

**CHALLENGES IN ADMINISTRATION OF MICROINFUSION MEDICATION BY
CRITICAL CARE NURSES AT INTENSIVE CARE UNIT KENYATTA NATIONAL
HOSPITAL**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE
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(CRITICAL CARE) OF THE UNIVERSITY OF NAIROBI**

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DECLARATION

I, **ONWONGÁ ISAAC NYABUTO**, declare that this research dissertation titled, '**Challenges in administration of Microinfusion medication by critical care nurses at ICU Kenyatta National Hospital**' is my own original work and has never been submitted for award of any degree at any university or for any other purpose.

Signature.....Date

CERTIFICATE OF APPROVAL

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DEDICATION

I dedicate this research work to the Almighty God for His sufficient grace and gift of good health throughout my time in school.

I Also Dedicate this research work to my loving mother **Esther Osebe Onwongá** and my son **Elijayden Mokaya Onwongá** for the unwavering enduring support and encouragement.

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ABBREVIATIONS AND ACRONYMS

ADE – Adverse drug errors

ADR – Adverse drug reactions

CCN – Critical care Nurse

CCU – Critical Care Unit

CDSS – Clinical decision support system

ICU – Intensive care unit

IV – Intravenous

IOM – Institute of Medicine

JCIA – Joint Commission International Accreditation

KNH – Kenyatta national hospital

MAEs - Medication administration errors

ME - Medication Errors

NCC MERP – National coordinating council for medication Error Reporting and prevention

NCK – Nursing Council of Kenya

UoN – University of Nairobi

USA – United States of America

US FDA – United states food and drug administration

WHO – World health organization

OPERATIONAL DEFINITIONS

Adverse Drug event - An injury resulting from medical intervention related to a drug.

Adverse Drug Reaction - Any response to a drug which is noxious and unintended which occurs at doses normally used in man for prophylaxis, diagnosis, or therapy of disease, or for the modifications of physiological function. Source: (World Health Organisation (WHO), 2012)

Competence - The ability to do something successfully or efficient. In this document, the term has been used synonymously to mean knowledge level

Critical care nurse – Is a licensed professional nurse who is responsible for ensuring that acutely and critically ill patients and their families receive the highest nursing care and deals specifically with life threatening health problems and works within a critical care unit.

Harm - Impairment of the physical, emotional, or psychological function or structure of the body and pain or injury resulting there from.(NCC MERP, 2004)

High alert medication – Medication that bear a heightened risk of causing significant harm when they are used in error, although mistakes may or may not be more common with these drugs, the consequences of an error are more devastating to the patient.

High alert medication Error – Is any preventable event that may cause or lead to inappropriate medication use or significant patient harm involving high alert medication. They cause harm more commonly and the harm they produce is likely to be more serious and leads to patient suffering and additional cost associated with care of these patients.

Intervention – The act or fact of becoming involved intentionally in a difficult situation with the intent of modifying the outcome

Interventions necessary to save life – Actions and decisions required through the life of a case to assure that life is protected.

Medication administration – The process of preparing, giving and evaluating the effectiveness of prescription and non-prescription drugs, it's often the chief responsibility of the nurse.

Medication Error - 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. Source: National Coordinating Council(NCC) for Medication Error Reporting and Prevention (MERP). (Becker and MERP, 2017)

Microinfusion medication – These are emergency drugs infused during emergency and critical conditions of patients to save lives. These drugs because of their narrow therapeutic window are prescribed in Microinfusion doses and administered via syringe infusion pumps they are administered during emergencies, Some of which include; vasopressors, inotropes, hypertonic saline.

Monitoring – Observe and check the process or quality of something over a period of time; keep under systematic review.

Prevalence – This refers to the percentage of critical care nurses who have performed Microinfusion Medication Administration Errors (MAEs) at Kenyatta National Hospital's ICU

Shock – An acute medical condition associated with a fall in blood pressure, caused by such events as loss of blood, severe burns, allergic reaction, or sudden emotional stress, and marked by cold, pallid skin, irregular breathing, and rapid pulse and dilated pupils.

ABSTRACT

Background of the study: Most drugs given as Microinfusion require infusion pumps to administer. They are very potent with very narrow therapeutic index and any small changes on the process results in enormous effects to patients. The nursing profession has a duty to advocate for patients rights as well as do no harm. One of the core goals of nurses is medication administration; this puts nurses in the last line of defense against medication administration errors (MAEs). Microinfusion medication studies over the years have focused to improve therapy delivery to patients while reducing chances of errors. This study aimed to look into the roles played by the patient, nurse, system and structure that hamper the efforts to reduce the Microinfusion MAEs on which minimal studies have been done.

Objective: This study determined the prevalence of drug errors, competency level, institutional and structural related factors influencing the administration of Microinfusion medication by critical care nurses at Kenyatta National Hospital's (KNH) Intensive Care Unit (ICU).

Significance of study: Local data in the area of Microinfusion MAEs is not available, specifically KNH's ICU. This study therefore sought to breach this gap and hopes to influence policy on management of critical patients, patient safety, environment, and curriculum development so as to reduce Microinfusion MAEs.

Methodology: This study used a descriptive cross-sectional study design, simple random sampling was used pick 64 participants. Quantitative data was analyzed by both descriptive and inferential statistics, which included regression analysis. Descriptive statistics were presented by use of the mean, percentages and standard deviation. Chi-square was used to determine statistical significance of the differences in proportions and logistic regression was used to identify factors that lead to MAEs. Necessary ethical approval was sought.

Results: The prevalence of MAEs was at 64.1% in the last six months, 65.6% Of the respondents reported lack of supportive supervision, 37.5% of the respondents reported not to know mechanisms in place for reporting Microinfusion medication errors, 54.7% of the respondents reported the ICU was well designed for management of supplies and medication. This prevalence was of statistical significance when cross tabulated with critical care nurses competency level ($p < 0.05$) on aspects such as; having prescription checks [95%CI= 0.000-17.9; $p = 0.008$], working experience, type of medication error, checking weight of patients [$p = 0.019$], reporting of the errors [95%CI = 0.1-0.8; $p = 0.019$], documenting drug errors and monitoring patients after drug administration. Structural and institutional factor such as design and supervision were not statistically significant with Microinfusion MAEs ($p > 0.05$)

Conclusion and recommendation: The prevalence of Microinfusion administration errors in KNH-ICU is high. There is need to ensure that nurses are always equipped with adequate knowledge and experience in drug administration through trainings and mentorship programs as this will reduce medication errors and increase safety of patient in health facilities

CHAPTER ONE: INTRODUCTION

1.1 Background

In Critical care unit (CCU) patients change conditions suddenly and fast, it doesn't allow too much time to consult before making life saving interventions, therefore a critical care nurse is expected to be in the forefront in making critical decisions that can save the life of the patient before any further investigations and consultations for the next course of management happen. This requires that a lot of critical thinking is employed as well as existing knowledge on protocols and standard of operation in procedure manuals, produced by the practice governing body. The nurse should also be knowledgeable on drugs and modalities of administration used in emergency setups (Karavasiliadou and Athanasakis, 2014) all this puts additional pressure on the nurse as it takes time to master this art of care. Therefore knowledge of the various drugs administered in ICU as well as the standard operating procedures that guide the administration is crucial in managing the critically ill patients by critical care nurses and other healthcare providers.

During Microinfusion medication administration, critical care nurses act as the last line of defense against harm to the patient after all checks have been passed. They hold a superior role in saving patients from harm that could be as a result of medication administration error. It's therefore important to have systems and processes in place and equip the environment within which they work, and any necessary support systems to make it possible to achieve this roles that aim at protecting the health of patients (Faye *et al.*, 2010). The systems and processes are all grouped as standards of care. These functions apply to each individual department, unit, or service within the organization as well as to the entire organization structure (Joint commission international accreditation, 2011), when all the systems work well together then the chances of Microinfusion medication administration errors are significantly reduced.

There are available studies on the processes of Microinfusion medication administration, an inside look at the process of Microinfusion medication administration, (Aljadhey *et al.*, 2016) found out from his study that 10% of errors were because of lack of drug knowledge and 40% of errors were due to memory lapses, they were all cumulatively responsible at the administration stage. This high numbers on memory lapse were not surprising because health care workers work within an interrupt-driven environment hence slips and memory lapses are very common as they may have to deal with more than one communication task and most of the time simultaneously.

While it's expected that nurses with serving experience may prevent many errors since they have familiarity to the environment, drugs, dosages, and the population of patients in the unit, this nurses are leaving the workforce as they get older and more experienced. Hospitals are increasingly relying on new nurses with low level experience (Morrison *et al.*, 1994) which may lead to an increase in cases of errors when administering medication, as it takes time for one person to gain the skills and the required knowledge on the administration of Microinfusion medication and the management of the undesired events that may result from a medication error.

This study aimed to assess the challenges in administration of Microinfusion medication by critical care nurses at KNH ICU. By focusing on the current standard operating procedures of practice that have been put in place, the protocols and processes that are involved in the nurses practice, we will be able to identify challenges and gaps that exist in practice that lead to Microinfusion medication administration errors, the study will also look to identify modalities laid in place to prevent such errors, and managing consequences.

1.2. Problem Statement

Microinfusion medication administration errors are common, frequent and their effects range from harm to death. Over the years, there were a number of incidences, but there had been limited evidence to support those claims from associated factors or error severity (Westbrook *et al.*, 2011) Microinfusion Medication Administration involves a complex process and has multiple steps followed in preparation (calculation of dosage, reconstituting the medication and ensuring the right environment for preparation), administration and monitoring (Fekadu *et al.*, 2017) and there is no specific guidelines on how Microinfusion medication should be managed, making it a problem from one institution to the next.

