A Literature Review of Medication Errors in the United States of America

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Bachelor Degree Thesis

Nursing

2016

DEGREE THESIS	
Arcada	
Degree Programme:	Nursing
Identification number:	
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Title:	A Literature Review of Medication Errors in the United States of America
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Commissioned by:	Arcada University of Applied Sciences (MAQ project)

Abstract:

This study is a review fifteen articles selected from 395 articles of medication error in the United States of America between the year 2000 and 2015 from the CINAHL and Academic Search Elite databases. This study explored existing literature on medication error with the aim of providing knowledge about safe medical care. The goal of the study was to shed light to the following questions: (1) What factors contribute to the medication errors? (2). What can be done to mitigate these errors? Broadly speaking, deficits in knowledge and performance, lack of resources, tiredness, work environment, documentation, lack of information and failure to use available information, policy violation, product similarity and inexperience were identified as the causes of medication errors. The study identified education and training, improving the work environment, employing full-time unit based pharmacist, use of technology and encouraged error reporting as tested strategies that can reduce medication errors. This study reveals that management strategies that can better reduce errors should focus on the system as a whole and not just on individuals. It is evident in this study that medication errors are still quite common and are made by all categories of care professionals. This study is faced with the limitation to fifteen articles selected from two databases. The findings might be affected if a larger sample size is used. This work was commissioned by Arcada university of Applied sciences.

Keywords:	Medication errors, drug safety, medication safety, institutions
Number of pages:	41
Language:	English
Date of acceptance:	25Th May 2016

CONTENTS

1 INTRODUCTION

It is expected that patients are not harmed during care. The notion of no harm to patients is rooted in the care profession, and is one of the ideas most talked about by teachers and practical training tutors in the course of the journey to become a nurse. This notion is well grounded in health care, yet taken for granted. Safety issues arise in almost all patient care activities, including medication delivery. Medication errors or situations that can lead to their occurrences have been observed during my practical training periods and while doing part time job. The most glaring type of error being wrong time error. This is especially true with administering morning medication to the elderly, who tend to wake from after 8 am, which is the time that most morning medication are administered.

A medication error court hearing in 2012 arising from errors that occurred some years ago in Finland highlights the risk associated with medication use and patient safety. Three nurses faced trial and some charged for negligence in the use medication (Yle 2012). The incident involved administering Chlorhexidine (an antiseptic antibacterial agent that should not be ingested) to 3 two days old infants. This product was mistaken for sugar solution, because the bottles looked alike.

Patients are alleviated of the illnesses partly by use of drug therapy. Medications have the potential to create both beneficial and adverse effects to patients. The resultant adverse effects of medication use do not affect only patients, but also the health care personnel through whom the errors occurred. The health care professional who make errors in medication delivery to patients can suffer emotional distress, punitive actions and even face legal action, especially when the errors results in substantial patient harm. Patients and relatives of patients who suffer from medication errors may lose trust in care providers.

The outcomes of medication errors therefore call for the need to use medications in a manner that will produce the desired effects of treatment to the patient while causing minimal or no harm. Achieving these desired effects however is challenging, as medication delivery to patients involves many people with varied knowledge about medications and safe medication use. Preventing the adverse effects of medication use on both

patient and professionals is important. This thesis focuses on issue that can result in improved patient safety and is conducted as part of the MAQ medication project at Arcada.

1.1 Background

It is estimated that between 44000 and 98000 hospitalised Americans die annually from preventable medical errors, with more than 7000 deaths ensuing from medication errors in 1993 (Kohn et al. 1999 pp. 26-27). Medication errors are a worldwide problems, and not identifiable only to the United States. In Finland between 700 and 1700 people die each year from medication related errors (yle 2013). Medication errors occur in all settings where medication delivery to the sick is involved.

Many studies have highlighted the risks faced by patients, as they are exposed to errors made in the medication delivery process. These errors may or may not reach the patient. While it can be argued that not all errors arising from the medication use process reaching the patients will harm them, some do cause harm to the patients. Those that cause harm may result in prolonged hospital stays and additional cost to the patient and society, and may possibly lead to patients' death.
An observational study conducted in 36 heath care facilities (accredited, non-accredited and skilled nursing health care facilities) suggests a 19% error rate during medication administration, and that 7% of the errors have to the potential to cause harm (Barker et al. 2002). The study found no significant difference in error rates across the different types of facilities. Another study suggests that a large proportion of administration error reach the patient, with only 2% of administration errors being intercepted, while about half of prescription errors go un-intercepted and consequently reach the patients. The nurse is an invaluable asset when it comes to medication error interception, intercepting up to 86% of all intercepted errors, followed by the pharmacist. (Leap et al. 1995)

Patient safety challenges in medication delivery process cannot be overemphasised in the health care settings, where professionals work in multi-disciplinary teams with complex technologies. All steps in the medication delivery process are always intended to alleviate illnesses and suffering from patients, with no intention of creating new prob-

lems. Medication errors compromise patient safety, and the goal to alleviate illnesses from patients through medication therapy. Medication administration errors constitute the highest risk in medicine delivery to patients (Unver et al. 2012).

Error is failure to execute an action as intended. This means errors can be made by executing the planned actions with errors (commission errors) or falling to perform the intended actions (omission error). Medication errors are errors that arise in the medication delivery process. Medication errors that result in patient harm and adverse drug reactions are subsets of adverse drug events involved in medication use.

> *Medication error is defined as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of a health care professional, patient or consumer. The events leading to medication errors include: 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*. (NCC MERP)

This definition of medication errors thus includes errors that have occurred but are intercepted, therefore not reaching the patient and those that are not intercepted and do reach the patient. The National Coordinating Council for medication Errors Reporting and Prevention's taxonomy for medication errors defines four broad categories of errors: "No error", "error, no harm", "error, harm" and "error, death". From The National Coordinating Council for medication Errors Reporting and Prevention's listed possible causes of medication error it is clear that medication errors may not only originate from within the institutions where patients are care for, but also from exogenous sources including pharmaceutical companies.

Medication errors occurrence cuts across the different stages of the delivery process. This means that errors can be caused by doctors, pharmacists, nurses and anyone involved in the medication delivery chain. Findings from a study by Leap et al. (1995) on the common types of medication errors occurring in hospitals revealed that 39%, 38%, 12% and 11% of medication errors occur at the prescription, administration, transcription and verification, and dispensing phases respectively and identified dosing error as the most common error, with thrice the frequency of the next error type, and accounts for 28% of all errors.

Many studies identified wrong dose and wrong drug to be amongst the most frequent medication errors type following the "five rights of medication administration" (Choo et al. 2014, Kuitunen et al. 2008, Tang et al. 2007, Leap et al. 1995). Cottney & Innes (2015) also identified incorrect dose as one of the common error types. Their study, however, classified omission as the most common type of error. In yet another study that explored error types arising from all other stages of medication delivery process except prescribing; wrong time error, omission, wrong dose and unauthorised drug were identified as the common error types, with these errors constituting 43%, 30%, 17% and 4% respectively of the total number of errors that occurred (Barker et al 2002).

