN can perform (Anderson & Webster, 2001). This is also true for nursing students as they too, are required to go to the ward to care for patients and be involved in the administration of medication. For nurses be able to administer medications safely, they need to acquire knowledge of basic MA techniques, learn the actions and side effects of various drugs, and have the ability to observe and interpret patient's responses to them (Hee-Sung, Kwon & Ryu, 2008).

Knowledge and expertise in MA can only be acquired through adequate education through classroom learning and clinical experience. A study done by Sears, Goldsworthy, & Goodman (2010) proposed a link between decreased clinical placement time and the ability of students to safely perform MA. In other words, inadequate clinical experience can lead to unsafe performance during MA. Decreased time in the clinical setting could

result from difficulties in getting clinical placement in the hospital or because the program prioritized classroom teaching (theory) more than the clinical experience. These limitations may lead to a lack of real patient contact, and at the same time jeopardize opportunities for nursing students to administer medications during clinical practice. With these limitations, students will lack real nurse-patient contact experience. Wolf, et.al. (2006) agreed with this, reporting that one of the primary causes of medication errors is a lack of experience.

Sears et al. (2010) also mentioned the inadequacy of pharmacological content in the nursing curriculum education. In some countries there is no standardization in content and contact time for pharmacology courses. Bullock & Manias (2002) reported that there was a great variation across the United States in what students were offered in their pharmacology education with respect to course contact time and teaching approach. Findings from the study of Latter, Malone, Yerrell & Shaw (2000) revealed dissatisfaction with the perceived insufficient amount of teaching content in the preregistration curriculum, related both to the potential amount of pharmacology knowledge that nurses needed to know, and to student perceptions of the knowledge required for their fitness and readiness to practice. Several studies (Latter et al. 2000, Jukes & Gilchrist, 2005, Page & Mc Kinney, 2007, and Bullock & Manias, 2002) have urged for improvements in pharmacological knowledge through review of undergraduate curricula and teaching methods related to pharmacology. These study findings generally highlighted the importance of several dimensions of preparation for safe practice of an RN's role, which includes need for sufficient pharmacology content, opportunities for application, and integration of prerequisite knowledge and skills. Reid-Searl, Moxham,

Walker & Happell (2010a) agreed that MA safety is an important skill that should be emphasized in the education of undergraduate nursing students. The proposed study, using the Safe Administration of Medications (SAM) scale as an assessment tool, aims to examine and evaluate one method of teaching students about administering medications safely with the goal of increasing safe patient care.

Harding & Petrick (2008) reported that a violation of the basic principles (the Five Rights violation) was one of three categories that contribute to medication errors made by nursing students. During the initial analysis of this retrospective study, data were categorized as errors of commission and errors of omission. From the data, 34% comprised omission error in which 42% more were due to inexperience in reading or interpreting the Medication Administration Record (MAR) correctly. A further 27% were due to busyness and distraction during the administration process, 15% were due to failure to give medications on schedule (wrong time), and 6% were due to wrong route and wrong patient. In many parts of the world, the Five Rights have been included in the nursing education curriculum as foundation in the MA procedure. Unfortunately, despite stressing the importance and the time spent teaching and introducing the Five Rights of MA principle, violations of the Five Rights still occur. Harding & Petrick (2008) also revealed the non-adherence attitude of nursing students towards written policies and guidelines for safe MA leading to dosage error. Two studies (Bullock & Manias, 2002; Latter et al. 2000) noted that despite considerable content in the nursing curriculum, nursing education has been criticized for its lack of relevancy to clinical practice circumstances and insufficient training in actual MA practice. Findings from Latter et al. (2000) also identified that there has been frequent lack of opportunity within curricula to

integrate knowledge and skills related to the component areas of pharmacology, patient education, and communication skills. There is a need to maximize the teaching of safe MA to nursing students by improving their self-confidence in clinical situations through improving their knowledge of MA safety.

In Malaysia, the number of nursing colleges has doubled over the last few years. In 2011, 61 private institutions were approved by the Malaysian Ministry of Higher Education (MOHE) to conduct nursing courses and programs within the country. There are more than 37,500 undergraduates enrolled in these private institutions (Aliran, 2012). While the number of undergraduate nursing students increases, concerns about the ability to provide safe and quality care have also grown due to lack of clinical placements especially for those learning institutions that are not attached with any hospitals. In a recent Objective Structured Clinical Examination (OSCE) in one private college in Penang, 10 stations of medical and surgical procedures were set up for 47 third-year nursing students for their final semester clinical examination. One of the stations was for the nursing student to perform insulin administration. In this station, it was reported that 19% gave a wrong drug and 49% gave the wrong dosage to the patient (OSCE report, X College, 2013). This report is alarming and thus needs further investigation. A study conducted in one of the teaching hospitals in Malaysia by Chua et al. (2009) reported an error rate of 11.4% during MA by nurses. The rate is reported to be similar to that in the developed countries. It is a basic assumption of the Nursing Board of Malaysia (NBM) that nursing students who graduate from any nursing colleges in Malaysia are prepared to promote and practice safe, high quality patient care. All graduated nurses have undergone a basic nursing training that should be adequate to prepare them to function as a safe

nurse and are able to identify errors. Awareness of nursing errors is an impetus for nursing schools to pay attention to providing education to minimize them in the future.

In the Malaysian diploma in nursing curriculum, the pharmacology course is introduced to the students in the second semester of their first year of study. The procedure of MA is demonstrated in the skills lab after the didactic (theory) learning of pharmacology. Following the didactic and demonstration, students are allowed to give medications with clinical instructor's close supervision in the ward without having to practice it first in the skills lab. Pharmacology courses are usually three credits, equivalent to three hours per week in 12 calendar weeks. Bullock & Manias (2002) stated that there are indications of inadequacy of content as the subject is being introduced, as well as the amount of opportunity the student can practice the administration of medications in the ward; especially for private nursing schools that have difficulties in finding sites for clinical rotations for their students. In some cases, even though nursing students may be provided with adequate opportunities to administer medication in the ward, based on observation, the proper procedural steps of giving medications has been omitted due to busyness and time constraints. For example, double-checking may be impractical due to unavailability of RNs, or the taking of shortcuts (i.e not checking the patient's armband for the name and date of birth or identification number) due to time issues. The omissions of proper procedural steps by the nursing students can lead to habits that can lead to error, and this can pose danger to patients. Besides that, the possibility of forgetting what was taught during the first year may put the second and third year nursing students at risk of committing errors or near misses during MA. Therefore, it is proposed that the introduction of a simulation refresher course for second

and third year nursing students may be beneficial in strengthening knowledge and performance and thereby enhance safety during the administration of medication.

Given the high rate of errors by RNs, exploration of various teaching methods is warranted to identify which approaches may be more effective in teaching MA to undergraduate nursing students. Harding & Petrick (2008) concluded their study by suggesting to incorporate simulation in teaching of MA for nursing students. Conducting a study to evaluate the effect of a simulation refresher course in MA safety through theoretical means may be beneficial in improving the quality of health care by reducing the risk of MAE. Nishisaki et al. (2008) stated that refresher training provides opportunities for new learning, even in tasks performed routinely on the job. A study done by Joshi et al. (2006) shows that a refresher training course on maternal and child health had effectively increased the participants' knowledge and skills in specific areas. Short refresher courses have also been used in the aviation industry to enhance skills in handling real world emergencies (Malakis & Kontogiannis, 2012). As stated by Latter et al. (2000) there was some evidence to suggest that practice-focused seminars and study days may have facilitated the student's ability to integrate and apply the knowledge and skills needed during MA. The technique of using simulation as a teaching mechanism to improve skills is in line with the QSEN's goals and objectives, which are to prepare nurses with the competencies necessary to continuously improve the quality and safety of the system in which future RNs will work.

Theoretical Framework

The theoretical framework underpinning this research is Kolb's Experiential Learning Theory (KELT). Kolb believes that real or simulated experiences are simply a

catalyst for learning (Zigmont, Kappus & Sudikoff, 2011). Experiential Learning Theory affirms the centrality of experiential activities which is in line with simulation methods of teaching. The theory emphasizes that there are crucial links between the different moments where students are led through various cycles. In this theory, Kolb describes how individuals construct abstract representations from concrete experiences, which then influence subsequent actions in similar situations. In application of the theory to this study, experiencing the simulated MA procedure in the skills lab would guide nursing students in their subsequent actions in decision making through four learning modes: concrete, reflective, abstract, and active. Nursing students are taught to experience the tension and conflict among these orientations, thus strengthening their abilities to think like a nurse and be a safe nurse in the future especially in MA. This theory is congruent with this study to test the effectiveness of a simulation refresher course on nursing students' knowledge and performance of MA. The hypothesis was that the simulation would provide a learning process which is in line with the theory supporting the idea that knowledge is created through the transformation of experience.

Purposes and Aims of the study

The purpose of the proposed study was to examine the effectiveness of a simulation refresher course on nursing students' knowledge and performance in MA at the Adventist College of Nursing and Health Sciences (ACNHS), Penang. Malaysia. Nursing students were randomly assigned to a control group which was the "teaching as usual" group and an intervention group who were provided with the simulation refresher course. The Medication Administration Safety Assessment Tool (MASAT), which is in line with the basic principles of MA procedure (Five Rights), was used as a simulation

teaching process during the intervention. The study measured and compared nursing students' knowledge and performance regarding safe MA by utilizing the Safe Administration of Medication (SAM) scale before and after completing the simulation refresher course.

The specific aims of this study were to:

a) Describe the effect of a simulation refresher course on knowledge and performance in MA of nursing student of ACNHS using the SAM scale compared to a "teaching as usual" control group.

   This was done by comparing pre- and post-test results of the SAM Scale for both groups.

b) Describe the difference between year two and year three nursing students' knowledge and performance in MA before and after the intervention.

   This was done by comparing year two and year three student's pre-test and post-test scores.

c) Identify which sub-scales or categories in the Five Rights (right patient, right drug, right time, right dose, and right route) had the lowest score indicating the need to be highlighted for further intervention after the study.

d) Evaluate relationship between students' GPA in pharmacology and knowledge and performance (SAM scale score) in MA.

e) Identify perceived barriers to safe MA as reported by nursing students of ACNHS using the Gladstone scale of prioritizing medication safety barriers.

f) Identify perceived barriers to safe MA as reported by clinical instructors using the Gladstone scale of prioritizing medication safety barriers.

The exploratory questions will be:

1. What is the effect of the simulation refresher course on the nursing students' knowledge and performance in safe MA in ACNHS, Penang?
2. What is the difference between year two and year three nursing students' knowledge and performance in MA before and after the intervention?
3. Which subscales or categories in the Five Rights of MA require further teaching/ intervention for the students?
4. What is the relationship between student's GPA in their pharmacology course and their knowledge and performance in MA?
5. What are the main barriers faced by nursing students during MA as perceived by themselves?
6. What are the main obstacles faced by nursing students during MA as perceived by clinical instructor?

The proposed study hypothesizes that a simulation refresher course would be able to increase nursing students' knowledge and safe performance in MA, shown by statistically significant improvement in total post-test scores on the SAM scale of the intervention group. The improvement of scores in the post-tests would indicate that the safety of patients was enhanced after students were given the simulation refresher course as compare with students who did not have any simulation refresher course.

Definitions of the Study

The following operational definitions will be used to guide this study:

- *Safety* – The condition of being protected from or unlikely to cause danger, risk, or injury.

- *Medication administration* (MA) A process of administering medication to the patient from the time medication is being prescribed until the time medication is served to the patient.
- *Five Rights* – The right patient receives the right drug, in the right dose, by the right route, and at the right time. (Right patient, Right drug, Right dose, Right route and Right time).
- *Medication administration errors* (MAE)– "Any deviation from procedures, policies, and/or best practices for medication administration" (Drach-Zahavy & Pud, 2010). The American National Coordinating Council for Medication Error Reporting and Prevention's (NCC MERP, 2007) definition is,

  > "A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labelling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring and use."

- *Nursing students*- Second and third year nursing students from ACNHS, Penang who has undergone an undergraduate pharmacology course.
- *Simulation Refresher Course* **–** This is a two hour intervention course that will use the MASAT tool as a guideline during a medication administration simulated procedure in the skills lab. Each student will be provided a variation or method of MA (i.e. Oral, IV, IM, SQ and PR) using scenarios**.** Five scenarios will be designed to ensure the variations of MA method are adequate. However, each student is only required to complete two or three scenarios. The Five Rights in the

tool (MASAT) will be emphasized during the course, which is in line with the Penang Adventist Hospital (PAH) policy and procedure manual.

Significance of the Study

Significance to Theory

The study of MA safety has been prevalent in the United States and other developed countries in the world, but not in Malaysia. Only three Malaysian studies were located relating to this issue. The problem of MAEs in Malaysia has not been investigated openly due to its sensitivity where naming, blaming and shaming may be involved. However, a study dealing with safety is an important aspect of the health care sector and therefore needs to be studied in depth, especially in this country. Hence, the study may produce findings that could add to an understanding of the phenomenon in Malaysia where research in nursing education is sparse. This study used an intervention in the simulation refresher course emphasizing the basic principles of safe MA, the Five Rights, and the standard operating procedure of MA. While teaching and learning about MA safety take place within the education system, Kolb experiential learning theory (KELT) was utilized. This theory supports the provision of real or simulated experience for students so that learning can take place. With concrete experience, subsequent actions in similar situations can strengthen a nursing student's decision making process. The result of this study should reinforce the importance of the theoretical foundation.

Significance to nursing education

The causes of MAEs are multifactorial. A common cause of error from the human perspectives is deficiency of knowledge by nurses, either in mathematical proficiency or in compliance to guidelines and procedures (Latter et al. 2000, Page & McKinney, 2007

and Jukes & Gilchrist, 2005). This deficiency of knowledge could be due to failure of the individual and/or the failure of the education program (Koohestani & Baghcheghi, 2009). According to Reid-Searl, Moxham, & Happell (2010b) and Banning (2003), the educational preparation of undergraduate nursing students is an important component in the curriculum to ensure that future RNs have the necessary skills and knowledge to function independently. Nursing schools teach students the basic principles of safe MA. With comprehensive nursing education and training, nursing colleges aim to graduate students who can identify problems, devise solutions, and develop continuous quality improvement processes in all care of the patient, especially in providing safer MA. Nevertheless, because humans do make mistakes, MAEs do occur. The event of error should be treated as an opportunity to find methods for improvement in the system through the use of self-evaluation and critical analysis of the event and not to place 100% blame on the nurse.

Koohestani & Baghcheghi (2009) stated that there are limited studies available on the type and incidence of student-made medication errors worldwide even though the rate of MAEs was high. The main purpose of the proposed study was to assess the effectiveness of an intervention (simulation) hypothesized to enhance nursing students' ability to think like a nurse and improve knowledge and performance during MA and thus enhance patient's safety . The main implication of this proposed study was to improve the standard of teaching and learning in nursing education where a proposal to revise the curriculum may be necessary. Table 1 shows the comparisons of the current minimum requirements of the Malaysian Nursing Board in the nursing diploma education, the Adventist College of Nursing and Health Sciences pharmacology curriculum, and the

proposed intervention with the simulation refresher course inserted. Moreover, this study also provided information on the identification of barriers the students faced during the administration of medication.

Significance to health policy

Awareness of the obstacles to safe MA may enable the establishment of more effective educational strategies and lead to improved safety and quality of nursing service and nursing education systems through research and evidence-based practice. Identifying causal factors for this phenomenon not only promotes better understanding of the issue, but it can stimulate discussion and implementation of new interventions to reduce error occurrence in MA where it indirectly affects health policy. Healthcare in Malaysia has undergone radical transformation. The Malaysian government has developed a plan, the 10th Malaysia Plan (2011-2015), which details the health plan for Malaysia. This health plan aims for all stakeholders of health sectors from private and public institutions to work together to improve the health care system based on the concept of "1care for 1Malaysia" (One Care for One Malaysia). This is to restructure a national health system for improved responsiveness so that it can provide quality health care, ensuring universal coverage for health care needs (Country Health Plan, 2011-1015). Knowledge gained from this study can contribute to the revision of health policies as well as nursing education and service in Malaysia.

Chapter Summary

The patient is dependent on the nurse for safe administration of medications. The increase in number of undergraduate nursing students in Malaysia causes concern as to whether the students who have graduated have adequate knowledge in administering

medication safely. With increased enrollment, there are concerns as to how nursing students can be educated adequately so that they will be able to acquire the knowledge, skills, attitude, and commitment necessary to improve the quality and safety of the health care system in which they work. Student nurses who are not able to demonstrate safe behaviors need help in identifying learning/performance barriers and may need to be given additional learning opportunities to develop skills consistent with safe practice (Ryan, 2007). Clinical instructors, registered nurses, and nursing students should be vigilant and careful when administering medication to patients by observing the Five Rights and other guidelines that have been outlined by individual institutions. While acknowledging the importance of the basic principles of MA, identification of nursing students' perceptions of their own obstacles to safe MA can also assist in developing interventions to prevent MAEs in the future.

Overview of Remaining Chapters

This chapter will be followed by two remaining chapters: chapter two, the literature review and chapter three, the methodology of the study. In chapter two, a review of available literature regarding MA safety will be explored using a systematic literature review. The study variables, *safety, medication administration, medication administration errors, nursing students, the Five Rights, simulation course and nursing education,* will be introduced and explored in detail. Chapter three will explain the methods and research design of this quantitative study, the sampling strategies, ethical issues, and the procedure for data collection.

Table 1

Pharmacology Subject Curriculum Comparison: Malaysian Nursing Board Curriculum Versus ACNHS and Proposal (Pharmacology is taught in year 1 semester 2)

Nursing Board Malaysia		**ACNHS**					**Proposal**
Topics	**Hours**		**Lect**	**Tutor**	**Skills lab**	**Total**	**No Changes on the Hours with ACNHS**
Introduction to Pharmacology	10	Introduction to Pharmacology	3	1	4	8	Introduction to Pharmacology
The legal control of drugs	4	The legal control of drugs	2	1	3	6	The legal control of drugs
Pharmaceutical preparations	8	Pharmaceutical preparations	2	1	2	5	Pharmaceutical preparations
Broad classifications of drugs	10	Classification of drugs	3	2	6	11	Classification of drugs
Nursing responsibilities	2	Storage of drugs and lotions	2	-	5	7	Storage of drugs and lotions
Principles of serving medications	2	Principles of serving medication and giving injections	2	1	-	3	Principles of serving medication and giving injections
Injections – SQ, IM, ID, IV	6	Serving and administering of drug via various routes to adult and pediatric - Nursing responsibilities	8	2	22	32	Serving and administering of drug via various routes to adult and pediatric - Nursing responsibilities
NIL		NIL					**Simulation Refresher Course in Medication Administration (Will be done in every beginning semester of Year 2 Semester 1&2 and Year 3 Semester 1&2)**
	42		22	8	42	72	To be same as ACNHS

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

Current health care delivery systems emphasize patient safety as a central concern and an indicator of health care quality. Healthcare professionals, particularly nurses, have been informed by the United State Institute of Medicine (IOM) through the issuance of a report titled "*To Err Is Human – Building a Safer Health System*" (IOM, 2000) regarding patient safety, and reliability concerns involving how much they can be trusted in dealing with medications. Another report from IOM in 2007 emphasized the importance to severely reducing medication errors, improving communication, continually monitoring for errors, providing clinicians with decision-support and information tools, and improving and standardizing medication labeling and drug-related information (IOM, 2007). The most used indicators of patient safety in the health care setting are related to medication administration errors (MAE), due to their common incidence and the potential for injury to patients (IOM, 2004). MAE has been identified as the most common type of error affecting the safety of patients and is the single most preventable cause of adverse events (IOM, 2007). A review of literature by McBride-Henry & Foureur (2006) discussed the issue of MA within the acute-care setting that has long been the focus of scrutiny and research, partly due to the effect of medication errors that has contributed directly to patient morbidity and mortality.

McBride-Henry & Foureur (2006) stated that in the past, nurses were viewed as incompetent and in need of remedial assistance. Most analyses of MAE in the literature review by McBride-Henry & Foureur (2006) described the nurse as a source of unsafe

practices, and thus nurses have been the primary focus of attention. However, over the past few years, there is a shift in how MAE is understood and the view about nurses has changed positively. Since nurses are the key to the process of MA, it makes sense that they take control of the process. Erroneous perceptions about nurses' inability to deliver safe practice needs to be re-examined. The culture of "blaming and shaming" errant nurses needs to be moved toward a milieu of transparency, learning, and redemption. McBride-Henry & Foureur (2006) challenged nurses to begin addressing the issue of MAE from the position of being knowledgeable practitioners, with significant expertise in detecting prescription errors to keep patients safe at all times. It is imperative for nurses to participate and contribute their expertise towards directing practice strategies, as well as conducting research that examines the issue related to MAEs. Registered nurses are key individuals in the MA process. It is therefore important for nurses to intervene by contributing to the nursing knowledge and expertise in improving the issue of safe MA.

According to Mrayyan, Shishani & Faori (2007), even though other health care professionals such as physicians and pharmacists take part in the medication preparation and administration process, nurses are key participants in this activity because they are usually on the front line when medication errors occur. In general, forty percent of nurses' work time is consumed with drug administration because this responsibility remains their traditional task (Tang, Sheu, Yu Shu, Wei & Chen, 2007, and Armitage & Knapman, 2003). The IOM (2004) states that nurses are the health care providers patients are most likely to encounter, spend the most time with, and depend on for recovery. The quality of patient outcomes is directly related to nurses' ability to assess, evaluate and monitor care. Reid-Searl, Moxham, Walker & Happell (2008) reported that unintentional

medication errors made by nurses continue to be a major concern in hospitals, medical centers, and aged-care facilities. With this, the role of an RN in achieving safety in MA requires possession of skills, knowledge, attitude and commitment that they have acquired in their successful journey to becoming a nurse. This journey involves adequate preparation in nursing education, especially in MA, so that students who graduate are fit for practice, thus increasing safety for those patients for whom they care.

Method for Literature Review

This literature review presents articles that were published from 1995 to 2013, except for literature regarding theory, which was published in 1984. Multiple electronic databases, including EBSCO, PubMed, CINAHL, PsychoINFO, Google Scholar, and MEDLINE were used. The search was conducted using six keywords – *safe medication administration, medication administration error, barriers in MA, nursing students' involvement in MA, medication safety education and curriculum, refresher course,* and *simulation*. The search also focused on literature that included any MA safety enhancement courses related to nursing students. These keywords were chosen because this literature review aimed at identifying essential components of safe MA by nursing students and also to explore the role of nursing education and curriculum to improve safety in MA among nursing students. The abstracts of the retrieved articles were reviewed to determine whether they met the inclusion criteria of this review which include, 1) whether the article was relevant to nursing practice and education discipline, and 2) published in English. When *medication administration errors* were searched using academic search premier and all EBSCO databases, there were 355 articles available. When *nursing students* were added to the search, there were only 5 articles available.

This shows that there is an abundance of literature available identifying factors contributing to registered nurses making MAE; however, empirical studies reporting factors that may contribute to errors made by nursing students are severely limited (Reid-Searl et al. 2008). According to Reid-Searl & Happell (2012), the limited evidence of published research does not mean the involvement of students in MAE is not common but unexplored. Therefore, the area of nursing education in MA safety where nursing students are involved will be examined further.

Theoretical Framework

Kolb's Experiential Learning Theory (KELT) was used as a guide to the research conducted. This theory is consistent with middle-range theory that it is more abstract than narrow as it can be applied to a wider group of situations and allows for adaptation and application in a variety of disciplines. Kolb defines experiential learning as "the holistic process whereby knowledge is created through the transformation of experience" (Kolb, 1984. P. 41). It is a theory based on John Dewey's theory (1938) addressing the provision of learning experiences and offers different interventions to meet the needs of all types of learners (Lisko & O'Dell, 2010). Kolb stated that learning is a continuous lifelong process, and knowledge is created by transforming experience into existing cognitive frameworks, thus changing the way a person thinks and behaves. According to Chan (2012), experiential learning is learning by actual experience. Individuals create knowledge from experience rather than just from receiving instruction. Through participation in either real or simulated activities, students are able to efficiently transform the knowledge learned from the classroom and textbooks into their understanding.

Kolb's model portrays a four-stage learning cycle: concrete experience; reflective observation; abstract conceptualization; and active experimentation (see Figure 1). Using this framework, nursing students are required to experience the MA process in a simulated condition, reflect on what they have done, think critically and conceptualize the concept of the MA process, and finally act or perform the MA safely to patients in response to what is learned. Chan (2012) stated that concrete experience is gained through the process of reflection when the learner consciously reflects on and draws conclusion from their experience. It is a thought process that individuals experience when they encounter a new or unexpected situation. Reflection provides the ability to learn and develop continually by creatively applying current and past experiences and reasoning to

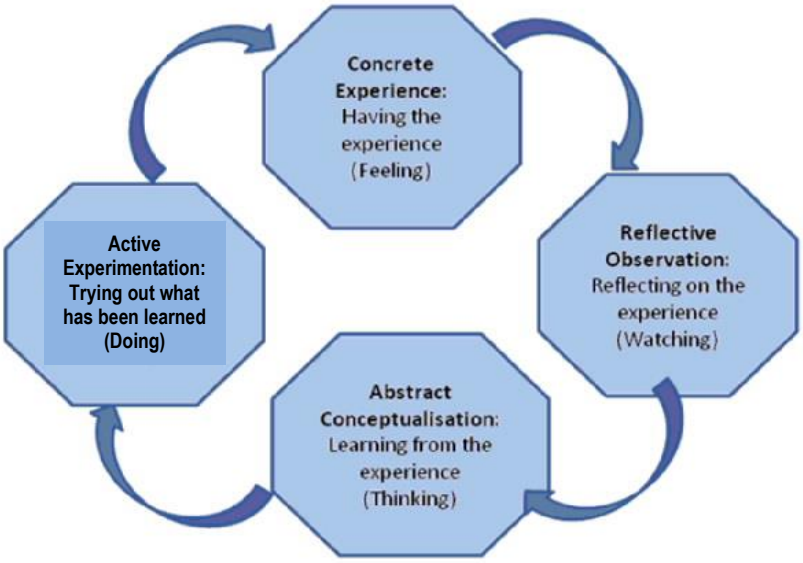

Figure 1. Theory model of Kolb's experiential learning

unexpected events while they are occurring (Wang, 2011). It is the process of thinking back especially on how one can learn not to repeat the same mistake, and this can be used when a person encounters a difficult situation in the future. According to Kolb, for one's

learning to transform fully into understanding, the learner must be provided with the components of the learning cycle which can begin at any one point (see Figure 1).

The learning process must involve the person and his or her environment, whereby the shared experience between the two (person and environment) should be a transaction that leaves both the person and environment changed (Wang, 2011). The person as a learner would reflect his or her actions to learn and develop continually by creatively applying current and past experiences and reasoning to the event that is occurring. Therefore, according to this theory the provision of simulated experience for nursing students in MA, should effectively improve their knowledge and performance resulting in safe care to their patients.

In support to the KELT, Modeling and Role Modeling (MRM) theory (see Figure 2) will also be used during the simulated MA. This is a nursing theory developed by Erikson, Tomlin & Swain (2002) that enables nurses to care for and nurture each individual with an awareness of and respect for the individual's uniqueness. For this research, although the theory is designed for nurse's action in caring for the patient while ensuring their safety, the theory of MRM can be applied to nursing education where nursing students should be cared for and nurtured by educators with the awareness that each of them is unique. Through MRM, educators can assist nursing students to practice and ingrain safe behavior in their actions during the simulated MA to create a positive experience for students, which is in line with KELT. Students value the teacher as an expert who models an image of what safe nursing practice will look like. Modeling contains both the art and science of nursing as it combines scientific aggregation and analysis of data with the image and understanding of the world from the student's view.

When an educator sees the world as the student does, then the educator can role-model. Role modeling is the facilitation of the individual in attaining, maintaining, or promoting health through purposeful interventions (Erikson et al. 2002).

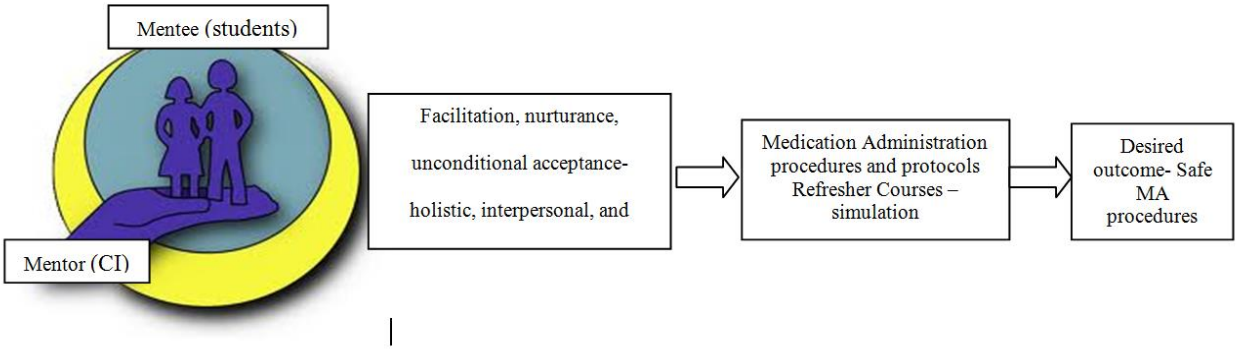

Figure 2: Theory of Modeling and Role Modeling

The Theory of MRM encompasses several major concepts that include both the role of the mentor and the human nature. A human is holistic, education-oriented being who strives for growth and development when facilitated in the continuous process of adaptation. The individual is the primary source of information concerning his or her needs and resources. The individual's inherent needs, including a need for affiliated-individuation, motivate the individual's behavior. Growth and development of a person are best advanced by nurturance and empathetic unconditional acceptance. In this theory, the student-teacher worldview encompasses mentor-mentee relationship to provide and demonstrate knowledge, skills, appropriate attitudes of learning, safety of patients and awareness through role modelling. With this environment, the student would feel safe and cared for, which induces a high chance that learning will take place. Nursing education is an interactive, interpersonal process that can facilitate learners in attaining growth, development, and holistic faith. The use of KELT supported by MRM Theory would enhance the ability of students to learn and experience in the best environment possible in

preparation to face the future of safe nursing practice. Figure 3 shows an illustration of the integration of KELT and MRM theories. Both theories aim to increase nursing students' knowledge and performance that can enhance their compliance with the Five Rights of MA, gain experience and confidence, to feel supported, answer nursing students' questions, and be able to report failures they faced during MA. During the simulation refresher course, while KELT is being applied, the environment provided for the nursing students will be encompassing the MLM theory so that at the same time both theories would contribute to increase in their performance and knowledge to achieve goals.

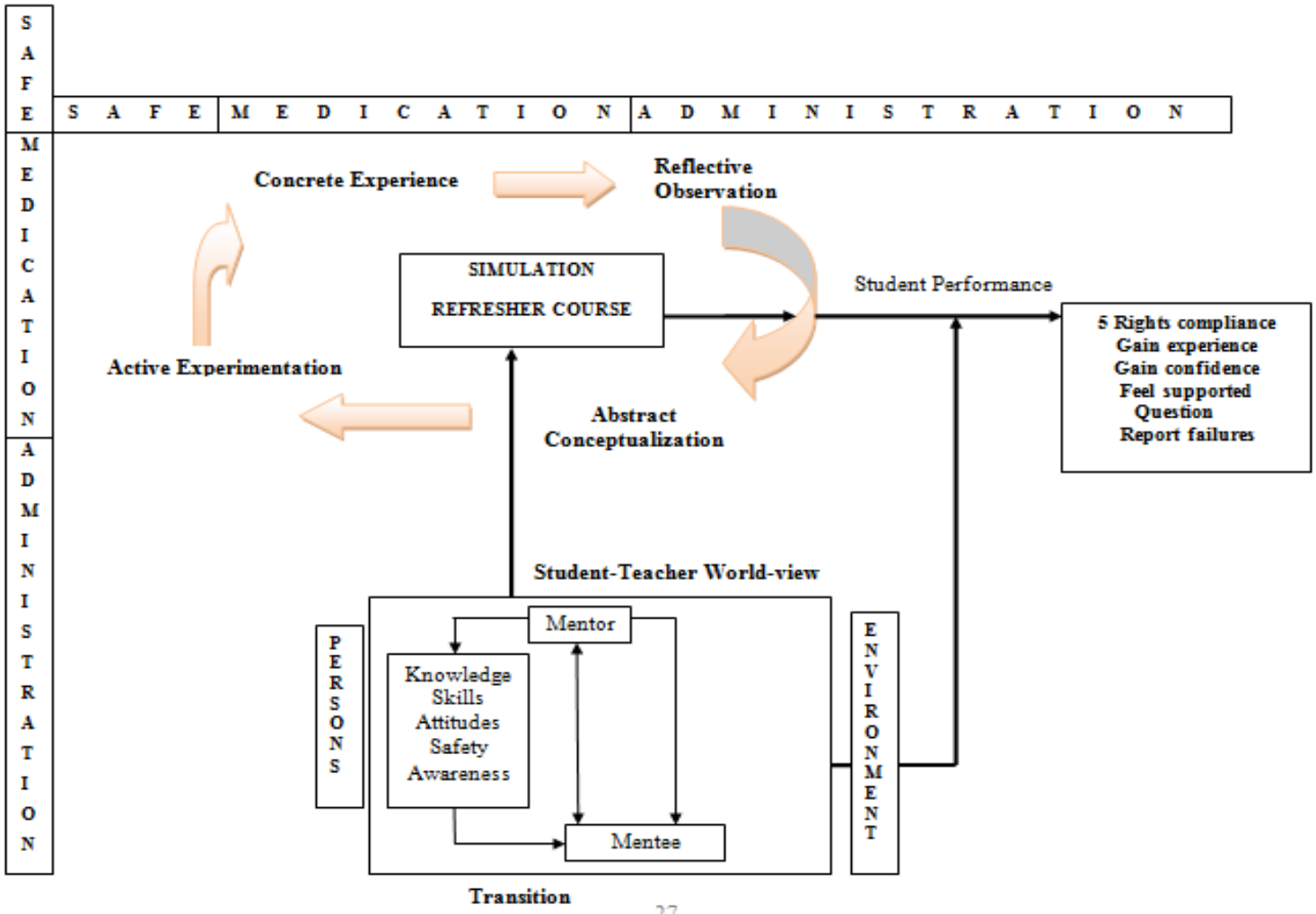

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Figure 3. Integration of KELT and MRM Theories

Significance of the Study to Nursing

According to O'Shea (1999), MAEs are a persistent nursing problem. More than 15 years have passed since O'Shea made this statement, but MAE still remains a significant problem in the healthcare sector. Recent systematic reviews of the MAE prevalence in healthcare settings found that some causes of MAE are due to unsafe acts and error/violation-provoking conditions (Keers, Williams, Cooke & Ashcroft, 2013). A study done in Malaysia by Johari, Shamsuddin, Idris & Hussin (2013) reported that 66% of medication errors resulted from personal neglect. According to some studies, nurses can play a role in medication errors (Reid-Searl et al. 2008 and 2010a, and Evans, 2009). Even though MA is a multidisciplinary task involving doctors who prescribe and pharmacists who dispense medications, nurses are at the end of this process of administration and should be able to recognize and prevent errors from reaching the patient. It is the utmost duty of nurses to ensure the safety of the patient under their care. The Nursing and Midwife Council's Standards for Medicine Management (2008) states that nurses must be sure to administer the right medicine to the right patient at the right time with the right dosage and route and be sure to document it correctly while exercising their professional accountability in the best interests of the patient. Identifying the factors that contribute to medication errors will enable the establishment of a more effective system and take steps to improve the quality of both nursing service and the nursing education system. Identifying causes of this phenomenon can stimulate the development and implementation of interventions to reduce error occurrence in MA. This is especially so when dealing with medication errors by RNs, newly licensed graduate nurses, and most importantly, nursing students.