Not so many studies had focused on Microinfusion medication administration errors, but those studies that were available confirmed high error rates. In the United States of America (USA) 60%, United kingdom (UK) 62%, Australia 18%, Germany 23%, Ethiopia 55%, of the incidents reported country wide were from Microinfusion medication administration. Investigations specific to the nurse character or with compliancy to policies in relation with recognized Microinfusion medication administration practices were rare (Schutijser *et al.*, 2018) it's not necessarily that the countries with high incidences reported have more Microinfusion medication administration errors but rather could have better channels through which this medical errors are reported.

There are existing curriculums by which Critical care nurses are trained in order to meet the ever arising challenges posed with the challenging environment and decision making process required for active resuscitation of patients under emergency circumstances. ICU nurses are equipped with knowledge that can help them in such times of emergency to be able to act accordingly (El-Shaer, 2015) There were so many Microinfusion medications used during the

stay of patients admitted in the CCUs, and those most of the time increase the chances of a drug error.

While some patients may not be in harm, some may be significantly injured, resulting in long-term hospital stay due to harm, hence cost of care and the burden pushed to patients and family. These errors when leaked to the public they damage the public confidence to the system and the reputation of the health-care professional who is the second victim (Mahajan, 2018) and this creates an additional problem which most of the time is overlooked when planning for the management of critical care patients.

1.3. Justification of the problem

The practice in ICU KNH at the timelines of this study was that the nurse received the medication prescription made by the Doctor and then copied the drug order to the daily medication administration sheet that was used through the 24 hour day shifts as the original prescribed medication chart was sent to the pharmacy for a new day order and replacement of medications that are out of stock for the patient in ICU. Once the medications were supplied to the unit they were stored in one patient drug cabinet that was clearly labeled the patient bed number. The medication were supposed to be given by two nurses to one patient as its directed by the procedure manuals by the Kenyan nursing licensing body, (Kenya Ministry of Health (MOH) *et al.*, 2012)(the Nursing Council of Kenya, ((NCK), 2009) this is in the assumption that when two professional nurses are involved in one procedure in this case medication administration, then it would reduce the chances of an error but most of the time the nurse patient ratios in most government hospitals has been way lower that the world health organization (WHO) recommended nurse-patient ratios making it rather difficult to be able to achieve the practice envisioned by the nursing council of Kenya as a guiding policy body on patient safety(Kenya Ministry of Health (MOH) *et al.*, 2012) the number in the country have

in a long time continued to be lower than the ones recommended making it hard to improve on the practice.

1.4. Significance of study

This study purposed to explore the challenges in administration of Microinfusion medication by critical care nurses at KNH ICU with the focus seeking to identify the barriers that were currently in place that hindered the nurse from achieving better patient outcomes which included but not limited to structural, institutional, personal, following through medication prescription, ordering, dispensing and administration. The evidence generated from the study would point out gaps that were currently in practice in KNH ICU which hindered the nurse from being adequately prepared to administer Microinfusion medications and what needed to be improved to give the nurse a more conducive environment that is enabling for the adequate care of Critical patients and medication administration.

The information would benefit associations, organizations and the Government at large to recognize, appreciate the gaps that exist in the administration of Microinfusion medication by critical care nurses at ICU KNH, the drug errors evident in their use and campaign towards making drug use in critical care settings more reasoned and safer, hence reduce the incidences or errors, and hope to reduce mortality.

The evidence would also help determine need for review of standards operating procedures to improve the patient outcomes in CCUs. It would also point to modalities by which nurses working in ICU can improve their knowledge by timely updates and improved research in this facility, and since critical care is a multisystem approach care the health care team would benefit on the modalities on how to coordinate and improve the processes that would reduce high alert medication errors to patients and give the highest benefit to patients admitted in ICU.

As we looked to determine factors that contribute to Microinfusion medication administration, channels in place for error reporting in the organization and how reported errors are reported. The factors contributing Medication administration errors (MAEs) would play an important role in making information available for planners, policy makers and any other stakeholders in the health care system would have information through which they could be able to identify the existing shortcomings and challenges to health care service delivery. This can help build a framework to improve the systems and also aid appropriate decision making processes on how actions could be taken and how policy need could be streamlined to involve a multi-disciplinary approach to aid in reduction of MAEs.

1.5. Study Questions

1. What are the factors that contribute to drug errors associated with the use of administration of Microinfusion medications by critical care nurses at ICU KNH?
2. What is the prevalence of drug errors associated with the administration of Microinfusion medications by critical care nurses at ICU KNH?
3. What is competency level of critical care nurses on the use of administration of Microinfusion medications at ICU KNH?
4. What are the institutional related factors that contribute to drug errors in the administration of Microinfusion medications by critical care nurses at ICU KNH?
5. What are the structural related factors that contribute to drug errors in the administration of Microinfusion medications by critical care nurses at ICU KNH?

1.6. Study Objectives

1.6.1. Main Objective

To determine the factors that contribute to drug errors, competency level, institutional and structural related factors influencing the administration of Microinfusion medication by critical care nurses at KNH ICU.

1.6.2. Specific Objectives

1. To determine the prevalence of drug errors associated with the administration of Microinfusion medications by critical care nurses at ICU KNH
2. To determine critical care nurses competency level on the administration of Microinfusion medications at ICU KNH
3. To find out institutional related factors that contribute to drug errors in the administration of Microinfusion medications by critical care nurses at ICU KNH
4. To identify structural related factors that contribute to drug errors in the administration of Microinfusion medications by critical care nurses at ICU KNH

1.7. Expected study benefits

The expected study benefits were;

1. Establish data that would help improve patient care and outcome on medication administration, by identify the gaps that exist in the practice and therefore raise the level of the nurses' competence and help to point out on the areas that needed strengthening and reinforcement in patient care.
2. Benefit the institution from the data to identify the gaps that exist in Microinfusion medication administration to put the necessary policies and structures that can help

improve patient outcomes. It would as well help the policy makers identify the gaps that exist in the policies and guidelines that are in use and build up to information that would influence policy formulation

1.8. Hypothesis

There is no relationship among the Institutional related factors, structural related factors, nurses' competency and prevalence of drug errors to administration of Microinfusion medications by critical care nurses at KNH ICU

1.9. Variables

The categories of variables addressed in this study included; dependent, independent and intervening variables

1.9.1. Dependent variable

The dependent variable in this study was;

- Reduction in medication error during administration of Microinfusion medications in ICU

1.9.2. Independent variables

The independent variables in this study comprised of;

- Demographic data: e.g. Age, gender
- competency
 - Low skill & competence
 - Lack of Experience

- Ineffective training
- Missing or unclear instructions
- Institutional factors
 - Inadequate supervision
 - Deficient co-ordination and responsibilities
 - Inadequate responses to previous incidents
 - Ineffective communications
 - Poor work planning, leading to high work pressure
 - Uncertainties in roles and responsibilities
 - Tired staff
- Structural factors
 - Illogical design
 - Noisy and unpleasant working conditions
 - Poor work planning, leading to high work pressure

1.9.3. Intervening variables

The intervening variables in this study included;

- Availability of resources (equipments, drugs, nurses)
- Nurses to patient ratio
- Refresher trainings
- Regular meetings
- Positive attitude
- Effective communication

1.10. Theoretical framework

This AACN synergy model was applicable to my study on investigating the challenges in administration of Microinfusion medication by critical care nurses at KNH ICU, having it in mind that the complexity of the nursing practice is determined by how compromised the patient's condition is and the needs that emerge from this severity and the need to meet the expectations. The dynamics of the nursing practice determined by the needs from the patients, which require that the nurse is better trained and prepared in multiple dimensions to meet these expectations. When nursing practice is based on the needs of the patient and the uniqueness of the patient and the service delivery of the a nurse are in agreement there is synergy, and optimization of patient outcomes definitely result.(American Association of Critical Care Nurses, 2015)

The Synergy Model states explicitly that there is a relationship between patient needs or expectations and nurse's ability to exhibit the skills and competencies that meet these needs, this is what the model calls "synergy" between the two, which leads to optimizing patient outcomes. (Bott, 2014) Each patient, Critical care unit, systems and structures are unique, having a varied capacity for health and vulnerability of patients to illness. All these variances give a new challenge to look to a patient as an individual more so when administering potent drugs to patients, two patients with the same condition given the same medication regimen will not have the same result hence the need to look at patients individually and not condition. All these bring the care of the patient into unique setting which modify the expectations of the patient to be very individualized to a particular patient and not shared by any other patient and this has to be met the way it presents in health and wellness struggle (American Association of Critical Care Nurses, 2015)

The theory makes assumptions that:-

- Particular to the developmental stage of the patient the patient is looked at as a whole, the body, mind and spirit.
- The relationship that exist among the patient, the family and the community influence the kind of nursing care a patient receives and the nurse- patient relationship.
- Different unique characteristics define any patient, all these characteristics are interdependent on each other and support each other and therefore they must have a collective look and none of them should be isolated. Similarly, different directions of the nursing practice and how the nurse chooses to associate and relate with others and his or her immediate environment and other dimensions define the nurse and give them a profile.
- Nurses work hard every day to endeavor to give the patient the best care and optimize the recovery process but also being positive that after doing the very best death is a possible outcome and is acceptable as long as one prepares the patient towards a peaceful death.
- The environment around the patient during critical care is modified by the nurse according to the needs of the patient but the complexity that comes with the modification of the environment affect the nurse's service delivery.
- There is a relationship between care needs and impact areas. The interrelatedness of the needs and impact change as experiences, situations, and settings change.
- The nursing work optimizes patient outcomes, those of the family and the expectations from the care system and structure of an organization.
- The nurse achieves a lot by bringing in his or her input to situations through a good background on education and personal knowledge gained the skills and experiences acquired during practice.