Medication errors are made by both newly graduated and old practitioners. In a study investigating the perspectives of nurses concerning medication errors, 62.1% of newly graduated nurses and 57.3% of nurses with at least 3 years of working experience confirmed having made at least one error during their career (Unver et al. 2012). Error reporting had no significant difference with regards to work experience. The study identified tiredness, distraction, failure to compare patient identity with medication administration records, "sound alike" and poor calculation skills as the common causes of medication errors. Tang et al. (2007) reported Personal neglect, heavy workload, new staff, unfamiliarity with medication, complexity of order and insufficient training, in decreasing order as causes of the errors nurses acknowledged committing, adding that 76.4% of the 72 nurses involved in the study claimed that more than one factor contributed to their errors. Lack of drug knowledge, faulty drug identification and Memory lapses were identified as the common causes of error, with lack of drug knowledge accounting for 46.4% of encountered errors (Choo et al. 2014). Leap et al. (1995) identified lack of drug knowledge, lack of patient information and rule violation as the leading causes of error. Blegen & Vaughn (1998) studied the relationship between nursing staff mix and medication errors. Their study revealed that medication errors will decrease with increase in the proportion of registered nurse in the staff mix. This decrease in errors however stops and error rate rises when registered nurse proportion is more 85% of the staff mix.

In an effort to examine the effectiveness of electronic medication record (eMAR) on medication error reduction, Choo et al. (2014) compared voluntarily reported medica-

tion error data from two hospitals before and after the implementation of eMAR, and found no significant difference in error rate. The most common prescribing errors were those involving allergy to medications and medication dosage, while wrong medication and wrong dose were common with dispensing and administration.
Evidence suggests that most errors may almost never be attributed to a single factor (eds Aspden et 2007 p 45, Tang et al. 2007). Reduction of medication errors therefore requires addressing all factors that can contribute to error occurence.

Although medication errors might not be eliminated, studies suggest intervention strategies will help reduce their occurrence (Niemann et al. 2014, Xu et al. 2014). Niemann et al. 2014 suggest that educating nurses and providing clear information about what constitutes a medication error in drug handling reduces errors per process, frequency of errors and the number of errors reaching patients. Xu et al. 2014, in an experimental study revealed that management interventions to improve medication management can lead to error reduction in medication use.
Medication errors and their causes cannot be fully understood without errors being reported. Evidence suggests that not all medication errors are reported. Results from a study investigating medication error reporting in Tehran lends support to the fact that medication errors are under reported, with only 1.3 error per nurse being reported as opposed to 19.5 errors per nurse recalled by nurses during the same period under investigation (Hajibabaee et al 2014). Haw, Stubbs & Dickens' (2014) study revealed that more than 50% of nurses will not report errors made by their colleagues and near misses made by them. The reasons advanced for not reporting errors made by colleagues and near misses made by them included excusing, fear, knowledge deficit and the burden associated with reporting errors (Haw, Stubbs & Dickens 2014). The purpose of this study is to explore contributing factors to medication errors and strategies used to remedy these errors in the United States of America.

2 CONCEPTUAL FRAMEWORK

The conceptual framework serves as a tool for observing phenomena in the study.

2.1 Patient safety

Patient safety is a subject that concerns not only caregivers who are in direct contact with the patient in the treatment and care delivery process, but everyone who has a stake in the wellbeing of the patient. This includes but not limited to pharmaceutical companies and policy makers within and out of the healthcare facilities. Patient safety is providing patients with harm free treatment or care. The World Health Organisation (2005) defines patient safety as the reduction of unnecessary harm related to healthcare to an acceptable minimum.

Patient safety can only be improved by adopting good error management policies. The analysis in this thesis will follow the system approach to error management.

Reason (2000) suggests that there are two approaches to error management. These include the person and the system approaches. Each of these approaches has its model of error causation, therefore giving rise to different thoughts of error management. The person approach of human errors focuses on the person who committed the error than the reason for the occurrence of the error. This approach considers errors to arise mainly from mental lapses, carelessness, lack of motivation, inattention, negligence and forgetfulness.

Looking at error causation from this perspective results in error containment strategies aimed at reducing unwanted variability in human behaviour. The person approach of error management results in practices such as punishment and blaming of the person who committed the error. While reducing error to a certain level, it has shortcomings. The person approach results in medication errors not being fully reported or understood as a result of the anticipated blame or punitive actions. Without details of medication error incidence, there is no way we can anticipate and prevent similar events from reoccurring.

The system approach however assumes that humans are fallible and can make errors even in the best organisations. According to this approach, errors are seen as conse-

quences of flaws existing in organisations and organisational processes. Error prevention strategies designed with the system approach of human error consideration aim at improving those conditions under which humans work.
As stated by Reason (2000), error management has two components: limiting error incidence and creating systems that are better able to tolerate error occurrence and manage their effects. Implementation of the system approach will mean establishing an organisational culture and management strategies aimed at preventing persons from making mistakes as well as eliminate organisational conditions that make error occurrence possible.

According to Reason (2000), systems are made of defences, barriers and safeguards that protect potential victims and assets from local hazards. In an ideal system the defences, barriers and safeguards should stop errors from going through to the patient. As depicted in figure 1, organisational defences, barriers and safeguards are arranged in layers in what Reason (2000) refers to as the Swiss cheese model, with error causing opportunities (what is represented by holes in the model) in each layer. If these error causing opportunities align across the barriers error occurrence is made possible. The arrow going through holes in the model demonstrates error going through the various layer towards the patient. Organisations are susceptible to errors because of the existence of both person and system failures, and not one or the other. The goal of any health care institution striving to prevent medication errors occurrence will be to prevent these error causing opportunities in the different defence layers from aligning. Patient safety can only be improved if the factors needed to deliver care and those interacting with them are considered together. This means considering the environment in which work is being done, safety culture within the organisation and the human and individual characteristics that influence behaviour at work in a way that patient safety can be affected.

It could be argued that the system approach to human errors should be more beneficial than the person approach to all parties who have a stake in patient safety in that it highlights the factors leading to the errors from both persons and other components of the organisation within which services are provided, thereby providing clues to error prevention and consequently safe patient care and employee satisfaction. The system approach as opposed to the person was chosen because it aims at preventing errors ema-

nating from persons as well as the system. Secondly, the system approach by not laying emphases on the person who committed the error but rather on the cause of the error, eliminates the blame game and the punitive fear in employees and encourages error reporting. The reporting of errors lead to understanding why errors occur and makes it possible to develop better error prevention strategies.

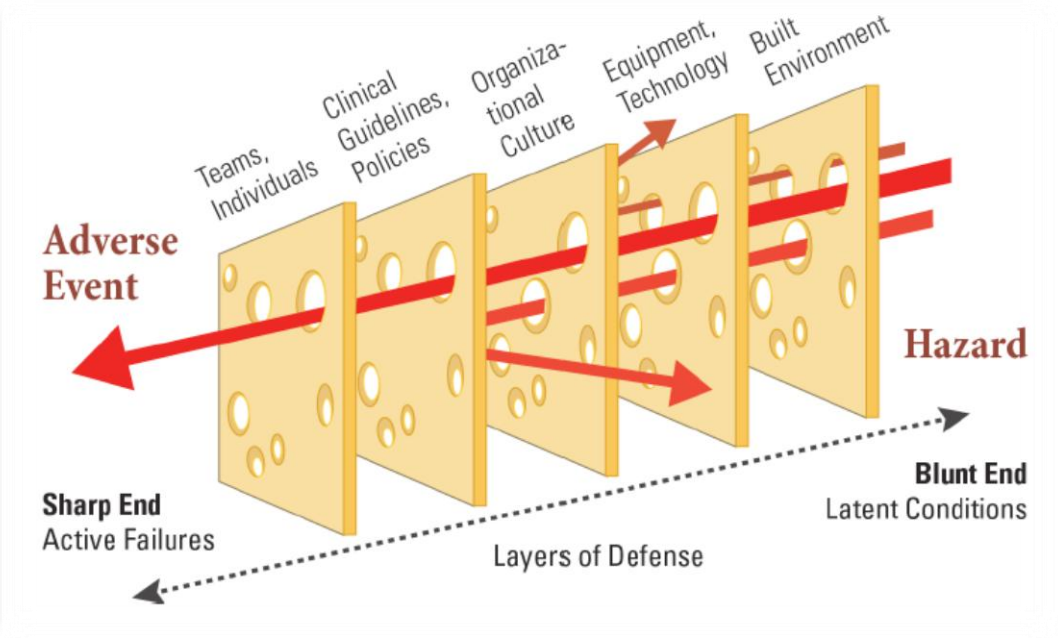

Figure 1. Swiss cheese model. Source: http://www.fgiguidelines.org/pdgs/fgi_update_sra_130711.pdf

2.2 Aim and research questions

This thesis will explore existing literature on medication error with the aim of providing knowledge about safe medical care. Specifically, the paper seeks to address the following questions:

1. What factors contribute to the medication errors?
2. What can be done to mitigate these errors?

3 METHODOLOGY

Research method refers to the techniques used to structure a study and gather and analyse the information relevant to stated research questions (Polit & Beck 2006, pp.15).