This study evaluated the effect of a simulation refresher course as an intervention aimed at strengthening and enhancing nursing students' pharmacological knowledge and performance to promote safety of patients during MA. It measured the students' ability to comply with the Five Rights and other basic principles of MA safety. Hence, the study findings about the effectiveness of this intervention will be used to guide preparation of nursing students for safe administration of medications as well as to promote better teaching protocols in nursing education. Barriers to safe administration of medication as perceived by nursing students and clinical instructor were identified. With a clearer understanding of this phenomenon of MA safety through the process and outcome of the study, it will help to promote participation of the nursing profession in the shaping and making of health policy and in patient and health management in the future. The emergence of many new nursing schools in Malaysia (Aliran, 2012) that are not attached to the hospital (for practice) can result in inability to provide adequate clinical placements for nursing students. This is a concern when nurses graduate from the educational institution lacking experience in MA procedures. Lack of experience with real patients in the ward may affect the nursing students' ability to perform nursing duties with confidence. Besides having proper legislation before permitting new nursing colleges to operate, multiple methods of research could be used to examine issues regarding MA safety as well as the instruction necessary to reflect the best nursing practice.

Medication Administration Errors - A Concern in Malaysia

Nursing education in Malaysia has a responsibility to be fulfilled in overcoming the issue of MAE. Globally, many studies examining the causes of MAE by RNs can be found. However, participation in research and publication is a major challenge for nurses

in Malaysia. The number of published studies and research in regards to MA safety by nurses and other healthcare professionals is small, and no studies on MA safety by nursing students in Malaysia were found during the literature search. However, the lack of studies does not indicate that MAE does not occur in Malaysia. The result of a study conducted by Chua et al. (2009) showed that drug administration errors were common in Malaysia. Using a prospective study, researchers were stationed in the ward that was under study and observed MA activity by nurses. The researcher compared the information recorded during the observation with the doctor's orders in the patient's medication file. The purpose for the comparison was to detect any discrepancies. As a result, a total of 1118 opportunities for errors were observed during the 15 days of study, and 127 administrations of medications had errors. The error rate found in this study was 11.4%, which indicates that at least (for this study) the frequency of MAEs in Malaysia is similar to that in the developed countries. Another study that was done in Malaysia by Chua, Chua, & Omar (2010) with the aim to determine MAEs and to identify measures to reduce such errors in two pediatric wards, found that RNs committed 100 dose medication errors out of 857 observed MA procedures. Wrong time administration were the most common types of errors (28%), followed by incorrect medication preparation (26%), omission errors (16.3%), and incorrect dose (11.5%). Chua et al. (2010) concluded that MAEs occurred frequently in the pediatric wards at a rate of 9.5 – 13.9% of doses. The study also proposed that the possible causes of MAEs were due to inadequate knowledge, training, awareness and some weaknesses in the medication distribution system. As a result of the study, researchers recommended that the institution

provide education and awareness programs to their staff regarding the issues mentioned in an effort to reduce the occurrence of MAEs.

A retrospective study unrelated to nursing was done by Khoo et al. (2012) to assess whether the incidence of medication error was common in Malaysia. In Khoo's study, medical assistant personnel (healthcare providers with a Diploma in Medical Assistance, a 3-year medical training program that allows independent or limited supervision in patient care provision) committed 1,169 errors out of 1,612 prescriptions in a single week. This high error rate can be due to the difference in the nature of type of errors such as diagnostics (history or physical did not match diagnosis stated in medical records), management (error in investigation, medication or in the decision making process) and documentation error (missing or inadequate documentation or issue with illegibility) as well as the differences in responsibilities of the personnel. Even though the study was not directly related to nursing students, the implications were to alert nurses to be aware of potential medication errors that can occur to anyone.

Medication administration errors committed by nursing students in Malaysia have not been addressed openly. This could be due to the fact that the Malaysian Nursing Board (NBM) requires that all nursing students to be supervised either by a clinical instructor (CI) or RN during MA, and therefore it was presumed that no MAE should occur. The CI or RN seems to be the interceptor in preventing errors from occurring for the nursing students. However, even with the close supervision from CIs or RNs, verbal reports through personal conversation from CIs or RNs as well as from literature indicate that near misses by nursing students are frequently happening (Reid-Searl, et al. 2010b). Near misses are considered when there is an occurrence of error, but it did not reach the

patient. Near misses by nursing students during MA should raise concern for the nursing education as they could lead to serious errors that provide potential harm to patients.

Common Barriers to Safe Medication Administration

Human Factors

Although there are many viewpoints stated in the literature regarding the main cause of MAE, one viewpoint, as stated by O'Shea (1999) and Preston (2004), is that most medication errors are due to human factors. Although nurses do not prescribe, Hewitt (2010) concluded in her comprehensive literature search that the nurse's role in MA is crucial, complex, and requires multidisciplinary processes. Much literature agrees that nurses' inaccurate calculation, and insufficient knowledge, competency of medications with complacency are the main reasons for MAE (Jukes & Gilchrist, 2006, Krautscheid, Orton, Chorpenning, & Ryerson, 2011, Whitehair, Provost, & Hurley, 2013, Calliari, 1995, Hsiao, Chen, Wei, Fang & Tang, 2010, Tang et al. 2007, Brady, Malone & Fleming, 2009, and O'Shea, 1999). Hewitt (2010) stated that distractions, fatigue, and exhaustion from working long shifts are among the causes of MAE. Nurses will be continually challenged with ensuring their patients' safety if they have inadequate education and knowledge about safety and quality care. Therefore, the following common barriers to safe MA in terms of human factors are being discussed in detail.

i) Knowledge and Performance Deficit

Hsaio et al. (2010) reported that one of the performance deficits in medication errors was the human factor of insufficient knowledge. Although the main aim of Hsaio's et al. (2010) study was to develop and validate an instrument, their finding strongly suggests that some nurses have insufficient knowledge about medications and therefore

require additional education associated with the administration of medication. In this study, using snowball sampling, 385 nurses (response rate of 79.2%) working in acute general hospitals across Taiwan were recruited to answer a questionnaire developed from literature reviews and expert input. The nurses were selected because they had more opportunity to administer high-alert medications and chemotherapy drugs. The questionnaire evaluated nurses' knowledge of high-alert medications and analyzed known administration errors. It consisted of two sections which required participants to answer True/False for parts A and B, selecting contributing factors for part C, and self-evaluation (multiple choice) for part D. The average correct answer rate for part A and B was only 56.5%. The leading obstacles in part B were due to insufficient knowledge (75.4%). The majority of nurses (84.6%) hoped to gain more training. Although Hsaio et al. (2010) stated that the questions were valid and reliable, the authors concluded that nurses have insufficient knowledge about high-alert medications. The limitations of this study can be improved by evenly distributing geographically proportionate sample to reduce bias from uneven sampling. Even though the study was strong, the questionnaire would not be applicable for nursing students because experience contributed to the numbers of correct answers to the questionnaire when measuring knowledge. Nursing students do not have enough experience as compared with registered nurses. Hicks (2004) in his study of medication errors concluded that performance deficit was the leading cause of this event to occur in an emergency department. Using a national database to identify trends in the nature and type of medication errors, 3,440 medication errors reported from emergency departments in 300 facilities were analyzed. Error outcome category, mode, type, cause, contributing factors, level of staff involved,

product reported, and patient outcome fields were included in the analyses to extract common themes and medication-use problems. MAEs such as improper dose/quantity (27%) and prescribing errors (22%) were the most common types of errors, and performance deficit was concluded as the leading cause. In the Intensive Care Unit (ICU), the performance level failures were commonly slips and lapses. Slips are defined as attention deficit errors when the person/nurse knew better but because of inattention or distraction she or he did something wrong, whereas lapses are mistakes which occurs because of lack of knowledge (William, 2004). In their retrospective analysis of mortalities associated with medication errors, Philips et al., (2001) found that 44% of 5307 errors events were due to performance and knowledge deficits. These findings (Hsiao et al., 2010, Hicks, 2004 and Philips et al. 2001) strengthen the case that nursing education needs to find solutions to increase understanding of MA procedures to prevent MAE occurrence.

Another study done by Johari et al. (2013) to identify the level of knowledge in administering medications by RNs at Sik Hospital, Malaysia, found more than half (54%) of the participants had only medium knowledge regarding MA. In this descriptive cross-sectional study, 48 nurses were recruited from several wards in one hospital. A self-administered questionnaire comprised three sections: demographic data, closed-ended questions of knowledge regarding the process of administration, drug calculation/ regimen/ injection site, and factors contributing to medication errors was done. In this study, when measuring the knowledge of medication, 83% of the questions (10 out of 12) did not get a 100% correct answer from the participants, which might reflect nurses' unsafe administration of medication practice. The study could have been more

meaningful if the authors had described how the environment was controlled while the questionnaire was being administered and commented more on the meaning of the result of low, medium or high knowledge when reporting the data. Nevertheless, the finding of this study seemed to call for more research about MA to be done in Malaysia to provide more evidence of contributing factors especially in deficit of knowledge, so that the safety of patients can be assured.

A cross-sectional study by Lexshimi, Daud & Zulkifili, (2009), suggested that nurses do possess sufficient degree of pharmacological knowledge, but only in certain aspects of pharmacology. In this study, 40 nurses from the medical wards in University Kebangsaan Malaysia Medical Centre (UKMMC) were recruited. Questionnaires were used to measure the level of knowledge, skills, and attitudes of nurses, and a direct observation technique with checklist was used to record the practice of nurses. The mean score for knowledge, skills, and attitude were all within average distribution, indicating that the nurses in UKMMC possessed an average level of knowledge and attitude in administering oral medication. The authors stated that based on the results, nurses had limited knowledge specifically on administration of medication and needed to improve their knowledge, especially on the different routes of MA. Surprisingly, contrary to some research that has been done, the study concluded that the work experience of nurses has no influence on knowledge gained and good practice in administering oral medication. The study overall contained several limitations. For instance, the questions in the questionnaires measuring knowledge were simple and lacked depth. It also did not cover related aspects of pharmacology such as mathematical skills. Safety when administering medications requires a certain level of knowledge about the process and the drugs.

Findings similar to the study done by Lexshimi et.al (2009), were reported earlier by Meurier, Vincent, & Parmar (1998) who, in their study of medication errors, concluded that lack of knowledge in medication was the primary reason for newly licensed graduate nurses making errors. Therefore, our aim as researchers should focus on finding ways in nursing education to improve teaching methods that can help to develop nursing knowledge that can be effective in practice over the long term.

In our attempt to improve knowledge in MA, consideration to improve mathematical proficiency should be one of the priorities. To see if there was a significant direct correlation between initial mathematical test failure and future increase in rate of medication errors, Calliari (1995) did a study to test whether nurses who fail the medication test during an orientation program would make a medication error in the future. In this descriptive study, medication errors made during the 3-year period of time were reviewed to determine the number of errors made and the nurses who made the errors. The pass/failed score result during the orientation was assessed to see whether the nurse who made the medication errors had passed or failed the test. The result showed that nurses who failed were more likely to make medication errors than nurses who had passed the medication test. Poor mathematical skills were suggested to be the key contributory factors towards medication errors (Amritage & Knapman, 2003; and O'Shea, 1999). These findings indicate that student nurses must be prepared to be mathematically efficient. Nursing students should be able to calculate any medications requiring calculation using the right formula before they graduate. This challenges nursing educators to develop a curriculum covering the topic of pharmacological calculations in depth and provide sufficient time for students to learn. Based on these

findings of mathematical issues, attention should be made for any encounter requiring calculation during students' assessment of the MA procedure when carrying out the research. With this issue being important, the content for the intervention group (simulation refresher course) in this study reviewed calculations in pharmacology through provision of scenarios involving medication calculations. Jukes & Gilchrist, (2006) stated that the consistent lack of mathematical proficiency by nurses has been a worldwide issue in nursing contributing most MAE. To support this statement, their study used a 10-item drug calculation test to evaluate the numerical skills of 37 second year nursing students, and showed none of the participants achieved full marks. The median correct score was only six out of 10. Jukes & Gilchrist (2006) emphasized drug calculation as the crucial aspect of nursing education in preventing MAE. Calculation incompetency can also be one of the reasons for MAE or near misses by nursing students. Beside the need for mathematical proficiency, Jukes & Gilchrist (2006) also reported on the lack of requirements for mathematical qualifications for entry into nursing school, raising questions whether nursing programs are indeed educating nurses who are fit to work, if mathematical competence is not being achieved. The lack of knowledge, especially about medication dosage calculation, potentially can cause serious issues for nurses, since they are mainly responsible for the actual administration of the drug (Dean, Schacter, Vincent, & Barber. 2002). The lack of knowledge in mathematics was alarming when McMullan, Jones & Lea (2009) conducted a correlational cross-sectional study to assess 229 second year nursing students and 44 RNs' mathematical abilities showing a failure rate of 55% of students' and 45% of the RN in the numeracy test while 92% of students and 89% RNs failed the drug calculation test. The test was carried out under controlled conditions. With

these findings, McMullan et al. (2009) urged nurses to continue to practice and refresh all the different types of drug calculations as often as possible to prevent losing skills. Jukes & Gilchrist (2006) recommended that admission to nursing school should be reviewed and that students are tested on their mathematical abilities throughout their program of studies. This statement supports the need for this study that will be conducted in testing the effectiveness of simulation refresher course for second and third year nursing students in ACNHS, Penang.

ii) Lack of experience

Besides performance deficit and lack of knowledge, lack of nursing experience or practice is another variable that can lead to medication errors in drug administration (Schulmeister, 1999). Chang & Mark (2009) extracted data from the Outcomes Research in the Nursing Administration Project (a multisite organizational study) from the United States, where a total of 4,954 RNs who were employed for more than three months in any medical-surgical unit such as orthopedic, neurology, telemetry, or step-down were recruited. The purpose of this study was to identify antecedents of severe and non-severe medication errors. It was found that nurses' experience was significantly and positively related to non-severe medication errors: when the wards had more experienced nurses, more non-severe medication errors were reported. The researchers further stated that both experienced nurses and newly licensed graduated nurses made different types of medication errors. Experienced nurses tended to commit rule-based errors, whereas newly licensed graduated nurses tended to commit knowledge-based errors. Rule-based errors as described by Chang & Mark (2009) are errors committed when nurses gain confidence with their knowledge and skills and become less attentive to procedures they

have performed repeatedly. Knowledge-based errors are made by limited experience or education due to insufficient skills and inadequate knowledge of pharmacology. Although the study can provide a rationale for a new perspective on the different types of medication error, which requires a different approach to error prevention, the study may not be generalizable to other types of nursing units (wards) such as intensive care unit or emergency departments. The study's results that experienced nurses commit more non-severe medication errors agrees with Lexshimi et al. (2009), who stated that nurses' work experience has no influence on good practice or knowledge gain that is directly related to occurrence of non-severe MAE. A literature review by O'Shea (1999) which accumulates studies in the past also shows that nurses' length of experience did not mitigate the rate of error.

Medication management process involves intellectual activity in addition to the physical act of medication preparation or administration (Brady et al. 2009). There is a need for every nurse to be alert when engaging with professional judgment and critical thinking to observe patients, communicate with stakeholders, interpret relevant data, and apply the knowledge and experiences to specific patient situations (Eisenhauer, Hurley & Dolan, 2007). This quality is normally found only in experienced nurses who have gone through the process of MA multiple times. It is mostly through experience that a nurse could perform any tasks using their critical judgment. Newly graduate nurses and student nurses who do not completely possess this quality, due to lack of experience, are normally at higher risk of committing errors especially while administering medication. With this in mind, the intervention of this study should expose students with an extra experience tied with the KELT theory that will enable nursing students to use critical

thinking in performing their duties, and with this, errors can be detected before they reach the patient.

iii) Deviation from Procedures and Protocol

Manias, Aitken & Dunning (2005) highlighted the importance of protocol and standard operating procedure (SOP) in the ward setting to help not only newly graduate nurses, but also nursing students to integrate new knowledge into practice and promote effective decision-making. Using a descriptive prospective qualitative design, Manias et al. (2005) enrolled 12 nurses and observed them during a two-hour period of MA to patients followed by an in-depth interview with the nurses. From the data, six themes emerged. The researchers concluded that nurses would adhere to MA protocols if they were perceived not to impede other nursing activities, if they felt encouraged to make their own decisions, and if there was decreased likelihood that disciplinary action would be involved. The result of the study is in line with the National Health and Medical Research Council which proposes that MA protocols and policies should be designed to improve the quality of health care, to reduce the use of unnecessary, ineffective or harmful interventions, and to facilitate the treatment of patients with the maximum chance of benefit, with minimum risk of harm, and at an acceptable cost (NHMRC, 1999, P. 9). Even though there are limitations in the study by Manias et al. (2005) due to small sample size and short observation period (two hours), the study raises important implications for the use of protocols for safe MA as well as to standardize practices in health care. A quality assurance study done in Malaysia on MA by nurses was aimed to determine the rates of non-adherence to standard steps of the MA and MAEs committed by RNs (Raja Lope, Boo, Rohana & Cheah, 2009). In this study, a baseline assessment

of compliance with ten standard MA steps by Neonatal Intensive Care Unit nurses was carried out over a period of two weeks and then followed by a re-education program as an intervention. Reassessment was done three months later. The baseline findings showed that nurses did not carry out at least one of the ten standard administrative steps during the administration of 188 medication doses. Ninety five percent of doses administered where nurses were observed did not have another nurse witness the administration of the medication, 88% did not label the drug prior to administration, and 71% did not check the patient's identification tag. This action is a deviation and violation of the MA policy. The study could be more valid if the observation for the assessment were made by nurses instead of by third year medical students, as the expectation or perspective may be different from an expectation of a medical doctor.

A deviation from protocol during MA can be a critical factor for MAE to happen. An observational study done in Korea by Kim & Bates (2012) on adherence to guidelines, namely the Five Rights, indicated low rates of adherence to guidelines. A total of 293 cases of medication activities were observed using a checklist following basic medication guidelines that was developed by the researchers. It was observed that only 45.6% of nurses verified the amount of medication indicated on the vial at least once for one second, 6.5% read the name of the patient from the wristband, and only 41% administered medications at the correct time as per guideline. The result suggests that many MA guidelines are not strictly followed by nurses. This critical information would support the need to emphasize the importance of adherence to MA protocols and guidelines during the simulation refresher course. Brady et al. (2009) described some reasons for the deviation of protocols and guidelines, such as the delay in administering

intravenous (IV) drugs due to lack of already present IV cannula that can affect timely administration of the drugs. Nurses may feel pressure to deviate from official procedures to save time and follow what is commonly being practiced in the institution, such as the administration of IV boluses that is faster than infusing the medications as is recommended. Patients with continuous infusion may experience an error when nurses deviate from the prescribed administration rate, with lack of understanding of the potential implications of administering too slowly or too quickly. According to Hewitt's (2010) integrative review of literature on nurses' perceptions of the causes of medication errors, failure to follow the Five Rights or failure to follow protocol is the second most frequently seen reason for medication errors by nurses. In summary, MAE is more likely to occur when the standard operating procedures and protocol are not being observed by nurses when administering medications. The reasons for this non-adherence attitude are not clearly known, but questions nursing leaders should ask include whether nurses value the fundamental principles or does it lose its importance after they are no longer being observed by their superior after they graduate? Other reasons provided by Hewitt (2010) include the possibilities of heavy workloads, long shifts, and fatigue that affects the nurses' ability to focus and concentrate on the importance of the Five Rights and other protocols. The information obtained from Hewitt's study had provided guidelines for the study that was conducted, where basic protocols and guidelines that need to be adhered to during MA were included in the simulation refresher course for the intervention group.

iv) Quality of Prescriptions

Incomplete or illegible writing and poor verbal communication in relation to prescriptions, particularly between RNs and physicians, can contribute to MAE. Both

Brady et al. (2009) and Amirtage & Knapman (2003) in their reviews of literature agree that the quality of prescriptions may affect safety during the administration of medication. Health personnel, especially RNs and physicians, need to communicate and listen carefully to all information regarding prescriptions and administration of medications. Failure to communicate prescriber (physician) changes after doctors' rounds to the nurse who is serving the medication can result in dose omission. Poor and illegible handwriting by the physician due to fatigue and distraction were also reasons for MA error. A ten-year series (1997-2007) of internal audits in one of the general hospitals in New Zealand by Gommans, McIntosh, Bee & Allan (2008) found out that there was an unacceptable proportion of medication charts in which documentation was inadequate. The result of the audit shows 58% had no prescriber identification, 14% were without legible prescriptions, 14% did not state route of administration, 11% had no dosage or date, and 8% were without adequate patient information. Charts were assessed against predetermined standards for good quality prescribing. In the same study, only 53% of charts had any information about medication alerts, and 15% contained at least one verbal order. Nevertheless, progressive improvements in all items were shown at the end of the period of study in 2007. Although these findings do not directly influence the study being conducted, understanding the challenges and issues such as these in the clinical setting is critical to ensure safe MA, especially by nursing students. Drugs with similar sounding names are particularly an issue in negotiating verbal drug orders. The overuse of abbreviations and ambiguous and incomplete or unclear orders can cause misinterpretation of prescriptions and thus cause MAE. Therefore, institutional policies and protocols regarding abbreviations have been instituted to standardize usage to

minimize this error. Some health institutions resort to the use of technology to manage patient information data, including prescriptions, to avoid incomplete and illegible physician orders and handwriting, for example using computerized system such as an electronic physician order entry.

v) Failure to Report

Nurses are obliged to report all MAEs, though they are often reluctant to do so. Knowing the accurate rate of occurrence is essential in the effort to decrease medication errors. Reporting is important not only to improve the medication management process as stated by Brady et al. (2009), but also because hiding errors can produce serious adverse consequences at both a practical and a moral level, as discussed by Koohestani & Baghcheghi (2009). In relation to this issue, a cross-sectional descriptive study was conducted by Koohestani & Baghcheghi (2009), using self-administered questionnaires that comprised 18-item barriers to MAE reporting. Questionnaires were given to 240 nursing students in three nursing schools in Iran. It was estimated that 80.12% of all medication errors were reported to their instructors. The study also found that barriers such as no positive feedback, an individual rather than a systems focus, response of the instructor not matching the severity of the errors, and fear were the top reasons for not reporting MAE among nursing students. Koohestani & Baghcheghi (2009) concluded that occurrences of MAE among nursing students are often under reported, and therefore the researchers urged clinical instructors to demonstrate a positive response to nursing students for reporting medication errors and commit to a quality management process that is perceived by nursing students as designed to improve patient safety as opposed to discover mistakes. Brady et al. (2009) agrees with Koohestani & Baghcheghi (2009) that

the reasons for the reluctance of nurses to report MAE can be due to the fear of disciplinary action, not being able to report anonymously, time constraints, and also the thinking that it was unnecessary to report the errors because there were no negative outcomes. However, failure to report MAE means that both near misses and medication errors are not analyzed; thus the body of knowledge in this area is not expanded.

System Errors

Medication administration errors that are due to the system is difficult to resolve, as the solution is often formulated at higher administrative levels, away from the point of care. Two systematic literature reviews (Brady et. al. 2009, and McBride-Henry & Foureur, 2006) and a study done by Philips et al. (2001) identified that multiple system issues contribute to an error-prone environment that may cause MAE. This includes critical shortages of healthcare professionals, increased numbers of high acuity patients, inadequate access to policy and medication information, physical environment (poor lighting and suboptimal drug preparation facilities), organizational culture, organizational communication channels, organizational routines, pharmaceutical related issues and incident reporting culture. Agyemang &While (2010) describe distractions and interruptions system factors that leading to medication errors. During the process of MA, nurses are multitasking, both in action and thought, and a fast-paced health care environment can offer immense distraction and interruptions (Eisenhauer et al. 2007). The most problematic interruptions come from non-stop calling from patients followed by answering telephone calls. This situation requires manpower solely dedicated to medication administration, who are not pulled to attend to other patients. Another form of

distraction causing errors is the unavailability of the drugs at the time of administration, requiring nurses to spend time looking for and henceforth obtaining the drugs.

William (2004) highlighted that system factors likely to contribute to MAE include information overload, lack of clinical decision supports, inadequate checks and balances, lack of centralized and standardized healthcare databases, and punitive measures for those who commit any human error. Information overload occurs when too much medical research information makes it difficult for doctors and nurses to stay current. This can happen when there are several new drugs being introduced to the market at once. The expectation that doctors and nurses be required to know all drugs' side effects, pharmacological actions, adverse effects, and all information regarding the new drugs before prescribing and administering to patients can be challenging. William (2004) also stated that a medication use process that has inadequate checks and balances may cause a nurse to give a drug with a normal dosage to the wrong patient; which could be life-threatening or even fatal. Other causes of medication errors contributed by the system were identified by Brady et al. (2009), such as the process of receiving medication from the pharmacy with issues such as late deliveries, lost orders, inadequate 24-hour coverage limiting the availability of drugs, and delayed or incorrect transcriptions that can increase omission errors.

The MA process is a complex subsystem of a hospital. It demands that multiple hospital department work together in order to reduce errors related to the system. Most acute care settings have put strategies in place to reduce the number of system related errors through purchase of new technology such as a single type intravenous medication pump that requires access to a specific computer program to change the pump's setting or

even using electronic physician's order entry. Within the past decades, there has been shift internationally in how adverse event as a result of MAEs, are understood, and more attention is being paid to the organizational system errors (Vincent, 2003). With this move, attention is focused on system issues in an attempt to address gaps or failings within the system itself. There have been a marked decrease in the rate of MAE occurrence since the focus was on to improve systems (McBride-Henry & Foureur, 2006).

The intervention for this conducted study incorporated the standard operating procedure (SOP) of PAH where the observation of the Five Rights was emphasized. This was to ensure that the nurses (both RNs and nursing students) had a good understanding of organizational culture in relation to medication safety by adhering to the SOP as well as recognizing the importance of effective multi-disciplinary teams in maintaining a safe environment for patients. The study aimed to highlight the meaningful contribution nurses can make regarding safety issues, and therefore the organization would empower nurses by listening to them and promoting decision-making in any quality improvement initiatives.

Nursing Students' Involvement in Medication Administration Procedure

Although there are many studies regarding factors associated with medication errors by RNs, studies reported that the reasons for medication errors committed by nursing students have been largely unexplored (Dolansky, Druschel, Helba, & Courtney, 2013 and Reid-Searl et al. 2008). Nevertheless, this does not mean that student involvement in MAE is uncommon (Reid-Searl & Happell, 2012). Reid-Searl, Moxham, Walker & Happell (2010a) agreed that MA safety is an important skill that should be

clearly embedded in the nursing education of undergraduate nursing students. This aims to prepare students to understand medications and how to administer them safely. In order for nursing students to acquire such knowledge, skill, and experience, they need the opportunity to build on their theoretical knowledge by practicing the administration process in the clinical setting (Honey & Lim, 2008). This requirement of having to perform on real patients in the real world puts nursing students in an error-prone environment. The importance of supervision was identified by Reid-Searl et al. (2010a). Reid-Searl & Happell (2012) conducted a study using an exploratory qualitative methodology in which focus group interviews were conducted with 13 RNs. Participants were asked to describe their experiences and opinions regarding student supervision; they regarded supervision as an important process in fostering student learning and ensuring safety. Even though the findings provide valuable information about the opinions of the RNs, the extent to which these opinions represent the practices of most or all nurses cannot be accurately predicted. However, in most cases internationally, as stated by Reid-Searl et al. (2010b), students are only allowed to administer medications with the supervision of an RN or a CI after they have completed their pharmacology course. Supervision must be rigorous and provide the support necessary to facilitate nursing students developing the confidence and competence to administer medications safely (Reid-Searl & Happell, 2012). Learning safe MA procedures requires a great deal of critical thinking. Therefore, the CI has the vital role to prepare student nurses for the realities and dynamics of clinical practice. This is in line with the Modeling and Role-Modeling theoretical foundation where the CI acts as a role model for students while modeling them into becoming safe nurses. The role of the CI cannot be underestimated,

because it is the challenge for the CIs to best facilitate the students' learning through developmentally appropriate strategies that are responsive to the fact that learners may arrive at the clinical placements with some theoretical knowledge but not having seen it in practice (Valdez, Guzman & Escolar-Chua, 2012).

Acquisition of knowledge, skills, and attitudes can be achieved by employing a thought-provoking move, facilitating focus on learning goals and through action-enabling moves where the CI guides, oversees, and anticipates when students feel confident in their skills. They can incite new learning by letting students experience beyond what has been already taught and expected. Scaffolding is a term identified as a diagnostic tool enabling both supervisor and learner to recognize knowledge-in-waiting and knowledge-in-use. Using a descriptive phenomenology, a study was done in the Philippines to capture 31 nursing students' views and experiences of scaffolding moves of their clinical instructors and concluded that nursing students acquire and develop knowledge, skills and attitudes regarding MA safety through engagement of critical thinking activities (Valdez et al.,2012). The finding of this study suggested that the moves that promote learners to be self-directed can stimulate students to attain an inquisitive mind, which is essential in critical thinking and also applying the concepts they have learned to clinical orientation. Valdez et al. (2012) believes that these acts can empower students to become more independent in MA activity in the future. However, before the concepts are applied in the clinical field, some studies (Reid-Searl et al. 2010a, b) suggest the use of skills lab practice as a preparation tool for nursing students before they enter the real world. The skills lab practice can provide students with an environment that simulates the ward

experience, which has been proven beneficial by empirical studies (Reid-Searl et al. 2010a, b).

Nursing students are introduced to the principles of MA during their pharmacology course in the nursing education curriculum to strengthen their preparation for MA safety. According to Reid-Searl et al. (2010a), nursing students are first taught about administering medications in the nursing skills laboratory, a controlled environment where it is relatively safe for them to carry out the activities of MA. Here they have the opportunity to apply the principles of pharmacology they have learned in the classroom and practice safe administration of medications before they encounter real medications with real patients in the clinical setting. Case scenarios, simulated drugs, role play, and manikins are used to enhance learning.

Reid-Searl et al. (2010a) stated that besides skills lab session practice using simulated patients and placebo medications, the real clinical setting presents students with the opportunity to practice MA skills with real medications and real patients. While having this opportunity, ensuring safety of patients in the ward is crucial. Because nursing students have no legal authority to administer medications independently, the university or the academic institution where the student is learning has the responsibility to ensure that nursing students receive an appropriate level of supervision while serving medications to their patient. Reid-Searl et al. (2010a) highlighted that CIs, who are also RNs appointed by the university or school to oversee and supervise student's learning during their clinical placement, provide supervision for a number of students that sometimes are in more than one ward or unit. This situation makes it difficult for CIs to be physically present to all students all the times. In some institutions, CIs are stationed

in one ward. Although taking care of only one ward, the high student to faculty ratios will not enable faculty to meet the learning needs of all students, especially regarding to MA procedures.

The Malaysian nursing board (NBM) requires a faculty to student ratio of 1:12 to 1:15 for nursing students to be allowed to practice in the clinical setting. When the ratio exceeds what is allowed, an RN-preceptor in the ward will share the responsibilities with the CI in supervising student practices, especially in the administration of medications. The changing of supervising personnel (CI to RN-preceptor) for the student may be a contributing factor leading to errors during MA. The expectations of the RN preceptor toward nursing students may not be the same as that of the CI. Nursing students may not be getting adequate attention and full supervision from the RN due to the fact that the RN carries a full case load. Reid-Searl et al. (2010a) conducted a qualitative study using grounded theory of 28 final year students of a Bachelor of Nursing program in Queensland, Australia to examine factors influencing their experience when administering medication in the clinical setting. Semi-structured in-depth interviews with open-ended questions were conducted to facilitate discussion based on each participant's experience and opinion. In this study, the participants inferred that RNs' attitudes towards nursing students would influence the level of supervision provided. The central properties of RNs' attitudes towards the student nurses as suggested by Reid-Searl et al. (2010a) included whether RNs wanted or liked the students, what the RNs expected of a third-year student, and whether RNs were university or hospital educated. Reid-Searl et al. (2010a) noted that these attitudes determine what type of influence and attention RNs would give to the nursing students. A "positive" influence will make the MA procedure

less challenging for nursing students and, problematic if it were “negative” when nursing students are not wanted in the clinical setting. The “negative” influence might cause higher risk of MAEs to occur. To prevent the “negative” influence between nursing students and the RN in the ward, the CI needs to work together with the RN and discuss challenges both faced to provide a better learning environment with similar directions and goals for the students. Other influencing factors include communication from the university to the hospital/ward where the students will be working, regarding information on preparation so that RNs can provide adequate supervision. The busyness and excessive workloads also meant that RNs frequently did not have adequate time to provide close supervision to nursing students (Reid-Searl et al. (2010a).

The Role of Nursing Education in Medication Administration Safety

According to Reid-Searl et al. (2010a), the educational preparation of undergraduate nursing students is an important component to ensure that future RNs have the necessary skills and knowledge before they are able and allowed to function safely and effectively in the ward. The pharmacology curriculum in nursing schools teaches students the basics of safe MA. Therefore, the curriculum should be designed to ensure that nursing students are given adequate information before they can provide competent care for the patients in the clinical setting. In designing a curriculum that can assist nursing students to achieve what is required, conducting a study may be necessary to ensure effectiveness of the proposed plan before it is carried out. The purpose of the conducted study was aimed to evaluate the effect of a simulation course to strengthen and enhance nursing students' knowledge and performance in medication administration.

The Five Rights are one of the basic principles of MA which is normally taught in the first year (second semester) of the nursing education program in most nursing schools in Malaysia. The Five Rights are an appropriate and important practice in administering medications to patients. These principles will serve as a useful guideline for standard operating procedures (SOP) for students to be used in their nursing practices. Using simulated patients and placebo medications, nursing students should be given the opportunity to practice their skills for safe MA through instruction and supervision within the skills lab before they are allowed to administer medication to real patients in the clinical ward setting. Papastrat & Wallace (2003) provide educational information regarding medication error prevention in which the researchers used a problem-based learning approach. The goal was to prevent medication errors and facilitate error reporting by first-semester students when exposed to situations that reflect the real world scope and complexity of medication administration and errors. Using the frameworks of Failure Mode Analysis and Human Error Mode and Effects Analysis, student groups should be able to identify hypotheses, devise solutions, and develop continuous quality improvement processes to prevent errors (Patpastrat & Wallace, 2003). During the student's learning process, they were reminded of the increasing complexity of pharmacological agents and medication calculations to enable them to employ critical thinking skills and develop the confidence necessary for safe, professional practice.