1.10.1 Application of the theory to the study

This theory was applicable to my study in showing a relationship among the patient, nurse and healthcare system. They all have to work in unison and towards the same direction to ensure effectiveness. In Microinfusion medication administration, so many roles come into play and they have to be properly identified using proper detailed steps.

The theory categorizes patient based on needs (resiliency, vulnerability, stability, complexity, resource availability, participation in care, participation in decision-making, predictability) and nurses competencies (clinical judgment, advocacy, care practices, collaboration, system thinking, response to diversity, facilitation of learning) to create a synergistic nurse-patient relationship. This ensures that the patient needs are met leading to patient satisfaction as well as ensuring a desired degree of wellness is attained.

The theory also identifies that the nurse and patient cannot achieve synergy if the system does not support such relationship to exist, it points out clearly what needs to be done by the system to foster a good relationship between the nurse and patient and as well as improve the outcome. (Scott Swickard, Wendy Swickard, Andrew Reimer, Deborah Lindell, 2015) indicates that this theory will point out on what the system and the structure are supposed to contribute to limit the challenges that may occur between the patient and the nurse during Microinfusion medication administration.

1.11. Conceptual framework

This conceptual framework demonstrated the existence of a relationship between the independent variables and the dependent variables using confounding variables. The figure below shows the study's conceptual framework which illustrates the relationship between the variables of the study.

The independent variables relate to level of preparedness on administration of Microinfusion medication administration critical care nurses in ICU which is the dependent variable in this study. The independent variables are nurses' competencies, institutional and structural factors. A conceptual framework has been drawn to show the link between the dependent and the independent variables. To contextualize this review and make it relevant to this study, the concepts will be tackled one after the other.

INDEPENDENT VARIABLE

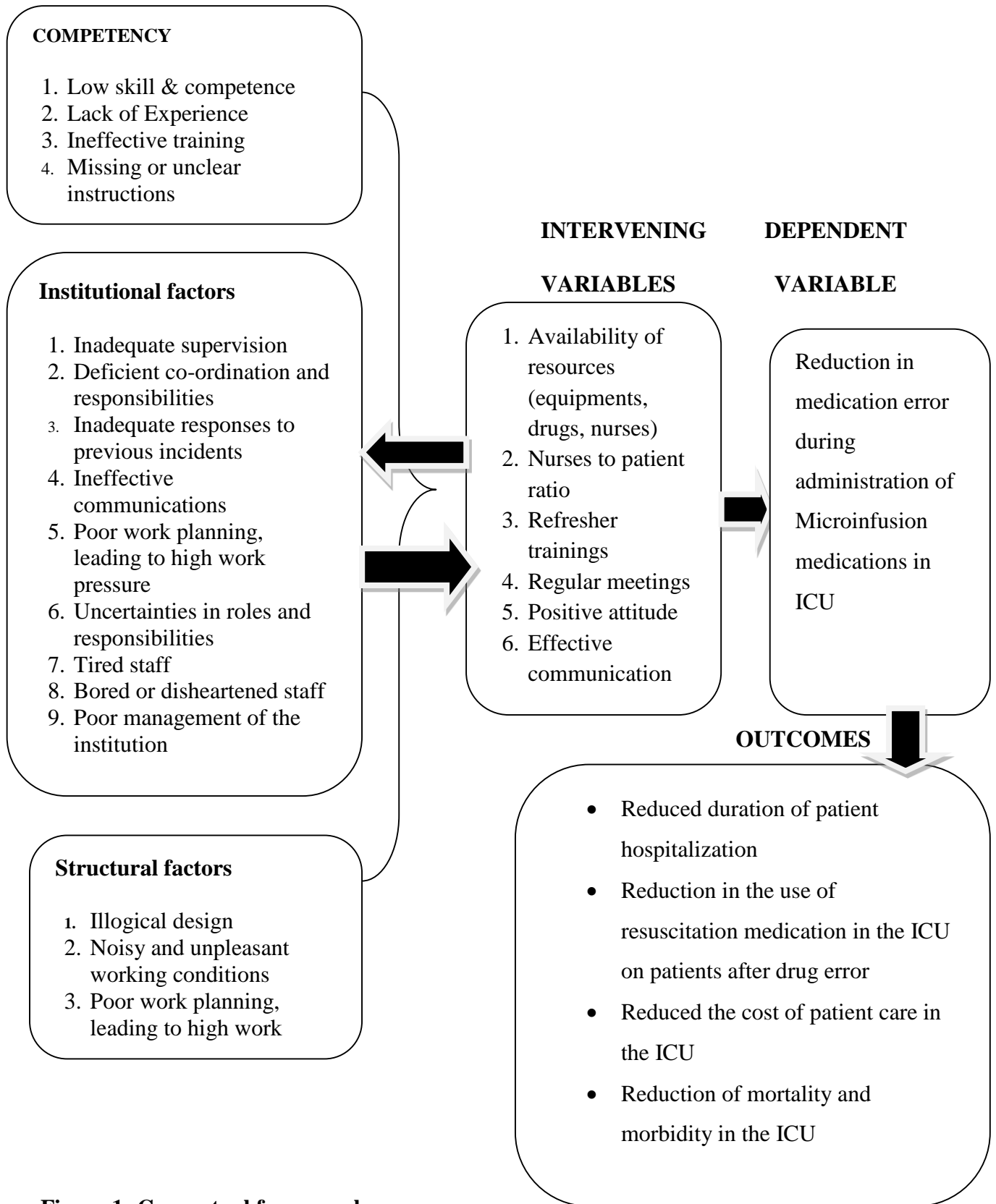


Figure 1: Conceptual framework

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter reviews previous studies done in relation to Microinfusion medication administration, on the protocols of medication administration and errors. This study will also look at the challenges in current practice of critical care nurses and how these challenges have led to existing statistics on Microinfusion administration errors. The review will be based on themes specific to the study.

The ICU is a very busy environment to work in as one has to monitor more than one activity at a time and also be involved in other activities at the same time, to ensure that the patients are closely monitored and the nurse must be well trained and ready to work in such an environment. Studies done by (Ojerinde and Adejumo, 2014) have estimated the set of different activities carried out on one patient admitted in the ICU to be at 178 per day. These activities would require the care giver in which most of the time is a nurse to interact with the support systems, his or her colleagues, monitoring and evaluation of the patient, administration of treatment regimen to the patients, appraising the family with the progress of the patient, maintaining a clean and infection free environment and keeping an eye on the severely ill patient whose condition change suddenly with sudden changes in management.

Nurses forms the majority of the health workforce in any hospital and safe medication administration is one of their key roles as they provide care to the critically ill patients, it can be noted that the care of the ICU patient is based on medication support majorly, which most of the time help improve patient's health status markedly, but also this medication if not given in the right form and means may result to incidents of medication administration errors (MAEs). (Ojerinde and Adejumo, 2014) therefore, the nurse has to be equipped with the right

knowledge and the skills required in order for the nurse to perform activities that will lead to patient safety and well being. To ensure that Nurses give the patients the best of the care that speeds up the recovery they need support from the institutions that give them an enabling environment to be in the forefront in championing health practices that meet the standards approved by the relevant bodies that are tasked with formulating the guidelines.

Patients in ages 60-79 years, are 1.5 times more likely to experience Microinfusion medication administration error compared to patients between ages 18-39 years. 90% of patients admitted in ICU receive Microinfusion medication (Schutijser *et al.*, 2018) Since most Microinfusion medication are used during medical emergencies, it is required that the nurse who is in ICU managing a patient as last line of defense to the patient should be able to recognize the condition of the patient and activate the right channel of response as well intervene(El-Shaer, 2015) consequently, the nurses need to be knowledgeable as they are expected to be in the fore front to determine the change of the condition of the patient for reporting or even the management.

2.2. Critical care nurses competency

This part looks at the knowledge level of the nurse and their skills and competencies required in performing specific factions in the care of critical patients in the ICU in comparison to what is expected of the nurse at their level of practice. It will as well look at the practice of nurses at different levels as reported by other studies. On that account, comparing the performance of the nurses with the knowledge level;

2.2.1. Competence in high alert medication administration.

When it comes to Microinfusion medication administration, performing technical tasks of medication administration is very important but not the only important thing to do, it's also important to do ethically safe and competent medication management of medication

administration which requires that the administrator of medication in which case most of the time is a nurse taking care of the critically ill patient must have a good judgment of his or her actions after review of the patient to have a clear picture. The nurse should also have the knowledge of the drugs to be administered including the adverse effects and how to manage these adverse effects and have experience and skills needed to carry out the processes without forgetting any process steps (Bassi, Park and Azevedo, 2013) Thus, the nurse working in CCU should pay keen attention to details which in some case would look insignificant but very crucial in the management of patients receiving Microinfusion medication in the ICU setup.

To be able to manage a Safe and effective medication practice efforts have to be made to achieve the results and this has to do with many individuals and reliable systems. When nurses are skilled and have knowledge of the right orders they are at liberty to question medication orders that are unclear or inconsistent with therapeutic needs of the client and client outcomes or best practice (College and Association of Registered Nurses of Alberta, 2014) that being the case, the nurse has to have the right knowledge and competency in practice through many sources to enable them to advocate for better management of medication to ensure patient safety, this can only be possible through a lot of research and specific case reports as it reported experiences of other health workers and the outcomes, this empowers the nurse to engage in constructive dialogue with other care givers in making decisions of management.