3.1 Design

This work is a qualitative study based on a review of studies conducted by researchers in the United States of America. The literature review was performed using content analysis. Polit & Beck (2006, pp. 497) defined content analysis as process of organising and integrating narratives, qualitative information to emerging themes and concepts.
The choice of a literature review over an observational study is primarily explained by financial limitations and other impediments such as complex logistical considerations associated with different protocols. The studies used for this work are those that investigated medication errors; their causes and preventions in institutionalised settings from the year 2000 – 2015.

3.2 Data collection

The data for this study came from secondary sources, and was searched for after formulating the research questions. It was necessary to formulate the research questions, as they guided the literature search that was aimed at answering the raised question. These data was collected through Arcada University of applied Sciences' portal "Nelli-Portal" that gives students and staff of the institution access to databases holding scientific literature. The search was performed using Keywords that helped the author to gather the material needed for the study.

In order to determine the contribution of the ground breaking report "*To Err is Human: Building a Safer Healthcare System*", cited in many patient safety studies (Barker et al. 2002, Unver, Tastan & Akbayrak 2012), a preliminary search was conducted on the CINAHL and Academic Search Elite databases for "medication errors" in the United States of America (USA) from 1985 – 2015. The search was performed using advanced

search and truncating the search phrases, and limiting the search to English language peer reviewed articles. These combined searches yielded 1731 articles, of which 90% (1560 articles) were published after the above mentioned report. Such an increase indicates the potential contribution made by the above mentioned study, by highlighting the risk that patients face while being rendered care services by health care professionals. A final search was conducted by combining the keywords "medication errors", "drug errors", "causes", "prevention", and limiting the search to English language, peer reviewed scholarly articles published between year 2000 – 2015 in the United states of America. This search produced a total of 395 articles from CINAHL and Academic Search Elite databases. Not all studies published in the United States are conducted there. It is however logical to assume that majority of the studies conducted in the United States will be published there, a reason why the search was limited to the United States.

Abstracts of the search generated articles were read to determine the articles that could be used in this thesis. Articles whose abstracts indicated could answer the research questions of this study were downloaded for complete and thorough reading. Fifteen articles were selected from the downloaded articles and used in this thesis. These articles do not include those used in the introduction and background sections of this study.

Inclusion and exclusion criteria

The articles used in this study were selected following the criteria outlined in table 1. Some are articles were excluded just by the titles. Examples of articles excluded by looking at their titles included those whose titles clearly indicated that the studies were conducted in a country other than the United States.

Table 1. Inclusion and Exclusion criteria

Inclusion criteria	**Exclusion criteria**
1. The study was conducted in the United States. 2. The study was addressing medication errors. 3. The study was conducted or published between the year 2000 and 2015.	1. Study was not conducted in the United States. 2. Study was not treating medication error. 3. The study was conducted before 2000 or after 2015.

4. The study was conducted in English. 5. The article must be answering at least one of the research questions. 6. The full article can be gotten free of charge. 7. The study has a clear research methodology. 8. Persons involved in delivering medications are health care professionals. 9. The study pertain to findings from institutional settings.	4. The study was not conducted in English. 5. The study was not answering any of the research question. 6. Financial cost involved in getting the article. 7. The study has no clear research methodology. 8. Medication delivery done by others than health care professionals. 9. Studies non-institutional settings and transition care.

3.3 Data analysis

Data analysis is define as the systematic organisation and synthesis of research data (Polit & Beck 2006, pp. 498). Simply put, data analysis is transforming data into meaningful categories and themes. The goal of analysing data is to make it possible to organise identified themes so that patterns and relationships can be identified.

Collected data for this study was analysed using relational qualitative content analysis and applying inductive reasoning. Relational content analysis is an analysis approach that examine the relationships amongst concepts in a text or set of text (Colorado State University). After establish relationships amongst concepts, the relationships were explored. The relationships were explored by considering their strength, sign and direction.

Strength of the relation refers to the degree to which concepts are related. Sign of the relationship involved determining whether varying an independent variable will cause the dependent variable (medication error in this case) to increase or decrease.

The selected articles were read several times with the aim of identifying categories and subcategories. The identified categories were coded as depicted in example in figure 2.