The main goal of nursing education as stated by Papastrat & Wallace (2003) is to transition students from novice practitioners to competent, self-directed, critically thinking nurses. Therefore, the nursing education system plays an important role in providing and preparing nurses with the above qualities so that MAEs can be prevented

and patients will be safe under their care. Clinical instructors have the primary responsibility and challenge to ensure that nurses whom they educate and train are able to practice safely and perform competently, including in MA procedure. As student's abilities and performance develop throughout their program of study, the role of teaching in preparing student nurses to be a safe practitioner in the field is highly important (Wolf et al. 2006 and Papastrat & Wallace, 2003). Multiple findings in the literature agree that teaching and learning should prepare nurses to become competent professionals that provide and improve patient quality of care by preventing MAEs from occurring (Banning, 2003, Nurit, Bella, Gila & Revital, 2009, Fry & Dacey, 2007, Page & McKinney 2007, and Athanasakis, 2012). Athanasakis' (2012) systematic review of literature, found that nursing education, especially dose calculation skills was a protective measure in preparation for the student nurses' clinical duties after graduations and therefore suggested attendance at educational courses with pharmacology topics and for hiring organizations to provide educational opportunities concerning all procedures involving the use of medication. This conducted study included dosage calculation in the intervention (refresher course) to allow nursing students to practice mathematical skills they had learned previously. The study also used the SAM scale as the evaluation tool to determine the effect of the intervention to increase knowledge and performance of nursing students in MA. This study intended to determine not only the effect of the intervention but also whether it could be used as a basis for remediation of weak nursing students. Page & McKinny (2007) agreed that comprehensive nursing education has the potential to make a substantial contribution to ensure safety during MA by strengthening

nursing students' theoretical pharmacological background and assist them in recognizing potential medication errors in the future.

Multiple methods of teaching and learning can be adapted in nursing education to achieve the goal of ensuring patient safety while administering medication. Papastrat & Wallace (2003) promote the use of problem-based learning approach towards safety in MA. Using this approach, students can successfully demonstrate transfer of knowledge of MA to the clinical setting. This approach can prove to increase students' awareness of the potential risk of error. Development of nursing curriculum that uses problem-based learning can provide students to "experience" the consequences of medication errors without actually committing the error (Papastrat & Wallace, 2003). This encourages the learner to actively participate, simulate actual patient experiences, provide clinically relevant material, and create renewed enthusiasm for classroom learning. According to Krautscheid et al. (2011), effective education in MA should include demonstration, peer-learning opportunities, and repetitive practice with timely feedback. Reid-Searl et al. (2010a) and Reid-Searl et al. (2010b) found supervision to be the central issue influencing MA for students and therefore emphasized the need for supervision during the MA process. Both studies agreed that undergraduate nursing students are at risk of making MA errors when inadequate supervision is given.

The use of simulation in nursing education can also contribute to reduction in MAEs (Sears et al. 2009). In an experimental study conducted by Sears et al. (2009) to test whether a simulation-based educational intervention can in fact contribute to the success of new nurses in overcoming the risks of error and increase their safety in medication administration, 54 second year Bachelor of Science in Nursing student

volunteers were randomly assigned to a treatment group (n = 24) or control group (n = 30). All of these students were scheduled for placement in medical surgical or maternal child field environments. The intervention consisted of replacing some early-term clinical hours with exposure to simulated case scenarios that were related to the type of placement. The result of the study was that nursing students said that they were thrilled for the simulation experience, which helped them to identify their knowledge gaps and provided them with a safe opportunity to learn without harming the patient. The results show that the control group had a disproportionately larger number of errors, 24 out of 30 in the control group sample, compared with 7 errors out of the 24 treatment group sample. With this result, there was compelling evidence that collectively, students in clinical placement generate fewer medication errors if they had prior exposure to a simulation-based related experience. It was also interesting to see that this study introduced two types of errors; actual MAEs and potential MAEs. The latter arose because instructors intervened to prevent actual misadministration of medication. Although this study can provide a base to support the proposed study for more evidence for usage and effect of simulation refresher course, it needs to take into consideration that the sample size and the clinical placement need to be equal for both groups (treatment and control). The different clinical placement of the study with different clinical instructors for assessment could have provided a bias report of the error.

Another approach that was assumed to support safe practice and protect patients from nursing error was through the improvement of mathematical proficiency for nursing students. Through nursing education, student nurses learn and improve their dosing calculation skills and other mathematical competencies. Due to the serious mathematical

deficiency that can contribute to MAEs, competent math skills should be emphasized in the nursing education curriculum. However, Dyjur, Rankin & Lane (2011) in their literature review challenge the assumption that successful mathematics examination performance indicates safe future MA. According to the authors, some educational institutions continue to equate math skills with safe MA, to the point that nurse educators treat math skills as an essential but exclusive tool to determine students' competence. Nevertheless, the authors failed to provide robust and empirical evidence about this issue and recommend further study. The authors' intention was not to urge education institutions to stop teaching math skills, but merely not to rely on one method when predicting safe future MA. However as opposed to the results of the literature review by Dyjur et al. (2011), multiple studies, have shown evidence of MAE reduction with good math skills (Jukes & Gilchrist, 2006, Page & McKinney, 2007, Schulmeister 1999, and Hicks, 2004). Therefore, attention will be made in emphasizing basic calculations during the intervention of the proposed research.

Gaps in Nursing Education

Despite realizing the importance of education in ensuring patient safety, there is evidence of inadequacy of nursing education in pharmacology, in preparing nurses to be competent and safe healthcare providers. According to Walley & Webb (1997) and Latter et al. (2000), undergraduate pharmacology education and training in the curriculum has indicated that preparation may be inadequate to prepare junior nursing students for practice. This inadequacy can contribute to more MAEs or near misses by student nurses. Page & McKinney (2007) and Bullock & Manias (2002) expressed concern about the adequacy of the content of pharmacology included in present nurse education curricula.

Page & McKinney (2007) presume that an increased focus on pharmacology in the curriculum would help to decrease MAEs and would make a substantial contribution to MA safety. Athanasakis (2012) describes the need of educational programs with pharmacology topics and provision of educational opportunities concerning all procedures involving the use of medications as measures to prevent MAE. Bullock & Manias (2002) urged regular updating in pharmacological topics to develop a pharmacology knowledge base that would expand the breadth and depth of understanding to what is required to safe administration of medication practices. The Department of Health, London (2004) stated that undergraduate nurse education needs to consider further the nature of educational preparation that is required to support nurses' roles in medication safety. The department suggested that the nursing education in London strengthen teaching in pharmacology and cover medication safety comprehensively in the undergraduate program.

Studies from the United Kingdom have concluded that there is insufficient pharmacology content in the undergraduate nursing curriculum (Morrison-Griffiths, Snowden & Pirmohamed, 2002, King, 2004 and Page & McKinney, 2007). The study by Morrison-Griffiths et al. (2002) found that 90% of pharmacology content was integrated into the curriculum making it difficult to estimate the exact number of hours of pure pharmacology education. Latter et al. (2000) reported dissatisfaction of students and lecturers with a perceived insufficient content in the pre-registration curriculum to assure the amount of pharmacology knowledge that nurses need to know for their fitness to practice. In their findings, Latter et al. (2000) mentioned lack of curricula opportunity for integrating prerequisite knowledge and skills, lack of evidence-based teaching, lack of

consistency across programs studied, and limited opportunities for practice-based learning. A qualitative approach using semi-structured interviews by King (2004), exploring nurses' pharmacology education needs by identifying nursing roles requiring pharmacology knowledge and nurses' preparation for practice, revealed that nurses have limited understanding of pharmacology and are dissatisfied with how the subjectis taught. In King's (2004) study, 10 RNs from an emergency admission unit were selected as participants. The study concluded that improved pharmacology teaching might increase nurses' confidence in performing drug administration and nurse education. However, this study only measured perceptions of nurses and does not reflect the true nature of the event. There is a need to give more focus in nursing education in improving methods in teaching pharmacology through creating educational initiatives and collaboration with other involved healthcare personnel. This effort may help to improve the quality of safe medication administration. This study promoted a refresher course through simulated environments to enhance effective learning of the nursing students in an effort to provide safe care to patients during MA.

Refresher Course

Refresher courses involve didactic content, simulated laboratory experiences and precepted clinical experiences (Griffiths & Czekanski, 2003). In nursing, refresher courses are offered mainly for nurses who have been long inactive and would like to return to work in an effort to address the shortage of nurses. Several authors attest to the fact that nurse refresher courses have proven to be an effective means for re-entry into practice. However, other studies indicate refresher courses are effective in increasing knowledge and performance of actively working nurses. Joshi et al. (2006), carried out a

study to understand the effect of refresher training courses on the knowledge and skills of 56 urban community health volunteers about maternal and child health (MCH). A semi-structured questionnaire with pre-coded closed and open ended questions in MCH was used before and after the training. Nursing tutors, medical officers, the principal of the school of nursing, and medical faculties of obstetric, pediatric, and community medicine were selected as facilitators for the training. The training was six hours a day for three days. The training methods included brief didactic lectures, small group work including practical sessions, individual lesson planning, focus group discussion, and micro teaching practice. Joshi et al. (2006) found that there was a significant increase in knowledge and skills of the volunteers, showing effectiveness of the refresher course. Another study that shows the effectiveness of a refresher course was done by Sclauzero et al. (2006) to determine if improved theoretical knowledge and performance of acute renal failure (ARF) nurses working in the intensive care unit (ICU) might improve clinical management of critically ill patients. When the refresher course was introduced, all the nurses from the nephrology and dialysis unit nurses and 108 ICU nurses attended the course which used lecture as the teaching method. The outcome was successful as evidenced by the reduction in mortality rate of dialyzed ARF patient although the observation period was only one year.

Most courses involving simulation are conducted for several days or sessions. However, other studies of cases where short refresher courses were conducted reported improvement as well. In the aviation industry, short and brief refresher courses as stated by Malakis & Kontogiannis (2012) have been used to enhance skills in handling real world emergencies. Nishisaki et al. (2008) investigated the effect of short term refresher

training on in situ simulated pediatric tracheal intubation psychomotor skill performance, concluding that the immediate refresher training was effective. Nishisaki et al. (2008) observed immediate participants' improvement on the second intubation during the refresher course. In this study, 26 skilled non-anesthesiology providers whose duty was to provide advanced airway management for children were enrolled. A priori-defined pre-training data were collected via a questionnaire at the time of training. Data were collected on whether participants had recent pediatric advanced airway management training (within 3 months) and pediatric intubation experience (over more than 3 years). Each subject was asked to participate in six simulation sessions with identical objectives, all of which required pediatric advanced airway management, including oro-tracheal intubation for an infant trauma patient. Researchers prospectively defined the immediate effectiveness of refresher training as the ratio of time required for successful intubation at the second versus the first session. With the six attempts given, researchers assume that clinical providers are actually "refreshing" at their first attempt. In this study, the first session serves as refresher training and the second as a competence measurement. The researchers concluded that short refresher psychomotor training, even as short as two sessions, was effective. Raja Lope et al.'s (2009) study on quality assurance in Malaysia showed that re-education program in MA could improve awareness of RNs of the correct steps in MA and therefore could provide a positive result. In this study, a re-education program was launched after a baseline assessment of compliance with ten standard MA steps. The nurses were reassessed similarly three months later after the re-education program. There was significant reduction in non-adherence to MA steps and the rate in MAEs decreased from 31% to 15.4%. Raja Lope et al. (2009) concluded that a

continuous quality improvement approach, namely the re-education program would help significantly in improving patient safety. A potential limitation of this study could result if multiple persons conducted the observations as there were no mention by the researcher regarding interater reliability of observer to obtain homogeneity or consensus of the result. It could be improved by having a single observer. It was also not clearly known how long the re-education program was and what content was provided at that time.

Based on what these studies have found, refresher courses and training can be given to nursing students to update and upgrade their knowledge and performance to deliver comprehensive and integrated services and develop self-confidence to provide safe patient care. These studies were used as guidance for the conducted study on MA safety and nursing students.

Simulation

Simulation techniques have long been used as a teaching strategy in a variety of programs designed to enhance the skills of health care providers. Nursing education utilizes simulation in some form to teach principles and skills of nursing care to assimilate clinical knowledge and skills through active learning. According to Ravert (2008), high-fidelity patient simulators are used in nursing curricula with the belief that the simulated situation provides practice and facilitates the transfer of learning to practice. It allows the learner to acquire competencies necessary to practice in a real-world environment without real-world risks. Simulation is a strategy to amplify real situations with guided experiences in a fully interactive way and can be done frequently without the concern of causing pain, fatigue, or distress that could occur with real

patients. It offers a realistic opportunity for health care workers to demonstrate competency in using verbal and nonverbal caregiving skills. A review of the literature done by Ravert (2002), found that in 75% of studies, the participants highly favored simulation as a method of teaching and learning. Brooks, Moriarty, and Welyczko (2010) listed 14 benefits of simulated learning:

“

- The clinical environment and clinical scenarios can be simulated authentically.
- It is a safe environment and there is no risk to patient safety or public confidence in the profession.
- Variables and outcomes of simulated scenarios can be manipulated by lecturing staff in accordance with students’ knowledge.
- Differing levels of complexity, progressing from core clinical skills to complex scenarios involving teams of students and critical problem solving, enhance the ethos of a spiral curriculum. Using a spiral model is thought to be useful in helping learners make greater progress in their learning.
- Active, shared multidisciplinary learning can occur.
- Specific learning outcomes and module-specific patient situations can be created and explored.
- Errors can be identified, corrected, and discussed in a constructive way.
- Consistent and comparable experiences can be created for all students, negating the unpredictability of clinical practice.
- A problem or inquiry-based approach to learning is fostered.
- Self-evaluation and reflection is encouraged.

- 360˚ feedback can be obtained from peers, lecturing and clinical staff, and from 'simulated' patients if used. 360˚ feedback places an individual figuratively in the center of a circle. Feedback is provided by subordinates, peers and supervisors. It also includes self-assessment and, in some cases, feedback from external sources.
- Greater partnership working between academic and clinical practice staff occurs through involvement of clinical practitioners in developing and implementing the simulation exercise.
- There are opportunities for patient and public involvement through using patient advisers in developing exercises and potentially in acting as patients.
- There are opportunities for real inter-professional education by using simulation activities as a focus for an inter-professional learning event. "

(Nursing Standard, Art & Science education, Vol.24 (20) p.42)

Implications

From the review of literature, it is clear that multiple studies have explored the common factors contributing to MAE in nursing practice. Nurses are aware of the danger medication errors can pose for the patients. What is needed right now in Malaysia is more evidence-based research to understand the impact of educational preparation on preventing MAEs by nursing students. More studies to explore and to understand further how the curriculum is being shaped in preparing students for entry into practice is needed. Following a MA procedure is an important nursing action with implications for safe health care. Nursing students need solid and comprehensive education in this area so that they are able to identify possible actions leading to MAEs and therefore be able to prevent errors from occurring. Manias & Bullock (2002) reinforce that preparation of

nursing students for nursing practice and continuing education for graduate nurses is crucial. Nurses are in need of remedial assistance and teaching if they are not proficient (McBride-Henry & Foureur, 2006). Reid-Searl & Happell (2012) highlighted that nursing students should be afforded the opportunity to practice the skills of administering medication on real patients throughout their undergraduate educational program. This study aims to add to the body of knowledge in effective medication safety strategies as well as to speak to the IOM report on medication safety that calls for more future research.

A multidisciplinary approach of education towards safe administration of medication practice should be adopted to foster better understanding of the involvement of different professions in the MA process. The QSEN competencies require teamwork and collaboration so that together the health care team can function effectively within nursing and inter-professional teams, fostering open communication, mutual respect, and shared decision-making to achieve quality patient care (AACN, QSEN, 2012). Members of the healthcare profession are required to analyze their own and other team members‘ strengths, limitations, and values, and understand their own roles and scope of practice so that work can be done effectively in providing the highest possible level of care.

Summary

Medication administration errors have been on the rise despite efforts at prevention. Multiple activities and research, directed towards registered nurses, have been initiated to ensure patient safety. Errors by RNs may be related to inadequate preparation during their nursing education. Nursing students’ errors or near misses in MA can indicate the need for more effective learning. A primary nursing education goal is to

ensure that all nursing students graduating from the nursing school/institution must be able to provide the safest care to their patients. The role of nursing education is also to ensure that adequate support and guidance is available within a teaching and learning framework to integrate analytical and procedural competence and the creation of national standards. Therefore, this conducted study aims to strengthen curriculum design through MA simulation refresher course in assisting nursing students to expand their pharmacological knowledge and strengthening performance ability, thus promoting safety to patients.

CHAPTER THREE

METHODOLOGY

Research Design

This chapter describes how the study was conducted to achieve desired study outcomes. The research design, assumptions pertinent to the study, research questions, sampling procedure, methods of data collection used, and the proposed data analysis are described. Strategies for human rights protection were also considered.

An experimental repeated measure design was used to examine the effect of a simulation refresher course on nursing students' knowledge and performance of MA in ACNHS, Penang, Malaysia. The Safe Administration of Medication (SAM) Scale was used as an evaluation tool to evaluate the performance of nursing students through scores that were collected. The students were randomized into two groups; a control "teaching as usual" group and an intervention group using the simulation refresher course. The SAM Scale was administered to all nursing students before and after the intervention as a pre-test and two post-tests. This tool was used to measure knowledge and performance of nursing students during the administration of medication in theoretical means. The Medication Administration Safety Assessment Tool (MASAT) (Goodstone & Goodstone, 2013), was used in guiding the intervention group during the simulation refresher course. The MASAT tool was developed to measure the adherence to the "Five Rights" of MA. It contains an eight item checklist to assess the actions of students during the procedure. After the second post-test, a survey questionnaire, the Modified Gladstone Scale of Medication Errors, was given to both the intervention and the control groups of nursing students and also to the clinical instructors. The questionnaire aimed to identify perceived

barriers that would hinder safe MA by nursing students. The measures also asked nursing students to indicate the number of near misses and medication errors they encountered during their training session in the ward setting.

Philosophical Assumptions Supporting Research Design

Based on the research approach being addressed, a post-positivist worldview was used to investigate the epistemology of safety in MA by nursing students through an understanding of their knowledge and performance. It reflects a deterministic philosophy whereby causes probably determine the effects or outcomes. Thus the problem studied by post-positivists reflects a need to examine the causes that influence outcomes, such as issues examined in experiments (Cresswell, 2009). Post-positivism also suggests that there are existing theories that govern the world which needed to be tested, verified and refined so that we can understand the world. This study used Kolb's Experiential Learning theory (KELT) to guide students to achieve better outcomes in learning and therefore promoting safety in MA. While KELT was the major theory used in this study, Modeling and Role-modeling (MRM) were also applied during the research period so that nursing students who were the subjects/participants of the research would be cared for and nurtured by the researcher, with the awareness that each of them was unique with their learning process. This is in line with the philosophical foundation of post-positivism that recognizes the common humanity that connects researchers with the people who participate in the research, to learn with them rather than conducting research on them. Consequently, this study was quantitative in nature. The problem that was investigated fit into the theoretical framework and helped guide the study and enrich the findings. In application to my research, I believe that there is more than "just the facts", that theory

and practice cannot be kept separated but should work together to achieve common goals. Although dealing with the complexity of human beings, the emphasis of post-positivism is on good principles. It does not only deal with procedures, techniques, and methods but also involves ethical scrutiny. Overall, it was this research's assumption that the intervention (simulation refresher course) would result in a changed behavior of nursing students to render safe care to the patients during the administration of medication.

Research Questions

This study sought to answer the following exploratory questions:

1. What is the effect of the simulation refresher course on nursing students' knowledge and performance in safe MA in ACNHS, Penang?
2. What is the difference between year two and year three nursing students' knowledge and performance in MA before and after the intervention?
3. Which subscales or categories in the Five Rights of MA require further intervention for the students?
4. What is the relationship between student's GPA in their pharmacology and their knowledge and performance in MA?
5. What are the main barriers faced by nursing students during MA, as perceived by themselves?
6. What are the main obstacles faced by nursing students during MA, as perceived by clinical instructor?

Methods

Sample

The sample population was from the second and third year nursing students in the

diploma program of ACNHS, Penang, Malaysia. In this nursing college, there were a total of 83 Diploma in Nursing students in the second and third year. Forty two students were in the second year and 41 students in the third year. Therefore, there were 42 students in one group and 41 students in the second group at the beginning of the study. All subjects met the inclusion criteria and provided consent indicating their willingness to participate in the study. The participants satisfied the inclusion criteria to be enrolled in the study which were 1) participants were students in the Diploma in Nursing program studying in ACNHS, Malaysia, 2) only second and third year nursing students who had passed their pharmacology course in year one at first attempt were allowed to participate in the study, 3) the students were on a regular scheduled list for clinical practice prior to taking the SAM Scale, and 4) the participants were required to obtain at least the second column on the procedure log book in all drug administration including oral, PR, SQ, IV, and IM injections. The fulfilment of signature in the log book indicated the student had done the procedure under clinical instructor's supervision and was verified to be competent during the procedure according to the institutional standard operating procedure. Students who repeat the semester and repeat the pharmacology course were excluded from the study.

Participation was voluntary, but encouraged for all nursing students in year two semester 1 and year three semester 1 in the ACNHS. Once the students had volunteered to participate and signed the consent form, they were randomly assigned to two groups. A systematic sampling was used to divide the students in two groups. This was done by obtaining the name list of students in year two and year three from the college. Using the name list, students were selected into an "even" number group and an "odd" number

group. Students with even numbers on the name list belonged to "even" number group and student with odd number belong to "odd" number group. After the two groups were formed (without knowing which group is the intervention or control), the researcher then placed two numbers (#1 as odd number and #2 as even number) inside a box and asked one of the participants at random to draw one number without looking inside. The first number that was drawn (either #1 or #2) was assigned as the intervention group for the research. The researcher had informed all participants about the research and the procedures before the drawing of the number. After each group had been identified, the research was commenced by giving a pre-test using the SAM Scale to all participants. Each group (control and intervention), had an equal mixture of second and third year students.

Protection of Human Subjects

The proposal was submitted to the Loma Linda University Institutional Review Board (IRB) for ethics approval. At the same time approval from the Penang Adventist Hospital Clinical Research Centre (ACRC) committee was obtained prior to carrying out the research within this facility. Even though the ACRC is not an ethics committee, the committee ensures that any research conducted within the institution is safe for both the participants and researcher.

To protect the rights of the nursing students, full explanation about the study was given. Written consent was obtained from the participants to assure the voluntary nature of their involvement and to inform them that they had the right to withdraw at any time without penalty should they chose to do so. All participant were informed about confidentiality of their information and that no names would be published at anywhere at

any time without the participant's approval. No personal identifying information was included in the study. Student names were replaced with a coded number. The completed tool was collected by the researcher and stored in a locked cabinet accessible only by the researcher. After the data was entered into the computer, the data was stored in the encrypted file. One year after the study has been completed; the master list will be destroyed. The students were informed that participation in the research would not affect their academic grade at the college at any time.

The Modified Gladstone Scale of medication errors (see Appendix C) was administered to all participants from both groups after the administration of the second SAM Scale post-test. In addition to nursing student participants, clinical instructors were also requested to complete the survey questionnaire. For the CI, their completion of the questionnaire indicated consent and agreement to participate in the survey. Participants were assured of the confidentiality of the survey and that no names should be written on the questionnaire paper when answering.

Risk to the participants during the study was minimal. Some students may have experienced fatigue due to the length of the SAM scale potentially leading to boredom and the possible abandonment of the scale. There were no incomplete questionnaire were counted and were discarded according to policy during the study. The simulation refresher course was based on the Kolb's Experiential Learning Theory (KELT) where it portrayed a four-stage learning cycle to obtain concrete experience; reflective observation; abstract conceptualization; and active experimentation. During the simulation refresher course, the researcher showed concern and guidance to the participants as mentor and model, and role-modeled the participants according to the

MRM theoretical framework. Each student participating in the study was given an incentive of Ringgit Malaysia (RM) 30 upon the completion of the study as a token of appreciation for their participation. Indirectly the students may have benefited from the experience and the direct consultation from the researcher during the course of the study being conducted.

Procedure

Intervention- Simulation Refresher Course

A simulation in MA functioned as a refresher course in the intervention group of nursing students in year 2 and 3 at Adventist College of Nursing and Health Sciences (ACNHS), Penang. Students in the intervention group were informed that the course was for them to refresh what they had already learned previously in the pharmacology course and was not an examination. This was to reduce fear and anxiety that could affect performance The refresher course (see Appendix D – Intervention Package) took approximately two hours to complete. Each student was provided with a variety of methods of MA (Per oral, IV, IM, SQ and per rectum). Five scenarios designed to enable students to develop their problem-solving skills and to emulate a safe behavior during MA, were used. Scenarios contained simulated patient' demographic data (name, sex, age, allergies, date and hospital ID), chief complaint, history and physical examination, diagnosis, and medication orders in a medication administration record (MAR). The MAR contained at least three different medications to be administered via various routes (oral, SQ, IV, PR, or IM injections). Each student completed two or three scenarios performing the MA procedure. For each scenario, students were given approximately 10 minutes to complete the procedure. Any extra time was used to repeat the procedure if the

student did not comply with the Medication Administration Safety Assessment Tool (MASAT) or did not feel confident performing the administration of medication. During the MA simulation refresher course, all students in the intervention group were observed and guided by the researcher using the MASAT. Students could refer to the MA procedure manual (see Appendix D- Intervention Package) by the ACNHS which they had used during their pharmacology course. The procedure manual contained observable behaviors representing behaviors to be exhibited during medication administration. The equipment for the scenario included human patient simulators (HPS), medication Pyxis system, and physician's orders in the MAR. Student participants administered medications in accordance with the scenario.

The MASAT is an eight-item checklist that records the participant's behavior regarding adherence to each of the rights of MA. It is scored in a dichotomous fashion with the researcher checking Yes or No in the box for each of the observations associated with the rights of MA during a single medication pass. The checklist items correlate to each of the rights of MA which are the right patient, right drug, right dose, right route, right time, and right documentation which is congruent with the Penang Adventist Hospital (PAH) and ACNHS administration of medication standard operating procedure and manual. Criteria are specific. For example, if the student did not check the correct drug and route for each medication, the item was checked as "No". In order for the student to complete the intervention, each student was required to earn all "yes" in the MASAT checklist for each of the medications in order to pass. If they failed to do so, they were required to re-do (remediation) the intervention until all the eight "yes" was obtained.

The MASAT was developed using a content-validity approach. It is an instrument used to measure adherence to the rights of MA that can be used in a simulated or actual clinical setting. However, for this research MASAT is used as a guide for learning and to observe the student's behavior during the simulation refresher course. To achieve content validity, initial item content was derived based on the literature and drawn directly from the specified content domain. It was further established and documented prior to pilot testing using subject matter expert (SME) ratings using a survey designed to measure the extent to which the content of the MASAT represents and adequately samples the knowledge of the rights of MA (Goodstone & Goodstone, 2013). The scale content validity index was 0.93 which considered acceptable for the measure. Inter-rater reliability was calculated across all four raters, using the rater agreement index and was 0.83 for 14 student samples showing agreement. The internal consistency of the MASAT was assessed with a Cronbach alpha of 0.84.

Steps of the Procedure

A formal letter (see Appendix J) was sent to the Administrative Committee of ACNHS to inform the college administration of the intent and objectives of the study and to seek permission to allow nursing students and clinical instructors to be involved. Permission and approval of support (see Appendix J) were obtained from both the college administration and from the Penang Adventist Hospital Clinical Research Centre (ACRC). The LLU Internal Review Board approval (see Appendix G) was also obtained prior to the beginning of any research activity. After permission was granted for the study to be conducted in ACNHS, an appointment through open announcement during college assembly was made. This announcement invited all year two and year three nursing

students to come for a briefing on the study objectives, purpose and procedure. The purpose of the meeting was also to have a question and answer session and to provide information regarding the voluntary nature of the study. During the scheduled meeting, the venue, the time for the pre-test, the random selection of groups, the intervention process and post-test 1 and 2 (overall schedule), and overall general expectation during the research period was explained. After the explanation, consent (see Appendix I-Informed Consent Form) was obtained from students who agreed to participate. A date was arranged, and the SAM scale (pre-test) was administered to all students (both groups). To reduce the sensitization of the scale, students were told not to discuss the questions until the research period was over. Two weeks after the pre-test the intervention group underwent the simulation refresher course. The purpose of the time period (two weeks) was to reduce the effect of sensitization of the questionnaire so that students would be less likely to remember the question or the flow of the SAM scale that could have affected the performance during the simulation refresher course. The control group carried out their routine learning activity as usual. (i.e. care plan, clinical, possible MA in the ward etc.). The post-test #1 SAM scale was administered to the control group one month after the SAM Scale pre-test. Students in the intervention group were given the SAM scale within the next week (one week) after the treatment, which was approximately one month after the pre-test. Thus the control and intervention group took the post-test #1 SAM scale at the same time. This was to prevent loss of information received during the refresher course. To ensure sustainability, the SAM scale was administered one more time (post-test #2), both to the intervention and control group,

approximately two months after the SAM scale pre-test or one month after the post-test #1. The research flow of the study is shown in Table 2.

Table 2

Intervention versus control group schedule

	Pharmacology Course (Y1S2)	**Pre-Test (O) (SAMS)**	**Treatment (X) (Simulation Refresher Course)**	**Post-Test #1(O) (SAM Scale) – one month after SAM pre-test**	**Post-Test #2(O) (SAM Scale) – two months after SAM pre-test**	**Modified Gladstone**
Intervention Group (n =42)	Yes	Yes	**Yes**	Yes	Yes	Yes
Control Group (n =42)	Yes	Yes	**No**	Yes	Yes	Yes
CI (n =19)	No	No	No	No	No	Yes

Intervention group:	O1a	X	O2a	O3a
Control group:	O1b		O2b	O3b

After completion of the SAM Scale post-test #2, all student participants and CIs were asked to complete the Modified Gladstone Scale questionnaire. Each student took less than 10 minutes to complete the scale and submitted it to the researcher. Clinical instructors also participated in answering the Modified Gladstone Scale questionnaire. The questionnaire contained no identifiable information and completion indicated consent from the CI to participate. Clinical instructors were asked to return the questionnaire within three days. The timeline and schedule of the research study are shown in Table 3.

Table 3

Timeline for research activities

Date	Activity
Week 0	Send letter to the ACNHS administrative committee
Week 1	Meet all potential participants (nursing students) during college assembly.
Week 2	Meet with CI. Explain the objectives and purpose of the research – Modified Gladstone Questionnaire.
Week 2	Meet with students (year 2 and year 3) – inform about the time and venue of the pre-test and expectation during the research period.
Week 3	Randomize to intervention and control groups according to name list (even and odd number). First drawn number (even or odd) selected as the intervention group.
Week 4	Administer SAM Scale to all participants as **Pre-test** (Intervention and control group)
Week 6	Start Simulation-refresher course for the intervention group (1 instructor only) Group 1: Day 1– 10 students Group 2: Day 2– 10 students Group 3: Day 3 – 11 students Group 4: Day 4 – 11 students (Due to the number of participants (42), the group will be divided into smaller groups to ensure that information will be equally distributed)
Week 8 (1 month after the pre-test)	Administer SAM Scale (Post-test #1) to an intervention group and the control group at the same time
Week 12 (1 month after post-test 1)	Administer SAM Scale (Post-test #2) to an intervention group and a control group
Week 13	Modified Gladstone scale of medication errors administered to all participants – intervention group and control group and clinical instructors (Completion of the questionnaire for the CI indicates consent for participation). (To prevent fatigue, the Modified Gladstone scale of ME will be administered at least one week after the SAM scale)
Week 14 - 20	Analysis of data

Measurement of concepts/ variables

Included in this section are two tools/instruments (see Appendix A & C) that were used to measure variables and another tool (one) used for intervention purposes. They

were selected based on their reliability and validity. Permission for copyright tools (see Appendix F) was obtained prior to use of the tools. No adjustments were made to alter tools without the permission of the person(s) or organization that had copyrighted the tools or instruments.

SAM Scale

The Safe Administration of Medication (SAM) Scale (see Appendix A) is a pencil and paper test which is able to measure theoretical knowledge and performance of the nursing students (Ryan, 2007 & Gonzales, 2011), rather than measuring performance through direct observation. Ryan (2007) provides evidence that the SAM Scale can be used as one method to theoretically measure individual student's knowledge and performance in administering medication. The SAM Scale was developed by Ryan (2007) as a part of a dissertation paper to measure knowledge and performance objectively during the administration of medication by student nurses; it is based on the Five Rights of safe MA. Initial content validity was established by Ryan (2007) by employing five nurse experts, four nursing faculty from the university where the data collection was made, and one non-faculty who was a bedside nurse and who routinely administered medications. For this tool, Ryan (2007) reported evidence of fit validity, specifically both person fit and item fit, indicating the model fits the data. Specifically, Ryan (2007) reported a mean unfit statistic of 0.99 and a mean outfit statistic of 0.86 for person fit, and a mean unfit statistic of.99 and a mean outfit statistic of.87 for item fit. For reliability, Ryan (2007) reported that items on the SAM scale were significantly differentiated from one another and reliably defined item difficulty. Reliability of separation was 0.87 for medication items, indicating that items are significantly

differentiated from one another and reliably define item difficulty. Person separation reliability is similar to the KR20 measure of internal consistency. Reliability of separation of nursing students was 0.39, indicating that student nurses are not well differentiated. Gonzales (2011) repeated the study and found the Cronbach's alpha for all 70 items to be 0.77, which demonstrates that the SAM scale has moderate evidence of internal consistency reliability.

This tool/instrument includes a total of five cases. Each case has two or three vignettes, and each vignette consists of five items for a total of 70 items. Each vignette comprises a short scenario, and participants are to determine if each action taken by the nurse, in the process of administering the medication, is a correct or incorrect action. Using a case response table, participants indicate a correct action by placing "yes" or a "check" (√) in the corresponding box and "no" or (×) if the action the nurse took was incorrect. The corresponding boxes represent the Five Rights of MA for each vignette, which are also the sub-scales in the tool; Right Patient, Right Drug, Right Dose, Right Time and Right Route. The result will be able to indicate which particular category or sub-scale (i.e. right patient, right drug, right dose, right time or right route) has the highest number of right or wrong answers which means that this particular sub-scale (right) needs to be emphasized. There will be a total of 14 vignettes; therefore the possible highest mark for each sub-scale will be 14, whereas the overall total score for this tool will be 70. The SAM Scale requires students to use critical thinking in making decisions, and this action will require them to "put themselves in the situation" projected in the scenario in order for them to be able to check for the correct answer.

The procedure for completing the SAM Scale was the same for all participants. Following review of the informed consent document and completion of the demographic data questionnaire, students were given the SAM Scale and reviewed instructions for completing it. Nursing students were given one and a half hours to complete the SAM scale as suggested by Gonzales (2011) and were allowed to use calculators and drug books when taking the test.