In patients admitted in ICU, to restore and maintain the cardiac output and perfusion pressure is the major concern of hemodynamic therapy. A study conducted in a 15-bed university hospital adult medical ICU during a routine rounds in civils de lyon in france demonstrated that, vasopressors, inotropes, or both are required for the Patients who do not respond to initial fluid resuscitation. Since they are potent, have a very short half-life and a narrow therapeutic index. Any slight variations could induce life-threatening challenges and cause variations in

arterial pressure as well as cause variations in cardiac rhythm. Therefore, these drugs require atomization of the smart pumps to deliver the required doses as well as maintain the desired doses to enable the drugs to give the desired therapy outcomes (Cour *et al.*, 2013) as a result, smart pumps reduce the chances of having to engage in active resuscitation all the time as a result of delivery of wrong doses to the patients as well as it reduces the chances of under treatment.

Even though most studies could not show that there is no clear cut between MAEs and their contributing factors, most studies have not shown a strong cause and effect relationship, the whole system needs to be looked at including trainings conducted to the staff, staffing ratios, number of activities carried out by one nurse in one shift to a patient in the unit and distractions from the nature of environment. The critical care nurses pointed to this as some of the main reasons why the errors continue to exist and contribute to nurses not meeting the demands of the patient they are looking after. These findings are similar with the findings from a study done by the world health organization through their independent reports (WHO, 2017) that being the case, most ICU settings should have comprehensively looked at to ensure that they meet the standards to enable nurses perform according to the known best practices.

For the nurse to have it easy to manage Microinfusion medication and reduce the errors associated with medication administration, there must be a clear communication all the way from the time of ordering of Microinfusion medication is made to the time of ordering from the supplying department to the time the order is actually delivered to the patient so there is need to have clear orders from the prescriber and they should entail all the following but not limited to: the full names of the patient, the prescription dates, use generic names of the drugs and avoid trade names to have common names used for prescription, give clear drug strength where applicable and dosing, clearly indicate route, frequency, duration these drugs have to be

administered. The prescriber should have his/ her name well written so that if clarity has to be sought one does not struggle finding out who the prescriber could be, the order has to be signed and if possible indicate the purpose for the order or prescription and monitoring as required. Most of the time there is no common or shared understanding of the use of abbreviations in the medication process. Abbreviations lead to confusion and misinterpretations of prescription, most of the time they can be confused for something else which can result in very serious and often fatal errors in Microinfusion medication.(College and Association of Registered Nurses of Alberta, 2014) on that account, all the care givers working or caring for patients in an ICU settings should at all times endeavor to build on a good communication process, as well they should be patient with each other so that they can hear and understand each other's point of view or even suggestions that could be beneficial but overlooked because they were not clearly communicated or because one was not given a chance to give their views. The nurse being the primary person taking care of the patient comprehensively should be able to give critical information about the patient that will be able to help in the care of patients.

To avoid any forms of confusion when administering Microinfusion medication one has to perform necessary checks, so as to avoid errors that would become very common when managing patients if this checks are not looked into. According to six rights of medication administration studied by (Edwards and Axe, 2015), the following principles can improve safety of Microinfusion medication if followed properly. They include but not limited to: identifying the right patient, selecting the right medication, calculating the right dose, identifying the right route, administering the medication at the right time, and using the right documentation (Edwards and Axe, 2015) If followed strictly, Microinfusion medication administration errors will be prevented thus reducing the cost burden on the patient and by extension the morbidity and mortality in critical care patients (Ebrahimipour *et al.*, 2014) That being the case, all this will require trained and competent nursing professional to be achieved.

After WHO encouraged reporting of errors in the year 2004 where they encouraged looking at the problem from all angles rather than just blames and victimization, many studies have been done to find out the progress of these reports. An observational study done and published by the WHO (World Health Organisation (WHO), 2008) entitled rebuilding trust in the health care team revealed that most of the time it's very tempting to apportion blame and victimize individual practice or just one issue or person involved in an incidence. But that could prove too simple and an exercise in futility. It's out rightly not right for one individual person to be blamed without carefully looking at the whole system and taking a good analysis to finding out clearly where the problem lies and what could have contributed to the wrong practice or even where exactly the loophole within the system is. There is need in strengthening the defense that generally exists in the health-care system as a whole. All this should be done without necessarily pointing out fingers to individual health-care workers. That does not imply that individuals are not accountable for their roles (World Health Organisation (WHO), 2008) However, relying on blame approach only will most likely burry problems under and make it impossible to carry a honest and effective strategy that can lead to patient safety

In the prospective observational study carried out in the University Hospital (Girardis *et al.*, 2009) reports that when patients with a diagnosis of shock were admitted in the ICU and were started on Microinfusion medication in a single-centre experience. The study demonstrated that it was important to address specific programs which were addressing the departmental problems in turn that existed and when these are replicated in all departments within the hospital setup then the whole hospital improves on evidence-based service provision to its clients. These practices enable improvement of the survival rates of patients receiving Microinfusion medication admitted in ICU.

Management of infusion pumps has to be done while all the teams are involved, the training of personnel should not just focus on a specific carder or specialty but everyone working in the ICU and may have a chance to be involved in the handling of the pumps, this makes it easy for the nurse as he or she doesn't end up being involved in doing everything. In their model of study (Girardis *et al.*, 2009) focused on a multidisciplinary approach where each specific team play a key role in giving early and appropriate management to patients with automated pumps delivering high potent drug in the in-patient management program, these included educating health-care personnel and improving on the process to improve the adherence to guidelines and improving patient care optimization (Girardis *et al.*, 2009), a multi disciplinary approach has been seen to give a better outlook and enable smooth running of care on the patients as no one does not feel helpless because they were left out of the training or the management of the infusion pumps when delivering Microinfusion medication to the patient.

2.2.2. Competence in administration by use of technology and medication calculations

One of the most valued nurse's professional responsibility is the administration of medication and therefore there is need to ensure that proper training on drug management is prioritized so that to increase patient safety (World Health Organization, 2014). A study conducted in the Middle East by (Alsulami *et al.*, 2015) with the focus on nurses working in the pediatric units revealed that most nurses were not adhering to the policies that had been put in place to improve performance and bring about uniformity of practice, the study also noted that it was urgent to review the guidelines, procedures and frameworks of Microinfusion medication administration from time to time to ensure improved services and make them applicable for the changing times in practice. There was also need for continued training of nurses on the new treatment regimen, calculation of dosages and administration protocols of Microinfusion medication administration as this helps to shape the skills and mastery of the process. (Alsulami *et al.*,

2015) hence, when a nurse is better informed and skilled it reduces the stress one has to undergo in the management of the patients, compared to when everything a nurse does when they are not trained which involve a nurse not being sure of the process or what is expected of them, they are not sure if what they did was what they were intended to do, taking note that most infusion pumps come with guidelines from the manufacturers.

Weight is used as a key measure for calculation of dosages for most Microinfusion medication for patients admitted in the ICU. Mathematical calculations and formulas are used to get required doses to the patients and its noted that this is not the case in most ICUs where you will find out that the calculations are frequently based on estimated weights especially in establishments where there are no ICU beds that can weigh the patients hence, increasing the risk of error (Moyen, Camiré and Stelfox, 2008a) As the United Kingdom's Nursing and Midwifery Council states that medication administration requires scientific judgment, knowledge and skills application. On average 40% of the working time of any nurse in each shift deals with themes related to medications administration. Therefore, to improve the better management of Microinfusion medication the nurses who are left to do the calculations and then administer this medication have to get support on standardization of formulas so that they do not end up delivering medication regimen not intended, as well as during medication calculations the institutions should improve to alleviate chances where patients have to be given medication based on estimates of weight used to give estimated dosages.

Institutions should endeavor to keep their nurses working in the ICU informed and updated all the time, the department of patient safety should have a champion in every department in the hospital and more so in the ICUs where most errors are likely so that they can champion patient safety by ensuring standardization of formulas as well involve all the nurses in refresher training on medication management from time to time. At a steady state the rate of drug

elimination is equal to the rate of maintenance of drug administration; the dosage used in maintenance which is a function of clearance is not used in the calculation of the maintenance dose of the drug dosing rate. The drug dose is calculated using a unit time. (Katzung and Trevor, 2015) If a nurse gets the formula wrong or somewhere within his or her calculations ends up with a wrong figure then the result will definitely be wrong which will lead to the patient receiving the wrong dosage, this can lead to harm of the patient.

It will be unfair to blame one party in all this because it may not be an individual problem but on the other hand nurses are advised not to carry procedures alone more so when they are not very sure of how they ought to be carried out (Morrison *et al.*, 1994) thus the nurses should work hard to be informed of the current treatment guidelines, this can be made possible by creating personal time to read and if this is not possible the nurses working in the ICU department must keep informing each other and discussing conditions that are admitted in the wards to help the nurses handling the patients to understand what is expected of them and this gives the general understanding to the other nurses of all the patients, this on the other hand allows nurses to engage in constructive discussion when consulting each other as well as when they are seeking clarification. Partner nurses can as well remind their colleagues when they are witnessing a possibility of an error being carried out, this in turn will improve patient care and reduce the risks.

When administering Microinfusion medication which are high risk medications most of the time infused using pumps in a critical care setup, at KNH's ICU the nursing staff ensure that the infusion rate and dose programmed (which most of the time is calculated and fed into the infusion pump) are correct for the patient. According to (Erdman *et al.*, 2017) The pump setting should be independently checked when high risk drugs are administered. Having two trained and licensed nurses independently check and recheck the infusion pump to ensure that the

settings and the calculations have been well undertaken for high risk medications is a way to notice the errors in advance and avoid them.