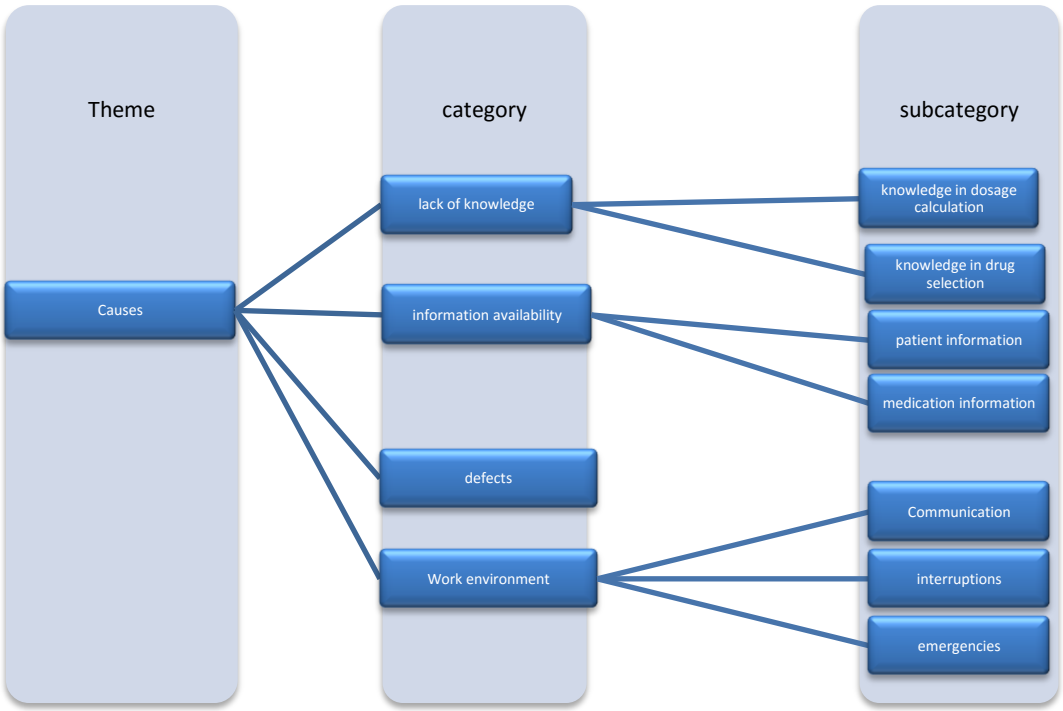

Figure 2. Category and subcategory formation

Table 2. Summarised list of reviewed articles

Author(S)	Article	Year published	Methods/instrument	Results
Rogers, A. E., Hwang, W-T., Scott, L. D., Aiken, L. H and Dinges, D. F.	The working hours of hospital staff nurses and patient safety	2004	Review of 5317 work shift of a nationwide sample of 393 registered nurses working full time in hospitals. Data was collected using logbooks mailed to the nurses.	199 errors and 213 near errors occurred. 58% errors and 56% near error were related medication administration. Procedures, documentation and transcription accounted for 18%, 12% and 7% of errors respectively. 30% of nurses reported making at least an error. Work duration, overtime and number of hours worked per week have significant impact on error rate. The likelihood of making an error is 3 times higher for shifts lasting more than 12.5 hours. Overtime increases the chances of making at least an error.
Gorbach, C., Blanton, L., Lukawski, B. A., Varkey, A. C., Pitman, E. P. and Garey, K. W.	Frequency of and risk factors for medication errors by pharmacists during order verification in a tertiary care medical center	2015	Review of pharmacists' verified orders.	Errors increase with number of verified medication orders per shift. Most verification errors reach patients.
Winterstein, A. G., Johns, T. E., Rosenberg, E. I., Hatton, R. C., Gon-	Nature and causes of clinically significant medication errors in a tertiary care hospital	2004	Analysis of solicited medication errors reports from personnel in adults general and specialty units	240 errors occurred in 12 weeks. Error by stage of medication process were: prescribing (72.5%), administration (14.6%), dispensing (6.6%) and transcribing (6.3%). 75.3% of prescription errors reached the patients.

zalez-Rothi, R. and Kanjanarat, P.			in a tertiary hospital.	Wrong dose (48.8%), lack of drug therapy (17.9%), wrong drug (10.8%) and unnecessary drug (10.8%) were common error types. Most medication errors reach patients. Prevalent causes of errors are: knowledge deficit (39.2%), performance deficit (30.4%) and laboratory tests not considered (13.3%).
Frith, K. H., Anderson, E. F., Tseng, F. & Fong, E. A.	Nurse Staffing Is an Important Strategy to Prevent Medication Errors in Community Hospitals	2012	Retrospective, correlational study in 9 medical-surgical units in a hospital. Data was analysed using hierarchical lineal modelling and logit model.	58% of errors occurred at administration stage while 22% and 17% occurred at transcription and dispensing stages respectively. 58% of errors reached the patient, and included 10% errors that resulted in patient monitoring and 4% that caused temporary harm to patients. Common errors were omission, failure to follow protocols, wrong dosage and wrong patient. Higher levels of RN HPEqPD result in fewer errors. Higher levels of LPN HPEqPD result in more errors.
Chang, Y. & Mark, B. A.	Antecedents of severe and non-severe medication errors.	2009	Questionnaire analysis and review of collected administrative data. Data from 286 acute care units in 246 hospitals	There was no significant relationship between work environment and severe and non-severe errors. Expertise had significantly negative relation with non-severe errors. Experience nurses tend to make more non-severe errors. Severe Errors decrease as number of registered nurses increase.
Flynn, L., Yulan Liang, Y., Geri L. Dickson, G. L., Xie, M. & Suh, D-C.	Nurses' practice environments, error interception practices and inpatient medication errors	2012	Questionnaire and reported medication errors data. 686 registered nurses from 86 acute medical surgical units in 14 hospitals. Data was analysed using hierarchi-	Nurses participation in hospitals affairs, nursing foundation of quality, collegial nurse-physician relation, and supportive and competent nurse manager were each positively related to error interception practices. Nursing foundation of quality, collegial nurse-physician relation had the most significant relationship with error interception practices. Staffing and resources had no association with error interception practices.

			cal lineal modelling.	Error interception practices are significantly related to error rate.
Stratton, K. M., Blegen, M. A., Pepper G. & Vaughn, T.	Reporting of Medication Errors by Pediatric Nurses	2004	Questionnaire and reported medication errors data. Participants included: 57 and 227 acute care nurses from 6 pediatric and 27 adult units respectively, in 11 hospital.	Reported medication error rates per 1000 patient days are higher in pediatric (14.8) than in adult (5.66) care units. Both groups of nurses think that administrative as well as individual reasons contribute to not reporting errors. Reasons for error occurrence included: distraction and interruption, RN-to-patient ratio, volume of administered medication and not double checking doses.
Pape, T. M	The effect of a five-part intervention to decrease omitted medications	2013	Observational study in a medical-surgical unit in a hospital. Wearing fluorescent sash, use of medication administration checklist, marking medication area as quite zone, using of do not interrupt signs and education other personnel not to interrupt nurses administering medications, but to help intercept possible interruptions.	Most common sources of distraction and interruption were: conversations, personnel and phone calls. On average, more time (5.03 minutes) was used to administer a medication by the control group compared to 3.47 minutes for the intervention group. Interventions resulted in a reduction (84%) of distractions.
Fortescue, E. B.;	Prioritizing strategies for medi-	2003	Assigning of potential	5.7% orders involved at least an error at prescribing, transcribing, dis-

Kaushal, R.; Landrigan, C. P.; McKenna, K. J.; Clapp, M. D.; Federico, F.; Goldmann, D. A and Bates, D. W	cation errors and adverse drug events in pediatric inpatients		prevention strategies to errors in 9 pediatric units in 2 tertiary hospitals. Analyses done using univariate analyses.	pensing, administration and monitoring. Most of the errors occurred at prescribing, administration and transcription, with physicians making 71.9 % and nurses 25.4% of all errors. 19.5% of errors had potential to cause harm. 42% of the patients experienced at least an error. Frequent error types were: dosage errors 28.4% (failure to document dose (38.3%), missed dose (28.6%) and overdose (22.9%)), route error (17.7%) and time errors (12.5%). Strategies with high potential to prevent errors were: clinical pharmacist monitoring prescription, transcriptions and medication administration (81.3%), improved communication amongst health care personnel (75.5%), computerised physician order entry with decision support system (72.7%) and computerised medication administration record (27%).
Kalisch, B. J. and Aebersold, M.	Interruptions and multitasking in nursing care	2010	Observation and interview of 36 registered nurses in 7 medical-surgical, intensive care and progressive care units in 2 hospitals.	1354 interruptions occurred in 136 hours; that is 10 interruptions per hour. 39% of the interruptions resulted in break in activities. Registered nurses were interrupted 36% to 57% of the time administering medications. Interruptions came from patients (28%), other nurses (25%), assistive personnel 10%) and physicians (9%). 200 errors (7% medication errors) were observed. Error rate was not affected by interruptions and multitasking.
Hicks, R. W., Cousins, D. D. & Wil-	Selected medication-error data from USP's MEDMAX pro-	2004	Review of 192477 medication errors reported by	Errors occurred during medication administration (33%), documentation (23%), dispensing (22%), prescribing (21%) and monitoring (1%).