The Modified Gladstone Medication Errors Questionnaire

The Modified Gladstone survey (see Appendix C) was used to collect data to examine the barriers or obstacles of safe medication administration by nursing students and by clinical instructors. This instrument measures (i) perceived causes of medication errors (10 items), (ii) percentage of drug errors or near misses reported to nurse managers or CIs (1 item), (iii) types of incidents that would be classified as (a) medication errors, (b) reportable to physicians, or (c) reportable using an incident report (6 items), (iv) nurse views about reporting medication errors (6 items), and (v) student nurses biographical data. For the first item no (i), participants were required to indicate with the number "1" the most common perceived cause of medication errors and the number "10" indicated the least common perceived cause of medication errors. The instrument content validity was determined acceptable by Osborne, Blais, & Hayes (1999) and Goldstone (1995). In addition, Osborne et al. (1999) established reliability using the test-retest method (0.78) in their sample. The Cronbach's alpha was 0.65.

For this research, this tool was modified by having only one section of the questionnaire which is to rank the perceived causes of medication administration error. This is to suit the need of the study and the applicability of the tool within the

environment and the subjects. Permission for modification was obtained from the author. The most important part of the tool is the perceived causes of medication errors (10 items), where participants are given a list of 10 possible causes. Participants would label each cause on a scale ranging from 1 and 10, where "1" indicated the most frequent cause and "10" indicated the least frequent cause. The researcher totaled the numbers and calculated an average score for each item. An additional space was provided for the participants to write down the barriers they thought could lead to medication errors, but were not already noted on the questionnaire

Demographic Profile

Along with the above measurements of the main concepts, demographic information of nursing students was collected. This information was included in a researcher-developed questionnaire which included the SAM Scale form, and was easy to be filled-in by the students. Demographic data included gender, age, and current semester level. These items were arranged in ordinal categories and were collected to help interpreting the results and in understanding the population to whom the findings could be generalized.

GPA in Pharmacology Subject

Each nursing student was asked to enter their Grade Point Average (GPA) for a pharmacology subject that they took in year one semester 2. Students were reminded to check and obtain their pharmacology grade prior to taking the questionnaire. After the students have enter the GPA on the questionnaire, the researcher would obtain a copy of the grade report from the school to validate a correct documentation by the students. The purpose of this was to see whether higher GPAs obtained by students for pharmacology

subject had any relationship to the knowledge and safe performance in MA as indicated by the SAM scale score.

Statistical Analysis

The analysis of data was done using statistical package of social Science, SPSS (Version 22). Descriptive statistics (mean, standard deviation, and frequencies) were used. In understanding the effect of the simulation refresher course on nursing students, it was necessary to compare scores between the intervention and control group. For this a repeated measures ANOVA was used to gain scores. To examine whether pharmacology GPA is predictive of scores on the SAM Scale, multiple regression was used. A correlation coefficient was reported. To report performance differences between groups (year 2 and year 3) in the intervention, independent t-tests was used.

Data Preparation & Management Plan

Once the data were collected, any names in the data sheets was removed and replaced by a code. A master code list matching subject names to numbers assigned to data was kept in a separate file locked by a password. In a situation where a student was not able to complete the study or requested to withdraw during or after the intervention, they were dropped from the study and the worksheet destroyed. A backup storage strategy was put in place in the event of computer technical issues.

Limitations

Anticipated limitations for this study was a low sample size due to the trouble of student's lacking time to take tests or a lack of interest in the subject matter. The limited number of nursing students in ACNHS affected available sample size and therefore this may affect the generalizability of the study. The length of the SAM Scale may have

caused students to feel tired and fatigued during the test and therefore the rate of abandonment might have been high, but this did not turn out to be a problem. Other potential limitations could be due to the sensitization from the pre-test where students may remember part of the SAM scale question even after one month, and another one month after the first post-test #1. This could affect the score that reflects an increase in knowledge and performance of nursing students.

Summary

This section discussed the strategies that were employed during the research period, the procedure, and the rationales designed to achieve the study outcomes. A description of the research design, the assumptions that are relevant to the study and research questions were presented. The methods used and the data analysis plan were described in detail. For the intervention in this study, Medication Administration Safety Assessment Tool (MASAT) was used to indicate whether nursing students who were in the intervention group performed according to a policy related to the Five Rights. MASAT is normally used in studies concerning adherence to MA policy and has not been used as an intervention to improve knowledge and performance in MA. This was the first time MASAT has been used as intervention tool for the benefit of the study.

The SAM Scale can be considered a new tool, hence there were minimal benchmark data as to the expectations of the tools outcome to compare with the proposed sample. Findings from this study using the SAM Scale, will contribute to benchmark and guidelines for future research as well as an improvement in safety that is related to MA procedure. This study intended that the tool would be able to make a meaningful

contribution to the understanding of safe administration of medication while providing possible future interventions to achieve the aims.

CHAPTER FOUR

RESULTS

Introduction

This chapter describes the analysis of data. The chapter is divided into four subsections: the data management process, the geographical sampling sites and the sample demographics, results of the descriptive analysis and results of the inferential analysis. The research questions relating to the aims organize the presentation of the descriptive and inferential results sections. Data were analyzed to identify, describe, and explore the effect of a simulation refresher course on knowledge and performance of nursing students in medication administration (MA) in a private nursing college in Penang, Malaysia. Barriers to safe administration of medication were also identified by students and by clinical faculty.

Data Management

Data Preparation

Prior to data entry, variables were pre-coded and a data dictionary was established. Students answered directly on the test questionnaire, and the researcher was present during all the testing to ensure that all questions were answered and demographic profiles were filled up before submission by the participants. This action was to ensure that there was no missing value when entering data to the SPSS (version 22). Two participants were not able to take the second post-test due to health reasons, and therefore, "999" was used to represent missing values so that the mean total score could be calculated despite their absence. After the data were cleaned and checked for accuracy, they were converted to total of scores so that normality of data could be

established. The data were also checked for outliers. Based on the type of data in the final phase, adjustments were made as it regarded the use of parametric or non-parametric statistics (Field, 2013).

Data Collection and Entry

The data were collected over a period of 14 weeks from October 2014 through January 2015. The test format was pen and pencil and in English. Following the informed consent process, and after a date had been set up, the questionnaire was distributed to all participants. At the beginning (pre-test), all 83 participants completed the SAM Scale pre-test in the college's examination hall. The hall holds more than 100 students with individualized tables and chairs suitable for examination. Before the participants answered the test questionnaire, they were given instructions by the researcher on how to complete the test. The session was treated like a real examination and each participant's answers were not shared with other participants to maintain the validity and credibility of the test result. To represent real-life experience, participants were allowed to use calculators and access drug books available at the examination hall. The researcher was present at all times during the test to answer all general questions from the participants. Questions from participants asking for direct answers were not entertained. The researcher had informed the students that they could ask the researcher to translate any questions (from English to Bahasa Malaysia) if there were any doubt about the language. The students were given adequate time (one and a half hours) to complete the test. All participants completed the pre-test within the time frame. The same process occurs at the post-test #1 and post-test #2. Two participants were absent during the post-test #2, therefore both of them were dropped from the study, making the total sample size 81,

instead of 83 from the original sample.

During the data-collection process, participants were required to enter demographic data prior to answering the SAM Scale. Demographic data included the participant's given an identification number (by the college), gender, education level, age, and grade point average (GPA) of the student's pharmacology subject taken in year one semester two. No names of participants were obtained at any time during the study. All scores for pre-test and post-tests for each participant were linked using the participant's identification number. When all the questions on the test were completed and submitted to the researcher, the researcher reviewed the test questionnaire paper to ensure that all questions had been answered according to instructions before allowing the participant to leave the examination hall. This was done for each participant. The data were then entered into SPSS software (Version 22) by a data entry person hired by the researcher (who was not involved in the study) and the researcher visually checked the data for any errors immediately after it was entered into the SPSS. Any identified errors due to omissions from entering the data, incorrect data entry, or incorrect reading of codes was rectified immediately by the researcher. Frequency tables were generated to verify accuracy. Each variable was checked one by one and compared with the original test questionnaire by the researcher.

Data Cleaning

Based on established guidelines, the data cleaning process was carried out after the completion of the data entry. Data that were wrongly entered were assessed for omissions, data entry error, incorrect information, or even out of scope values. The data dictionary was checked thoroughly for inconsistencies in the coding scheme. Frequency

tables were generated for all variables, including participant answers for pre-test and post-tests. No reverse coding was required for these data. Missing data were replaced and coded with 999 so that it would not interfere with the means result of the variables. Due to the small data set, no issue pertaining to data cleaning was encountered.

Data Checking for Normality

The "Explore" function in SPSS was used to determine normality of the data in preparation for statistical decision making and testing. Various aspects of the quantitative data were assessed, including means and medians, standard deviations (SD), 95% confidence intervals (upper and lower limits), variance, skewness, and kurtosis. Further evaluation of the data included the use of Kolmogorov-Sminov or the Shapiro-Wilk tests, P-P and Q-Q plots, box plots and histograms.

Preparation of SAM Scale Data for Analysis

The Safe Administration of Medication (SAM) Scale questionnaire developed by Ryan (2007) has the ability to theoretically measure the knowledge and performance in administration of medication. This instrument has an accompanying scoring guide (see Appendix B) for each question (total no. of items = 70) so that it can be compared with that of participants' answers to establish a total score. Descriptive data were generated so that mean and percentage of the total scores could be used to evaluate the effect of the intervention and to compare groups. The percentage of the scores from each subscale were also calculated to identify types of medication "Rights" as required by the research question. The Cronbach's α as determined by Gonzales (2011) for all 70 items is 0.77 which demonstrates that the SAM Scale has moderate evidence of internal consistency reliability.

Preparation of the Modified Gladstone of Medication Errors Scale for Analysis

The Modified Gladstone Scale is a 10-item tool to measure perceived causes of medication errors where participants were required to rank item with the number "1" as the most common perceived cause of medication errors and number "10" as the least common perceived cause of medication errors. Cronbach's α as determined by Osborne et al. (1999) is 0.65 whereas the reliability using test-retest method is 0.78. Descriptive statistics can be generated from this scale to obtain median, interquartile range (IQR), and percentage, so the main causes of medication errors by nursing students can be obtained as perceived by themselves (nursing students) and by clinical instructors.

Geographical Sampling Sites

Data were collected at the Adventist College of Nursing and Health Sciences (ACNHS), Penang, Malaysia. This is a small nursing college with a student population of approximately 170. There are only two nursing programs offered currently which include the Diploma in Nursing program and the Assistant Nurse program. There are three groups in the Diploma classes and two in the Assistant Nurse program. See Table 4 for the ACNHS census with a more female population than males. Participants selected for this study were students from year 2 semester 1 and year 3 semester 1. They were selected because they had undergone the pharmacology course in Year 1 Semester 2. After an explanation about the study was given to all the students who agreed to participate, a consent form was distributed to each of the selected students for them to sign indicating that they voluntarily agreed to participate in the research. No questions were asked by the participant during the session. The goal for the number of subjects was to include all

willing students in year 3 semester 1 (Diploma Class 2015) and students from year 2 semester 1 (Diploma Class 2016) to participate in this study.

Table 4

Student Population of ACNHS in Penang as of November 2014

Level	level	male (n)	female (n)	Total (N)
Diploma Class 2015	year 3 semester 1	6	35	41
Diploma Class 2016	year 2 semester 1	2	41	43
Diploma Class 2017	year 1 semester 1	6	44	50
Assistant Nurse 2014	year 2 semester 2	2	14	16
Assistant Nurse 2015	year 1 semester 2	6	14	20
Total (N)		22	148	170

Results of Descriptive Analysis

Demographic Profile and Homogeneity Test of the Sample

The sample of eighty three subjects recruited from senior class (year 3 semester 1, n =41) and sophomore class (year 2 semester 1, n =42), completed the pre-test and post-test #1. However, for the post-test #2, there were only 97.1% (n =83) participants who completed the SAM Scale and the Modified Gladstone Scale. Two students were not able to take the SAM Scale post-test #2 due to their physical health. Participant's age, gender, level of education and GPA for pharmacology subject was collected as demographic data, shown in Table 5. The participants age ranged from 18 to 25 (M = 20.36, SD = 1.50) and with more female (90.4%) than male (9.6%). This is expected because the nursing profession worldwide is dominated mostly by the female gender. For age, 63.9% (n =53) of the participants were in the age range of 18-20 years old, 31.3% (n =26) in the age ranges of 21-23, and only 4.8% (n =4) participants in the age range of 24-26. Each participants' pharmacology subject GPA was recorded. Only 4.8% (n =4)

Table 5

Demographic data of participants

Variables		N	%
Gender			
	Male	8	9.6
	Female	75	90.4
	Total	83	100
Age			
	18-20	53	63.9
	21-23	26	31.3
	24-26	4	4.8
	Total	83	100
Level of education			
	year 2 semester 1	42	50.6
	year 3 semester 1	41	49.4
	Total	83	100
Student's Pharmacology GPA in Year 1 Sem. 2			
	3.0	4	4.8
	3.3	19	22.9
	3.6	54	65.1
	4.0	6	7.2
	Total	83	100

(n =83)

participants had a GPA of 3.0, 22.9% (n =19) had a GPA of 3.3, 65.1% (n =54) had a GPA of 3.6 and for the highest GPA of 4.0, there were 7.2% (n =6) . The sample was divided into two main groups: an intervention group (49.4%, n =41) and a control group (50.6%, n =42). Table 6 represents the educational level and number of participants in the control and intervention groups and the number of participants involved in each of the tests.

Table 6

Number of students represent each group

Level	n	Intervention	Control	Pre-test	Post-test1	Post-test2
Y 2 S 1*	42	19	22	42	42	41
Y 3 S 1*	41	22	20	41	41	40
Total	83	41	42	83	83	81

**Y=Year, S=semester*

Students were randomized into the intervention and control groups. The intervention group underwent a 'treatment' – a simulated medication administration refresher course - while the control group continues their education as usual. Levene's test was used to test differences between variances among groups. Table 7 indicates the result of the homogeneity test of variances for the SAM score on the pre-test. Based on the result of the Levene's test, there were no differences between the intervention and control groups in the mean scores for SAM Scale. The result indicates that the variability within the two groups (intervention and control) was not statistically significantly different indicating that the total sample was homogenous.

Table 7

Homogeneity testing of the two study groups for SAM Scores

Characteristic	Intervention (n =41)	Control (n =42)	*Levene's Test*	p
	Mean±SD	Mean±SD		
SAM Score (Pre-test)	*58.71±4.9	59.71±3.878	3.970	.050
SAM Score (Post-test #1)	*61.29±3.723	60.67±3.552	.012	.911
SAM Score (Post-test #2)	62.28±3.154 (n =39)	61.93±3.031	.001	.981

*Note** Sig. p<.05*

** Before dropping 2 subjects with missing data on Post-test 2*

Knowledge and performance in MA were evaluated, using the SAM scale as a pre-test. There were 14 vignettes with five questions in each vignette, each asking

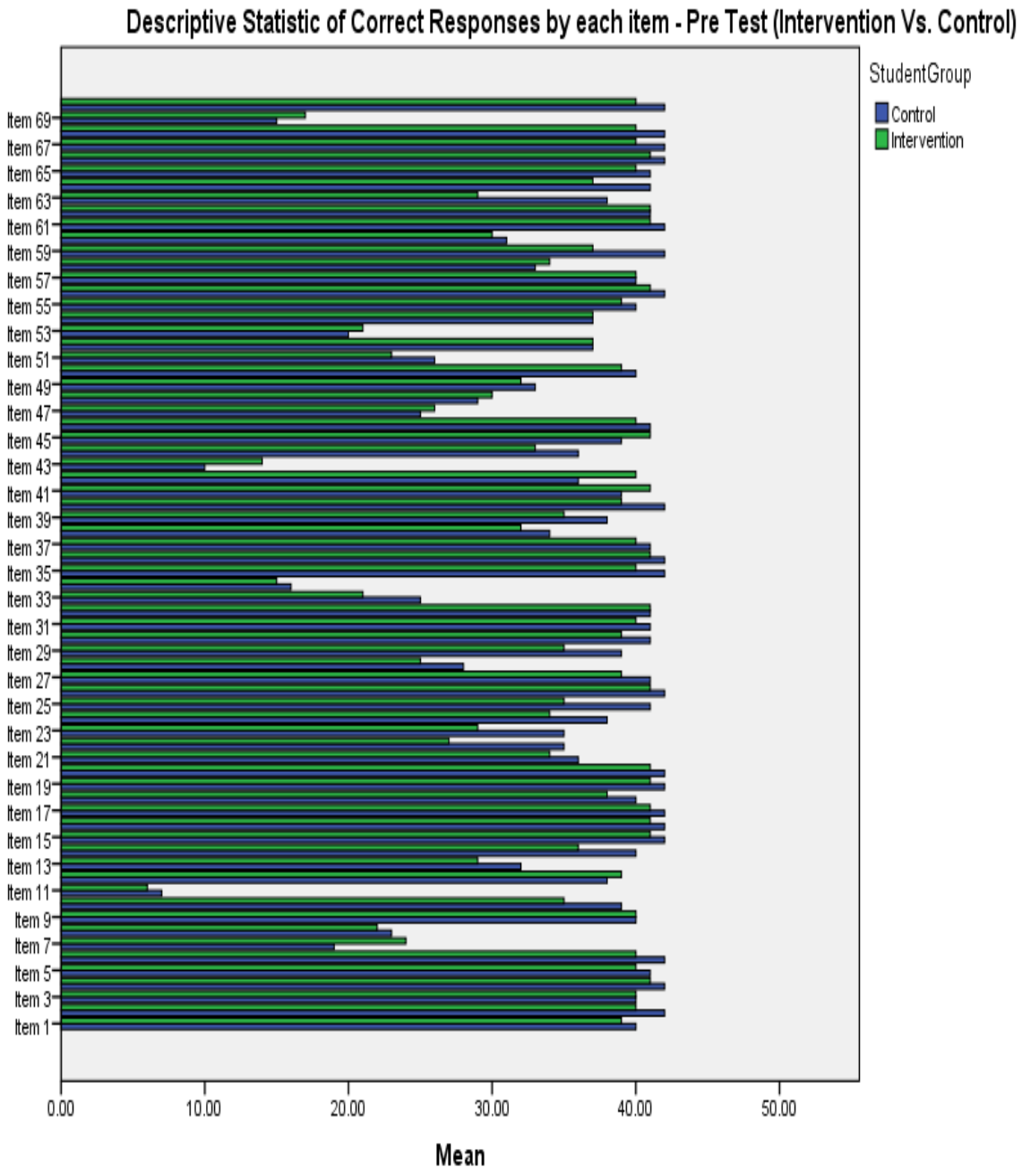
whether the action taken by the nurse in the scenario is according to the right patient, drug, dose, time, and route. Scoring was based on right action labelled as "1" and wrong action labelled as "2" in SPSS. Using the scoring guide, each participant answers were compared. For a correct answer, the participants scored 1 point. No point was awarded for a wrong answer. The overall mean score of the pre-test for both groups was 59.22 (84.6%). The mean scores for post-test #1 and #2 were 60.98 (87.15%) and 62.10 (88.7%) respectively. Table 8 shows the descriptive statistic of an overall score of the pre-test, post-test1 and post-test 2 scores of both groups.

Table 8

Descriptive statistic of overall SAM Scale score (Intervention and Control group)

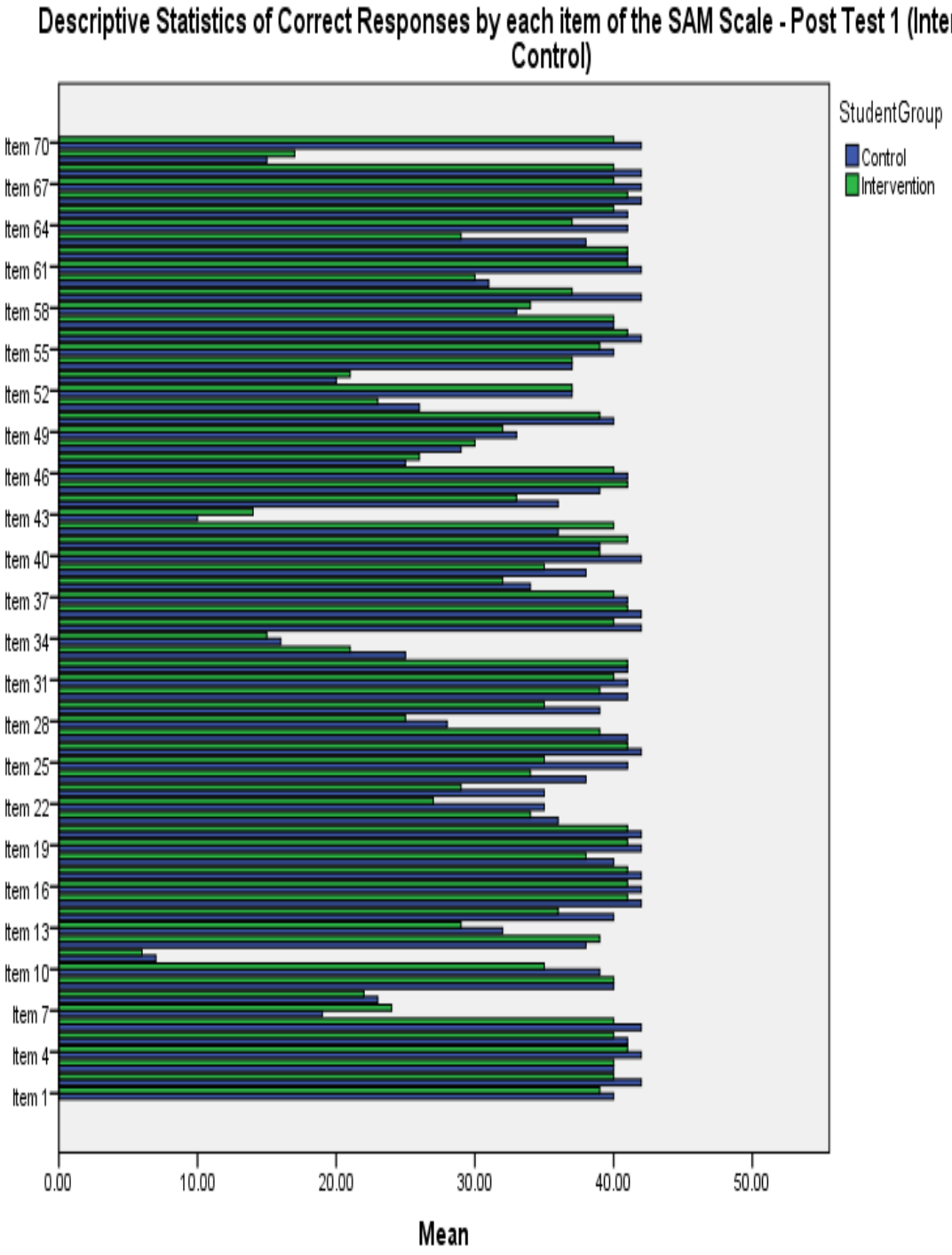
	N	**Min**	**Max**	**Mean**	**%**	**SD**
Total Score pre-test	83	48	67	59.2	84.6	4.415
Total Score post-test 1	83	50	68	60.9	87.2	3.629
Total Score Post-test 2	81	54	67	62.1	88.7	3.077

It is interesting to note the general pattern of student responses on the SAM Scale. Items where 100% of both the treatment (n =41) and control (n =42) got the following items correct during the pre-test: 15, 19, 26, 36, 56, 61, and 66, totaling 7 items or 10% of the SAM Scale. During the post-test #1, the number of items where 100% of the treatment (n =41) and control (n =42) got the following items correct: 9, 10, 15, 16, 19, 26, 27, 31, 36, 41, 56, 61, 62, 65, and 66, had increased to 21.4%. During the post-test #2, the number of items where 100% of both groups got correct increased to 25 (35.7%) (items 1, 2,6,10, 16, 19, 20, 26, 27, 31, 32, 35, 36, 41, 45, 46, 55, 56, 61, 62, 65, 66, 67, 68, and 70). Figures 4, 5, and 6 show comparison of the pre-test, post-test#1 and post-test #2 between intervention and control groups.



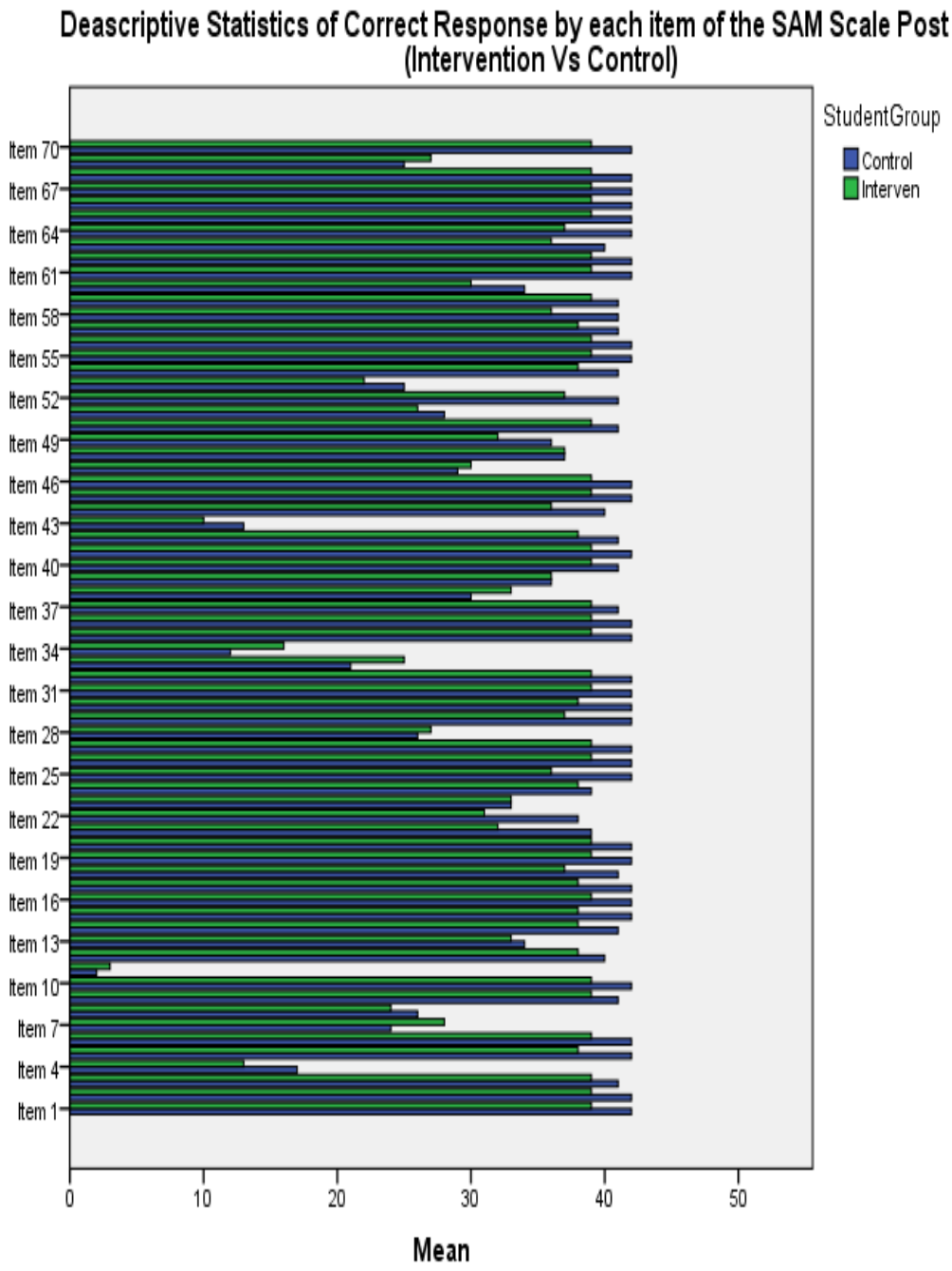
(Intervention n =41, Control n =42)

Figure 4. Descriptive Statistic of Correct Response by each item – Pre-test



(Intervention n =41, Control n =42)

Figure 5. Descriptive Statistics of Correct Response by each item – Post-Test #1



(Intervention n =39, Control n =42)

Figure 6. Descriptive Statistics of Correct Response by each item – Post-Test #2

In the Modified Gladstone questionnaire, 44% (n =100) of the participants of nursing students and clinical instructors admitted to having experienced medication errors or near misses during MA procedure. The questionnaire also recorded information whether or not

participants had been willing and comfortable to report any medication error they had committed to the clinical instructors (for nursing students) or/and to the administration (for clinical instructors). Table 9 shows the descriptive statistics of the willingness of participants to report any MAEs or near misses.

Table 9

Willingness to report medication errors

Feel comfortable to report	**Role**		**Total**
	Clinical Instructor	**Nursing Student**	
Yes to Administrator	18	0	18
No to Administrator	1	0	1
Yes to Clinical Instructor	0	76	76
No to Clinical Instructor	0	5	5
Total	**19**	**81**	**100**

Results of Inferential Analysis

Research Aim I

Describe the effect of simulation refresher course on knowledge and performance in medication administration of nursing students of ACNHS (Penang) using the SAM scale to compare the intervention group (given the simulation refresher course) to a "teaching as usual" control group.

Question One

What is the effect of the simulation refresher course on nursing students' knowledge and performance in safe medication administration in ACNHS, Penang, when comparing the intervention group to the control group?

To evaluate the effect of the simulation refresher course on the nursing students' knowledge and performance, different statistical tests were performed. Responses to the

SAM scale for two groups were compared; an intervention group (given the simulation refresher course) and a "teaching as usual" control group.

A two-way repeated measures analyses of variance (ANOVA) was conducted to evaluate the null hypothesis (*H*o: there is no change in participants' SAM scale scores when measured at pre-test, post-test #1 and post-test #2) in the intervention group (n =39). Two subjects were dropped from the original intervention group because of physical illness interfering with their completion of the post-test #2. Scores for the intervention and control groups are described in Table 10 below. In Table 10 we see an increase of score in the intervention group from pre-test ($\bar{x}$=58.82, SD=4.77), post-test #1 ($\bar{x}$ =61.8, SD= 3.68) and post-test #2 ($\bar{x}$ =62.28, SD=3.154) indicating a minor effect of the treatment on the intervention group (*n* =39). However, there is also a small increase in the control group scores.

Table 10

SAM Scale Scores for Intervention and Control Group

Characteristic	**Intervention (n =39)**	**Control (n =42)**
	Mean±SD	**Mean±SD**
SAM Score (Pre-test)	58.82±4.77	59.71±3.878
SAM Score (Post-test #1)	61.08±3.688	60.67±3.552
SAM Score (Post-test #2)	62.28±3.154	61.93±3.031

Table 11 shows the ANOVA results for all test scores of SAM Scale. Mauchly's Test of Sphericity was satisfied with the significance level of *p* =.066. The table shows that there is a significant time effect *p* = .000, indicating a significant change in the total score of SAM Scale over time. However, the interaction between groups (intervention

versus control) was not significant, $p = .198$, which indicates no group effect over time (see Table 11 and Figure 7). The effect size was calculated as .236, which is a small effect according to Cohen (1998).

Table 11

General Linear Model of Total SAM Scale

	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Time	327.584	2	163.792	24.379	.000	.236
Interaction	21.970	2	10.99	1.635	.198	.236

*Note** Sig. p<.05*

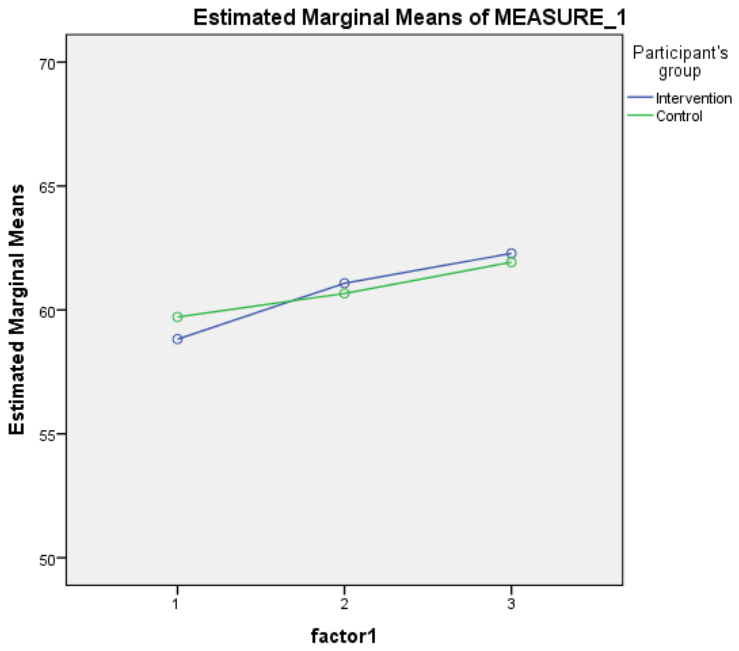


Figure 7. Profile plot of interaction effect between intervention and control group

Question Two

Is there any difference between year two and year three nursing students' knowledge and performance in medication administration before and after the intervention?

Independent t-test were performed to evaluate the difference between year two and year three nursing students' knowledge and performance in medication administration before and after the intervention based on the SAM Scale score. The effect size for each score was calculated to discover whether the effect is substantive using equation as below to convert the *t* statistics into a value of *r* (Field, 2013).

$$r = \sqrt{\frac{t^2}{t^2 + df}}$$

Three comparisons of scores between the groups (year 2 semester 1 and year 3 semester 1) were made: (a) pre-test score, (b) post-test #1 score, and (c) post-test #2 scores. On the (a) pre-test, on average, year 3 nursing students scored slightly higher ($\bar{x}$ =59.54, SE=.806) than year 2 nursing students ($\bar{x}$ =58.90, SE=.551). This difference was not significant *t* (71) = -.647, *p >.05;* the effect size was very low, *r*=0.08. On the post-test #1 score (b), on average, year 3 nursing students also scored slightly higher ($\bar{x}$=61.63, SE=. 628) as compared to year 2 students ($\bar{x}$=60. 33, SE=. 480). The difference between the two groups are also not significant *t* (81) = -1.65, *p*= >. 05; the effect size was also low, *r*=0.18. The last score (c) post-test 2, on average, the year 3 nursing students again scored slightly higher ($\bar{x}$=62.63, SE=.539) as compared with the nursing student year 2 ($\bar{x}$=61.59, SE=.415). Although there appeared to be a difference in the score, this difference was not statistically significant *t (79) =1.53, p*= >.129 (Table 12). The effect size of this score was *r*=0.17, which is also low. The three comparisons show that even though the year 3 semester 1 (senior) nursing students appeared to score higher than the year 2 semester 1 nursing students, the difference was not statistically significant for all three comparisons.