Studies conducted in a Japanese hospital assessing working conditions of nurses which influenced near miss medical errors of Microinfusion medication administration. The nurses blamed the work load allocated to one nurse working within a critical care unit in relation to the experience of the nurse. Also when nurses are faced with experiences in practice which can either be through studies or continuous medical trainings planned and carried out within the facility which at the end of the day encourage knowledge and improve practice that can in turn help nurses to be able to detect and prevent Microinfusion administration errors before they occur. Therefore newly employed nurses (recently graduated or change working environment) are more likely to miss or even may not detect signs of medical errors and even if they did it will be with difficulty and not be able to know how go about them as well as report them with the fear of victimization, this may also take time during the process of Microinfusion medication administration procedures.(Al-shara, 2011) then, the approach should focus more on patient safety not entirely just on the nurse who made an error, to reduce the errors then the nurse has to undergo a vigorous induction process before they start handling patients and should be under supervision of a more skilled nurse and who has a passion to help others become better in practice. So that if the nurse is comfortable with his or her practice then it becomes easy to detect errors as well as they will feel at easy to report the errors.

There are high incidents of Microinfusion medication administration errors, institutions with good error reporting policies have better mechanisms by which medication administration errors are reported and proper channels that allow for speedy resolution that cater for patient safety. A study conducted in Ethiopia on factors contributing to Microinfusion medication administration errors by (Sada, Melkie and Shibeshi, 2015) revealed that 71% of those who

responded to the study admitted that in the last 12 months of their practice they had made medication administration error. There was a very low percentage of about 0.7% of the cases of dose administration considered to have met the criteria for medication administration. Therefore, presenting a very high figure in the findings which made observations that an Ethiopian hospital had displayed protocols, a majority number of the nurses did not follow those protocols for uniformity of medication administration (Abdel-Latif, 2016). Majority of the errors have been attributed to an illegible handwritings, distraction during drug administration, a low nurse to patient ratio, poor communications, lack of proper staffing, lack of continuous nurse education and training leading to incompetent nursing team that is not updated on the current managements of conditions and low skills to a practice (McDowell, Ferner and Ferner, 2009) as a result, this increases the time one takes to handle or accomplish activities putting up an increased work load to the nurse and as a result poor management of the patient.

In a prospective observational study conducted in 102 severely injured patients, it was observed that infusion of crystalloid solution during the first 24 hours was associated with increased pulmonary dysfunction. Although no direct relationship between fluids loading and pulmonary dysfunction could be established, but a new thought process was evoked for the indication of the use of Microinfusion medication during early stages of resuscitation. Moreover, restrictive fluid therapy and Microinfusion therapy to optimize the Mean arterial pressure (MAP) and the cerebral perfusion pressure (CPP) may also have beneficial effects in head-injured patients. Volume sparing effect of vasopressors may lead to decreased cerebral edema and maintenance of adequate blood pressure in polytrauma patients with head injury, in whom even a single episode of low blood pressure may prove detrimental and worsen the outcome (Gupta, Garg and Ramachandran, 2017) on that account, the use of Microinfusion therapy if administered

according to the available standard would result in beneficial results to the patients as well as reduce chances of resuscitation.

Each critical care Nurses are personally accountable for their practice and cases of wrong dose calculations and inadequate knowledge on Microinfusion medications administration; this may lead to medical legal issues for the nurse responsible for not upholding practice. Nurses play a major role in patients right advocating and have a duty to ensure no harm to patients, it is important to note their importance in improving patient safety via quality trainings on Microinfusion medications since any error may lead to increased cost through the stay of patients and lead to harm to the life of these patients. (Machado *et al.*, 2018) Patient safety improves when systems effectively assure and improve patient safety.(Whalen, Finkel and Panavelil, 2015)(Li *et al.*, 2015) that being so, the systems have to be put right to avoid the cases where errors are due to the systems not functioning or are not clear on what needs to be done when this or that happens.

In a study conducted in hospitals in Brazil on how nurses are affected cognitively when working in ICU, looking on the inventory that was used in the study 61% of the nurses in the study presented with psychological symptoms of stress. 45% of the 61% nurses that had shown stress had a gross score higher in one symptom accounting for symptoms of depression and anxiety. The study revealed that during a 24 hour shift in a CCU where there is increased workload as the day progresses leading to increased stress levels, decreasing attention span and attention process and a decline of psychomotor aspects (Machado *et al.*, 2018) to reduce the stress levels which if left to accumulate for a long time may lead to depression, there has to be cooperation to have every part of subjects involved in the function of a working ICU play its part to ensure smooth running of services.

2.3. Use of infusion pumps

Infusion pumps have proved essential and contributed to improvements in patient care and safety, following the current inventions allowing for greater levels of control, accuracy and precision in Microinfusion medication delivery. The development of medical device technology combined with advanced medication and better requirements to control infusion therapy have increased the use of infusion pumps. Today infusion pumps that also include syringe pumps have been used in various clinical applications that have involved both life-sustaining as well as life-saving treatments within clinical areas like anesthesia, intensive care and oncology where patients most of the time are on Microinfusion medication.

2.3.1 Challenges in the use of infusion pumps

There have been so many challenges in the use of infusion pumps most of which have been captured in studies that have been conducted over a period of time to enable the manufacturers improve the quality of these pumps to give optimal output and reduce chances of errors. A report of medical products agency of august 2014, a competent authority that is responsible for the surveillance of medication equipment in the Swedish market noted that there were safety issues with infusion pumps. They sort to identify the problems and risks that users had observed and experienced using infusion pumps during a period between January 2011 and December 2012. They report that it was the highest number of incidents reported approximately 1700 cases, and that some incidents were so severe to the point that patient safety was not guaranteed (Medical Product Agency, 2014) hence the need for continued internal time to time checks by the patient safety departments in the hospitals to ensure that the infusion pumps are tested from time to time to ensure that faulty machines are detected as soon as possible, there also has to be a well supported biomedical department at every ICU hospital that responds to the needs of

the unit in time and which will do surveys from time to time to ensure that the pumps are in good condition for use on patients to guarantee patient safety.

The report noted three major areas where they had noted problems: there were software related problems with infusion in some instances; the health care providers using the infusion pump had difficulties in knowing how, where and when to report incidences to the competent authority; and there were low rates of reported incidents compared to the ones observed, since individuals often had to postpone or refrain from reporting to the authority (Medical Product Agency, 2014) where the nurses feel inadequate in training on the use of infusion pumps and there is fear of taking responsibility for an error exist, it becomes so hard for the staff to do self reporting of errors committed when no one is watching, when the environment provided gives the nurses the understanding that the effects are on patient safety and the nurse should work to ensure the patient is safe and that should not be shameful to do, then self reporting becomes easy where there are proper channels in place.

The medical products agency in their recommendations (Medical Product Agency, 2014) noted that there should be established additional requirements for infusion pump manufacturers and users so as to improve knowledge and understanding of the use of infusion pumps, as well as to proactively improve the device to become user friendly by also increasing user awareness and management of infusion pumps by offering adequate and effective trainings to primary users who in this case happen to be nurses in the facilities. (U.S. Food and Drug Administration, 2010) therefore, much emphasis should be taken to ensure that the manufacture is involved in the training of the staff in the use of the pumps and ensure that they have an easy interface that is easy to use by the end user, the nurses should also be willing and ready to enhance technology in a positive way to impact on patient safety and making work easy.

A study in the Alberta health care services on patient safety improvement when using infusion pumps noted that for effective management of risks, the software used should be applicable and easy to use, the managers and staff that come into contact with infusion pumps should be educated and put on continuous support, the pumps must undergo regular maintenance and repair and that nurses should be able to troubleshoot. They also recommended that there should be procedure manuals available regarding the use of the pumps. The nurses should be able to do independent double checks when infusing medication, adverse events should be recorded and reported promptly (College and Association of Registered Nurses of Alberta, 2014) this should be done in order to ensure patient safety.

It's through the reports given by the end users that the manufacturers depend on to improve on the experience of the users, so nurses should be in the front line to make suggestion targeting to improve the end user's experience. An article by (Neil, 2017) on infusion pumps-markers looking to improve safety through interoperability reports that US FDA (United States Food and Drug Administration) between 2005-2009 received 56,000 reports on adverse infusion pump events, which were more than any other medical technology in use, it reported that these events resulted in 710 patients deaths, during the time 87 pumps were recalled, from the Institute of Medicine reported that infusion pump users alone cost the health system \$ 2bn annually. Nurses complained that infusion pumps been too complicated with interfaces that are not intuitive or easy to use which leads to errors noted that nurses wanted pumps that are simple to use, reliable and safe to patient.

2.3.2 Selecting a syringe pump to use for infusion

In a report by WHO on frequently asked questions on infusion pumps states that in order to select a safe syringe pumps should be reliable and electrically safe, able to deliver infusion accurately and consistently easy to set up and use, able to lock instructions, should be portable

and robust, powered with both batteries and mains, should be usable with syringes of all sizes, should be equipped with and override rapid infusion facility, should be capable to alert when there is occlusion or time to change syringe and also able to display the rate of infusion and volume infused (World Health Organisation (WHO), 2012) as a result, make it a user friendly so that the nurse who handles it doesn't take too much time to figure out what should be done but have it easy to carry operations without problem.