liams, R. I	gram for 2002		staff from 482 hospitals through voluntary reporting.	Error types were omission (25.6%), dosage (quantity 30.47%), unauthorised drug (11.1%), Wrong time (6.92%) and wrong patient 4.69%. 35.18% of errors were averted. 49.18% of errors reached the patients. 1.67% errors resulted in patient harm and was mostly caused by wrong administration techniques and wrong route of administration. Wrong route was generally associated with intravenous administration of medication intended for intramuscular injections. Leading causes of medication errors were performance deficit (36.7%), failure to follow protocols (16.6%) Transcription inaccuracy (13%), computer entry issues (10.3%), documentation (10.2%), knowledge deficit (9.9%), communication (9.4%) and drug distribution system (9.4%). Distraction, workload increase, inexperience, shift change, staff insufficiency, staff from agency and emergency were contributing factors to errors.
Kaushal, R., Bates, D. W., Abramson, E. L., Soukup, J. R. and Goldmann, D. A.	Unit-based clinical pharmacists' prevention of serious medication errors in pediatric inpatients	2008	Pre-intervention and post-intervention study of serious medication error in 6 units in a pediatric hospital.	Most errors occur at ordering stage. Serious medication errors reduced from 29 per 1000 patient days to 6 per 1000 patient days (reduction rate of 79%) when a full time Unit-based clinical pharmacist was added to an ICU. The rate of serious medication error was not affected when a part-time clinical pharmacist was added general medical and surgical units.
Stetina, P., Groves, M. and Pafford, L.	Managing medication errors – a qualitative study	2005	30 – 90 minutes long interviews of 6 nurses working in clinical set-	Three key themes arose from the study: Time is on our side, context counts and reliance on systems. Nurses generally agreed that violating the five rights of medication

			tings in Texas.	administration will constitute a medication error. Nurses generally acknowledged not consciously using the five rights. Late medication administration was not considered as critical as other elements of the five rights. Wrong time was not considered to be truly an error if the delay was caused by other happenings in the unit. Nurses believed the systems put in place in hospitals will help them prevent errors and relied much on them for error prevention.
Seibert, H. H., Maddox, R. R. Flynn, E. A. and Williams, C. K.	Effect of barcode technology with electronic administration record on medication accuracy rates	2014	Study conducted by review direct observational data for nurses administering medications, voluntarily reported medication errors and those detected by BCMA-eMAR before and after the implementation of BCMA-eMAR. Chi-square test was used to compare pre-implementation and post-implementation results. The study was conducted in 10 uinits in 2 hospitals.	Error types before implementation of BCMA-eMAR included: wrong time (33.9%), omission (27.7%), wrong technique (18%), wrong dose (13.3%) and unauthorised drug (2.9%). Error trend after implementation of BCMA-eMAR were the same except for unauthorised drug that was replace by wrong route. There was significant improvement in medication accuracy in hospital 1 following the implementation of BCMA-eMAR. There was no significant change in accuracy in hospital 2 following implementation of BCMA-eMAR. BCMA-eMAR accounted for many of all detected and averted errors. There was a general decline medication errors after the implantation of BCMA-eMAR. Implementation of BCMA-eMAR reduced all targeted errors (wrong dose, wrong form, unauthorised drug, omission and extra dose).
DeYoung, J. L.,	Effect of bar-code-assisted	2009	Direct observation of	There was an error rate of 19.7% before implementation and 8.7% after

VanderKool, M. E. & Barletta, J. F.	medication administration on medication error rates in adult medical intensive care unit		medication error data before and after the implementation of BCMA in an intensive care unit. Pearson's chi-square test was used to compare error rate between groups, and student t-test was used compare continuous data.	implementation of BCMA. Indicating a reduction of 56% errors after implementation, with wrong time error being the most significantly reduced error type. Wrong time and omission errors were the most common errors before and after implementation of BCMA.

4 ETHICS

Ethics is a set of principles that guides people to decide what is right and what is wrong (Macmillan English dictionary 2002). In research, the focus of ethics is to provide guidelines for researchers, in data collection, analysis, use of studies of other researchers and presenting findings. Abiding to ethical principles is required in all types of research, and not limited to studies involving human participants.

The purpose of ethical considerations in research is to avoid causing harm to any stakeholder involved in the research. A research with human participants for example will require the researcher to provide enough information that will guide the participants to decide whether or not to participate in the study, while letting the participant know that he/she can quit participating in the study at any time.

This Study does not require human participation, and therefore will not require going through the process of acquiring informed consent as is the usual case with such studies. However this study is conducted in conformity with Arcada University of Applied Sciences' laid down guidelines of good scientific practice and laws governing copyrights. In following the guidelines, the principles of integrity, meticulousness and accuracy in conducting research were applied. Details of the research process have been provided to enable another researcher to replicate my process, readings and findings.

All articles used in this work were taken from the databases used by Arcada, which the author as a registered student with the institution has right to. Thoughts of the authors of articles were either paraphrased as accurately as possible and or cited directly as indicated by direct quotation marks. Any data provided in this research is from cited articles and not fabricated and have in no way been distorted, falsified by the author, and no data that would have given different meaning to the study has been omitted.

5 RESULTS

This section seeks to provide answers to the research questions for this thesis. Factors contributing to medication errors and strategies to prevent errors will be discussed. Error types and frequencies will also be discussed here.

5.1 Error occurrence in the medication delivery process

This section will try to investigate the frequency of error occurrence, the common types of errors and stages in which errors occur during medication delivery to patients.

It is estimated that between 57% and 67% of errors that occur are reported (Stratton et al. 2004). From these figures it is clear that other methods than voluntary reporting should be considered if we should have a better picture of medication errors.

Nurses in a study examining work patterns of hospital staff nurses and relationship between worked hours and frequency of error reported 199 errors and 213 near misses (Rogers et al. 2004). Medication administration errors constituted 58% of all errors and 56% of all near misses resulting from the nurse. The study also revealed that all reported errors were committed by 30% of the nurses who participated in the study. Thirty one of fifty pharmacists (accounting for 62% of the sample) made at least one error during medication order verification (Gorbach et al. 2015).

An analysis of medication administration data generated 240 clinically significant medication errors, of which 39.6% harmed patients, 39.2% reached the patients but caused no harm and 21.3% was averted before reaching patients (Winterstein et al. 2004). The study therefore indicates that 79% of the errors reached the patients. In another study, 58% of errors were reported to have reached the patients (Frith et al. 2012).

Ranking medication errors as per the stage in the medication delivery process produced prescribing errors as leading errors, followed by medication administration errors, dispensing and finally transcribing errors (Winterstein et al. 2004). Voluntary error reporting data, produced medication administration error as the leading category of error, followed by documenting, dispensing, prescribing and monitoring errors (Frith et al. 2012 and Hicks et al. 2004).

Frith et al. 2012 suggest that omission errors, failure to follow protocols, wrong dose and wrong patient were the most common error types across 24 medical-surgical units

in 8 hospitals. The most common types of medication errors reported voluntarily on the MEDMARX database in 2002 were Omission (25.60), wrong dosage (25.49), Prescribing error (18.53), Unauthorized drug (11.10) and Wrong time (6.92) (Hicks et al. 2004). The Medication error type that accounted for a majority of clinically significant medication error were related to dosage, medication not prescribed, wrong drug and unnecessary drug (Winterstein et al. 2004).

A study revealed that figures for reported medication error rates per 1000 patient days are higher in paediatric (14.8) than in adult (5.66) acute care hospitals (Stratton et al. 2004).

Gorbach et al. 2015) suggest that 4.87 error are made per 100000 medication orders verified by pharmacists. Additionally, the study revealed that most of the errors (3.76 errors per 100000 verified orders) reached patient. In other words 77% of pharmacists' verification errors are not averted and thereby reach patients. Winterstein et al. (2004) also documented medication errors from physicians reached patients, revealing that 75% of physician errors reach patients.

Most medication errors do not result in patient harm. However some do harm patients resulting in additional patient monitoring and prolonged hospitals. Although small, 2% of error made during medication order verification resulted in patient harm (Gorbach et al. 2015). When considering medication errors that can result in adverse effect, nurses and researchers may almost never consider wrong time error as an issue. However data from voluntary reports of medication errors revealed that wrong time error can cause harm to patients (Hicks et al. 2004).