Table 12

Independent t-test scores – Level (RQ2)

Scores	Level	Mean	SD	*t*	*p*
Pre-test	1	58.9	3.57	-. 65	.518
	2	59.54	5.163		
Post-test #1	1	60.33	3.11	-1. 65	.103
	2	61.63	4.22		
Post-test #2	1	61.59	2.66	-1. 53	.129
	2	62.63	3.41		

1= Year 2 Semester 1 (n =42)
2= Year 3 Semester 1 (n =41)
*Note** Sig. p<.05*

Research Aim II

Identify which sub-scales or categories in the Five Rights show the lowest test scores, indicating a need for particular attention in teaching MA.

Question Three

Which subscales or categories in the Five Rights of MA require further intervention for students, based on the SAM Scale results?

Table 13 represents the "Five Rights" with the item number in the SAM Scale questionnaire. In each of the "rights", there is a total of 14 vignettes. Table 14 represents the percentages of correct answer for each test (pre-test, post-test# 1 and post-test #2) with each "right." After that, the total mean for each "right" was calculated to obtain the percentage

Table 13

The "Rights" with item number

Right	Item no: (Total 14 Vignettes)
Patient	1,6,11,16,21,26,31,36,41,46,51,56,61,66
Drug	2,7,12,17,22,27,32,37,42,47,52,57,62,67
Dose	3,8,13,18,23,28,33,38,43,48,53,58,63,68
Time	4,9,14,19,24,29,34,39,44,49,54,59,64,69
Route	5,10,15,20,25,30,35,40,45,50,55,60,65,70

From Table 14, we can see that Right Dose has the lowest raw score of 75.6%, followed by Right time (81.6%), Right drug (91.1%), and Right patient (91.7%). The highest score is a Right route (95.1%).

Table 14

Percentage of correct responses of "Rights" by participants in each test.

Rights	Intervention Group			Control Group			Total Mean
	Pre-test (n =41)%	Post Test#1 (n =41) %	Post Test#2 (n =39) %	Pre-test (n =42) %	Post Test#1 (n =42) %	Post Test#2 (n =42) %	
Patient	88.7	90.2	96.3	88.9	88.9	97.1	**91.7**
Drug	89.2	92.2	93.8	88.4	90.1	93.0	**91.1**
Dose	70.3	78.6	78.9	73.0	76.0	76.5	**75.6**
Time	77.4	80.0	85.2	80.8	81.8	84.4	**81.6**
Route	93.7	96.9	97.2	95.6	88.8	98.3	**95.1**

To analyze the five sub-categories within the SAM Scale, a two-way ANOVA was performed, looking for time and group effects on subjects with completed data. The findings are shown in Tables 15 - 19. For the subscale "Right Patient" Mauchly's Test of Sphericity was not met. Therefore Greenhouse-Geisser was used, showing that both time and interaction was non-significant (see Table 15 and Figure 8).

Table 15

General Linear Model of Subscale: Right Patient

	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Time	1.412	2	.706	1.525	.221	.019
Interaction	.754	2	.377	.814	.445	.010

*Note** Sig. p<.05*

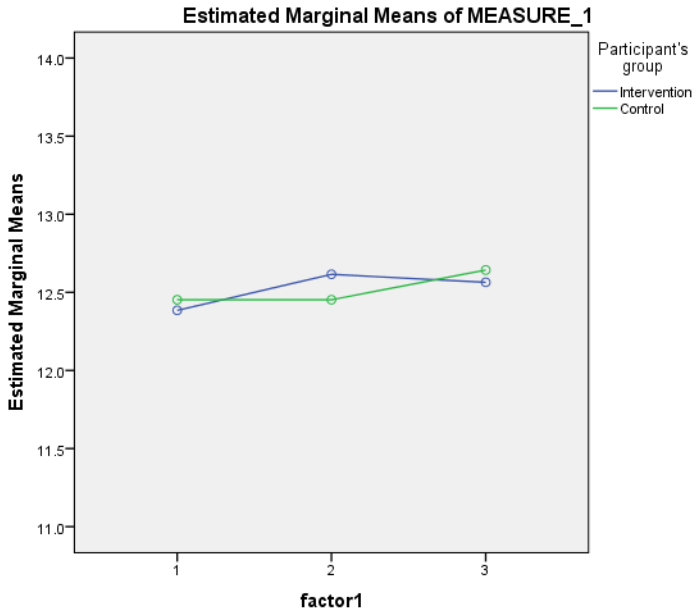


Figure 8. Profile Plot of Subscale: Right Patient

For the subscale "Right Drug" Mauchly's Test of Sphericity was not met. Therefore Greenhouser-Geisser was used. Time was significant, showing a change of score over time, but there was no significant interaction between groups (see Table 16 and Figure 9).

Table 16

General Linear Model of Subscale: Right Drug

	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Time	17.343	1.701	10.198	11.886	.000	.131
Interaction	.010	1.701	.006	.007	.987	.000

*Note** Sig. p<.05*

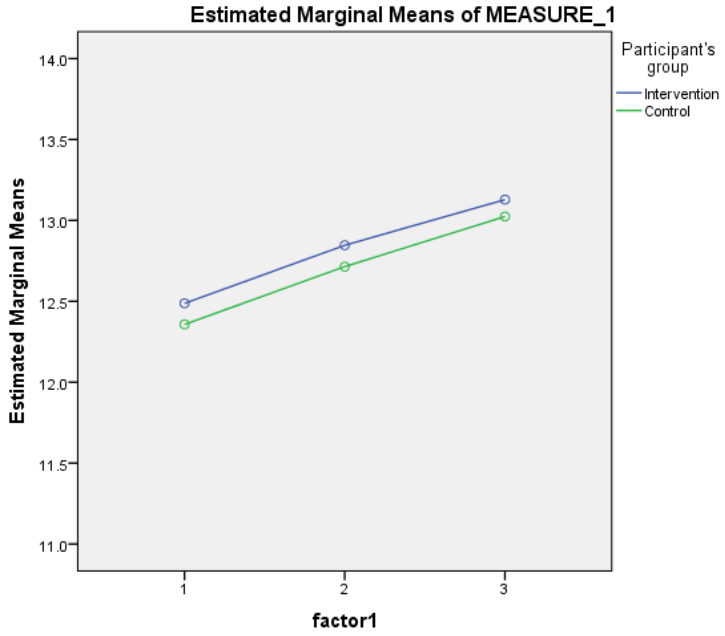


Figure 9. Profile Plot of Subscale: Right Drug

For the subscale "Right Dose" Mauchly's Test of Sphericity was satisfied with a significance level of p =.110. There was a significant change over time in scores, but there was no significant interaction between groups, as shown in Table 17 and Figure 10.

Table 17

General Linear Model of Subscale: Right Dose - Mauchly's Sphericity assumed

	Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Time	31.895	2	15.948	8.890	.000	.101
Interaction	4.883	2	2.441	1.361	.259	.017

*Note** Sig. p<.05*

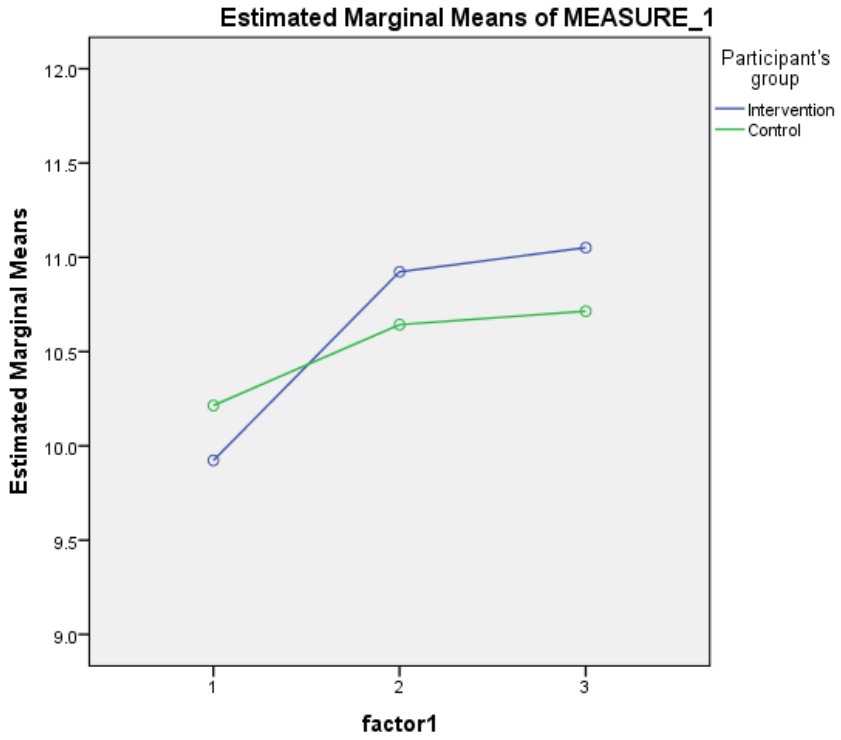


Figure 10. Profile Plot of Subscale: Right Dose

For the subscale "Right Time" Mauchly's Sphericity was not met. Therefore Greenhouser-Geisser was used. Time was significant, showing a change of score over time, but there was no significant interaction between groups (see Table 18 and Figure 11).

Table 18

General Linear Model of Subscale: Right Time

	Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Time	24.473	1.641	14.911	9.927	.000	.112
Interaction	3.403	1.641	2.073	1.380	.254	.017

*Note** Sig. p<.05*

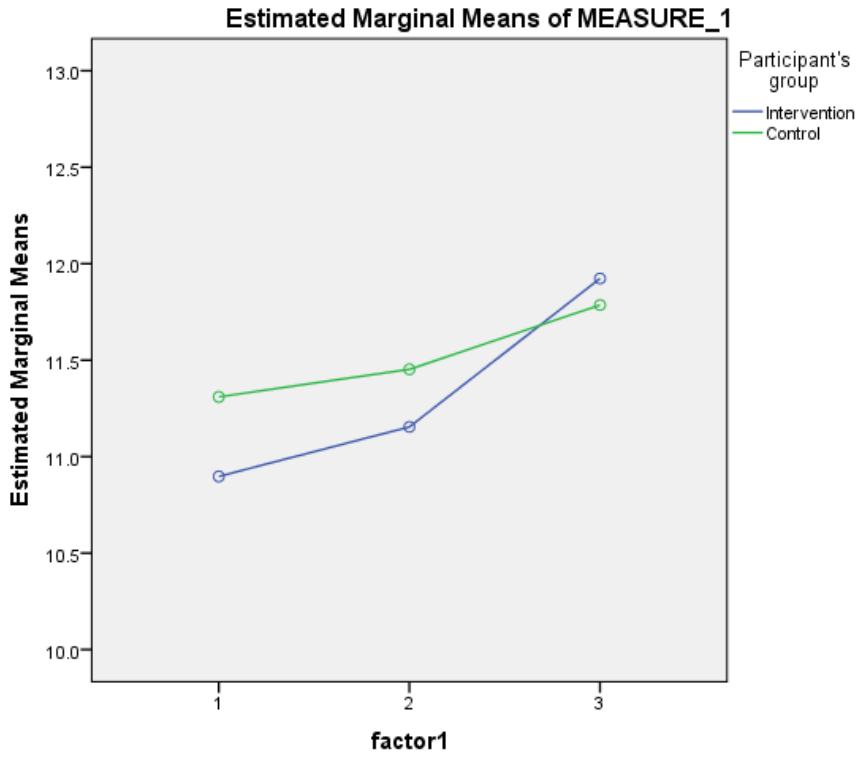


Figure 11. Profile Plot of Subscale: Right Time

For the subscale "Right Route", Mauchly's Test of Sphericity was satisfied with a significance level of p =.109. There was a significant change over time in scores, but no significant interaction between groups as shown in Table 19 and Figure 12.

Table 19

General Linear Model of Subscale: Right Route - Mauchly's Sphericity assumed

	Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Time	7.620	2	3.810	7.327	.001	.085
Interaction	1.612	2	.806	1.550	.215	.114

*Note** Sig. p<.05*

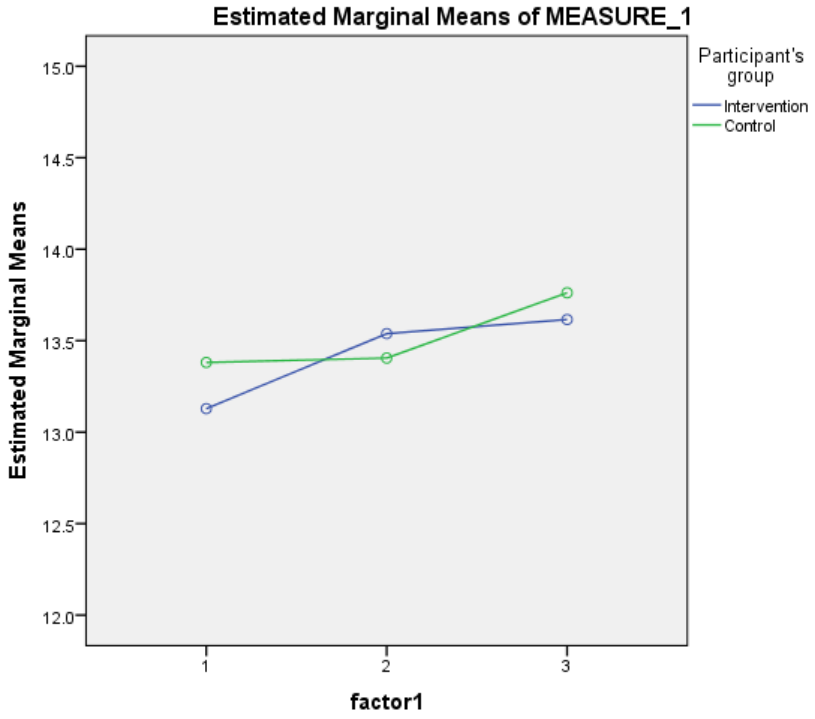


Figure 12. Profile Plot of Subscale: Right Route

For all the subscales of the Five Rights, except for "Right Patient", time was significant showing improvement in SAM Scale scores over time. However, interaction was non-significant in all of the five subscales. This result indicates that there was no difference in scores between the intervention group and the control group.

Using a Modified Gladstone questionnaire where 81 nursing students and 19 clinical instructors participated in the survey, results showed the highest violation of the "Right Time" during medication administration, followed by "Right dose" (see Table

20). The results from the Modified Gladstone questionnaire agree with the score obtained from the SAM Scale where the violations mainly occur with the "Right Time" and "Right Dose".

Table 20

Type of error occurrence according to the Five Rights

Type of error	**Role**		**Total**
	Clinical Instructor	**Nursing Students**	
No Error	1	55	56
Wrong Patient	1	3	4
Wrong Drug	3	8	11
Wrong Time	8	7	15
Wrong Dose	5	7	12
Wrong Route	0	1	1
Others	1	0	1
Total	**19**	**81**	**100**

Research Aim III

Question Four

Is there correlation/relationship between students' GPA in their pharmacology course and their SAM scale score?

To identify the relationship between nursing students' GPA and SAM Scale score, bivariate correlation coefficient was performed. All correlations between nursing students' pharmacology GPA taken during year 1 semester 2 and the SAM Scale score were significant ranging from .26 to .36 (p=<.05) (See Table 21). The correlation table (see Table 21) shows that nursing students who obtained a higher pharmacology examination GPA taken during year 1 semester 2 appear to be the same students who had higher scores on the SAM scale during the tests.

Table 21

Pharmacology GPA & SAM Scale score Correlations

SAM Scale scores	*r*	*p*
Pre-test	.26*	.02
Post-test #1	.30**	.01
Post-test #2	.36**	.00

*Note** Sig. p<.05*

Research Aim IV

Identify perceived barriers to safe administration of medication as reported by nursing students and clinical instructors of ACNHS according to the Modified Gladstone Scale.

Question Five

What are the main obstacles/barriers faced by nursing students during administration of medication as perceived by themselves (nursing students)?

There were 81 nursing students who completed the Modified Gladstone Scale. Table 22 shows the percentage results of the survey questionnaire. Number "1" was used as an indicator to identify the most common cause of medication errors, whereas "10" was used to indicate the least common cause of medication error. In Table 22, the statement "*Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible*" has the highest score from students where they have marked as number 1 (44.4%, n =36, 660 points), whereas the statement "*Nurses are distracted by other patients, co-workers or events on the ward*." has the highest number of students selecting number 10 (least common), with percentage of 24.7% (n =20, 314 points). Table 23 indicates the rank order of the causes of medication errors by nursing students as perceived by them. (*See Appendix L for calculation of points).*

Table 22

Causes of Medication Errors as perceived by nursing students

Causes of medication errors	Med	IQR	Rating of errors*										Total N (%)
			1	2	3	4	5	6	7	8	9	10	
The doctor's writing on the prescription (MAR) chart is difficult to read or illegible.	2	3	36 (44.4)	11 (13.6)	10 (12.3)	7 (8.6)	5 (6.2)	3 (3.7)	3 (3.7)	3 (3.7)	3 (3.7)	-	81 (100)
There is confusion between the two drugs with similar names.	4	4	8 (9.9)	23 (28.4)	8 (9.9)	12 (14.8)	8 (9.9)	11 (13.6)	3 (3.7)	2 (2.5)	4 (4.9)	2 (2.5)	81 (100)
Medication errors occur when the nurse miscalculate the dose	4	3	8 (9.9)	8 (9.9)	15 (18.5)	20 (24.7)	6 (7.4)	10 (12.3)	6 (7.4)	5 (6.2)	3 (3.7)	-	81 (100)
The doctor prescribes the wrong dose.	5	5	8 (9.9)	10 (12.3)	17 (20.9)	4 (4.9)	12 (14.8)	2 (2.5)	6 (7.4)	6 (7.4)	9 (11.1)	7 (8.6)	81 (100)
The nurse gives medication without a witness/checker.	5	4	5 (6.2)	5 (6.2)	7 (8.6)	15 (18.5)	9 (11.1)	7 (8.6)	6 (7.4)	8 (9.9)	13 (16.0)	6 (7.4)	81 (100)
The nurse fails to check the patient's name band with the MAR.	6	6	10 (12.3)	7 (8.6)	9 (11.1)	7 (8.6)	5 (6.2)	5 (6.2)	6 (7.4)	5 (6.2)	9 (11.1)	18 (22.2)	81 (100)
The medication labels/packaging are of poor quality or damaged.	6	5	2 (2.5)	6 (7.4)	6 (7.4)	8 (9.9)	9 (11.1)	10 (12.3)	11 (13.6)	6 (7.4)	6 (7.4)	17 (21.0)	81 (100)
The nurse sets up or adjusts an infusion device incorrectly.	7	3	1 (1.2)	5 (6.2)	2 (2.5)	5 (6.2)	9 (11.1)	10 (12.3)	20 (24.7)	16 (19.8)	9 (11.1)	4 (4.9)	81 (100)
Nurses are confused by the different types and functions of infusion devices.	7	2	-	2 (2.5)	3 (3.7)	2 (2.5)	10 (12.3)	13 (16.0)	13 (16.0)	20 (24.7)	11 (13.6)	7 (8.6)	81 (100)
Nurses are distracted by other patients, co-workers or events on the ward.	8	5	2 (2.5)	4 (4.9)	5 (6.2)	1 (1.2)	10 (12.3)	10 (12.3)	20 (24.7)	11 (13.6)	12 (14.8)	20 (24.7)	81 (100)

**Rating of causes of medication errors from 1-10 (1 is the most common and 10 is the least common) (N =81)*

Table 23

The rank order of causes of medication errors as perceived by nursing students

Causes of Medication errors	Ranking
Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible.	Most common causes of Medication errors. (660 points)
Medication errors occur when there is confusion between the two drugs with similar name.	Second most common cause of Medication errors. (566 points)
Medication errors occur when the nurse miscalculate the dose	Third most common cause of medication errors. (543 points)
Medication errors occur when the doctor prescribes the wrong dose.	Fourth common cause of medication errors. (483 points)
Medication errors occur when the nurse gives medication without a witness/checker.	Fifth common cause of medication errors. (425 points)
Medication errors occur when the nurse fails to check the patient's name band with the MAR	Sixth common cause of medication errors. (414 points)
Medication errors occur when the medication labels/packaging are of poor quality or damaged.	Seventh common cause of medication errors. (373 points)
Medication errors occur when the nurse sets up or adjusts an infusion device incorrectly.	Eighth common cause of medication errors. (360 points)
Medication errors occur when nurses are confused by the different types and functions of infusion devices.	Ninth common cause of medication errors. (322 points)
Medication errors occur when nurses are distracted by other patients, co-workers or events on the ward.	The least common cause of medication errors. (314 points)

Question Six

What are the main obstacles faced by nursing students during medication administration, as perceived by clinical instructor?

A total of 19 clinical instructors participated in the survey and completed the Modified Gladstone Scale. Surprisingly, similar to nursing students, the clinical instructors also had the same statement that has the highest percentage of the most common perceived barrier to safe medication administration. In Table 24, 52.6% (n =10) of clinical instructors agreed that "Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible" (169 points). The least common cause of medication errors as perceived by the clinical instructors was "Medication errors occur when nurses are confused by the different types and functions of infusion devices" (52 points). Table 25 shows the rank order of the causes of medication error as perceived by clinical instructors. (*See Appendix L for calculation of points).*

Table 24

Causes of Medication Errors as perceived by Clinical Instructors

Causes of medication errors	Med	IQR	Rating of errors*										Total N (%)
			1	2	3	4	5	6	7	8	9	10	
The doctor's writing on the prescription (MAR) chart is difficult to read or illegible.	1	1	10 (52.6)	5 (26.3)	0 (0)	3 (15.8)	0 (0)	0 (0)	0 (0)	0 (0)	1(5.3)	0 (0)	19 (100)
There is confusion between the two drugs with similar name.	3	3	2 (10.5)	3 (15.8)	5 (26.3)	3 (15.8)	2 (10.5)	3 (15.8)	1 (5.3)	0	0	0	19 (100)
Medication errors occur when the nurse miscalculate the dose.	4	3	0	1 (5.3)	6 (31.6)	3 (15.8)	1 (5.3)	6 (31.6)	2 (10.5)	0	0	-	19 (100)
The doctor prescribes the wrong dose.	7	4	0	2 (10.5)	2 (10.5)	0	2 (10.5)	2 (10.5)	4	1 (5.3)	4 (21.1)	2 (10.5)	19 (100)
The nurse gives medication without a witness/checker.	7	5	1 (5.3)	2 (10.5)	2 (10.5)	2 (10.5)	1 (5.3)	1 (5.3)	3 (15.8)	5 (26.3)	1 (5.3)	1 (5.3)	19 (100)
The nurse fails to check the patient's name band with the MAR.	5	6	3 (15.8)	2 (10.5)	1 (5.3)	3 (15.8)	3 (15.8)	1 (5.3)	1(5.3)	3 (15.8)	1 (5.3)	1 (5.3)	19 (100)
The medication labels /packaging are of poor quality or damaged.	9	5	0	1 (5.3)	0	1 (5.3)	3 (15.8)	1 (5.3)	2 (10.5)	1 (5.3)	1 (5.3)	9 (47.4)	19 (100)
The nurse sets up or adjusts an infusion device incorrectly.	7	3	0	0	0	1 (5.3)	2 (10.5)	2 (10.5)	5 (26.3)	4 (21.1)	5 (26.3)	0	19 (100)
Nurses are confused by the different types and functions of infusion devices.	9	2	-	0	0	2 (10.5)	0	1 (5.3)	1 (5.3)	4 (21.1)	6 (31.6)	5 (26.3)	19 (100)
Nurses are distracted by other patients, co-workers or events on the ward.	4	3	3 (15.8)	3 (15.8)	3 (15.8)	1 (5.3)	5 (26.3)	2 (10.5)	0	0	1 (5.3)	1 (5.3)	19 (100)

**Rating of causes of medication errors from 1-10 (1 is the most common and 10 is the least common) (N =19)*

Table 25

The rank of causes of medication errors as perceived by clinical instructors

Causes of Medication errors	Ranking
Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible.	Most common causes of Medication errors. (169 points)
Medication errors occur when nurses are distracted by other patients, co-workers or events on the ward.	Second most common cause of Medication errors. (139 points)
Medication errors occur when there is confusion between the two drugs with similar name.	Third most common cause of medication errors. (139 points)
Medication errors occur when the nurse miscalculate the dose.	Fourth common cause of medication errors. (122 points)
Medication errors occur when the nurse fails to check the patient's name band with the MAR	Fifth common cause of medication errors. (116 points)
Medication errors occur when nurses give medication without a witness/checker.	Sixth common cause of medication errors. (99 points)
Medication errors occur when the doctor prescribes the wrong dose.	Seventh common cause of medication errors. (85 points)
Medication errors occur when the nurse sets up or adjusts an infusion device incorrectly.	Eighth common cause of medication errors. (71 points)
Medication errors occur when the medication labels/packaging are of poor quality or damaged.	Ninth common cause of medication errors. (61 points)
Medication errors occur when nurses are confused by the different types and functions of infusion devices.	The least common cause of medication errors. (52 points)

Summary of Main Findings

Initially, a total of 83 nursing students participated in the study to show the effect of simulation refresher course on MA knowledge and performance. There were 41 nursing students in the intervention group and 42 nursing students in the control group. The intervention group was given a two-hour refresher course on MA safety that emphasized specifically the Five Rights and the use of the MASAT to guide practice in MA. The control group continue their study routine (clinical and classroom) as usual. The SAM Scale was administered to all nursing students at the beginning of the study prior to the intervention and was administered two times post treatment to both groups (intervention and control groups). At the end of the study, only 81 student results were qualified to be included in the total scores as two participants was dropped out of the study due to their being absent for the post-test #2. A total of 81 nursing students who participated in the study and 19 clinical instructors of ACNHS also completed the Modified Gladstone Scale in order to identify the barriers to safe medication administration by nursing students as perceived by themselves (nursing students) and clinical instructors.

In establishing result of the effect of refresher course (Question 1), both groups (intervention and control) mean scores on the SAM Scale were established and compared. The effect size was also determined. The knowledge and performance in MA, according to nursing student level of education (year 2 and year 3) was also compared (Question 2). In response to the SAM Scale categories of the Five Rights of MA (Question 3), using percentages, the subscale with the lowest score has been identified

which indicate the type of "Rights" the students need to work on. This result indicates the need of further study for the teaching methodology to improve on this specific "Right."

The Modified Gladstone scale was used to answer research Question 4 and 5 to determine any barrier to safe administration of medication as perceived by both the nursing students and clinical instructors. Surprisingly, both nursing students and clinical instructors identified "*Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible* "as the most common causes of medication error. Besides answering the research question, the Modified Gladstone scale tool was also able to provide extra information regarding percentage of medication error or near misses committed by nursing students, as well as the type of Rights that were violated the most during administration of medication. The participants' willingness to report any error was also identified.

CHAPTER FIVE

DISCUSSION

Introduction to Chapter

This chapter provides a summary of the study and highlights the important conclusions gleaned from Chapter Four. A comparison of the findings with current literature precedes the description of the study's strength and limitations. Subsequent sections include the implications for theory, nursing practice and education, policy and recommendations for future research.

Summary of Study

The main goal of this study was to evaluate the effect of a simulation refresher course in MA safety among nursing students in a selected nursing college in Penang, Malaysia. Four specific study aims were to (a) describe the effect of simulation refresher course on knowledge and performance in MA of nursing students using the SAM scale to compare students in the intervention group to a "teaching as usual" control group, (b) identify sub-scales or categories among the Five Rights in medication administration (MA) of the SAM Scale that showed the lowest scores, indicating a need for particular attention in teaching MA and improvement strategies in nursing practices, (c) evaluate any correlation between students' GPAs in pharmacology and score in the SAM scale, and (d) by using the Modified Gladstone to, identify perceived barriers to safe MA as reported by nursing students and clinical instructors of ACNHS.

An experimental randomized repeated measure design was used to collect data from a convenience sample of 83 nursing students from year 3 semester 1 and year 2 semester 1. The data were analyzed using descriptive and inferential statistics. Data

cleaning was performed and relevant parameters evaluated to ensure the data were managed appropriately. This included verifying normality, assessing and replacing missing values before the data were used for statistical testing. Descriptive statistics comprised of frequencies, percentages, means and standard deviation. The main inferential statistical tests used included a two-way repeated measures analysis of variance (ANOVA), independent t-test, and Pearson correlation. Reliability was based on Cronbach's alpha that was established by a previous study for the SAM Scale and Modified Gladstone tool.

The study of MA is a globally important issue. This study was the first to be conducted in Malaysia to examine the effect of a simulation refresher course on knowledge and performance among nursing students in MA procedure, as measured by the SAM Scale. The primary finding of this study was that there was a statistically significant change in student SAM Scale score in the intervention group over time (pre-test: $\bar{x}$=58.71, post-test : $\bar{x}$ = 61.29, post-test 2: $\bar{x}$= 62.28, p value < .05) with a small effect size. However, the control group also revealed a statistically significant increase in the SAM Scale scores over time (pre-test: $\bar{x}$=59.71, post-test 1: $\bar{x}$ = 60.67, post-test 2: $\bar{x}$= 61.93, p value < .05) despite no "treatment". When comparing the intervention group and the control group, there was no statistically significant difference in score. This indicated that the treatment of simulation refresher course may not be the tool responsible for the improvement of scores within the intervention group. Based on the statistical result of the significant increase in score for both groups, it may be that the use of the questionnaire, SAM Scale itself was responsible for the improvement. In this study, the

treatment that was given to the intervention group did not really provide a significant improvement to nursing student in terms of their knowledge and performance in MA.

In comparing year 3 nursing students with year 2 nursing students, the study showed that although there was a superficial difference in the SAM Scale score, the difference was not statistically significantly different. Based on the statistical analysis, both year 3 and year 2 nursing students' knowledge and performance in MA safety can be considered equal, even though they are one year apart in terms of the level of study and experience. This study also revealed the subscale from the Five Rights that are being violated the most. Within the five subscales of medication rights, right dose seemed to be violated the most followed by right time. In analyzing the relationship between achievement of GPA in the pharmacology subject and score in the SAM Scale, the study suggests that nursing students who achieved a high GPA in pharmacology also scored higher in the SAM Scale, suggesting that these students (with high GPA) have better knowledge and performance in MA as compared to those students with lower GPAs. Using Modified Gladstone Scale, both nursing students and the clinical instructors concluded that "*Medication errors occurs when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible*" was the main barrier to safe administration of medication for the nursing students.

Comparison of the Findings with Literature

It has been established in some studies that a refresher course provides an effective means to increase knowledge and performance of nurses in their area of working (Joshi et al., 2006; Sclauzero et al., 2006). Additionally, two reported studies (Malakis & Kontogiannis, 2012 and Nishisaki et al., 2008) found that a short refresher

course would provide an improvement to skills performance in handling real world emergencies both in the aviation industry and in pediatric intubation. A study in Malaysia by Raja Lope et al. (2009) concluded that a re-education program (similar to a refresher course) about MA would help significantly in improving patient safety as evidenced by reduction of occurrence of MAEs. Simulation techniques have been used in most refresher courses for improving and enhancing nursing skills. According to Robert (2002), 75% of studies where the participants highly favored simulation as a method of teaching and learning concluding it offer a realistic opportunity for workers to demonstrate competency in using verbal and nonverbal care giving skills. To date, most literature that was located strongly favored simulation refresher course as a method of teaching that is most effective.

The current study does not agree 100% with the literature, as the result shows a different perspective from the point of utilization of simulation refresher course as an intervention to increase knowledge and performance in MA. This current experimental study showed that even though there was a significant increase in the SAM Scale score after the treatment for the intervention group, the control group also shows a significant increase of score over time. Statistical analysis shows that there was no significant difference in score obtained from the SAM Scale between the intervention and the control group. Therefore, from this study, we cannot conclude that the treatment/intervention (simulation refresher course) was responsible for the increase in score for the intervention group. So what caused the increase of the score in both groups? Contrary to what the literature have mentioned and what was hypothesized, the simulation refresher course should not be considered as the reason for improved

knowledge and performance in MA by nursing students in this study. Instead, taking the SAM Scale test may have produced learning for all nursing students and hence all the scores improved over time. The scores continued to increase on the second post-test even though one would expect it to drop off after post-test #1. This was evidenced by the progressive increase of scores for both groups when all of them (N =81) took the test, and there was evidence that their scores were better each time.

The belief that possessing more experience would influence better knowledge and performance may be true, especially in the MA process. Schulmeister (1999) noted that lack of experience can lead to medication errors, and also Chang & Mark (2009) in their study pointed out that experienced nurses mostly commit medication errors that are non-severe. With the supported studies about the importance of experience, we would expect significant differences of score between the senior nursing students (year 3) and the junior nursing students (year 2). In this current study, we can see the superficial score difference between year two and year three nursing students. Students in year two are in their second year of nursing education, whereas year three students are almost at the completion of the nursing course. However the raw scores showed that the senior (year 3) nursing students scored only slightly higher in the SAM Scale test than did the junior (year 2) students. Statistically, there is no significant difference in scores between year two and year three nursing students.

Several previous studies (Amritage & Knapman, 2003; O'Shea, 1999, & Jukes & Gilchrist, 2006) stressed the importance of mathematical skills. According to these authors, the lack of mathematical proficiency can lead to severe MAEs which can harm patients. These studies suggested that student nurses must be educated to be

mathematically efficient before graduating. It is true that without proficiency in mathematical skills, nursing students are susceptible to the risk of committing MAEs, thereby potentially harming the patient. The current study revealed which "Right" principle in MA requires more attention by educators as well as by nursing students themselves. In this study, among the Five Rights of MA principles, the "Right Dose" showed the lowest score that was obtained by nursing students. Fourteen questions from this "Rights" category require nursing students to perform some simple to moderately difficult mathematical calculation. The result showed that mathematical proficiency continues to be an issue not only for the practicing nurses as stated in the literature, but also for nursing students. This is an area for both education and further research. Studies need to be conducted so that a solution can be found to improve mathematical proficiency and thus minimize medication errors, and students need to be taught appropriate mathematical skills to decrease the risk of medication errors.

As expected, higher GPA results in the pharmacology subject in year one semester two would determine a better score for the students' score on SAM Scale. This study showed a statistically significant correlation between higher GPA score with higher scores in the SAM Scale score. Students who obtained a high GPA during the subject of pharmacology being taught in a previous semester also performed better and had a higher score in the SAM Scale questionnaire as compare to those students with low GPA scores.

Several reasons for the occurrence of medication errors have been reported in the literature. Multiple barriers to safe MA have been discussed in the Literature Review chapter of this paper. Major barriers to safe administration of medication were divided into human factors and system factors. Multiple studies (Jukes & Gilchrist, 2006;

Krautscheid et al, 2011; Whitehair et al., 2013; Calliari, 1995; Hsiao et al. 2010; Tang et al, 2007; Brady et al. 2009; and O'Shea, 1999) stated that distractions, fatigue, and exhaustion from working a long shift were among the main causes of error. This differs from what this study reveals. Using the Modified Gladstone Scale, the most frequent causes of medication errors found in this study, as stated by both clinical instructors (n =19) and nursing students (n =81), was "*Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible*." The result is not surprising in an environment such as Malaysia, where medication orders are handwritten by the physician. This is in line with what Brady et al. (2009) and Amirtage & Knapman (2003) found in their literature review stating that the quality of prescriptions can affect the result of safety during MA. Poor or illegible handwriting by the physician that can be due to fatigue and distractions, are the main reasons for nurses to make an error in the administration of medication. Illegible and difficult to read prescriptions can come in the form of incomplete prescription (i.e. no route of administration, no dosage, no date and no patient information), as well as the doctors' poor handwriting. The result of this study indicates that doctors and other healthcare personnel, particularly nurses must communicate and listen carefully to all information regarding prescriptions and administration of medication. The study also may provide motivation for institutions to move towards an electronic hospital information system that requires physicians to type their orders instead of writing them.