2.4. Institutional related factors

The improvement of institution to care delivery takes into account the efficiency of its systems effectually assure definite outcome to patient, it should be in a way designed to ease the work pressure while making it easy for the health personnel to efficiently provide services that meet patient's needs without difficulty. When systems are complex to execute, they lead to an additional workload for the service providers and mental exhaustion work pressure further compromises the ability to focus and limit the distraction through the care of patients have been mostly associated with Microinfusion medication administration errors. Institutional staffing levels most of the time do not reflect the high work load and the stress experienced when working in a critical care environment, this leads to non compliance to the "six Rights" principles set out for drugs administration. The results a compromised patient safety and leading to poor prognosis. Drug overdose has been cited as the most common error by thirty percent of the nurses (Ojerinde and Adejumo, 2014) the main aim of every institution should be focused on the individual needs of the patient and how this individual needs should be met and just now work being done, that way the nurse to patient ratios can be rationalized to have the nurse deliver per the needs of the patient and administer medication without being under pressure with the amount of work.

Microinfusion medication administration error are due to events all the way from medication orders done by a qualified prescriber, order communication, the system at the supplying pharmacy all the way to administration of medication.(Becker and MERP, 2017) hence need to equip a critical care nurse with enough support both at the system level, organizational level and appropriate knowledge that can increase their level of preparedness in management of emergency situations and complications that arise.

Health care delivery is fallible, in the health care system, Microinfusion medication administration errors and other forms of medication administration are reported to be the seventh commonest cause of death overall according to the study. (Moyen, Camiré and Stelfox, 2008b) The Patient character determine the ADE rates, in most cases that ICU patients are the most critically ill and are put on more medication regimen than patients in the ordinary wards, noting that the environment in the ICUS is complex, and the volume of medications prescribed per patient its then more definite to say that ICU patients have a compromised immunity and are less likely to survive cases of ADEs (Faye *et al.*, 2010) and therefore, more emphasis should be made to have a well organized and collaborative ICu where the roles of taking care of patients are done in a smooth way that it does not create extra workload to the care givers which may impose additional stress to the care giver as a result influence the chances of having a Microinfusion medication administration error for this vulnerable class of patients.

The organizational factors and working environment influence the occurrences of Microinfusion medication administration errors during management of patients receiving potent drugs. These services hinder service delivery and the ability to meet patients' demands of care and they include distractions during procedures, interruptions when emergencies occur in the unit and a nurse needs to give a helping hand, a high nurse-patient ratio and new nurses in the unit who are not well oriented to their environment and institutional values and

expectations and who do not necessarily have the experience and competencies. As a result, increasing the nurse's task both on schedule and those not schedule. (Cloete, 2015) These interventions that occur simultaneously most of the time have to be managed by nurses thus increasing chances of Microinfusion medication administration errors.

In a study conducted by the ministry of health in Kenya (Kenya Ministry of Health (MOH) *et al.*, 2012) to find out the relationship of the nurse-patient ratios and whether it has an impact on service delivery found out that, the nurse-patient ratio has an impact on the outcome of the cases of patients, increasing the number of nurse to patient ratios in hospitals result to most of the time in reduced mortality and reduction in system failures and as well lead to decreased casualties in the hospital (Ministry of medical Services, Ministry of Public Health and Pharmacy and poisons Board, 2016) hence for a better outcome in patient care the staffing numbers should be in such a way that the nurse is not so much overburdened by work to a point where they will forget to do regular checks which result in avoidable errors.

In studies done to analyze the effect of nursing staff ratios done by (Kane RL, Shamliyan T, Mueller C, 2008) found out, there is a relative reduction in the risk to the care of the patient and this consistent across all studies carried and was correlating to high critical care nurses to patient ratios but there was no relation to the working time in hours and the skills displayed. It is important to be able to understand the unit needs in order to be able to estimate the nursing needs in staffing for effective service delivery determined by a number of factors and characteristics including the commitment hospitals have put enable high quality care to their patients and this wasn't considered in most of the studies (Kane RL, Shamliyan T, Mueller C, 2008) then, a high number of nursing staff who are trained and oriented well ensure better service delivery in the critical care units

According to a study on Nurses' perceptions on Microinfusion medication administration done by (Kim *et al.*, 2014) in southern side of Korea focusing on contributing factors to errors in hospital, communication among critical care nurses about medication administration details and confirming the regimen with another qualified experienced nurse reduces errors that could rather be obvious but could happen as a slip from one nurse qualifying the fact that nurses in the critical care unit should be in constant communication and should improve their way of communication to ensure that they clearly communicate orders (Louie *et al.*, 2010) This can significantly reduce Microinfusion medication errors.

High patient -to- nurse ratio" and "increased workload" have been identified to have severe consequence on quality of health care delivery. It has been associated with a relationship like that of a "cause and effect".(Mohammed and El-sol, 2017) When the a nurse takes care of many patients the severity of the consequences is determined by High number of patients per nurse, the staffing ratios in a CCU are very important in service delivery an attempt not to have the required size of staffing needs leads to increase in the output requirements referred to as the workloads these staffing needs accounts for a significant number of Microinfusion medication errors in hospital CCU (Hassan and Qrishah, 2017) it's thought to be the third most common cause of errors.

When a patient stays in the critical care unit for a period of time, the patient is handled by different physicians and a number of different nurses who provide services differently, as much as the ICU way of patient management is team based and multi-disciplinary oriented, the fact that there are human variations in the way two different people with the same qualifications provide care impacts the care delivery system and this variations are very high and may impacts patient outcomes. (Fernando *et al.*, 2018) the environment at ICU should be in such a way that the needs of the patients are met regardless of the person giving care to the patient this can be

achieved by making sure that the standards of operation in the ICU are the same and much emphasis should be given to the time a nurse is receiving his or her orientation, and as well continuous education.

a study done on role of organizational factors on the ‘weekend effect’ in critically ill patients in Brazil found out that ICU organizational factors, such as decreased nurse-to-patient ratio, absence of checklists and fewer standardized protocols, with a disrupted continuity of care and adherence to best practice may explain, in part increases in mortality in patients admitted to the ICU mortality on weekends(Zampieri *et al.*, 2018) that being so, a hospital should ensure that a competent and experienced team leader and staff are also involved in the care of patients over the weekends so that there is no laxity and the nurses are motivated to give the same care as the care given on the weekends.

2.5. Structural related factors

The ICU brings together the experience of caring for patients who are at a very high risk in health and an environment which is complex. Adverse drug Events (ADES) are strongly predicted by the severity of the patient’s illness and the care demand of the patient. most of the patients in the CCU have been shown to receive high number of medication at the same time some times estimated to be twice as much drugs compared to those administered to the patients in general wards within the hospital. Multicentre studies by (Dünser, Hjortrup and Pettilä, 2016) and (Calabrese *et al.*, 2001) identified vasoactive drugs, muscle blockade and analgesics as medications prone to risks of error when using programmed Microinfusion pumps. Because the patients receiving these drugs are in a complex environment it is also likely that the prescriptions are made in the same complex environment where more than one person gets to attend and provide service to the patient independently. (Moyen, Camiré and Stelfox, 2008b) Nurses most of the time managing patients who are in a crisis, which may be a risk to being

involved in errors most of the time through conflicting ideas on the management of these patients.

When it comes to critically ill patients it's better to recognize that these patients have a lesser defense mechanism that is mostly compromised and there is need to consider a number of issues surrounding the ADEs when administering potent drugs. These patients most of the times do not participate in their own management at the CCU and they psychologically cannot effectively tolerate any addition to the injury that already exists. These patients are beneficiably of the quality of care that will be administered to them and the ability of the nurse to use the sophisticated available technology and intelligent software equipment to deliver most Microinfusion medication and essential care prescribed to the patient (Moyen, Camiré and Stelfox, 2008b) yet these machines are prone to technological failures which can result in undesired outcome or even worsen the patient's outcomes and increase safety risks.

A narrative review by (Calligaris *et al.*, 2009) on factors contributing to Critical care Nurse Microinfusion medication administration error indicated that within the critical care environment, clinical workload and work setting / design were identified as predictors of medication administration errors. The work-setting environment in a critical care unit consists of: a structure designed to meet the patient's needs, nursing work organized to have a leader, teamwork since most procedures are not one nurse procedures and communication which includes having safety measures in place. The critical care design also takes into consideration the size of ICU that provides space to meet the patient's needs.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Introduction

This chapter gave details on the research design, methodology, and methods of sample selection, data collection and analysis of the results that are used in this study. Ethical considerations that have been utilized in coming up with this study have been explained in details. It's the hope of the study that the methodology generates practical and useful information through the collection of data, analysis and dissemination of these findings on the knowledge and practices of critical care nurses on Microinfusion medication administration, which include the following;

3.2 Study design

The study used analytical cross-sectional design. As it was seeking to examine the challenges in administration of Microinfusion medication by critical care nurses and analyzes the factors contributing to medication errors when using Microinfusion medications to manage patients by critical care nurses at the study area, it focuses in nurses working at the ICU of Kenyatta national hospital at the time of the study.

3.3 Study area

The study took place at the adult critical care units of Kenyatta National Hospital. KNH is the oldest hospital in the Kenya having been founded in 1901 as a native Civil hospital, with 40 bed capacity, it was renamed the king George VI hospital. Following independence the hospital was then named Kenyatta National hospital after the first Kenyan president. Currently it is a tertiary referral hospital managed as a parastatal under the ministry of health. The hospital has a bed capacity of 1800patients in the general wards and 209 private beds; the hospital also

serves as a teaching institution for the university of Nairobi collage of health sciences, Kenya medical training collage and a number of other institutions that bring students for clinical training. The hospital is located in west side of upper hill Nairobi in the capital city of Kenya, in Nairobi City County, Its 3.5km from the central business district on a 45.7 acres piece of land.