5.2 Factors contributing to medication errors

5.2.1 Lack of Knowledge

The foundation of skills for all professions lies in the knowledge acquired during the career path to their professions. Knowledge provides a base on which decisions are made and implemented, lack of which may result in poor decision making and poor performance. Winterstein et al. (2004) identified knowledge deficit in determining the correct dose and choosing the right medication as leading cause of medication errors. Their

study suggests that 39% of the medication errors are attributable to lack of knowledge. Omitting medication therapy as result of knowledge gap (Winterstein et al. 2004) is indicative that patients may continue to suffer without prescribed medication to alleviate their symptoms. Voluntary reported medication error data suggest that insufficient knowledge in medication use was a leading cause of both harmful and non-harmful medication errors (Hicks et al. 2004). Knowledge deficit was also demonstrated in medication related calculations (Hicks et al. 2004).

Findings from a study revealed that Pharmacists with Bachelor degrees make more medication errors than those with doctorate degrees in pharmacy, during medication order verification (Gorbach et al. 2015). The findings however demonstrated no significant difference in medication error rates between the two groups of pharmacists when they were stratified by the number years working at the site.

5.2.2 Resource availability

Provision of care to patients requires personnel and other resources (for example syringes, beds, intravenous pumps, to name a few), without which safe patient care could be compromised. Lack of ordered medication and intravenous pumps in units was reported as factors leading to medication errors (Stratton et al. 2004).

While it is important to have the resources needed to deliver services, it is equally important that these resources are in proper functional state. When it comes to productivity, there is no difference between having a device that is not functioning, and not having the device at all. In a survey, 7% of nurses identified malfunctioning equipment as a reason for medication error occurrence (Stratton et al. 2004). Equipment malfunction has also be reported as cause of medication errors by Hicks et al. (2004) and Winterstein et al. (2004). Errors from defects do not only result from equipment, but also medications. It will be difficult to tell the right strength or the name of a medication if the package or label is illegible or damaged. In the study of Stratton et al. (2004) nurses reported damage package or labels as source of medication errors.

5.2.3 Work hours

"Work hour" measure the effects of shift duration (shift length), overtime and number of hours worked in a week. Rogers et al. (2004) found a positive relationship between shift duration and Medication error. There was a tendency for medication errors to rise as the number of working hours in shifts increase. Moreover, the risk of medication error occurring does not maintain a steady increase with work shifts lasting more than 12.5 hours. Working more than 12.5 hours during a shift increases the risk of committing errors by three folds. Twelve percent of study participants identified overtime as cause of medication errors (Stratton et al. 2012). Overtime was also found to have a positive relationship with Medication errors (Rogers et al. 2004). Medication error risk increases with overtime regardless of the initially scheduled shift length. The risk medication error is significantly higher when working overtime after 12 hour shift. Data indicated a possible relationship between hours worked per week and medication errors. According to Rogers et al. (2004) working more than 40 hours per week significantly increases medication errors and near misses.

5.2.4 Workload

The degree of tiredness may affect one's alertness capabilities and ability to act. One can argue that productivity and efficiency declines with increased levels of tiredness. It will be expected that patient safety, which is a determinant of the level of efficiency in patient care will decline with increased tiredness. Tiredness arises from working too many hours without sufficient rest or having to accomplish too much within a certain time frame.

Workload and insufficient staffing were identified as leading causes of medication errors (Hicks et al. 2004). Workload is a relational concept. Employees will complain of increased workload even in situations where there had been no complaint before, if the number of employees is considerably reduced. Increased workload therefore mean additional work without increased number of employees or reduced workforce without reduced amount of work. Registered nurses (RN) are nurses who have acquired sufficient knowledge and training to handle medication administration and complex patient care tasks better than nursing professionals with lower levels of education. Nowadays, be-

cause of staff shortages, health care institutions are increasingly using a staff mix of registered nurses and nurses with less education and training. Achieving a proper staff mix is crucial for patients' outcomes. A study suggest that medication administration error rates are inversely related to registered nurses' hours per equivalent patient day (Frith et al. 2012). Chang and Mark (2009) found no significant relationship between registered nurse hours and either type of medication errors. Findings from another study revealed no relationship exists between registered nurse staffing and medication errors (Flynn et al. 2012).

Gorbach et al. (2015) suggest that there is significantly more risk of medication error occurrence with increased workload. Their study revealed that increasing the number of medication orders verified per pharmacist in a shift resulted in an increased number of medication errors and established that the number of verified medication orders was a significantly independent risk factor for medication errors. Two work load related factors; register nurse-patient ratio and volume of medication administered were selected as leading causes of medication error by 37% and 35% of nurses respectively (Stratton et al. 2004).

5.2.5 Work environment

The atmosphere of the environment in which activities take place plays a role in the outcomes of those activities. It will undoubtedly be accepted that a serene and good work environment will have a positive impact on events' outcomes. The atmosphere in a work environment is affected by the relationships existing among staff within the environment and the population within the environment at a given time.

Gorbach et al. (2015) reported more medication errors in morning and evening shifts than in night shifts, and similarly more errors in weekday shifts than in weekend shifts. Although no information was provided about how busy the study units were during different shifts, based on experience it can be agreed that morning, evening and weekdays shifts are busier than night and weekend shifts, making it a possible explanation to why the error rates were higher during those periods.

The study of Kalisch & Aebersold (2010) revealed that approximately 37% of interruptions result in a break in activity and that nurses were interrupted between 36% and 57%

of the time during medication administration. The study however found no relationship between interruption and neither medication errors nor other errors. In the same vein, no significant relationship was found between work dynamics (defined by the frequency of interruption and unanticipated events) and neither severe nor non-severe medication errors (Chang & Mark 2009).

Yet other studies suggest a relationship between interruption and distraction, and medication errors. Hicks et al. (2004) reported that distractions are positively related to medication errors and also identified change as cause of errors. Distraction and interruption was cited as the leading cause of medication administration error by nurses in paediatric as well as in adult care units (Stratton et al. 2004).

Emergencies and crises; both having disruptive attributes have been shown to contribute medication errors. Stetina et al. (2005) suggest that emergency situations caused errors in medication delivery. Stratton et al. (2004) revealed that 10.5% of nurses identified unit or patient in crisis as cause of medication errors. Communication plays an important role in situations involving more than one person, and is particularly important when working in multidisciplinary teams. Failing to communicate actions that should be executed or receiver failing to get the right information may produce undesired actions and effects.

Communication was identified as a leading cause of medication errors (Hicks et al. 2004). Chang & Mark (2009) however found no significant relationship between nurse-physician communication and medication errors.

5.2.6 Experience

People are expected to perform better in an activity after doing the same activity repeatedly and acquiring experience. It is for this reason that potential employees are always expected to have a certain amount of experience relating to the task they are expected to perform upon being hired. A study revealed that inexperience as well as agency staff were causes of medication errors (Hicks et al. 2004). Staff from job agencies are generally newly graduated professionals with little or no experience. The inexperience from the young professionals could be a reason for medication errors being caused by agency staff.

Gorbach et al. (2015) found no significant relationship between pharmacists' number of years at site and medication error rate. In another study, a significantly positive relationship was established between nurses' experience and nonsevere medication errors (Chang & Mark 2009). In other words, the number of medication errors increased with increased experience in nursing units.

5.2.7 Performance deficit

Performance is a measure of individuals' output against set standards. In quality oriented institutions individuals are expected to meet or exceed laid down standards during performance appraisal. Failure to meet the standards is termed a deficit in performance and may require additional training in order to meet the requirements of the institution. Quality performance appears to be an issue in health care. Deficits in performance were cited in 36.7% of reported errors as the cause of medication errors, another 46.6% cited performance deficit as the cause harmful errors that happened in 2002 (Hicks et al. 2004). These figures make performance deficit the number one cause of harmful errors in particular and errors in general. In another study, performance was the second leading cause of medication errors and accounted for 30% of errors (Winterstein et al. 2004).