This issue may not arise in developed countries where computerized patient information systems, includes prescriptions, are being used to avoid incomplete and illegible doctor's order. For an institution where the cost and affordability to purchase

such a system is an issue, appreciable risk of medication errors will continue to exist due to physicians' illegible handwriting and therefore proper communication between the prescriber and the nurse is paramount. A strict institutional policy and protocol in regards to abbreviations used during prescribing should be also put in place to standardize usage to prevent errors from occurring.

Study Strengths and Limitations

Strengths

This study had several areas of strength. A key one is that by being the first reported study in medication administration safety with nursing students in Malaysia, it fulfilled the quest of the Malaysian government needs to conduct more research to improve patient safety. The randomization assignment of participants to a control and intervention group also strengthened the study design as random assignment increased the possibility of a representative sample of nursing students in ACNHS. The overall participant response rate was almost 100%. Participants were allocated time to attend all research activities during the study and hence the high response rate. Data collection was completed on all subjects for both the pre-test and the first post-tests. Only two participants were not able to complete the post-test #2 due to health emergencies.

The study had strong theoretical and psychometric bases that allowed all research questions to be answered clearly. The psychometric design allowed detailed profiling of scores, including scores to differentiate categories and sub-categories. The reliability testing of the SAM Scale was at an acceptable level. Another strength was that the study indicate that the use of the SAM Scale might be an effective "refresher" that can be used for both nursing students and practicing registered nurses.

Limitations

There are some limitations of the study that are important to acknowledge. One major limitation of the study was the lack of complete separation between nursing student participants in the intervention and control groups. The intervention group participants were not isolated or separated during the period of study from the control group. Therefore, it was possible that participants from the intervention group might have shared information with the control group regarding the simulation, even though they (intervention participants) were asked not to discuss what they have learned during the "treatment class" with any other student. Most of the students were in the same class, and some were in the same dormitory and may even have been roommates. They may have discussed the treatment to the control group and thus may have contaminated the result. Another factor that may have caused the insignificant difference in scores between the two groups is that the control group may have felt left out or jealous as they were not selected to be in the intervention group. They may have tried harder to prove that they were safe nursing students, resulting in an increase in score for them too.

Another limitation that should be considered is that even though the participants were given adequate time to perform all research activities, they were still required to fulfill their clinical credit by going to the clinical laboratory and to perform their duties as usual. The intervention group, because they were required to attend the simulation refresher course after their clinical laboratory experience, may have experienced fatigue causing them to give less than 100% attention during the course. This may have resulted in performance of the SAM scale score that was similar to the control group. A

suggestion for future study, that the refresher course should be done during time when students are not required to perform their clinical duty.

With regards to the Modified Gladstone scale, only one section of the original scale was used. This was because other than section one, the rest of the questionnaire did not address the research questions. A major limitation was that the instructions were confusing to some participants. Some participants assigned number "10" to the statement they perceived as the most common cause of medication errors, contrary to the actual instruction to place "1" for the most common perceived cause. Some participants assigned the same number to different statements (which caused the disqualification of the participants). However, the mistake was rectified immediately as the questionnaire was submitted directly to the researcher. In the future when using the scale of Modified Gladstone, the instruction should be re-phrased in a language that is completely understandable. An example question and answer should be used in instructions to avoid misunderstanding.

Recommendations

Implications for Theory

The initial idea of the theoretical foundation of Kolb experiential learning theory (KELT) appeared to provide a good fit, support, and guidance for the study. Several key principles of the theory were identified which supported provision of real or simulated experiences for nursing students so that learning could take place. It affirmed the centrality of experiential activities where nursing students are led through various cycles, and approach a person holistically; hence nurse educators' role is explicit in providing learning to nursing students. However, although the KELT model is useful, the result of

the current study did not agree 100% to cause changes in the SAM Scale score as predicted.

Nursing students in the intervention group participated in the simulation refresher course where MA procedures were performed so that experience could occur. Using the medication administration safety assessment tool (MASAT) scale, students complied 90% to 100% with the procedural steps. During the intervention/treatment phase, KELT was demonstrated throughout the simulated administration of medication procedure. Nursing students demonstrated interest and understanding of the importance of the protocol to be followed with the Five Rights, thus avoiding MAEs.

There were some noticeable gaps that could be seen in using this theory for the study. First, according to Kolb as cited by Armstrong & Fukami (2008), in order for one to learn from their experience, there must be some conversational space where members can reflect on or talk about their experience together. The simulation refresher course in MA that was performed for this study did not include the researcher-participants conversational dialog post refresher course. This may be a reason for the ineffectiveness of the treatment. Second, the learning style of individual nursing students may have differed and not everyone could learn based on experience. The demands of the present environment as well as difference in personality may have caused one to develop a preferred way of choosing individual learning modes. Third, this theory may not be effective for short term learning experiences. Therefore, for future use of the theory, it may be beneficial to use KELT as a theoretical basis to design a simulation curriculum intended to develop competencies in medication administration procedures rather than to use it in implementing a ready-made curricula. Last, although the theory can be useful in

simulated conditions to improve knowledge and performance, there is a lack in caring attitudes, the effective role of the nurse educators or clinicians, and therefore it lacks emancipatory knowledge and collaborative partnership.

Another simple theory that was adopted in supporting of KELT when the simulation course was conducted. The modelling and role-modelling (MRM) theory was used to enable nursing students and clinical instructors to care for and nurture each individual with an awareness of and respect for the individual's uniqueness. The combination of both theories was to enhance the ability of students to learn and experience in the best environment possible in preparation to face the future for safe nursing care. However, the theory of MRM would be most suited during clinical experience in the real ward where nursing students require facilitation, nurturance, and unconditional acceptance while performing care for their real patients. It was possible to integrate the application of MRM in the research intervention. The intervention/treatment was conditioned in such a way that the students did not feel threatened and were told that they could ask questions at any time during the period of treatment. However, there is a need for the theory of MRM to be fully developed, before it can really be used as a strong basis to guide a study on its own.

For future theory use, even though KELT has been widely accepted as a useful framework for learning centered educational innovation, including instructional design, curriculum development and a lifelong learning, the extended version of the KELT, from specialized to balanced learning styles, should be considered. This is a new direction where there is empirical testing of its theoretical propositions with regard to integrated learning. Kolb (2008) stated that the integrated learning is conceptualized as an idealized

learning cycle or spiral where the learner "touches all bases" – experiencing, reflecting, thinking and acting – in a recursive process that is responsive to the learning situation and what is being learned.

Implications for Nursing Practice and Nursing Education

It was previously stated that promoting safe and high quality care is of the utmost importance in nursing. Nurses must be taught the importance of safe MA and this competency needs to be assessed routinely. In normal circumstances, nurses are assessed incrementally through a medication calculation test or observation during orientation. Alarmingly, findings resulting from this study showed a lack of standardization in how safe administration of medication can be assessed in nursing education programs as well as in the nursing practice area (Gonzales, 2011).

From the study result, it is seen that the limitation of mathematics proficiency by nursing students provides implications to both nursing practice and nursing education in looking for methods to strengthen drug calculation ability among nurses. Having known from the study that "Right Dose" was the weakest of the "Five Rights", the need for nursing practice to conduct a routine and regular assessment of mathematical proficiency for all registered nurses, clinical instructors, and student nurses is evident.

The study results reveal that the SAM Scale itself can be used as a tool to improve knowledge and performance in MA. Therefore, the SAM Scale should be utilized by both nursing practice and nursing educators as a tool to assess continuous progress in this procedure while at the same time helping to improve knowledge and performance. It has been demonstrated that there are very few instruments with evidence of sound psychometric properties, and there is evidence to support the lack of standardized

strategies to document performance of nursing students in the area of medication administration. The current study provides a preliminary data to inform nursing practice and nursing education in Malaysia and worldwide in general, of the use of this tool which can assist in improving knowledge and performance and therefore reduce medication error occurrence. In short, the SAM Scale seems to be able to function as a comprehensive tool towards safe MA and therefore should be used both in nursing education and in nursing practice.

Simulation refresher courses in MA should continue to be used as a teaching tool. Even though this study does not provide a concrete result to support that the use of simulation refresher course in improving MA safety, multiple previous nursing studies have been done in other countries indicating that refresher courses provide benefit in improving nursing skills. Therefore, it is recommended that nursing educators continue to provide an ongoing simulation refresher course for nursing students to enhance knowledge and performance of MA procedure. Nevertheless, one recommendation to improve the simulation course for future study is to be more aware so that the intervention will not duplicate what the questionnaire measure, as the duplication can interfere with the result of the study. Recommendation from the study also suggest for curriculum modification to include the refresher course as part of nursing education training, done not only at the year where pharmacology subject is being introduced, but at every year or even every semester.

Implications for Policy

According to the Director General of Health Ministry Malaysia, a total of 33.6 million prescriptions was dispensed at the outpatient pharmacy, while 7.9 million

prescriptions were filled for inpatients in the year 2008 compared to 32 million and 6.9 million prescriptions respectively for the previous year. This number shows a significant increase in the number of prescriptions filled and dispensed by pharmacies and the growing trend is very likely to continue in the years ahead. Therefore, further enhancement of the awareness on medication safety is important. The Health Ministry urges a Medication Reporting System that creates a paradigm shift for the health care team towards developing a non-punitive culture, resulting in the exchange of knowledge and experience that will help to promote the implementation of safety measures associated with medications, and prevent costly and tragic loss. A cause for the lack of implementation of methods to avoid medication errors is because the culture of reporting errors has not been the norm for health care personnel in Malaysia. Therefore, a policy regarding reporting medication errors should be in place and audits done on reporting compliance. The policy, outlining the proper way of reporting as well as providing a standardized and user-friendly form for reporting, should be drafted and distributed to all healthcare institutions in Malaysia. With the policy in place, healthcare personnel, especially nurses may be more likely to report errors. Policy regarding the use of abbreviations in prescribing medication and legible prescription writing also should be in place, especially for physicians, so that those implementing the order can do so correctly.

A strong suggestion for all registered nurses as well as nursing students to refresh mathematical skills at least annually is implied from the study. This is to ensure the quality affecting the performance of the RN. Registered nurses who fail the assessment should not be allowed to administer medication until remediation is provided and reassessment shows improvement and ability to administer medication safely. In line with

that, an annual medication administration competency based check off should also be in the policy to have the same purpose as the mathematics test. From the nursing education perspective, enrollment pre-requisites should include a specified score in high school mathematics. Some of these policies may already be in place, however, the implementation of the policies should be carried out.

Implications for Future Research

This study is the first of its kind in evaluating the effect of a simulation refresher course in MA among nursing students in Malaysia. Hence, it has advanced the field of knowledge in nursing education and also in nursing practice. The study has suggested a new perspective that the use of the SAM Scale tool can increase knowledge and performance in MA procedure among nursing students in Penang, Malaysia. Therefore, a replication of the similar study with different sample such as registered nurses should strongly be encouraged and compare with the current result. This could fill the information gap to ascertain whether the effect of increase knowledge and performance is really due to the test given (SAM Scale), the intervention, or there are other unknown confounding variables that was not able to be identified during this study.

It has been suggested in previous studies to shorten the length of the SAM Scale. However, based on the current study conducted, the total number of vignettes and questions in the scale is necessary and required so that understanding of the Five Rights during the administration of medication can be assessed objectively. Instead, for future research, participants should be given a longer time to complete the test to allow time for them to search for certain medication that they are not familiar with and to let them use critical thinking rather than rushing to complete the test. In line with Gonzales (2011),

who stated that the SAM Scale tool was too easy, this was true for some parts of the questionnaire. Therefore, a possible improvement to the SAM Scale would be to increase the level of difficulty. Moreover, if the SAM Scale is extended to practicing registered nurses from the ward, the questionnaire must project a higher level of complexity. Because the level of understanding and knowledge of practicing registered nurses is expected to be higher than that of nursing students, the level of difficulty of the SAM Scale should be increased.

The current study also revealed that among all the Five Rights of medication administration, nursing students scored "Right dose" as the lowest. Since administering medication at the "Right dose" was the biggest challenge, future study should consider providing a serial of "drug calculations" class prior to taking the SAM Scale. Other than that, developing a tool that focuses only on mathematical proficiency for drug calculations should also be considered.

Replication of the same study should also be considered, resolving limitations that were mentioned above. First, when using the treatment for the intervention group, participants should be isolated and not talk about the treatment with other participants. Second, during the period of the research study, participants should be given time off whereby they do not have to attend clinical experience on the same day of treatment or taking the SAM Scale as participants may feel tired and may not give a true picture of their knowledge and performance due to fatigue. Third, the Modified Gladstone Scale should be used as a whole instead of taking only one part of the questionnaire as the tool by itself can assess certain principles in relation to the MA procedure.

Conclusion

The central assumption guiding this body of work was that nurses need to be prepared to promote safe, quality patient care (AACN, 2008). Thus, critical to this expectation is that nursing programs teach MA competency to nursing students, then enabling practicing nurses in the profession to be proficient in this area of safety. The data gleaned from this study has increased our understanding that a simulation refresher course is not necessarily the only method to increase knowledge and performance in the administration of medication, but the assessment tool itself, the SAM Scale can be used to improve understanding in regard to safety during MA. Both nursing education and nursing practice can utilize this information to facilitate safety in MA. Understanding nursing students' limitations on mathematical proficiency should also encourage nursing educators, managers and researchers to conduct more studies to discover the best methods to address this problem.

The nursing board and the ministry of health in Malaysia have the mechanism (policies, quality assurance agencies, etc.) to ensure that safety is mandated whenever patient care is concerned. These structures could benefit from a more focused, coordinated and deliberate approach by the healthcare sector. Nursing education institutions and nursing practice should ensure the implementation of all policies as well as ensuring the quality of care provided for the patients. Nursing students and registered nurses will only be able to perform at their optimal levels as they continue to participate in the MA activities both in action as well as in calculation theory practices, and continuous assessment of safe administration of medication.

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APPENDIX A

SAFE ADMINISTRATION OF MEDICATION (SAM) SCALE

Student ID:

Sex: Male / Female (circle one)

Level of student: Y2/ S1 or Y3/S1 (circle one)

Age:

Pharmacology GPA:

Date:

Instructions for completion of the Safe Administration of Medication Scale

This scale is designed to assess your ability to apply the five rights of administering medication safely.

1. Attached you will find five Clinical Cases that incorporate a total of fourteen vignettes of nurses administering medications.

2. Each Case incorporates two or three vignettes that describe the administration of medication by a nurse to a hospitalized patient.

3. Read each vignette and determine if the actions taken by the nurse, in the process of administering the medication is the correct action or an incorrect action.

4. Use the Case response table associated with each vignette to indicate a correct action by placing "yes" or tick with a (/) in the corresponding box and "no" or tick with a (X) if the action the nurse took was incorrect.

Item #					
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 1					

In the space provided describe a short narrative description of what the nurse should have done, if you determine the action the nurse took was incorrect. If all actions were correct, write "No Errors".

Provide correct nursing action for each identified error.

_____
_____
_____
_____
_____

Do Not Put Your Name on the Forms

Case 1

Patient: Chong Lee Jim
Sex: Male
Age: 75 years old
Allergies: NKA (No Known Allergies)
Date: 6/02/2014

Chief Complaint
Mr. Chong presented in the emergency room with a complaint of pain in the right upper quadrant. He states that the pain came on suddenly and it has not gotten any better over the last three hours.

History & Physical Exam
Mr. Chong appeared to be acutely ill and in a great deal of discomfort. He has a low grade fever of 38.4˚C. He describes a recent history of being bothered by fatty foods, and also feels discomfort and mild nausea after a meal. Admission weight/height: 76kg, 185cm

Diagnosis: Acute Gallbladder Attack

Physician orders
1. Admit to inpatient unit, room #236-1 @3:30pm
2. Clear liquids, NPO after midnight
3. Laparoscopic cholecystectomy
4. Ultrasound scan
5. Labs: WBC,AST, LDH, serum bilirubin level.
6. D5 NS with 20 Meq KCL/liter at 60ml/hr

Medication Orders
Demerol 75mg IM q6hrs PRN
Hydroxyzine 25mg IM on call to OR

Chong Lee Jim
ID#29475963

Case 1, Vignette 1

Ms. Katherine was the nurse caring for Mr. Chong. When she arrived on the floor at the start of her shift, Mr. Chong activated his call light and requested pain medication. Ms. Katherine looked at the medication chart and noted that it had been four hours since his last pain medication. She did the following:

Ms. Katherine accessed the Demerol from the narcotics cabinet. She selected Demerol for injection, 100mg/ml. She drew up 75mg (0.75ml) in a syringe and checked the dose with another nurse. She also had the other nurse witness her disposal of the remaining Demerol. She proceeded to the patient room, introduced herself to Mr. Chong and verified his name by looking at his armband and ID#. She then gave the injection in this right ventrogluteal muscle.

Item #	1	2	3	4	5
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 1					

Provide correct nursing action for each identified error.

_____
_____
_____
_____

Go To The Next Page

Chong Lee Jim
ID#29475963

Case 1, Vignette 2

The OR called for Mr. Chong and Ms. Katherine prepared his pre-op medication. She had a vial of Hydralazine 20mg/ml. She drew up 1.25ml, checked his armband and ID# and gave the injection in his left ventrogluteal muscle.

Item #	6	7	8	9	10
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 2					

Provide correct nursing action for each identified error.

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End of Case 1

Case 2
Patient: Peter Johnson
Sex: Male
Age: 5 years old
Allergies: pollen, dust mites & molds
Date: 5/02/2014
Hospital ID # 39294023

Chief Complaint
Peter Johnson was brought to the emergency room by his mother at 2:00pm. His mother states that he was playing outside with some children in the neighbourhood. He came inside because he was having difficulty breathing. She called the paediatrician. The paediatrician told her to bring Peter to the emergency department.

History & Physical Exam
Peter is a five-year-old male, sitting in mother's lap, presenting with respiratory rate of 36/minute, heart rate of 132, substernal retractions, bilateral inspiratory and expiratory wheezing on auscultation. Peter has history of allergies to pollen, dust mites and molds. He was admitted to the hospital six months ago with similar symptoms and was diagnosed with asthma. This is the first significant recurrent episode. He has had milder bouts of asthma that were managed at home with an albuterol inhaler.

Diagnosis: Acute Asthmatic Attack **Admission weight:** 16kg

Physician Orders
Admit to Pediatric Ward: Room #420 @3:30pm
Bedrest or in mother's lap
O2 2L/min via nasal cannula, Keep O2 sat >95%
Pulse oximetry
Arterial blood gasses (done in ER)
Chest x-ray (done in ER)
D5 ¼ NS with 20Meq KCL/ liter at 70ml/hr
Call physician for increased respiratory distress or no improvement after third dose of Albuterol
Monitor intake and output q4 hrs and daily weights.

Medications:
Nebulized albuterol with O2 @ 6 liters flow 0.15mg/kg/dose (max 5mg/dose) every 20 minutes up to 1 hour. (Done by Respiratory Therapist)
Prednisone 30mg po bid (at 8:00am + 4:00pm)
250mg aminophylline/250ml D5 ¼ NS IVPB to run at 1.5mg/kg/hr

Go To Next Page

Peter Johnson
ID # 39294023

Case 2, Vignette 3

Laura is the nurse assigned to care for Peter Johnson. She reviews the orders that came with Peter when he was transferred from the Emergency room at 3:30pm. Peter arrived on the unit with an IV in place and the following information on the label.

Peter Johnson Rm: Pediatric 420 Hospital ID # 39294023 Aminophylline: 250mg/250ml D5 ¼ NS IV Rate: 24ml/hr Date: 5/02/2014 Expires: 5/3/14

The nurse checks the IV label and determines it is what has been ordered. The IV site soft, dressing dry and intact and medication is compatible with IV fluid and KCL. She checks the IV pump and determines that it is set at 24ml/hr.

Item #	11	12	13	14	15
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 3					

Provide correct nursing action for each identified error.

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Go to Next Page

Peter Johnson
ID # 39294023

Case 2, Vignette 4

At 4:00pm, the nurse prepares to give Peter his prednisone. The prednisone comes in liquid version and the label reads Prednisone 5mg/ml. The nurse uses a 10ml oral syringe and draws up 8ml. She checks his armband and ID# and proceeds to give the prednisone to Peter while his mother holds him across her lap. She administers the medication orally. Peter spits out the medication.

Item #	16	17	18	19	20
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 4					

Provide correct nursing action for each identified error.

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Peter Johnson
ID # 39294023

Case 2, Vignette 5

The nurse notifies the doctor and he changes the order to: Prednisolone 30mg IV now and q 12 h.
Pharmacy sends up a vial in a plastic bag labelled Peter James ID# 28769233. The vial provides 50mg/ml. The nurse determines Prednisolone is compatible with Aminophylline, draws up 0.5mls, checks his armband and injects it slowly into the IV line port.

Item #	21	22	23	24	25
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 5					

Provide correct nursing action for each identified error.

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End of Case 2

Case 3
Patient: Jason Lim
Sex: Male
Age: 1 week old
Allergies: None Known
Date: 4/24/2014
Hospital ID # 5838298

Chief Complaint: Mother states that Jason has "not been eating well, he falls asleep after only a few minutes of breastfeeding and he has fewer wet diapers." "He just doesn't seem right, I wonder if I should give him formula instead of breast feeding."

History & Physical Exam
Jason was born on April 17th, 2014 at 5:37am, at Tanjung Community Hospital. He weighed 3.42kg. He was diagnosed with a ventricular septal defect (VSD) and referred to a cardiologist for further diagnostic studies. He was discharged to home on April 18, 2014 and had an appointment with a cardiologist scheduled on May 2nd, 2014. Over a period of several days, his mother noted his breathing was more rapid and he was falling asleep after only a few minutes of breast-feeding. He also has had fewer wet diapers. She called the cardiologist and he admitted Jason to Children's Medical Center for evaluation. He was diagnosed with mild congestive heart failure, tachypnea (50-70 breaths/minutes) and decreased urine output. He was scheduled for a cardiac catherization.

Current Weight: 3.4kg

4/24/2014 Progress Note
Jason had a cardiac catherization on 4/24/14, and has just returned to the unit. He is sleeping but will be able to resume breastfeeding when he wakes up. His mother has been instructed to keep his right leg straight, and notify the nurses if he has any bleeding from his pressure bandage.

Post-catherization orders:

1. Admit to cardiac step-down unit
2. Diagnosis: VSD
3. Status: Post catherization (right femoral)
4. Condition stable
5. Diet: breast-feeding
6. Daily weights
7. Intake & output
8. O2@ 2L/min per nasal cannula
9. Observe pressure dressing for bleeding, keep right leg straight
10. Check pedal pulses in both lower extremities with vital signs
11. Monitor vital signs q/15minutes for 1st hour, then q 1hr.

Medication Orders:

Furosemide 1 mg/kg PO stat & then q12hrs (available stock: 10mg/ml)
Digoxin 8mcg/kg PO stat and then qd (Available stock: elixir 50mcg/mL)

Jason Lim
ID # 5838298
Case 3, Vignette 6

Carol, RN is the nurse assigned to care for Jason. Jason has just been admitted to the cardiac ICU step-down unit after his cardiac catherization. It is 9:45am.

The nurse does an initial assessment with the following findings. Mother holding and breastfeeding infant, bilateral pedal pulses present with apical heart rate 124, good capillary refill, right foot slightly cooler than left foot, no edema, dressing dry and intact over right groin area. Informed mother of need to keep affected leg straight and notify nurse of any bleeding or color changes in right leg or foot.

The nurse prepares to give Stat Medications. The following is on the label.

Jason Lim Bed 2 Hospital ID # 5838298 Digoxin Elixir 50mcg/ml Expiration 10/7/2016

Medications are available on the unit at 10:00am. The nurse checks the Digoxin medication label against the original order. She calculates the Digoxin dose for Jason and determines she needs to administer 0.54ml. She informs the mother of the medication she is giving, checks Jason's apical pulse for 60 seconds (apical heart rate is 120) and checks his armband and ID#. She then administers the medication PO using an oral syringe.

Item #	26	27	28	29	30
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 6					

Provide correct nursing action for each identified error.

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Go To Next Page

Jason Lim
ID # 5838298

Case 3, Vignette 7

At noon, Carol, RN returns to Jason's room with 3.4 ml of Furosemide, rechecks Jason's armband and ID# and administers the medication orally.

Item #	31	32	33	34	35
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 7					

Provide correct nursing action for each identified error.

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Go To Next Page

Jason Lim
ID # 5838298

Case 3, Vignette 8

Nurse Hui Yi arrives on the unit to do her 7:00pm-7:00am shift. She gets report from Nurse Carol who is ending her shift. "Jason is a 1-week old infant who had a cardiac catherization this am. Mom is at the bedside and she is breastfeeding him. His heart rate has been 120-126 beats/minutes. He has had 6 wet diapers." At 10:00pm Nurse Hui Yi prepares his Furosemide.

Jason Lim Bed 2 Hospital ID # 5838298 Furosemide 10mg/ml Expiration 10/24/16

Nurse Hui Yi checks the medication sheet with the order sheet. She notes that Furosemide was ordered stat at 10:00am but given at 12:00 noon. Since the order stated q 12 hours she waits until 12 midnight to give the second dose. At midnight calculates the dosage and draws up 0.016ml in oral syringe. She checks Jason's armband and ID# and administers the medication orally.

Item #	36	37	38	39	40
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 8					

Provide correct nursing action for each identified error.

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End of Case 3

Case 4
Patient: Mr. Guna
Sex: Male
Age: 53
Allergies: None Known
Date: 10/02/2014
Hospital ID # 39294023

Chief Complaint
Mr. Guna arrived in the Emergency room at 8:00am, with a painful and slightly swollen right calf. He stated "My leg began to feel sore yesterday while I was at work. It seems to be swollen and feels warm."

History & Physical Exam
Mr. Guna denied any history of injury to his leg. In comparison to his left calf, his right calf is slightly swollen, warm and red. This is the first time he has experience there symptoms.
He is being treated for arthritis, but states "this pain is different." Mr. Guna was hospitalized two weeks ago for gallbladder surgery and had an uneventful stay. He has no known history of thrombosis. **Admission weight:** 72kg.
Diagnosis: Deep Vein Thrombosis (DVT) of right calf.
Physician Orders
Admit to hospital: Room 224 @ 9:45am
Complete bedrest with bathroom privileges, Elevate leg on two pillows
Avoid rubbing or massaging the affected calf
Thigh high elastic compression stockings
Peripheral IV Normal Saline with 20Meq KCL/liter at KVO (keep vein open)
Regular diet, Monitor intake and output q8hrs
Lab Work: APTT q4 hrs
Monitor for indications of bleeding

Medications Ordered:
IV heparin: Initial IV bolus 100 units/kg (7200u) given in ER @0930 by Paul RN
Upon arrival on the unit, begin continuous heparin at 10 units/kg/hr (720 units/hr)
Celebrex 100mg, PO BID (takes at 8:00am and 8:00pm at home)

Lab Values

Laboratory Test	Date/Time	Patient Value	Normal Range	Therapeutic Range
APTT	10/02/05 @1300	60 seconds	25.0-38.0 seconds	2.0-2.5 times normal range
INR	10/02/05 @1300	1.9	0.9-1.2	1.5-4.5

Mr. Guna
ID # 39294023

Case 4, Vignette 9

Susan, RN is the nurse assigned to care for Mr. Guna.
Mr. Guna has just arrived on the unit at 10:00am and is in room 224.
The nurse does an admission assessment and informs Mr. Guna that he will be getting his medications as ordered by the physician. He received his bolus of heparin 7200 units in the emergency room and should be started on his continuous heparin dose upon arrival on the floor. Nurse Susan receives an IV bag from the pharmacy that has the following information on the label.

Mr. Guna Room 224 Hosp. ID# 39294023 Heparin 10,000 units/100ml of Normal Saline Dose Ordered 720units/hour IV Rate: 72ml/hour Date: 10/02/2014 prepared by: *J. Parker* Pharm. D Expires: 10/03/14

The nurse checks the physician's medication orders against the original order form. Nurse Susan checks the APTT result for Mr Guna. It is 50 seconds. Nurse Susan goes to room 224 at 10:15am and says, "Good morning Mr. Guna, how are you feeling today?" as she checks his ID# and armband, IV site and medication label. "I have the medication Dr Jackson ordered for you." She proceeds to hang the Heparin and sets the IV pump to deliver 72ml/hr.

Item #	41	42	43	44	45
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 9					

Provide correct nursing action for each identified error.

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Go To Next Page

Mr. Guna
ID # 39294023

Case 4, Vignette 10

Susan, RN also has Mr. Guna' arthritis medication "this is your morning dose." She checks his armband & ID # and administers 100mg of Celexa (Two 40mg tablets and one 20mg tablet) PO with water.

Item #	46	47	48	49	50
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 10					

Provide correct nursing action for each identified error.

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Go To Next Page

Mr. Guna
ID # 39294023

Case 4, Vignette 11

Kathy, RN is the nurse assigned to care for Mr. Guna the next day. Mr. Guna had an uneventful first 24 hours.

The nurse informs Mr. Guna that she will be changing his IV medications shortly. Nurse Kathy receives an IV bag from the pharmacy that has the following information on the label.

Mr. Kuna Room 224
Hosp. ID: #32049293

Heparin 10,000 units/100ml of Normal Saline
Dose ordered: 600units/hour
IV Rate: 60ml/hour

Date: 10/03/2014 prepared by: *J. Parker* Pharm.D.
Expires: 10/04/14 @10:00am

Nurse Kathy goes to room 224 at 10:00am and says, "Good morning Mr. Guna, how are you feeling today? I have medication Dr Jackson ordered for you." The nurse states that the dose is lower than yesterday. She checks his IV site, armband and ID#. She then proceeds to hang the medication and sets the IV pump to deliver 60ml/hr. "I will be back to check on you. Use your call light if you need anything." She then leaves the room.

Item #	51	52	53	54	55
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 11					

Provide correct nursing action for each identified error.

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End of Case 4

Case 5
Patient: Patricia Kong
Sex: Female
Age: 61
Allergies: None Known
Date: 4/23/14
Hospital ID:#4528495

Chief Complaint:
Ms. Kong was having "trouble breathing" during the night and had to "sit on the side of the bed." She was still "short of breath" and called her son, who took her to the hospital.

History & Physical
Ms. Kong, a 61-year old female was admitted to the coronary care unit at 6:00am. Patient appears tired and anxious, skin cool and moist, capillary refill slow, peripheral pulses weak bilaterally, mild pitting edema in lower extremities.
Breath sounds: inspiratory crackles.

Vital Signs
Heart rate=120beats/min, irregular
Respiratory rate= 24 breaths/min shallow
Blood pressure =140/70mmHg
Temperature =38.10˚C
Wt: 70kg Ht: 168cm

Diagnosis: Congestive Heart Failure/Pulmonary Edema

Physician Orders:
1. Admit to 234 (Medical Ward 2)
2. Bedrest with HOB (head of bed) elevated 45˚
3. O2 via NC (Nasal canula) @ 2liters/min
4. IV D5W @KVO
5. Chest x-ray & EKG
6. Cardiac monitor
7. Foley Catheter
8. Daily weights, Low sodium diet
9. Labs: ABG, CBC, Electrolytes, UA
10. Digoxin Level @8:00pm (done), Ms. Kong's (0.06ng/ml) Therapeutic (0.5 -2ng/ml)

Medications:
Lasix 40mg IV @ 8:00am
Digoxin 0.7mg Stat @ 2:00am given in ER @ 2:30am. Kavitha, RN
Digoxin 0.35mg IV @ 8:00am and 2:00pm
Potassium Chloride 30mEq PO qd @2:00pm

Patricia Kong
ID # 4528495

Case 5, Vignette 12

Nurse Martha completes an assessment of Ms. Kong and prepares to give her 8:00am medications. Nurse Martha verifies medication orders with medication sheet. She prepares three medications: Digoxin, Lasix, and Potassium Chloride.

The first order is for 0.35mg Digoxin, IV. The ampule contains 0.25mg/ml. Nurse Martha calculates that she will need to withdraw the medication until it reaches 1.4ml. She then labels the syringe with the patient name and drug name/dose.
The nurse then proceeds to Ms Kong's bed and tells her she has her Digoxin and checks her armband and ID #. The nurse takes an apical pulse for 60 seconds, and proceeds to administer the Digoxin SQ in her right arm.

Item #	56	57	58	59	60
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 12					

Provide correct nursing action for each identified error.

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Go To Next Page

Patricia Kong
ID # 4528495

Case 5, Vignette 13

Nurse Martha also has Ms. Kong's second 8:00am medications, Lasix 40mg, IV to be given over 5 minutes. The dose on hand is 5mg/ml. The nurse drew up 6ml of Lasix in a 10ml syringe and labelled the syringe. The nurse checks the patient's armband & ID #, and notes the IV site is dry and intact without swelling or redness. She gives the Lasix by injecting it slowly into the IV tubing port over 5 minutes.

Item #	61	62	63	64	65
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 13					

Provide correct nursing action for each identified error.

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Go To Next Page

Patricia Kong
ID # 4528495

Case 5, Vignette 14

Nurse Martha also Ms. Kong's third medication, Potassium Chloride 30mEq PO, qd. Potassium chloride comes in individual 30mEq/15ml containers. The nurse brings one individually packaged oral Potassium Chloride. Nurse Martha then checks the patient's armband and ID # gives Ms. Kong her Potassium Chloride by mouth.

Item #	66	67	68	69	70
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 14					

Provide correct nursing action for each identified error.

_____
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End of Case 5

APPENDIX B

SAM SCALE SCORING GUIDE

Item #	1	2	3	4	5
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 1	No Error	No Error	No Error	Error	No Error
Item #	6	7	8	9	10
Case 1	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 2	No Error	Error	No Error	No Error	No Error
Item #	11	12	13	14	15
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 3	Error	No Error	No Error	No Error	No Error
Item #	16	17	18	19	20
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 4	No Error	No Error	Error	No Error	No Error
Item #	21	22	23	24	25
Case 2	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 5	Error	No Error	Error	No Error	No Error
Item #	26	27	28	29	30
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 6	No Error	No Error	No Error	No Error	No Error
Item #	31	32	33	34	35
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 7	No Error	No Error	Error	Error	No Error
Item #	36	37	38	39	40
Case 3	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 8	No Error	No Error	Error	No Error	No Error

Item #	41	42	43	44	45
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 9	No Error	No Error	Error	No Error	No Error

Item #	46	47	48	49	50
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 10	No Error	Error	No Error	No Error	No Error

Item #	51	52	53	54	55
Case 4	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 11	Error	No Error	Error	No Error	No Error

Item #	56	57	58	59	60
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 12	No Error	No Error	No Error	No Error	Error

Item #	61	62	63	64	65
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 13	No Error	No Error	Error	No Error	No Error

Item #	66	67	68	69	70
Case 5	Right Patient	Right Drug	Right Dose	Right Time	Right Route
Vignette 14	No Error	No Error	No Error	Error	No Error

Source: Ryan, D (2007). *Measurement of student nurse performance in safe administration of medication.* Unpublished doctoral dissertation. Emory University.