Kenyatta national hospital provides intensive care services among other services provided to both pediatric and adult patients admitted to the hospital. KNH has a main ICU and seven satellite ICUs with 5 bed capacity each, namely; Pediatric, neonatal, Medical, Neurological, Trauma and Emergency and cardiology ICU. The Main ICU where this research will be carried out has 21-bed capacity.

The main ICU is a multi-disciplinary unit admitting patients of all ages and the major indication for admission being from severe injuries including but not limited to; head injuries from road traffic accidents, assaults and other medical and surgical indications such as sepsis, neurological conditions, diabetes ketoacidosis and multi-organ failure. Most patients if not all in this unit usually are on Microinfusion medication.

The staff attending to the patient is a mixture of various health care professionals, the nursing team comprises of all carders who are permanently employed or on contract, internship or on voluntary basis. Since KNH is a teaching institution, there are students from various institutions who take part in the care of the patients.

3.4 Study Population

Professional nurses registered by the Kenyan nurses' regulatory body, nurses council of Kenya (NCK) working at the adult male and female critical care units of Kenyatta National Hospital who met the inclusion criteria into this study participated in this study.

3.5. Inclusion Criteria

1. Critical Care nurses on permanent employment at the time of the research
2. Critical Care nurses who voluntarily gave consent to take part in the study.

3.6. Exclusion Criteria

1. Nurses were on leave at the time of the research
2. Critical Care nurses who did not voluntarily consent to take part in the study
3. Certificate qualifications in nursing
4. Other health care team members such as doctors, physiotherapists, nutritionists, student nurses

3.7 Study Variables

The study variables are grouped into dependent variables and independent variables as they are shown below;

3.7.1 Dependent variables

The main variable here is the Reduction in incidences of medication error during the administration of Microinfusion medications in ICU.

3.7.2. Independent variables

1. Competency level
2. Institutional related factors
3. Structural factors

3.8 The sample size determination

Fisher *et al.*, 1998 and Cochran formula for sample size determination was used since the study population is less than 10,000. The following formula applies:

$$n = \frac{Z^2pq}{d^2}$$

Where,

- n = the desired sample size.
- Z = the standard normal deviate at the required confidence level.
- p = the proportion in the target population estimated to have characteristics being studied. In this study, the proportion in the target population is 30%,
- $q = 1 - p = 0.7$
- d = the level of statistical significance set = 0.05
- Z = Assuming 95% confidence interval $Z = 1.96$

$$n = \frac{1.96^2 \times 0.3 \times 0.7}{0.05^2} = 323$$

The largest population for the study was 100 which is less than 10,000 and thus sample size is determined by Cochran Formula.

$$nf \frac{n}{1 \times \frac{n}{N}}$$

nf = desired sample size

N = Was the estimate of population size = 80

$$nf \frac{323}{1 \times \frac{323}{80}} = 64$$

= 64

Sample size is **64**

3.9 Sampling method and procedure

Simple random sampling was used to select 64 respondents. The nurses, who consented and met the inclusion criteria, were recruited and then selected to participate in the study. The population under study was defined then a list prepared containing nurses who met the eligibility criteria. Numbers were assigned to units and sorting of random numbers was carried out. Finally, 64 were sampled and selected from the random numbers written between; 1-64 and the remaining papers to 80 were blank. This reduced bias from the selection procedure.

3.10 Recruitment and consenting of participants

Recruitment of participants was carried out in the month of June after approval to carry out the study, Professional nurses of all ages working at the adult male and female main critical care unit of Kenyatta National Hospital who met the inclusion criteria into this study and were willing to participate in the study were identified randomly to participate.

The principal investigator offered explanations on the procedures and expectations and all the questions raised during the exercise were answered. Participants were given random numbers in folded papers in a double blind way, the numbers were between 1 and 64, and the remaining folded blank papers to make a total of 80 papers, to equal the identified number of participants, and only those who had picked numbers from 1 to 64 were then allowed to participate in the study. Those who picked the blank ones were not admissible to participate.

The principal investigator and trained research assistants then administered questionnaires to the selected participants who already had an introduction of the study that had prior been explained to and then consented on the consent paper after reading and understanding on their own by signing and continued to the study after, those who wished not to continue with the study at this level were allowed to leave at their free will. The participants were given questionnaires at the beginning of their shifts or during their tea breaks in the conference room.

3.11 Data collection tools

Self-administered questionnaires containing structured and unstructured questions and participatory observation checklist were used in data collection.

The **questionnaires** had 4 sections grouped in accordance to the research objectives and each had questions on the following content;

Section A: socio- demographic data of the respondents,

Section B: Competency level of critical care nurses on administration of Microinfusion medications.

Section C: Institutional factors contributing to Microinfusion medication administration errors and

Section D: Structural factors contributing to Microinfusion medication administration errors.

The **participatory observational checklist** had three parts with checks to write yes or no and give an explanation there after the response, the parts of the checklist were:

Section A: infusion medication planning

Section B: infusion medication administration

Section C: post infusion medication administration

3.12 Pretesting of the questionnaire for validity

Prior to conducting the study, the study tools was pretested in ICU Machakos county referral hospital, 10% of the sample size of the study was used in the pretesting to determine the validity of the tools. The views of the participants on the wording and structure of the questionnaires were considered in the reviewing and restructuring of the questionnaires.

3.13 Quality assurance strategy for validity of findings.

1. The research methodology used was analytical cross-sectional study, which used both participatory observational tool and self-assessment tool to compare the findings and report the findings as they are on the ground; it was assumed that most people did not like reporting themselves on medical errors.
2. The research assistant thoroughly trained on tool implementation
3. The respondents were assured on confidentiality and anonymity to ensure truthful responses
4. Data was crosschecked for consistency and completeness before analysis
5. A high number of interviews was conducted categorically for precision

6. The questionnaire was as detailed as possible to ensure collection of all the important data required
7. The data collection tool used was adopted with minor modifications from JCIA

3.14 Training of research assistants.

Three nurses from the research area were recruited and trained to be research assistants of this study. They were trained and explained to on the aim of the study, the objectives, and the materials and methods that were used in the study. Matters to do with voluntary participation, consenting, anonymity, confidentiality and privacy of the participants were addressed. Prior to initiating them into the actual study, the principal investigator included them during the pretesting exercise.

3.15 Data collection procedure

With the help of the research assistants, the principal investigator explained to the respondents who met the selection criteria the aim of the study, the objectives, and the materials and methods that were used in the study. They were explained to on voluntary participation, consenting, anonymity, confidentiality and privacy. Self-administered questionnaires were issued to them after the instructions had been clarified. After the questionnaires had been filled they were checked for completeness before being received. They were then coded and keyed into a computer protected with a password to prevent access to any other person other than the principal investigator.

3.16 Data management and analysis

Used statistical package for social sciences (SPSS) version 23 to capture, clean and analyze data, used descriptive data analysis to describe frequencies proportions, measures of dispersion

and measures of central tendencies where necessary and applicable, inferential statistics were used to describe the relationship between the independent variables(Demographic data, negligence, knowledge of medication, workload and staffing ratios, interruptions and disruptions, years of experience of the critical care nurses, working shifts, institutional and structural factors) and dependent variables(Microinfusion medication administration errors). Data analyzed then was presented on pie charts, tables and graphs.

3.17 Study limitations and delimitations.

This was an institutional based study. The findings were not generalized therefore recommendations were made for similar studies to be done in other areas in Kenya that are within the private and public institutions so as to come up with the true picture of the prevalence of medication errors in the public health sector.

3.18 Dissemination plan

Upon completion of the study, the findings will be disseminated to the University library and at the Kenyatta National Hospital critical care unit resource centre. As well as through the print media, and publication in leading health peer reviewed journals. In addition the findings would be shared to the public and other health care professionals in conferences through presentation.

3.19 Ethical considerations

The researcher sought authority to conduct research from the UoN/KNH Ethics and Research Committee. The researcher also asked for permission from the research committee at the Kenyatta National Hospital. Raw data collected at the conclusion of the study was entered in the computer under password to safeguard the information from unwanted readers.

3.19.1 Voluntary participation

The nurse was approached and asked to willingly participate in the study without any form of coercion or victimization. Those who willingly chose to participate were required to give a written informed consent on the form provided. They then went ahead to fill given questionnaires, which had instructions on how to do it. They reserved the right to withdraw from the study at any point without any form of victimization. It took them about 15 minutes to complete the questionnaire. Respondents' informed written consent was sought individually. The researcher presented a written consent to every respondent who accepted to participate in the study.

3.19.2 Confidentiality

Confidentiality was maintained for information given on the questionnaires by coding the questionnaires. No names or personal identification was required on the questionnaire. To maintain confidentiality and anonymity, the name or any other information that may identify the participant directly was not required. However, the questionnaires were assigned a code number which was used in reporting not to single out a participant but provide demographics that were essential for report delivery.

3.19.3 Risk of participants.

There were neither risks nor harm anticipated on the participants when filling self assessment questionnaires as the study aimed to use honest personal experiences of the participants which was self reported in anonymity of the actual information given to protect their right to anonymity in the study. However, there could have been chances of risk and harm to the patients in this study, when a nurse under observation risked the patient to harm, the principal investigator stopped the nurse from carrying out the procedure consulted and rectified with the

participant and recorded it as an error. This participant was not eligible to continue in an observational study as they were now aware they were being observed. No invasive procedures were employed by the investigator or participant during this study.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the results of the study. It is organized such that Findings for each of the specific research objectives on challenges in administration of Microinfusion medication by critical care nurses at KNH's ICU are addressed consecutively. These include demographic factors, nurses' competency, institutional, structural factors, and lastly the results obtained from an observation checklist by a participatory observer. The data was collected from 64 nurses working in the ICU giving a response rate of 100%.