5.2.8 Similarity

Similarity between two things arises when the two things alike in some way, and one can be mistaken for the other. The existence of items that can be mistaken for others in any setting will require precaution when using any of those items, failure in which can result in error and unwanted outcome. There is a proliferation of pharmaceutical products in the market nowadays. While this large number of products increases the choices available for treatment, it also increase the risk of having products that look alike or sound alike but are not in any way related. Hicks et al. (2004) reported "sound alike" and "look alike" generic and brand names and similarity in packaging as causes of medication errors.

5.2.9 Documentation

Documenting is particularly important in health care, where people work in teams. Administering medication to a patient and failing to document it can result in administering the medication again to the same patient, in which case will result in an overdose. Similarly, documenting and failing to administer medication will result in omission of the dose of the required medication.

The quality of the documented information also plays a role in the actions that follow. If a medication order is transcribed with errors, it is quite likely that the patient will not be administered what was prescribed by the physician but the wrongly transcribed medication. Transcription inaccuracy, computer entry error, illegible handwriting, the use of abbreviations and documentation by nurses have caused medication errors (Hicks et al. 2004).

5.2.10 Lack of information and failure to use available information

Information availability plays in vital role in problem solving or creating new products and services. It is undisputed that solving a problem that has sufficient information pertaining to it will require less effort and cost compare to one without information.

Patient care starts with collecting information that can give clues to the cause of the patients' sickness or will be relevant for continued care once discharged from hospital. Medication errors resulting from the lack of information were reported by Stratton et al. (2004). Specifically, lack of adequate patient information and sufficient information about medication was identified as causes of errors.

Collecting the information is just as important as using it. Using available information can result in different actions thereby producing different outcomes. Failing to make use of the available information when solving a problem is tantamount to neglect, and can result to erroneous decisions. Studies have identified failure to use patient information as a cause of medication errors. According to medication error data, contraindicated drug allergy resulted in approximately 3% harmful errors in 2002 (Hicks et al. 2004). This error will not have occurred if information regarding allergies was sought from patients at the beginning of their treatment, or if patients' records were verified for allergies to certain medications before being administered those medications. Failure to con-

sider patients' laboratory test results and patients' history have also resulted in medication errors; with laboratory test result being the third leading cause of medication errors (Winterstein et al. 2004).

5.2.11 Policy violation

Rules and guidelines are made to ensure order, safety and quality of services produced. Failure to adhere to laid down guidelines can compromise the expected goals of those guidelines. Failing to follow protocol was identified as the second leading cause of medication errors in general and harmful errors in particular (Hicks et al. 2004). Failure to double check medication before administering was identified as the cause of medication errors by Stratton et al. (2004) and Winterstein et al. (2004).

5.3 Strategies to reduce medication errors

Medication errors ought to be eliminated for full benefits of medication use to be derived. Errors elimination could be achieved by redesigning procedures and implementing protocols that will place patient safety at the centre of all caring activities. Incorporation of technological innovations into the medication delivery process can also play a role medication errors and patient safety.

5.3.1 Education and training

Knowledge is intrinsically linked to education, however professionals do not need only knowledge to be efficient; skills together with knowledge make a better combination for efficiency.

Chang & Mark (2009) established a significant non-linear relationship between educational level and severe medication errors. Their findings revealed that severe medication error declined with increasing number of nurses with bachelor degrees in nursing in a unit. However, this decrease did not continue indefinitely. The decrease in severe medication errors stopped at the point where 54% of the nurses had a bachelor degree. Although the study demonstrated that hiring nurses with bachelor degrees could only have impact on medication errors to a certain extent, continuous education and training will be needed to keep care professionals informed with evolving technologies used in health

care and the discovery new illnesses and treatment options and techniques. A combination of experience and knowledge gained from studying or training or both produces expertise. Expertise has been shown to have a statistically significant negative relation with nonsevere medication error (Chang & Mark 2009). That is, nonsevere medication errors tend to decrease with improved expertise.

5.3.2 Improved work environment

A healthy work environment is necessary for functional interactions between personnel and consequently better productivity. Good work environments are those that contributions towards decision making and policy development are welcomed from all employees. Flynn et al. 2012 established that there is a significant positive relationship between nurse practice environment and error interception, and that interception practices significantly reduces medication errors. The intervention strategies investigated were: 1. comparing medication administration records with patient records at the beginning of shifts, 2. determining the rationale for the ordered medication, 3. ensuring that medication orders were clear and 4. Ensuring the patient or family is knowledgeable about medication regimen.

In their study, environment was composed of a composite score of sub-scores of (a) Nurse Participation in Hospital Affairs; (b) Nursing Foundations for Quality of Care; (c) Collegial Nurse-Physician Relations; (d) Supportive and Competent Nurse Manager; and (e) Staffing and Resource Adequacy. This implies that there is potential for more errors to be intercepted in an organisation with an employee friendly work environment. Organisations that lack such environments will therefore be expected to experience more errors. According to Flynn et al. (2012) nurse-physician relationship and nursing foundation quality care were the significant determinants of error interception practices. People can better communicate and try to make contributions in decisions taken by other only if there exists a functional relationships between them. There is possibility for nurses to question unclear medication orders or ask for a rewrite of an order if it illegible when there is a friendly nurse-doctor relationship within an organisation. Limiting the amount of interruptions and distraction has proved to reduce amount of time used in administering medication. Pape (2013) revealed that the control group (without control on interruption and distraction) spent 5.03 minutes per medication administered

while the intervention group spent 3.47 minutes per medication administered. The interventions in the study included: Marked quiet zone in the medication area, placing no interruption signs on the walls, using protocol checklist, nurses wearing fluorescent sash during medication administration and educating other nurses not to disturb but help divert interruptions and distractions during medication administration.

5.3.3 Monitoring staff and improved communication

The impact of unit-based clinical pharmacist was investigated, the study showed a reduction in serious medication errors from 29 to 6 per 1000 patient days following the recruitment of a full-time pharmacist whose task included monitoring medication errors at all stages of medication delivery (Kaushal et al. 2008). The pharmacist's intervention accounted for 79% reduction in all errors. The intervention intensive care unit had net 33 errors fewer than the control unit, at $p < 0.001$. Study units with part-time pharmacists who only worked in the morning did not experience any medication error reduction.

Fortescue et al. (2003) identified the clinical pharmacist as the best medication error intervention from the 10 intervention strategies investigated in their study. In what included monitoring prescription, transcription and administration errors, the pharmacists have the potential to reduce medication errors by 81.3%.

Improving communication amongst care staff also has the potential to reduce medication errors. Improved communication was identified as the third most effective error reduction approach (Fortescue et al. 2003). There is a potential to decrease medication errors by 64.8% just by improving communication, with improved communication between physicians and nurses accounting 17.4% while that between physicians and pharmacists accounts for 47.4%.

5.3.4 Technology

Technological advancements are aimed at improving productivity and efficiency in other sectors as well as in health care. DeYoung et al. (2009) studied the effect of barcode medication administration (BCMA) on medication errors in an intensive care unit

and found error rates of 19.7% before implementation and 8.7% after implementation of BCMA, translating into 56% reduction in error. The exclusion of documentation errors, an error category which cannot be detected and prevented by this technology from the data produced a total reduction of errors by 62.7%. The error type that was most reduced was wrong time error, with a reduction rate of 64%.

Improved medication error results were obtained with the introduction of Bar-code medication administration with electronic medication administration record (BCMA-eMAR) on the overall medication administration accuracy rates in two hospital (Seibert et al. 2014.) There was significant increase in the overall accuracy in medication administration. Although not significant, there was an improved accuracy rate in medication administration in the second hospital.