APPENDIX C

MODIFIED GLADSTONE SCALE

Objectives: To identify nursing students' barriers/obstacles to safe medication administration.

Section 1: Demographic Background

Years of service as clinical Instructor: _____
Level of nursing education: _____ (Nursing students: Year 2 Sem1/Year 3 Sem 1)
Setting of practice: Medical ward ____ surgical ward____ OB ____ ICU ____ Other ___

Section 2: Causes of Medication Errors

The following 10 statements are all possible causes of drug errors. Please read them carefully and then **rank** them from 1to10 according to the **frequency** with which **you think** they may cause an error. Insert number '1' in the box next to the statement that you think is the **most common** cause of errors, number '2' next to the second most common cause and so on, ending with number '10' next to the **least** common cause of errors. Each value can only be allocated to one statement (i.e. you cannot allocate rank '3' to two statements) but please add comments if you have particular difficulty in deciding between any of them.

Item no:	Causes of Medication Errors	Rank
i.	Medication errors occur when the nurse fails to check the patient's name band with the MAR.	
ii.	Medication errors occur when the doctor's writing on the prescription (MAR) chart is difficult to read or illegible.	
iii.	Medication errors occur when the medication labels/packaging are of poor quality or damaged.	
iv.	Medication errors occur when there is confusion between two drugs with similar names.	
v.	Medication errors occur when the doctor prescribes the wrong dose.	
vi.	Medication errors occur when the nurse miscalculate the dose.	
vii.	Medication errors occur when the nurse sets up or adjusts an infusion device incorrectly.	
viii.	Medication errors occur when nurses are confused by the different types and functions of infusion devices.	
ix.	Medication errors occur when nurses are distracted by other patients, co-workers or events on the ward.	
x.	Medication errors occur when nurses gives medication without a witness/checker.	

Section 3

For student nurse only

1. Have you experienced any medication error or near misses (almost an error but the error did not happen) before? Yes ____ No ____

If yes, what type of error? (Tick one)

- Wrong patient
- Wrong drug
- Wrong time
- Wrong dose
- Wrong route
- Others (Please specify) _____

2. I feel comfortable reporting to my Clinical instructor if or when I made a medication error (if any). (Please tick) Yes ___ No ___

For Clinical Instructor only

1. Have you experienced any medication error or near misses (almost an error but the error did not happen) with nursing students before? (Please tick)

   Yes ____ No ____

If yes, what type of error? (Tick one)

- Wrong patient
- Wrong drug
- Wrong time
- Wrong dose
- Wrong route
- Others (Please specify) _____

Approximate number of near misses _____ and medication errors _____ done by nursing students (under your supervision) within this year (2014) that you remember.

2. I will feel comfortable reporting to the nursing or college administration any medication error done by my nursing students (Please tick) Yes ___ No ___

Thank you for your participation!

Please return to Ms. Noraidah Guntalib

APPENDIX D

INTERVENTION PACKAGE

Lesson Plan and Procedure Guide

Title of study: The effect of simulation refresher course on medication administration knowledge and performance by nursing student Penang, Malaysia.

Simulation Refresher Course- Lesson Plan

Time: 2 hours
Title: Medication Administration Safety
Goal:

1. Improve patient safety during medication administration by nursing students.
2. Compliance to institutional standard procedural manual in medication administration.
3. Practice actions to improve safety in MA using the Five Rights.
4. Improve effective communication between nursing students, clinical instructors and Registered Nurses.

Objectives:
At the end of the course, the student will be able to:
1. Demonstrate appropriate knowledge and performance of medication administration safety.
2. Demonstrate knowledge of institutional policy and procedures manual.
3. Demonstrate understanding of medication safety checks.
   i.e. perform three checks for all medication administration
4. Demonstrate knowledge and practice in safe MA for all routes (scenario will be provided).
5. Demonstrate knowledge regarding: Criteria with MA
6. Perform patient assessment and correct documentation

Content of Simulation Refresher Course
A. Introduction
B. General Medication administration guidelines and policies revisions
   i. Review and read ACNHS procedure manual of
      a. Administering oral medications
      b. Administer IV medication
      c. Subcutaneous injection
      d. Administering IM injection
      e. Giving Rectal Suppository
   ii. Understand the responsibility and accountability of the process of medication management

iii. Common obstacles to safe MA (According to what is listed on the Modified Gladstone Scale)

C. Performance criteria for Basic Medication Administration Competency

Elements of competency	Performance criteria
1. Demonstrate appropriate knowledge and understanding of medication administration	1. Read and understand the MA standard procedure manual of ACNHS 1.1 Review & understand the Pyxis Med station usage 1.2 Understands the responsibility and accountability of the process of medication management
2. Demonstrate knowledge regarding medication administration safety	2. **The five medication rights** a. Right patient b. Right medication c. Right Dose d. Right Route e. Right Time **2.1 Three Checks for MA** 1st – Obtain medication from the storage point 2nd – Before placing medication back into storage point 3rd – After preparation and before administration
3. Demonstrate understanding of medication safety checks	Practice actions to improve medication administration safety 1. Do not use unapproved abbreviations 2. identify look alike and sound alike medications 3. label all medications not already labelled 4. careful care for patient on anticoagulant 5. minimise interruptions during MA 6. process medication according to current policies 7. calculate all dosages (oral, IM, IV, SQ) correctly 8. administer IV push medication according to institution policy 9. demonstrate proper use of Pyxis system (if available) following policy for the pulling and labelling of medications. 10. describe the nurses role in responding, reporting and documenting an adverse reaction to medication, medication event, including near misses 11. document all medication administration (including saline flushes in the MAR in real time)
4. Demonstrate knowledge and practice in safe MA for all routes	**Practice safe and effective medication – Oral /IM/SC/IV/PR** 1. Able to differentiate the structures involved 2. Recognise factors influencing choice of syringe and needles 3. Outlines sites basic preparation and administration

	techniques for IM/SC according to SOP 4. recognise importance of universal precautions when administering injections **Demonstrate knowledge regarding procedure for injections** 1. procedure for injections – site/correct needle and syringe/Aseptic Technique 2. Check patient identify and skin preparation 3. document procedure
5. Demonstrate knowledge regarding: Criteria with MA	Each patient has a current legal written - prescription/medication MAR Standard Operating Procedures for administration of Oral/IM/Sc medication to be adhered with Understand the potential complications with all routes of injections
6. Assessment and documentation	**Assessment** 1. Assessment needs vary and depend on routes and medication 2. Assess and record vital signs before and after giving drugs that may adversely affect RR, HR, BP 3. Assess drugs for their efficacy and adverse drug reaction 4. Verify allergies status of patients **Document** 1. Document all the above findings

Requirements

1. Five scenarios with patient condition with five different routes of medications.
2. MAR – with doctors handwriting.
3. Bed.
4. Maniquin.
5. Pyxis Machine.
6. Placebo medications with different route (Tablets, insulins, liquids, suppositories, antibiotics powder).
7. Equipment for
    a. Oral Medications
        i. Medications cups
        ii. A jar of water with cup
        iii. Receiver
        iv. Pestle and mortar
    b. Subcutaneous Injection
        i. Tray containing kidney dish, alcohol swabs, sterile syringes & needles or SQ needle.
        ii. Sharp Bin
        iii. Receiver
    c. Intramuscular Injection

i. Tray with ampule medications, vial of diluents if necessary, file or gauze to break the ampule.
ii. Kidney dish
iii. Sharp Bin
iv. Receiver

d. Suppository
i. Disposable rubber gloves
ii. Lubricant (KY Jelly)
iii. Toilet tissue paper and hand towel
iv. Receiver
v. Draw sheet to cover patient

e. IV injection
i. Tray containing NS flush 2cc in a syringe with needle, kidney dish diluents if necessary.
ii. Sharp Bin
iii. Disposable gloves
iv. Receiver

Step of assessment of each nursing student

1. Student to follow standard of procedure according to ACNHS manual (See attached) as what have been learned previously in pharmacology subject.

2. Observe student for safe medication administration according to MASAT

	"RIGHT"	Yes	No
1.	Student asked patient to state name and DOB		
2.	Student checked name and DOB against MAR		
3.	Student checked patients ID band for name and DOB		
4.	Student checked **each** medication from drawer against MAR for correct drug name.		
5.	Student checked **each** medication from drawer against MAR for correct drug dose.		
6.	Student administered **each** medication via correct route.		
7.	Student administered **each** medication at correct time.		
8.	Student documented **all** medications in MAR		
Key: MAR=medication administration record; DOB=date of birth; ID=identification			

(Permission to use the tool was obtained from Dr Lori Goodstone)

D. Remediation if any incorrect in the rights.

E. Conclusion

Scenario 1- Route: Oral

Ms. Susie Simon, 54-year old came in to the emergency room with complaints of chest pain two hours ago. The doctor ordered medications for him to be taken as prophylaxis before the diagnosis is being carried out. You are to serve the medications ordered.

MAR:

1. T. Plavix 75mg stat and daily

Scenario 2 – Route – Intramuscular injections

Mr. Siva was going to the operating room for prostatectomy. The pre-operation medications to be given before going to the operating theatre were ordered for him as below:

MAR:

1. IM Pethidine 50mg On Call

Scenario 3 – Route –Intravenous injections

Mr. Siva came in to the ward with fever for unknown cause. He was ordered an antibiotic to reduce symptoms of fever as below:

MAR:

1. IV fortum 10mg Daily
   (Dose available in an ampule: 20mg)

Scenario 4 – Route –Subcutaneous

Ms. Simon Susie is a diabetic patient. This morning her blood sugar level was 18mmmol/L. You are to give medications to her as prescribed.

MAR:

1. SQ Insulin Actrapid TDS with sliding scale

Sliding scale is

0	-	8.9	= Nil
9	-	11.9	= 6 units
12	-	18.9	= 10 units
19	-	24.9	= 18 units

Scenario 5 – Route –Per Rectum

Mr. Siva complaints that she has not open her bowel since her admission three days ago. The doctor ordered medications for her so that she can pass motion.

MAR:

1. Dulcolax suppository two Stat

Semester 2

ADVENTIST COLLEGE OF NURSING
PENANG

Subject: Administer IV Medication (Intermittent)

Purpose:

1. To achieve immediate and maximum effects of a medication

Requirements:

Tray:

1. Same as one time IV injection (No need tourniquet if for subsequent injection)
2. Add Heparin lock:
   - Heparin 1000 u in 100cc sterile H2O = 10u/cc
   - Draw 1 cc Heparin lock in syringe with needle (for adult patient)
3. Add 2cc of Normal Saline in syringe with needle.
4. IV stopper
5. Kidney dish
6. Receiver
7. Sharp bin
8. Disposable gloves

Procedure – Strict aseptic technique

Action	**Rationale**
1. Wash hands	
2. Wipe cap with alcohol swab.	
3. Aspirate to check for patency.	
4. Prime plug with 1cc Normal Saline	
5. Inject medication	
6. Flush with 1cc Normal Saline	
7. Flush with 1cc (10u) Heparin lock	To keep the vein from clotting.

Reference:

1. Kozier, B., Erb.G (2004) : Fundamentals of Nursing : Concepts and Procedures. 7th ed.- California: Addison-Wesley Publishing Co.

Review: Nov/07

ADVENTIST COLLEGE OF NURSING
PENANG

SUBJECT: Administering Intramuscular Injection

REQUIREMENTS:
Medication tray with:

- syringe (s)
- needle (s)
- alcohol swabs
- vial or ampules of medication
- vial of diluent (when necessary)
- file or gauze pad to break ampule
- kidney dish

Punctured proof container for used needles and syringes
Plastic bag for used swabs
Hand towel on rail

PROCEDURE:

ACTION:	RATIONALE:
1. Obtain Medication Administration Record. (MAR).	
2. Check MAR against the most recent physician's order.	Be sure it is the correct order.
3. Wash hands.	Maintain aseptic technic.
4. Assemble syringe and needle and place in kidney dish.	
5. Take medication from drawer and compare label with MAR.	Safety check – Right drug.
6. Check label again before calculating and preparing dosage.	Safety check.
7. Clean vial or ampula with alcohol swab.	
8. Withdraw correct amount of medication.	Right dose.

ACTION:	RATIONALE:
9. Expel air and place syringe and needle with alcohol swab in kidney dish and take to patient. (If drawn from vial, change needle.	
10. Identify patient: - ask patient to state name and identify with patient's identification band.	Right patient.
11. Explain procedure to patient patient and provide privacy	
12. Expose site of injection.	
13. Swab the injection site.	
14. Spread the skin to make it taut.	
15. Insert the needle at 90 (darting action). a) Withdraw plunger slightly. b) Observe for blood c) Inject medication slowly	
16. Place swab at the injection site.	
17. Remove needle.	
18. Assist patient to a comfortable position.	
19. Dispose syringe and needle correctly.	Infection control.
20. Documentation.	

Yr I Sem II

ADVENTIST COLLEGE OF NURSING
PENANG

Subject: Administering oral medications

Purposes:

1. To provide the most common, easiest and least expensive route of administering medication.
2. To provide sustained drug action and increased absorption time.
3. To provide oral liquid medication to client who has difficulty swallowing pills.

Requirements:

1. Medication
2. Medicine cups
3. A jar of water
4. Medication Administration Record (MAR)
5. Receiver
6. Mortar and pestle

Procedure **Action**	**Rationale**
1. Obtain patient's MAR	
2. Starting at the top of the medication record, check each medication in order against the medication packages in the drawer. Ensure that all medication are available for dispensing.	
3. Check physician's orders for any discrepancy between medication record and drug package.	To make certain that the order was transcribed correctly.
4. Wash and dry hands.	
5. Take medication cart or tray to patient's room. check room and bed number against medication record.	
6. Assess and determine patient's physical ability to take medication as ordered.	Some patients may not be able to swallow. Medicines need to be crushed.
7. Remove the medication from the drawer or tray on medication cart.	
8. Compare the label on the bottle or drug package to the medication record.	A safety check to ensure the right medication is given.
9. Correctly calculate dosage if necessary and check the dosage to be administered.	To ensure correct dosage.

Action	Rationale
10. For tablet: Pour medication into the lid of the container and then into the medicine cup.	To avoid contaminating the drugs.
11. Place medication in separate cups for drugs that require assessment before administration e.g. cardiac drug	This is a safety precaution for drugs that may be held following assessment.
12. For liquid: Shake bottle well for suspension before pouring into medication cup.	
13. For liquid with label facing up, wipe bottle off before replacing. Pour medicine at eye level.	To avoid obliterating label. To ensure accuracy.
14. Compare and check medication label again.	To confirm correct drug and dosages.
15. Check medication label and name on drawer when returning stock or unused medications to drawer.	To ensure the drug belongs to the right patient's drawer.
16. Bring medication with MAR to patient.	To ensure it is the right patient.
17. Check medication time e.g. ac, pc	To ensure medication is given at right time.
18. Identify patient by asking patient to state name and by checking arm band.	
19. Perform necessary pre-administration assessment.	
20. Explain purpose of medication to patient.	
21. Assist patient to sitting or side-lying position.	
22. Offer a glass of drink.	
23. Make sure the patient swallow the medication.	
24. Remove medication cup.	
25. Assist patient in returning to comfortable position.	
Record time and initial in the MAR. if drug is taken, write time and if drug is not taken, circle around the time. Indicate reason e.g. NPO, P.50 etc	

Action	Rationale
26. Dispose of soiled supplies.	
27. Wash hands.	
28. Return within 30 minutes to evaluate patient's response.	

Reference:

1. Kozier, B., Erb.G (2004) : Fundamentals of Nursing : Concepts and Procedures. 7th ed.- California: Addison-Wesley Publishing Co.

2. Smith, S.F., Duell, D.J. and Martin B.C. (2002): Photo Guide of Nursing Skills., New Jersey: Pearson Education Inc.,

Review: Nov/07

Yr I Sem II

ADVENTIST COLLEGE OF NURSING
PENANG

Subject: Giving a Rectal Suppository

Purposes:

1. To cleanse lower bowel.
2. To treat conditions e.g. haemorrhage
3. To administer medication e.g. antipyretic, analgesic

Requirements:

Tray:

1. Suppository as ordered in a medication cupboard
2. Disposable rubber glove
3. Receiver
4. Water soluble lubricant (KY Jelly)
5. Toilet tissues
6. MAR

Procedure

Action	**Rationale**
1. Wash and dry hands.	Prevents transmission of microorganisms.
2. Identify patient. Check doctor's written order.	Suppository is a form of medication and must be ordered by a doctor.
3. Explain procedure to patient.	Information allays patient anxiety. The procedure is less uncomfortable if the patient is relaxed.
4. Prepare the suppository: a) If a suppository was stored in fridge, it must be warmed at room temperature before insertion.	Reduces irritation of rectal mucosa.
b) Squirt some KY Jelly onto some folded toilet tissue.	Lubricant reduces friction between surfaces.
c) Unwrap suppository and place onto KY Jelly on toilet tissue.	Foil wrapper is difficult to manipulate with a gloved hand.
d) Fold some dry toilet paper.	To wipe anus after insertion of suppository.
5. Prepare patient: a) Assist patient to turn onto left lateral/Sim's position.	When lying on the left side, the suppository is inserted following the natural curve of the rectum and sigmoid colon.
b) Cover the patient with sarong/drawsheet, exposing only buttocks.	Prevents undue exposure of patient.
6. Put on glove.	Protects nurse's hand from contamination.

Action	Rationale
7. Instruct patient to breathe in and out slowly through the mouth.	Deep breathing may relax the anal sphincter and make insertion easier.
8. Spread patient's buttocks with non-dominant hand.	To visualize anus.
9. Insert suppository gently 7.5cm-10cm (3-4 inches) into patient's rectum with index finger in the direction of the umbilicus, moving along the wall of the rectum.	3-4 inches is approximately the length of the index finger. Index finger is used for an adult patient while the little finger is used for a child (1 inch). Suppositories need to be inserted beyond the internal and sphincter to be effective.
10. Remove finger from patient's rectum, while pressing patient's buttocks together with the other hand for a few seconds.	Prevents patient's urge to expel suppository.
11. Wipe patient's anus with clean toilet tissues.	
12. Remove glove and turn inside out. Discard glove.	
13. Instruct patient to lie on side for a few minutes.	Generally, suppositories are effective within 30 minutes.
14. Make patient comfortable.	
15. Tidy bedside unit.	
16. Wash and dry hands.	Prevents transmission of microorganism.
17. Record procedure done and patient's response.	

Reference:

1. Kozier, B., Erb.G (2004) : Fundamentals of Nursing : Concepts and Procedures. 7th ed.- California: Addison-Wesley Publishing Co.
2. Smith, S.F., Duell, D.J. and Martin B.C. (2002): Photo Guide of Nursing Skills., New Jersey: Pearson Education Inc.,

Reviewed: Nov/07

Yr I Sem II

ADVENTIST COLLEGE OF NURSING
PENANG

SUBJECT: Subcutaneous Injection

PURPOSES:

1. To facilitate absorption of medication by the subcutaneous tissues.
2. To provide for fast action of medications.
3. To provide an avenue for medications that would otherwise be destroyed by the gastro-intestinal secretions.
4. To administer medications to patients who are unable to retain medications taken orally.

REQUIREMENTS (STERILE PROCEDURE):

Tray containing/kidney dish:

- Sterile alcohol swabs
- Sterile syringes
- Sterile needles
- Required medications
- Container for used sharps
- Receiver

PROCEDURE:

ACTION:	**RATIONALE:**
1. Check Doctor's written order.	
2. Check the medication to be given.	To ensure the right medication.
3. Wash and dry hands.	
4. Assemble the syringe and needle. Do not handle the shaft of the plunger,and the tip or the shaft of the needle with fingers.	To prevent contamination.
5. Check the medication again.	To avoid errors in administration.

ACTION:	RATIONALE:
6. Withdraw the required dosage into the syringe from:	
A VIAL	
i) Remove the metal cap from the vial,if present.	
ii) Clean the exposed rubber stopper with an alcohol swab and allow the area to dry.	
iii) Draw the syringe plunger back to the point marking the dosage ordered.	To draw air into the syringe.
iv) Insert the needle into the vial through the centre of the rubber stopper,and inject the air into the vial.	To increase the pressure within the vial, thus facilitating the withdrawal of the solution.
v) Invert the vial and hold it upright.	To facilitate the flow solution by gravity.
vi) Withdraw the required dosage of the medication into the syringe.	
vii) Expel the air from the syringe into the vial.	
viii) Change the needle.	
7. Place the syringe in the covered receptacle with the alcohol swab. Ensure that the needle does not come into contact with the alcohol swab.	Alcohol causes irritation to tissues.
8. Identify the patient.	To ensure the right Patient.

ACTION:	RATIONALE:
9. Explain the procedure and its purpose to the patient.	To allay anxiety and obtain co-operation.
10. Ensure privacy and expose the site for injection.	
11. Clean the site with alcohol swab e.g. Upper lateral aspect of the arm. Lateral aspect of the thigh.	To remove microbes on the skin so as to prevent entry of micro-organisms into the tissues.
12. Give the patient the syringe containing the prescribed dose of insulin.	
13. Instruct the patient to hold the syringe as he would a pencl.	
14. Steady the syringe and the needle. Pinch the skin with the thumb and index finger to elevate the tissue before needle penetration.	To prevent the needle from entering the muscle.
15. A) Show the patient how to spread the skn taut on the anterior thigh,or form a skin fold by picking up subcutaneous tissue between the thumb and forefinger if the patient is thin.	Either of the techniques ensures that the needle tip is inserted into subcutaneous tissue and outside the muscle. Avoid pressing the skin tightly between the fingers because this is a common cause of local induration and infection.
Insert the needle at a a 45 or 90 degree angle depending on the amount of the tissue and the length of the needle.	

B) Select areas of upper arms, abdomen,and upper buttocks for injection after patient becomes proficient with needle inserton. (See accompanying figure)	The skin is loose and there is more sub-cutaneous fat in these areas. Systematic rotation of sites will keep the skin supple and favor uniform absorption of insulin.
Rotate within each site and keep in mind the various rates of absorption in different sites. Exercising an injected site will also hasten insulin absorption. (From ADA Forecast-the Diabetecs' Own Magazine. Vol.4[1]. Courtesy of Becton,Dickinson.	
Withdraw the plunger slightly and observe for any blood. If blood is withdrawn,remove and change the needle,and inject into a different site.	To ensure that the needle has not entered a blood vessel.
Assist the patient to insert the needle with a quick thrust to the hub at a right angle to the skin surface.	The insulin is injected into deep subcutaneous tissue.
C) Inject the medication with slow,consistent pressure without aspiration.	To minimize pain.
D) Instruct the patient to release the skin fold.	
E) Hold the alcohol sponge against the needle and gently withdraw the needle. Wipe area with alcohol sponge.	This maneuver prevents painful pulling of the skin as the needle is withdrawn.

ACTION:	RATIONALE:
F) Place a swab at the injected site and remove the needle quickly once the medication has been administered.	Rapid removal of the needle minimizes pain.
16. Massage the site gently.	To promote dispersion and absorption of drug.
- Make patient comfortable, remove equipment. - Wash and dry hands.	
17. Record the injection given, indicating date,time and the dosage. Sign on the patient's medication card.	
18. Dispose the used syringe and the needle into the container.	
19. Report and record any effects of the injection.	

NOTE:
If injections are to be given at regular intervals (e.g. Insulin),the site for the injection should be rotated to avoid scarring and variability in the absorption rate.

TO LOAD THE SYRINGE

1. Roll the bottle of insulin (NPH and Lente) between the palms of the hands.	The rolling action mixes the insulin.
2. Wipe off the top of the insulin vial with an alcohol sponge.	
3. Inject approximately the same volume of air into the insulin vial as the volume of insulin to be withdrawn.	Air is injected into the vial to keep its contents under slight positive pressure and to make it easier to withdraw the insulin.

TO FILL A SYRINGE WITH LONG-AND-SHORT-ACTING INSULIN MIXTURE

1. Wipe off the vial tops with an alcohol swab.

2. Inject air equal to the number of units to be injected into long-acting insulin first,withdraw needle.

3. Inject air into short-acting insulin bottle and withdraw prescribed amount of insulin.

4. Then withdraw prescribed amount of insulin from long-acting insulin bottle.

Reference:

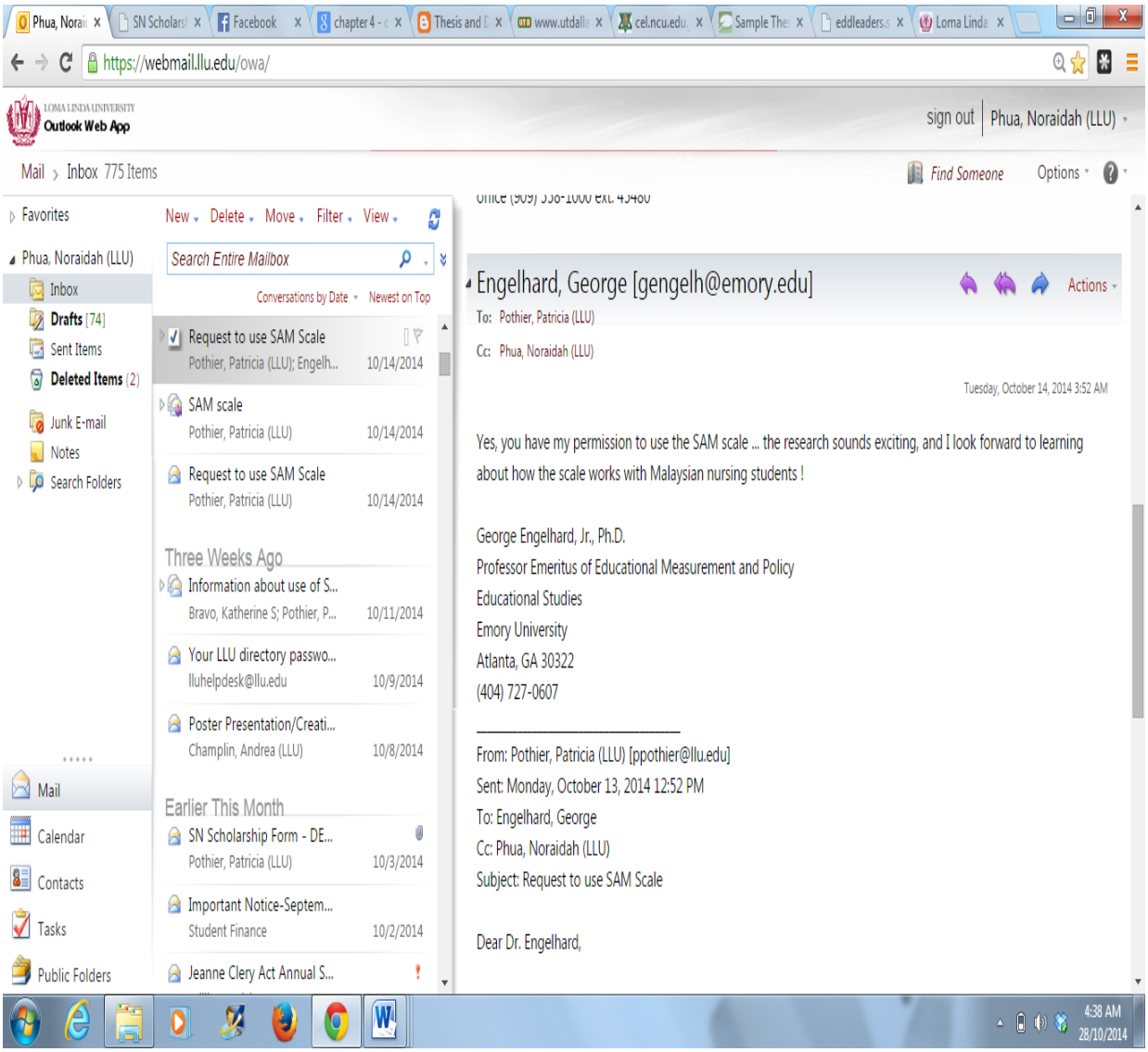
1. Kozier, B., Erb.G (2004) : Fundamentals of Nursing : Concepts and Procedures. 7th ed.- California: Addison-Wesley Publishing Co.
2. Smith, S.F., Duell, D.J. and Martin B.C. (2002): Photo Guide of Nursing Skills., New Jersey: Pearson Education Inc.,

Reviewed: Nov/07

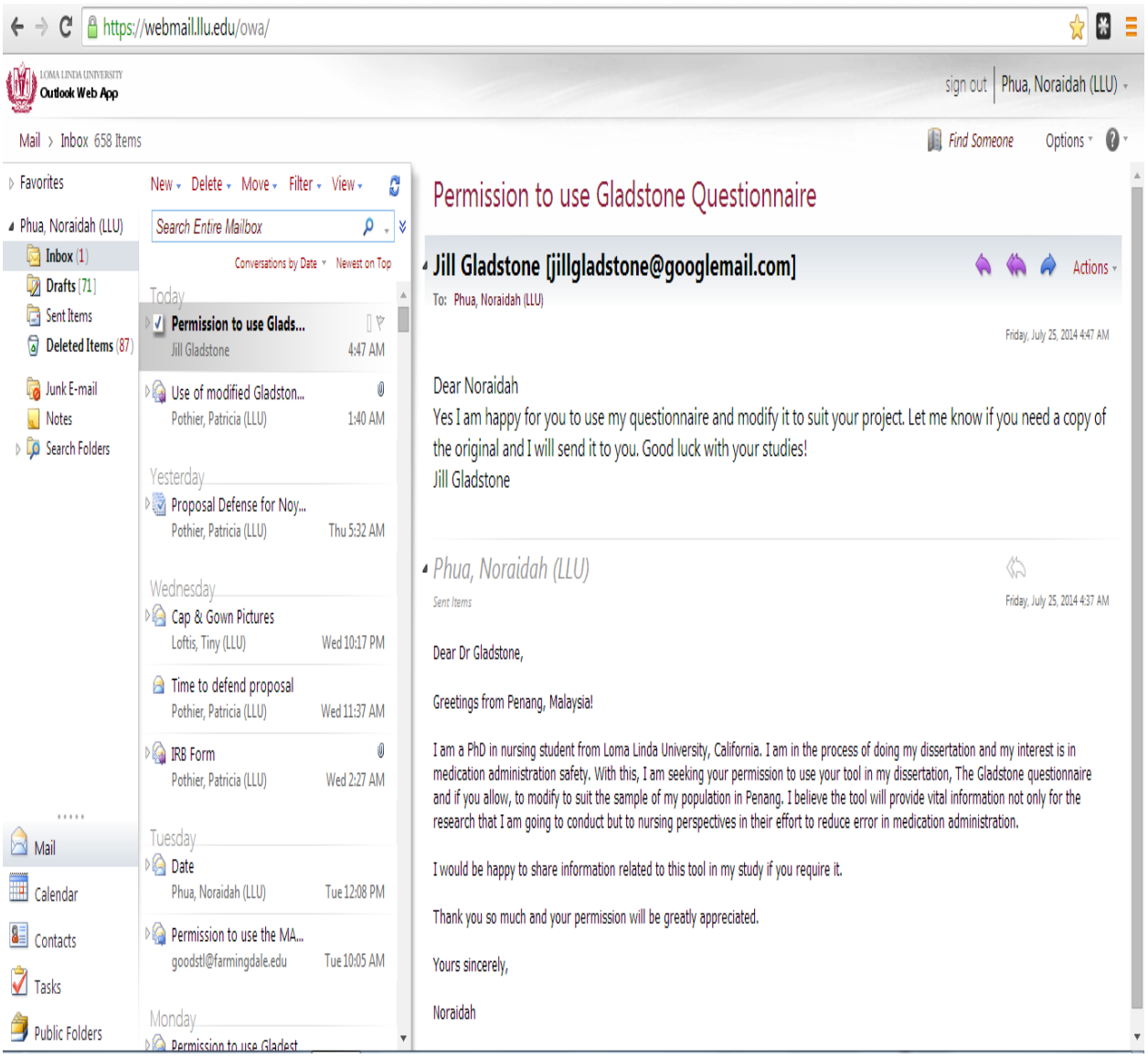
APPENDIX E

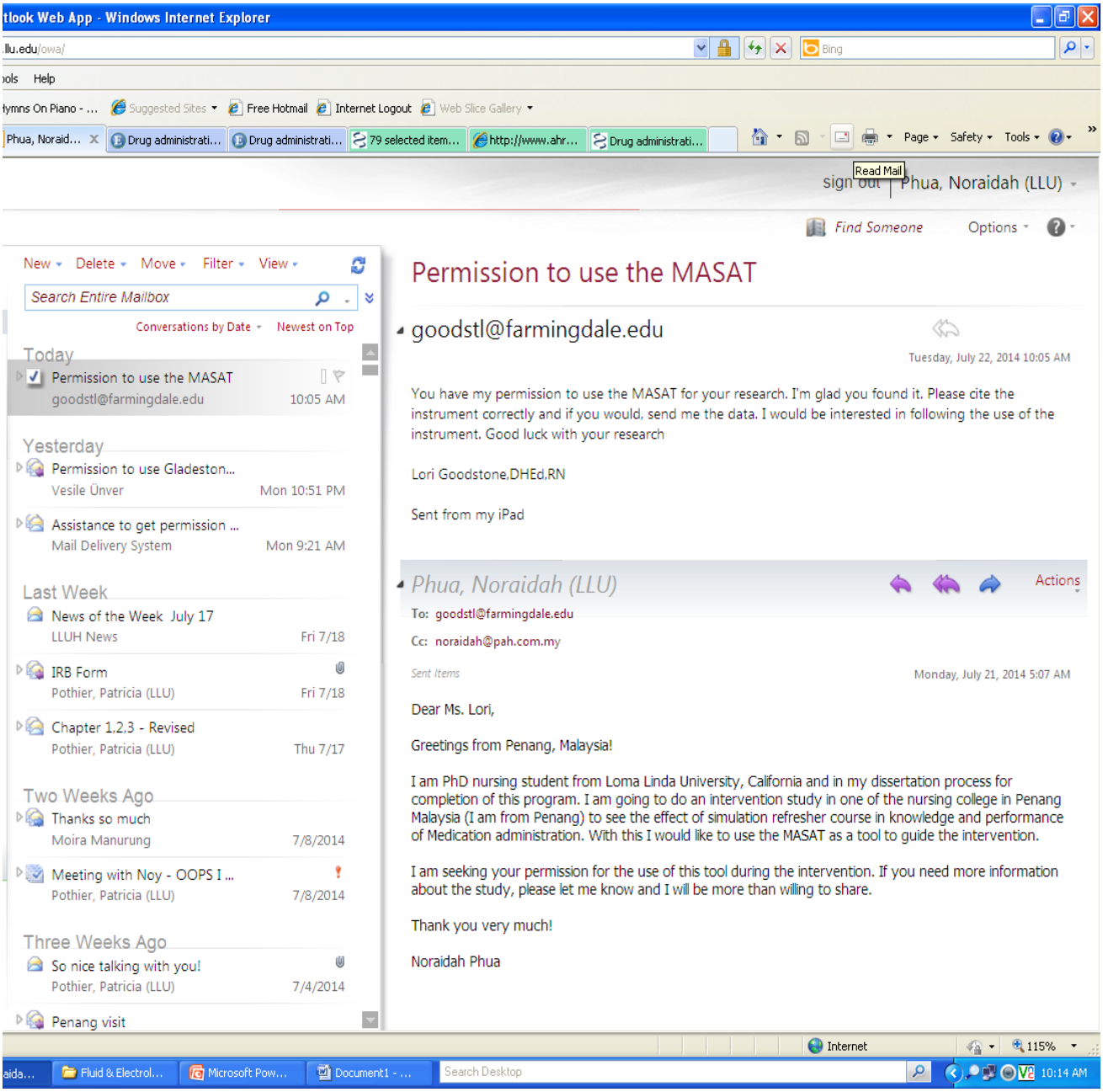
TOOLS PERMISSION

SAM Scale



Modified Gladstone Scale




tlook Web App - Windows Internet Explorer
Read Mail
sign out
Phua, Noraidah (LLU)
Find Someone
Options
New
Delete
Move
Filter
View
Search Entire Mailbox
Conversations by Date
Newest on Top
Today
Permission to use the MASAT
goodstl@farmingdale.edu
10:05 AM
Yesterday
Permission to use Gladeston...
Vesile Ünver
Mon 10:51 PM
Assistance to get permission ...
Mail Delivery System
Mon 9:21 AM
Last Week
News of the Week July 17
LLUH News
Fri 7/18
IRB Form
Pothier, Patricia (LLU)
Fri 7/18
Chapter 1,2,3 - Revised
Pothier, Patricia (LLU)
Thu 7/17
Two Weeks Ago
Thanks so much
Moira Manurung
7/8/2014
Meeting with Noy - OOPS I ...
Pothier, Patricia (LLU)
7/8/2014
Three Weeks Ago
So nice talking with you!
Pothier, Patricia (LLU)
7/4/2014
Penang visit
Permission to use the MASAT
goodstl@farmingdale.edu
Tuesday, July 22, 2014 10:05 AM
You have my permission to use the MASAT for your research. I'm glad you found it. Please cite the instrument correctly and if you would, send me the data. I would be interested in following the use of the instrument. Good luck with your research
Lori Goodstone,DHEd,RN
Sent from my iPad
Phua, Noraidah (LLU)
Actions
To: goodstl@farmingdale.edu
Cc: noraidah@pah.com.my
Sent Items
Monday, July 21, 2014 5:07 AM
Dear Ms. Lori,
Greetings from Penang, Malaysia!
I am PhD nursing student from Loma Linda University, California and in my dissertation process for completion of this program. I am going to do an intervention study in one of the nursing college in Penang Malaysia (I am from Penang) to see the effect of simulation refresher course in knowledge and performance of Medication administration. With this I would like to use the MASAT as a tool to guide the intervention.
I am seeking your permission for the use of this tool during the intervention. If you need more information about the study, please let me know and I will be more than willing to share.
Thank you very much!
Noraidah Phua
Internet
115%
Search Desktop
10:14 AM

APPENDIX F

INTERNATIONAL REVIEW BOARD APPROVAL LETTER

LOMA LINDA UNIVERSITY

INSTITUTIONAL REVIEW BOARD

RESEARCH PROTECTION PROGRAMS
24887 Taylor Street • Suite 202 • Loma Linda, CA 92350
(909) 558-4531 (voice) • (909) 558-0131 (fax)

Exempt Notice ***IRB#5140251***

To: **Pothier, Patricia K**

Department: **Nursing Graduate Programs**

Protocol: **The effect of a simulation refresher course on medication administration knowledge and performance by nursing students in Penang, Malaysia**

Your application for the research protocol indicated above was reviewed administratively on behalf of the IRB. This protocol is determined to be exempt from IRB approval as outlined in federal regulations for protection of human subjects, 45 CFR Part 46.101 (b)(1).