However the increase in overall accuracy of medication administration was not observed in all units in the hospitals. The targeted errors (which include: wrong dose, wrong form, extra dose, unauthorised drug and omission) were reduced in both hospitals. Omission errors were the most affected errors, resulting in 72% to 88% reduction post-implementation of BCMA-eMAR.

Fortescue et al. (2003) also report a reduction in medication errors by 72% by computerised physician order entry (CPOE) incorporated with decision support system. The use of CPOE will eliminate handwriting issues that usually contribute to medication errors if prescriptions are illegible and assumptions and speculations are made during medication order transcription and medication administration.

While depending on technology for efficiency and error interception, it should be noted that not all errors can be identified using technology and that errors can also arise when technology is designed with flaws and possibilities for users to overwrite programed actions in the technology used to reduce errors or when the user has limited abilities to use it. A comparison of the efficiency of direct observation and detection of errors by barcode medication administration technology revealed that some errors were not detected by the barcode technology and consequently not prevented (Seibert et al. 2014).

5.3.5 Medication error reporting

Understanding the root cause of errors plays a role in determining ways to mitigate the errors. Medication errors could only be fully understood if they are talked about or re-

ported. However these errors are hardly reported for fear of retribution and ridicule. A study revealed that errors are not reported because of individual and administrative related reasons, and highlighted nurses' fear of adverse consequences of reporting and the believe that other nurses will see them as incompetent (Stratton et al. 2004). Anonymous voluntary reporting seems to be a promising ground for medication errors reporting and a path to improving patient safety, with reporting facilities rising from 56 to 482 between 1999 and 2002, and medication errors reported rising by 82.2% between 2001 and 2002 (Hicks et al. 2004). Despite these strong figures, it will be difficult to conclude that the reported cases are a true representation of error occurrences in the American healthcare facilities. Getting a better picture of medication errors requires more than just voluntary reporting. It may require the use of other approaches, including the use of technologies and trained personnel to detect medication error. Observational studies should yield more reliable and accurate error results than voluntary reports, especially because employees will want to avoid making reports that will make them vulnerable to disciplinary actions. However, the use of the direct observation method to gaining insight into medication errors might require more personnel, thereby increasing cost.

The perception of what constitutes an error, and the importance attached to errors prevention can have a great impact on the occurrence of errors and the rate of reporting. Considering medication errors as an important healthcare issue will mean doing more to reduce their occurrence. A 2003 survey of 831 practicing physicians suggested that only 5% of physicians consider medical errors as one of United States' most important health issues (Traynor 2003). The low and varying rate of reported errors are partly affected by the perceptions of what constitute error and the significance and severity of the error. Although nurses generally agree that violating the five rights of medication administration constitute error, they consider the severity and circumstances surrounding error to be the determinant for reporting errors (Stetina et al. 2005). In the study, nurses were of the opinion that late administration of medication does not constitute a significant errors and it was unnecessary to report it. Constantly talking about medication errors in institutions and coming to agreement to what constitutes error can have a great impact on medication errors outcomes.

6 DISCUSSION AND CRITICAL REVIEW

This study revealed that patient risk being harmed when seeking medical care. The proportion of medication error that reach the patients ranges between 58% and 79% (Frith et al. 2012 and Winterstein et al. 2004. It should be noted however that the errors that reached the patient reported by Frith et al. (2012) arise mainly from medication administration while the other reported errors across the different phases of medication delivery.

There were mixed result concerning the stage of drug delivery that has the highest error rate. While Frith et al. (2012) identified medication administration, transcribing and dispensing in decreasing order as the stages with the highest error rate, Winterstein et al. (2004) identified prescribing, medication administration and dispensing. The difference can partly be explained by the study focus. The study of Frith et al. (2012) were concerned with effect of nurse staffing on errors; which possibly resulted in the kind of result it produced. The findings of Winterstein et al. (2004) are similar to those of Leap et al. (1995) which identified prescribing as stage with the highest error rate followed by medication administration. To ensure patient safety the nurse should be objective when going through medication orders and asking for clarity from the physicians if doubt be. This can only be achieved by understanding the patient's condition and relating it to the conditions treated by the prescribed medications.

Knowledge deficiency has been identified as a cause of errors by Hicks et al. (2004) and Winterstein et al. (2004). Their findings are consistent with those of Leap et al. (1995) and Tang et al. (2007). Patient safety can be promoted by ensuring that the nurse who stands as an advocate for patients and the last line of defence has acquired sufficient knowledge and skills needed in performing the task.

Tiredness is related to the length of time spent on a job and the amount of work to be completed within a given time. Rogers et al. (2004) identified work duration and overtime as causes of error. Workload was reported as cause of medication errors (Gorbach et al. (2015), Hicks et al (2004) and Stratton 2004). Unver et al. (2012) identified tiredness a cause of medication errors reported by both newly graduated and experienced nurses, while Tang et al. (2007) reported workload as a cause of errors.

A study suggest that medication administration error rates are inversely related to registered nurses' hours per equivalent patient day (Frith et al. 2012).
The inverse relationship established between medication administration error rates and the proportion of direct care provided by registered nurses reported by Frith et al. (2012) is consistent with findings by Blegen & Vaughn (1998).
Interruptive situations and distraction were established as causes of medication errors by Hicks et al. (2004), Stetina et al. (2005) and Stratton et al. (2004). Similar result was reported by Unver et al. (2012). Limiting the amount of distraction has been shown to reduce the amount of time used in administering medication (Pape 2013), and can play a role in error reduction.

Findings suggesting that failure to adhere to laid down policies resulted in medication errors reported by Hicks et al. (2004), Stratton et al. (2004) and Winterstein et al (2004) are in line with were also reported by Leap et al. (1995) and Unver et al. (2012). Results involving the relation of experience and medication errors appear to be mixed, with Hicks et al. (2004) suggesting that lack of experience results in errors while Chang & Mark (2009) suggest that nurses make more nonsevere errors with increased experience.

Results suggest that medication errors are more reported in pediatric settings than in adult settings (Stratton et al. 2004). Reporting of medication errors is undermined by fear of the reaction from colleagues and disciplinary actions from administration, a view echoed by Unver et al. (2012). The high error reporting rate in pediatric settings could be because the errors in that settings are usually more severe and easily noticed than in adult settings.

This thesis identified factors contributing to medication errors that are attributable to persons and those that are not attributed to persons. The factors that are attributable to persons will include: lack of knowledge, performance deficit, policy violation, failure to document and inexperience. Organising the work environment in a way that workers can work efficiently, organizing work schedules and ensuring availability of equipment and other work related items are the responsibilities of organizations' managements.

This study demonstrated that to better solve medication error problems, focus should not be only on person related factors as they are not the only factors leading to errors. Rather the organization as well as the people working in it should be considered.

7 CONCLUSION AND RECOMMENDATION

The articles used in this study answered the research questions raised. Findings from this study suggest that medication errors are still quite rampant, and that much still needs to be done to reduce this risks faced by patients during care. It also demonstrated that medications errors arise from the whole system and are usually attributed to the absence barriers that could have prevented their occurrence. Management efforts to reduce medication errors cannot be successful if the personnel through who errors occur are excluded in error reduction struggle. Defining what constitutes error will be important in reducing medication errors. Management should organize forums that will enable nurses and other care personnel who take part in medication delivery to suggest what they consider to be the cause of medication errors and ways to solve the problems. The nurse as the last line of defense should therefore look at each medication order with the assumption that all humans are fallible and so is the physician, and try to establish the reason for the prescription before administering the medication to patients.

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