Stipulations of approval:

Please note the PI's name and the IRB number assigned to this IRB protocol (as indicated above) on any future communications with the IRB. Direct all communications to the IRB c/o Research Protection Programs.

Although this protocol is exempt from further IRB review as submitted, it is understood that all research conducted under the auspices of Loma Linda University will be guided by the highest standards of ethical conduct.

Signature of IRB Chair/Designee: R I Rigsby Date: 9/24/14

Loma Linda University Adventist Health Sciences Center holds Federalwide Assurance (FWA) No. 00006447 with the U.S. Office for Human Research Protections, and the IRB registration no. is IORG0000226. This Assurance applies to the following institutions: Loma Linda University, Loma Linda University Medical Center (including Loma Linda University Children's Hospital, LLU Community Medical Center), Loma Linda University Behavioral Medicine, and affiliated medical practices groups.

IRB Chair:
Rhodes L. Rigsby, MD, MBA
Department of Medicine
(909) 558-2341, rrigsby@llu.edu>

IRB Administrator:
Linda G. Halstead, MA, Director
Research Protection Programs
Ext 43570, Fax 80131, lhalstead@llu.edu

IRB Analyst:
Anuradha Diekmann, MPH, CCRP
Research Protection Programs
Ext 86215, Fax 80131, adiekmann@llu.edu

APPENDIX G

DISCLOSURE OF SFI

LOMA LINDA UNIVERSITY

LOMA LINDA UNIVERSITY ADVENTIST HEALTH SCIENCES CENTER OFFICE OF RESEARCH AFFAIRS DISCLOSURE OF SIGNIFICANT FINANCIAL INTEREST(S)

For grant proposals, contracts, IRB protocols, and IACUC protocols

The Research Conflict of Interest policy and procedure requires that all personnel responsible for the design, conduct, or reporting of a research project, contract, sub-contract, agreement or protocol must disclose Significant Financial Interests (SFIs) that reasonably appear to be related to their institutional responsibilities. Training is required per policy and procedure. SFIs must be disclosed at the tim e a project is proposed, annually, at the time an amendment is submitted to add new personnel, and within 30 days of a change in a financial interest. Disclosures must also include the SFIs of family members. Forms may be returned by email (researchcoi@llu.edu), mail (Office of Research Affairs, 24887 Taylor Street, Suite 201, Loma Linda, CA 92350), or by fax (909/558-0577). **Institutional review of this research project will be pending receipt of this disclosure from all personnel.**

What should be reported?

Publicly Traded Companies: Combined equity value (ownership of stock, options, etc.) AND income exceeding $5,000 (or the equivalent cash value) from any one entity when aggregated over the preceding 12 months for the investigator and family that appears to be related to your institutional responsibilities.

Privately Held or Nonprofit Companies: Ownership in any dollar amount or income exceeding $5,000 over the preceding 12 months (or the equivalent cash value) from any one entity that when aggregated for the investigator and family appears to be related to your institutional responsibilities.

Intellectual Property Rights (e.g., patents, copyrights) from which you received any income over the preceding 12 months, and the intellectual property appears to be related to your institutional responsibilities.

Sponsored Travel over $5,000 paid for, or reimbursed directly to you, by an organization other than an accredited U.S. institution of higher education (including LLUAHSC) or by any U.S. government agency (federal, state, or local) when the sponsoring organization appears to be related to your institutional responsibilities.

Paid Positions of Influence in which you exercised an authoritative or direction-shaping role in any entity not affiliated with LLUAHSC (including non-profit organizations) and the interests of the entity appear to be related to your institutional responsibilities.

Definitions

Assets: Equity interests including stocks, stock options, warrants, partnerships, other equity ownership interests and intellectual property rights (e.g. patents, copyrights). This excludes income from investment vehicles in which the investigator does not directly control the investment decisions, e.g., mutual funds.

Family: Immediate family members, including spouse, children, step-children, siblings, parent and parental in-laws.

Income: Salary, consulting payments, honoraria, royalty payments, dividends, loans from the entity, or any other payments or consideration with value including those received for lectures, seminars, and/or teaching engagements. This excludes salary, royalties, or other remuneration paid by Loma Linda University Adventist Health Sciences Center or its affiliated corporations to the investigator if the investigator is currently employed or otherwise appointed by this institution.

Institutional Responsibilities: The investigator's professional responsibilities on behalf of Loma Linda University Adventist Health Sciences Center or its affiliated corporations, including but not limited to activities such as research, teaching, professional practice, institutional committee memberships, and service on panels such as the Institutional Review Board.

Intellectual Property: This includes patents, copyrights, or royalties.

Investigator: The principal investigator, co-investigator, significant personnel or any other person who participates in the design, conduct, or reporting of any portion of a research project.

Ownership/Equity Interest: Dollar amount of interest (current market value if publicly traded; internal estimate of value if not publicly traded; otherwise, amount of investment). May be in the form of stock, stock options, real estate, or any other investment or ownership vehicle.

Position of Influence: This includes board member, director, manager, officer, partner, consultant, or trustee in an outside entity that is affiliated with or will benefit from your institutional roles and responsibilities.

Research: A systematic investigation or study designed to formulate generalizable knowledge such that the conclusions of the study may be applied to areas beyond that of the original setting. Research may be related to any domain of knowledge, recognizing that at Loma Linda University most research is broadly related to the health, social and behavioral sciences. The term includes basic research (that seek to uncover fundamental rules or operations of nature), applied studies (that search for information to address practical issues), and product development, but it excludes quality improvement activities.

LOMA LINDA UNIVERSITY

LOMA LINDA UNIVERSITY ADVENTIST HEALTH SCIENCES CENTER
DISCLOSURE OF SIGNIFICANT FINANCIAL INTEREST(S)

This reporting of Significant Financial Interests request is made because of your involvement in research-related activities with Loma Linda University Adventist Health Sciences Center.

SECTION I. Researcher Information

Name NORAIDAH PHUA | School/Entity School of Nursing | Department – | Phone 6012-5531808

Email nphua@llu.edu | Sponsor/Funding Agency N/A | Your role on the project Researcher | Project Period From October 2014 Through June 2015

Project title The effect of a simulation refresher course on medication administration knowledge and performance by nursing students in Penang, Malaysia.

LLU Principal Investigator/Director Dr. Patricia Pothier | Institutional or other identifying account # 5140251

Disclosure Category (please circle one): (New) Annual renewal Change in Financial Interest – N/A

SECTION II. Significant Financial Interests disclosure

In the 12 months preceding this disclosure, have you or your family members had a Significant Financial Interest (SFI) in ANY (choose 'yes' or 'no' for each question):

Yes	No	
☐	☑	**Publicly Traded Entity** in which your combined equity value (ownership of stock, options, etc.) AND income (in any one entity) exceeded $5,000 and that entity appears to be related to your institutional responsibilities;
☐	☑	**Non-Publicly Traded Entity** in which you had ANY ownership interest OR income exceeding $5,000 (from any one entity), and that entity appears to be related to your institutional responsibilities;
☐	☑	**Intellectual Property** from which you received ANY income, and the intellectual property appears to be related to your institutional responsibilities;

Or received:

☐	☑	**Sponsored Travel** $5,000 or more that is paid for, or reimbursed directly to you, by any organization OTHER THAN an accredited, U.S. institution of higher education (including LLUAHSC) or by any U.S. government agency (federal, state, or local) and the sponsoring organization appears to be related to your institutional responsibilities;

Or held:

☐	☑	**A Paid Position of Influence** in which you had any authoritative or direction-shaping role in any entity NOT affiliated with LLUAHSC (including non-profit organizations) and the interests of the entity appear to be related to your institutional responsibilities.

If you have checked 'Yes' to any of the above, complete Sections IV and V on pages 3-4.

If you have checked 'No' to all of the above, complete Section III below.

Note: If "No," this declaration satisfies disclosure requirements for ***all research projects*** *in which you participate for a period of one year. However, if you acquire new financial interests, this provision will end and you must disclosure any new financial interest within 30 days..*

Section III. I certify that:

- I have reviewed Research Conflict of Interest Policy, and understand my obligations.
- The information submitted within this form is true, complete and accurate to the best of my knowledge.
- Any false, fictitious, or fraudulent statements may subject me to criminal, civil, or administrative penalties.

Signature _____ Date SEPTEMBER 3 2014

LOMA LINDA UNIVERSITY

LOMA LINDA UNIVERSITY ADVENTIST HEALTH SCIENCES CENTER
DISCLOSURE OF SIGNIFICANT FINANCIAL INTEREST(S)

This reporting of Significant Financial Interests request is made because of your involvement in research-related activities with Loma Linda University Adventist Health Sciences Center.

SECTION I. Researcher Information

Name	**School/Entity**	**Department**	**Phone**
Email	**Sponsor/Funding Agency**	**Your role on the project**	**Project Period**
LLU Principal Investigator/Director		**Institutional or other identifying account #**	

Disclosure Category (please circle one): New Annual renewal Change in Financial interest

Section IV. Project-specific Significant Financial Interest disclosure for investigators with known significant financial interests. Complete a separate form for each outside company/entity.

Company or Entity Name

Company or Entity Type (please circle one):

Privately Held
Publicly Held
Nonprofit

1) Have you or your family held any position or served on an advisory board or board of directors for this entity?

○ Yes
○ No

Position Title (please circle):	**Position Held By (please circle):**	**Paid Amount (please circle):**
Board Member	Self	$0
Director	Spouse	$1-$4,999
Manager	Dependent Child	$5,000- $9,999
Officer	Multiple Family Members (explain below)	$10,000-$19,999
Partner	Other (please describe)	$20,000-$39,999
Stock Owner		$40,000-$59,999
Trustee		$60,000-$79,999
Other (please describe)		$80,000-$99,999
		$100,000-$149,999
		$150,000-$199,999
		>=$200,000

Please describe the roles and responsibilities of this position and relationship to research project(s):

2) Have you or your family owned assets in this entity?

◯ Yes
◯ No

Asset Type (please circle one):
(please circle one):
Partnerships
Stock
Stock Options
Warrants
Other (please describe)

Assets Owned By:
(Please circle one)
Self
Spouse
Dependent Child
Multiple Family

Percent Ownership
(please circle one):
<= 5% Ownership
>= 5% Ownership
Not Applicable

Current Value (please circle one):
$0
$1-$4,999
$5,000-$9,999
$10,000-$19,999
$20,000-$39,999
$40,000-$59,999
$60,000-$79,999
$80,000-$99,999
$100,000-$149,999
$150,000- $199,999
>= $200,000

Comments/Description. Describe any relationship to research project(s):

3) Have you or your family received income from this entity?

◯ Yes
◯ No

Income Type (please circle one):
Consulting
Dividends
Honoraria
Loans
Salary
Other (please describe)

Income Received By (please circle one):
Self
Spouse
Dependent Child
Multiple Family Members (explain below)
Other (please describe)

Annual Amount(please circle one):
$0
$1-$4,999
$5,000-$9,999
$10,000-$19,999
$20,000-$39,999
$40,000-$59,999
$60,000-$79,999
$80,000-$99,999
$100,000-$149,999
$150,000-$199,999
>=$200,000

Describe the source of income, position or services for which it was received, and how it is related to your research project(s):

4) Have you or your family received any reimbursed/sponsored travel related to your institutional responsibilities?

○ Yes
○ No

Travel Type (please circle one):	Travel Provided For (please circle one):	Estimated Value (please circle one):
Sponsored	Self	$0
Reimbursed	Spouse	$1-$4,999
Unknown	Dependent Child	$5,000-$9,999
	Multiple Family Members (explain Below)	$10,000-$19,999
	Other (please describe)	$20,000-$39,999
		$40,000-$59,999
		$60,000-$79,999
		$80,000-$99,999
		$100,000-$149,999
		$150,000-$199,999
		>=$200,000

Purpose of Trip:

Destination of Trip:

Duration of Trip:

Comments/Description. Describe any relationship to your research project(s):

5) Have you or your family received income related to intellectual property rights and interests?

○ Yes
○ No

Intellectual Property Type (please circle one):	Annual Amount (please circle one):
Copyright	$0
License	$1-$4,999
Patent	$5,000-$9,999
Royalties	$10,000-$19,999
Other (please describe)	$20,000-$39,999
	$40,000-$59,999
	$60,000-$79,999
	$80,000-$99,999
Intellectual Property Owned By(please circle one)	$100,000-$149,999
Self	$150,000-$199,999
Spouse	>=$200,000
Dependent Child	
Multiple Family Members (explain below)	
Other (Please describe)	

a. Have these intellectual property rights been assigned to Loma Linda University Adventist Health Sciences Center or its affiliated corporations? (please circle one)

Yes
No
Unknown

b. Do you have an agreement with Loma Linda University Adventist Health Sciences Center or its affiliated corporations to share in royalties related to these intellectual property rights? (please circle one)

Yes
No
Unknown

Please describe the intellectual property and how/if it is related to your research project(s):

Section V. I certify that:

- I have reviewed Research Conflict of Interest Policy, and understand my obligations.
- The information submitted within this form is true, complete and accurate to the best of my knowledge.
- Any false, fictitious, or fraudulent statements may subject me to criminal, civil, or administrative penalties.

_____ **Date**

Signature

APPENDIX H

INFORMED CONSENT

LOMA LINDA UNIVERSITY

School of Nursing

INFORMED CONSENT

The Effect of a Simulation Refresher Course on Medication Administration Knowledge and Performance by Nursing Student in Penang, Malaysia

The purpose of this study is to evaluate the effectiveness of a simulation refresher course on medication administration knowledge and performance of nursing students in the Adventist College of Nursing and Health Sciences in Penang, Malaysia. I, Noraidah Guntalib, PhD (c), RN, am doing the study because I am interested in learning more about improving teaching and student learning strategy. It is also part of my program for the completion of a PhD in Nursing. You are invited to participate in this research project because you are a second or third year diploma nursing student in ACNHS who is 18 to 24 years old, who has undergone and passed the pharmacology subject in year one, and who has already obtained at least the second column of the logbook requirement in medication administration via all the routes (oral, IV, SQ, IM, PR).

The study will be accomplished by comparing two groups of nursing students. One group, the experimental group will undergo a one-hour refresher course with simulation of medication administration in the skills lab while the other group, the control group will continue to carry out their learning activities as usual according to the college's curriculum and schedule. An evaluative questionnaire (SAM Scale) will be used to objectively measure the student's knowledge and performance.

If you agree to participate you will be randomly assigned (like flipping a coin) to one of the two groups. Your participation will involve the following:

1. Attend a briefing about the study.
2. Take a pre-test and two post-tests of the SAM Scale using a paper-pencil format. The test will take approximately one hour for each session.
3. If you are in the 'experimental group' you will carry out your clinical practice as per the curriculum, and in addition you will attend a scheduled one-hour refresher course with simulation of medication administration in the skills lab.
4. If you are in the 'control group' you will carry out your clinical practice as per the curriculum. You will provide the comparison for the research.
5. At the end of the study you will take a brief survey questionnaire to determine what action or situation may contribute to medication administration errors. This will take about 10 minutes.

There is minimal risk to you for participating in this research project. While taking the tests, you may feel tired due to the length of the SAM Scale. If at any time during the conduct of the study you do not want to continue, you are free to withdraw from the study. If you do not wish to answer a specific question you may decline. Your participation in this study is voluntary.

(p. 1 of 2)

Loma Linda University
Adventist Health Sciences Center
Institutional Review Board
Approved 9/24/14
5140251 Chair R L Rigsby MD

The Effect of a Simulation Refresher Course on Medication Administration Knowledge and Performance by Nursing Student in Penang, Malaysia

Information that is obtained from this research study that can identify you will remain confidential and will be disclosed only with your permission or as required by law. Student's names in the data sheets will be removed and will be replaced with a code. A master code list that will match the subject names to numbers assigned to data will be kept in separate file that is locked with a password in the researcher's office. Collected data will be kept in a locked file in the researcher's office. In a situation where you will not be able to complete the study or drop after the pre-test, your collected information will be shredded.

There is no cost to you to participate in this research project. Your participation will have no influence on your nursing course grade or clinical hour requirement. At the end of the study, you will receive a small token of appreciation for your participation from the researcher.

Consent to participant

I have read and understood the consent document and have listened to the verbal explanation given by Noraidah Guntalib, PhD (c), RN. My question about the research study has been answered to my satisfaction. I know that my participation is voluntary and has no bearing or credit on my nursing course grade and clinical hours requirement and that I can withdraw at any time without giving any reason.

I agree to participate either in the control group or experimental group and give my permission for the researcher to take my results of the tests in the study without my name being disclosed.

I understand that the data might be reviewed by researcher's adviser and committee members without my identity being revealed. I may call Noraidah Phua during routine office hours at 0125531808. If I have additional questions or concerns I may contact Sherand Khor Heng Wei from the Penang Adventist Hospital Research Center at 04228 7566 Ext 241, or Noraidah's research adviser Patricia Pothier, PhD, RN at Loma Linda University in California at 909-558 1000 ext. 45480. I have been given a copy of this consent document for my keeping.

Signature of participant	Printed Name of Participant	Date

I have reviewed the contents of this consent form with the person signing above. I have explained potential risks and benefits of the study.

Signature of researcher	Printed Name of Researcher	Date

(p. 2 of 2)

APPENDIX I

REQUEST, PERMISSION AND SUPPORT LETTER

Noraidah Guntalib,
Nurse Tutor,
ACNHS,

Lim Gek Mui
Principal, ACNHS

Date: 17th July 2014

Dear Madam,

Re: Permission to conduct research for requirement in the PhD in nursing program

I would like to request your permission to conduct an experimental study to the year two and year three of the Diploma in nursing program students to test the effect of simulation refresher course in Adventist College of Nursing and Health Sciences.

The Clinical Instructors also will be given a survey form to be filled out regarding their perceived barriers to safe medication administration by nursing students by ranking the "barriers" that is given in the survey.

For your information, the title of my proposed study will be "The effect of simulation refresher course on knowledge and performance of nursing students in Penang, Malaysia"

I have attached a brief summary of the proposed study for your kind perusal.

Your permission for me to carry out the study in this institution will be very much appreciated.

If permission is granted, I would like to request for "Letter of support" from the college as part of the requirement from the Institutional Review Board (IRB) from LLU for ethics approval of the study.

Thank you and God Bless!

Yours sincerely,

Noraidah Guntalib

cc. Dr. Shee Soon Chiew
cc. Dr. Patricia Pothier (Chairman of Dissertation Committee)

Permission and Support Letter from ACNHS

KOLEJ KEJURURAWATAN ADVENTIST (ADVENTIST COLLEGE OF NURSING)

Operated by Adventist Hospital & Clinic Services (M) (255697-M)
465, JALAN BURMA, 10350 PULAU PINANG, MALAYSIA. · Tel: (604) 2227252 · Fax: (604) 2227274
E-mail: acn@pah.com.my · Website: www.pah.com.my/acn

15 August 2015

Internal Review Board
Loma Linda University
Office of the Vice President of Research Affairs
2488 Taylor Street, Suite 202
Loma Linda, California 52350

Dear Internal Review Board,

This is to inform you that the administration of the Adventist College of Nursing and Health Sciences is in support of the doctoral research proposed by Mrs. Noraidah Phua titled *"The effect of a Simulation Refresher Course in Medication Administration Knowledge and Performance by Nursing Student in Penang Malaysia"*. Mrs Phua has our support to work with and collect data from nursing students to complete the study. Our goal is to improve the educational outcomes of our students, and we hope that this study will provide information that can improve teaching related to medication administration and ultimately improve patient care.

Thank you.

Sincerely,

Lim Gek Mui
Principal

Permission Letter from ACRC- PAH

Penang Adventist Hospital

PENANG ADVENTIST HOSPITAL
Operated by Adventist Hospital & Clinic Services (M) (255697-M)
465 Jalan Burma, 10350 Penang, Malaysia

Tel (+604) 222 7200 ● Fax (+604) 226 3366
Website: www.pah.com.my ● Email: enquiry@pah.com.my
Patient Business Office Fax: (+604) 227 8512 ● E-mail: billing@pah.com.my

Adventist Clinical Research Centre
Adventist College of Nursing & Health Sciences
488B-07-01/02, Midlands One-stop (Level 7), Burmah Road,
10350 Penang, Malaysia.

1 October 2014

Dear Ms Noraidah Guntalib,

RE: Application For Research Committee and Medical and Dental Executive Committee Approval to Conduct a Research Entitled: A Study on Using 'The effect of simulation refresher course on medication administration knowledge and performance by nursing student in Penang.

We are pleased to inform you that your application to conduct a research entitled 'The effect of simulation refresher course on medication administration knowledge and performance by nursing student in Penang.' has been reviewed and approved by Penang Adventist Hospital. The final approval by our Medical and Dental Executive Committee is recorded in it meeting action number MDEC14-064.

We appreciate your cooperation in keeping us updated of any changes or development in your research. The first research progress report should be submitted 6 months from the date of issue of the research approval letter of the research project and thereafter every 3 monthly if the research project has not been closed.

We wish you the best of luck in your research study.

Thank you very much.

Your sincerely,

Dr Raymond Tah Kheng Soon
Head of Adventist Clinical Research Centre
Penang Adventist Hospital

APPENDIX J

FIVE RIGHTS CALCULATIONS TABLE

Right Patient		Pretest (%)		Post Test 1(%)		Post Test 2(%)	
Vignette	**Question**	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
1	1	95.1	95	95.1	97.6	100	100
2	6	97.5	100	97.6	100	100	100
3	11	14.6	16.7	9.8	0	100	100
4	16	100	95.2	100	100	82	92.9
5	21	82.9	85.7	90.2	92.9	100	100
6	26	100	100	100	100	100	100
7	31	97.5	100	100	100	100	100
8	36	100	100	100	100	100	100
9	41	100	92.9	100	100	100	100
10	46	97.6	97.6	100	97.6	100	100
11	51	56.1	61.9	70.7	57.1	66.7	66.7
12	56	100	100	100	100	100	100
13	61	100	100	100	100	100	100
14	66	100	100	100	100	100	100
Mean Total		**88.7**	**88.9**	**90.2**	**88.9**	**96.3**	**97.1**

Right Drug		Pretest (%)		Post Test 1 (%)		Post Test 2 (%)	
Vignette	**Questions**	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
1	2	97.6	100	97.6	100	100	100
2	7	58.5	45.2	65.9	47.6	71.8	57.1
3	12	95.1	90.5	97.6	92.6	97.4	95.2
4	17	92.7	97.6	95.1	100	97.4	100
5	22	65.8	83.3	75.6	76.2	79.5	90.5
6	27	95.1	97.6	100	100	100	100
7	32	100	97.6	100	97.6	100	100
8	37	97.6	97.6	97.6	100	100	97.6
9	42	97.6	85.7	100	97.6	97.4	97.6
10	47	63.4	59.5	75.6	59.5	76.9	69.0
11	52	90.2	88.1	90.2	92.9	94.9	97.6
12	57	97.6	95.2	97.6	100	97.4	97.6
13	62	100	100	100	100	100	100
14	67	97.6	100	97.6	97.6	100	100
Mean Total		**89.2**	**88.4**	**92.2**	**90.1**	**93.8**	**93.0**

Right Dose		Pretest (%)		Post Test 1(%)		Post Test 2 (%)	
Vignette	**Questions**	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
1	3	97.6	95.2	97.6	97.6	100	97.6
2	8	53.7	54.8	75.6	66.7	61.5	61.9
3	13	70.3	76.2	78.0	73.8	84.6	81.0
4	18	92.7	95.2	92.7	92.9	94.9	97.6
5	23	70.3	83.3	92.7	78.6	84.6	78.6
6	28	61.0	66.7	65.9	73.8	69.2	61.9
7	33	51.2	59.5	75.6	54.8	64.1	50
8	38	78.0	81.0	85.4	81.0	84.6	71.4
9	43	34.1	23.8	34.1	35.7	25.6	31.0
10	48	73.2	69.0	73.2	81.0	94.9	88.1
11	53	51.2	47.6	56.1	54.7	56.4	59.5
12	58	82.9	78.6	90.2	88.1	92.3	97.6
13	63	70.3	90.5	87.8	88.1	92.3	95.2
14	68	97.6	100	95.1	97.6	100	100
Mean Total		**70.3**	**73.0**	**78.6**	**76.0**	**78.9**	**76.5**

Right Time		Pretest (%)		Post Test 1(%)		Post Test 2 (%)	
Vignette	**Questions**	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
1	4	36.6	42.6	26.8	38.1	33.3	43.6
2	9	97.6	95.2	100	100	100	97.6
3	14	87.8	95.2	97.6	95.2	97.4	97.6
4	19	100	100	100	100	100	100
5	24	82.9	90.5	92.7	95.2	97.4	92.9
6	29	85.4	92.9	95.1	100	94.9	100
7	34	36.6	38.1	24.4	23.8	41.0	28.6
8	39	85.4	90.5	87.8	90.5	92.3	85.7
9	44	80.5	85.7	95.1	95.2	92.3	95.2
10	49	78.0	78.6	75.6	88.1	82.1	85.7
11	54	90.2	88.1	87.8	92.9	97.4	97.6
12	59	90.2	100	97.6	97.6	100	97.6
13	64	90.2	97.6	95.1	95.2	94.9	100
14	69	41.5	35.7	43.9	33.3	69.2	59.5
Mean Total		**77.4**	**80.8**	**80.0**	**81.8**	**85.2**	**84.4**

Right Route		Pretest (%)		Post Test 1(%)		Post Test 2 (%)	
Vignette	**Questions**	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
1	5	97.6	97.6	95.1	92.9	97.4	100
2	10	85.4	92.9	100	100	100	100
3	15	100	100	100	100	97.4	100
4	20	97.6	97.6	97.6	100	100	100
5	25	85.4	97.6	87.8	92.9	92.3	100
6	30	95.1	97.6	100	97.6	97.4	100
7	35	97.6	100	100	95.2	100	97.6
8	40	95.1	100	100	95.2	100	100
9	45	100	92.9	100	97.6	100	97.6
10	50	95.1	95.2	100	95.2	100	100
11	55	95.1	95.2	97.6	95.2	100	100
12	60	73.2	73.8	80.5	76.2	76.9	81.0
13	65	97.6	97.6	100	100	100	100
14	70	97.6	100	97.6	100	100	100
Mean Total		**93.7**	**95.6**	**96.9**	**88.8**	**97.2**	**98.3**

APPENDIX K

MODIFIED GLADSTONE SCALE POINTS CALCULATION

Modified Gladstone Scale: Nursing student

	1(Most common-10)	2 (9)	3 (8)	4 (7)	5 (6)	6 (5)	7 (4)	8 (3)	9 (2)	10 (Least Common-1)	Total Points
1. Fail to check name	10	7	9	7	5	5	6	5	9	18	414
	100	63	72	49	30	25	24	15	18	18	
2. Doctors handwriting is illegible	36	11	10	7	5	3	3	3	3	-	660
	360	99	80	49	30	15	12	9	6	-	
3. Labels/packaging are poor quality/damage	2	6	6	8	9	10	11	6	6	17	373
	20	54	48	56	54	50	44	18	12	17	
4.Confusion between two drugs name with similar name	8	23	8	12	8	11	3	2	4	2	566
	80	207	64	84	48	55	12	6	8	2	
5. Doctors prescribed wrong drug	8	10	17	4	12	2	6	6	9	7	483
	80	90	136	28	72	10	24	18	18	7	
6. Nurse miscalculate the dose	8	8	15	20	6	10	6	5	3	-	543
	80	72	120	140	36	50	24	15	6	-	
7. Nurse sets up or adjusts an infusion device incorrectly	1	5	2	5	9	10	20	16	9	4	360
	10	45	16	35	54	50	80	48	18	4	
8. Nurse confused by the different types and functions of infusion device	-	2	3	2	10	13	13	20	11	7	322
	-	18	24	14	60	65	52	60	22	7	
9. Nurse are distracted by other patients, coworkers or events in the ward	2	4	5	1	10	10	6	11	12	20	314
	20	36	40	7	60	50	24	33	24	20	
10. Nurse give medication without a witness	5	5	7	15	9	7	6	8	13	6	425
	50	45	56	105	54	35	24	24	26	6	
Total											**4460**

	Causes of MAE as perceived by Nursing students	Total Points
1	Doctors handwriting is illegible	660
2	Confusion between two drugs name with similar name	566
3	Nurse miscalculate the dose	543
4	Doctors prescribed wrong drug	483
5	Nurse give medication without a witness	425
6	Fail to check name	414
7	Labels/packaging are poor quality/damage	373
8	Nurse sets up or adjusts an infusion device incorrectly	360
9	Nurse confuse by the different types and functions of infusion device	322
10	Nurse are distracted by other patients, coworkers or events in the ward	314
	Total	**4460**

Modified Gladstone Scale : Clinical Instructor

	1(Most common – 10)	2 (9)	3 (8)	4 (7)	5 (6)	6 (5)	7 (4)	8 (3)	9 (2)	10 (Least Common-1)	Total Points
1. Fail to check name	3	2	1	3	3	1	1	3	1	1	116
	30	18	8	21	18	5	4	9	2	1	
2. Doctors handwriting is illegible	10	5	0	3	0	0	0	1	0	0	169
	100	45	0	21	0	0	0	3	0	0	
3. Labels/packaging are poor quality/damage	0	1	0	1	3	1	2	1	1	9	61
	0	9	0	7	18	5	8	3	2	9	
4.Confusion between two drugs name with similar name	2	3	5	3	2	3	1	0	0	0	139
	20	27	40	21	12	15	4	0	0	0	
5. Doctors prescribed wrong drug	0	2	2	0	2	2	4	1	4	2	85
	0	18	16	0	12	10	16	3	8	2	
6. Nurse miscalculate the dose	0	1	6	3	1	6	2	0	0	0	122
	0	9	48	21	6	30	8	0	0	0	
7. Nurse sets up or adjusts an infusion device incorrectly	0	0	0	1	2	2	5	4	5	0	71
	0	0	0	7	12	10	20	12	10	0	
8. Nurse confuse by the different types and functions of infusion device	0	0	0	2	0	1	1	4	6	5	52
	0	0	0	14	0	5	4	12	12	5	
9. Nurse are distracted by other patients, coworkers or events in the ward	3	3	3	1	5	2	0	0	1	1	139
	30	27	24	7	30	8	0	0	2	11	
8. Nurse give medication without a witness	1	2	2	2	1	1	3	5	1	1	99
	10	18	16	14	6	5	12	15	2	1	
Total											**1053**

	Causes of MAE as perceived by Clinical Instructors	Total Points
1	Doctors Handwriting is illegible	169
2	Nurse are distracted by other patients, coworkers or events in the ward	139
3	Confusion between two drugs name with similar name	139
4	Nurse miscalculate the dose	122
5	Fail to check name	116
6	Nurse give medication without a witness	99
7	Doctors prescribed wrong drug	85
8	Nurse sets up or adjusts an infusion device incorrectly	71
9	Labels/packaging are poor quality/damage	61
10	Nurse confused by the different types and functions of infusion device	52
Total		**1053**