4.2 Demographic Characteristics of the Respondents

The researcher sought to find out the demographic characteristics of the respondents.

Majority of the respondents that is 59.4% (n=38) were female while the male respondents were 40.6% (n=26) Shown on figure 2.

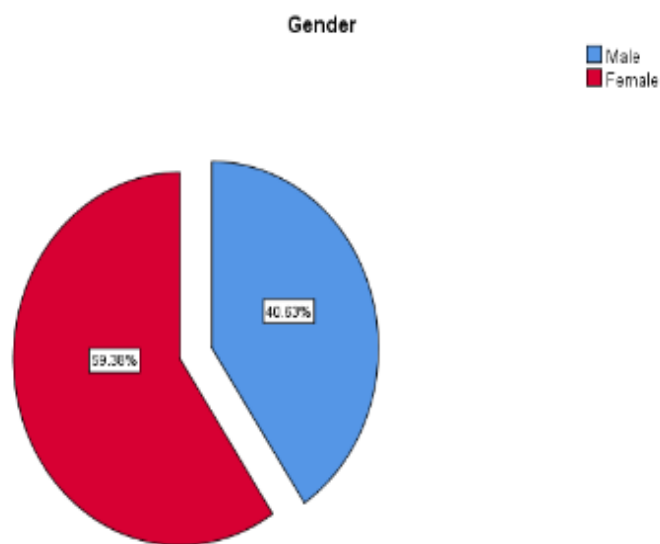


Figure 2: Pie chart of gender of the respondents

Amongst male respondents, 65.4% (n=17) reported to have made Microinfusion medication administration errors within the last six months as compared to 34.6% (n=9) who did not report any error in the past six months.

The youngest respondent in terms of age was 31 years old while the oldest was 59 years.

Mean 42, median 40, standard deviation 6.8, range 28 as shown in figure 3.

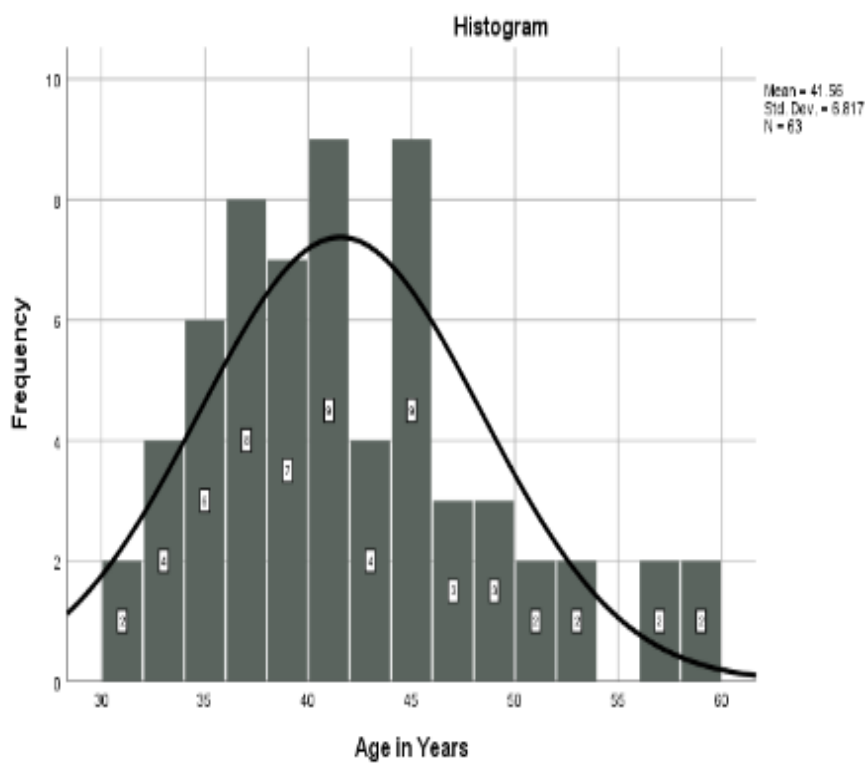


Figure 3: Histogram of the ages of the respondents

The researcher found out that on years of experience the respondent who had a least number of years of experience had 3 years while the one who had the highest had 36 years. Higher diploma 65.6 % (n=42), Bachelors degree in nursing 31.3%(n=20), Masters degree and above 3.1%(n=2) as shown in figure 4

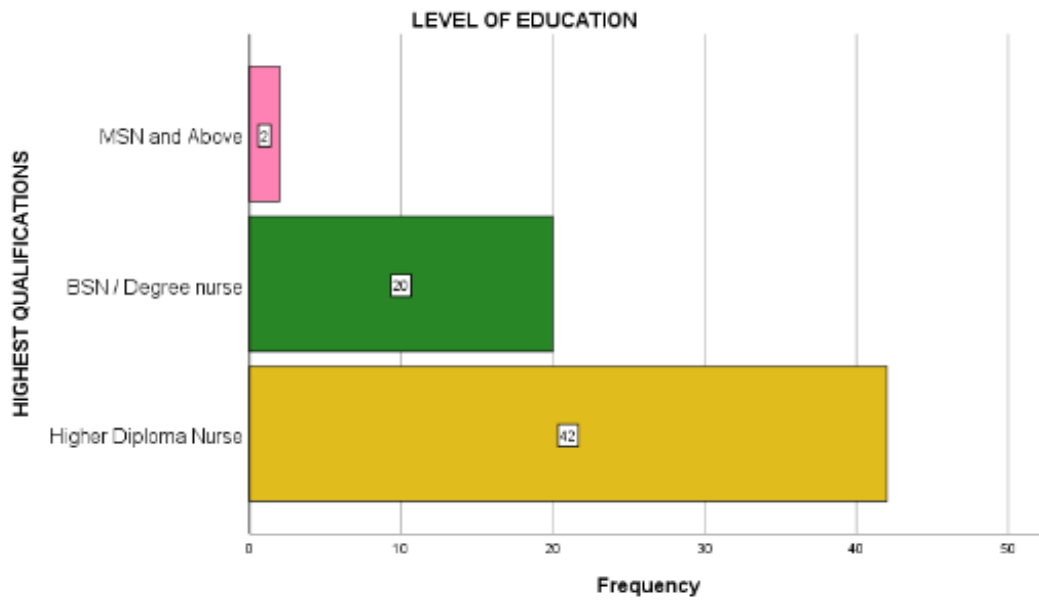


Figure 4: Bar graph on level of education

The researcher found out that among those who had Higher diploma 66.7 % (n=28) had reported Microinfusion medication administration errors in the last six months as compared to those who had a Bachelors degree in nursing and a masters in nursing.



Figure 5: Pie chart on special training on Microinfusion medication administration

As shown in figure 5 above the participants who had special training were 28.1 % (n=18) while 71.9% (n=46) had no special training.

The study also found out that amongst those who had special trainings 66.7% (n=12) reported Microinfusion medication administration errors in the last six months, while amongst those who had no special training on Microinfusion medication administration it was 63% (n=29).

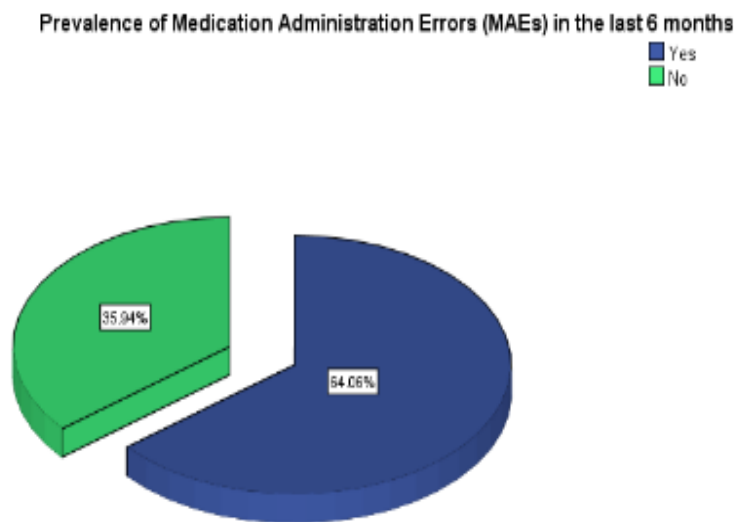


Figure 6: Pie chart on prevalence of medication administration errors (MAEs)

As shown above the researcher found out that in the last six months the respondents reported to have had 64.1% (n=41) MAEs while 35.9% (n=23) had no MAEs

The researcher found out that going by each respondent the one who reported the highest number of Microinfusion administration errors in 6 months among the ones that were asked had 8 incidences while the least had one incidence.

Table 1: Number of reported MAEs incidences in the last 6 months

	Reported MAEs	44
	Never reported MAEs	20
Mean		2.9773
Median		2.0000
Mode		2.00
Std. Deviation		1.79778
Minimum		1.00
Maximum		8.00

Among the types of Microinfusion medication administration errors the researcher sought to find out those respondents had made in the last 6 months type seven 70.9 % (n=11) were common among the respondents. On the type(s) of MAEs that were reported during the review period, this study established that majority of the respondents reported more than one type of error in a 6 month period.

Table 2: Relationship between demography and prevalence of micro infusion medication error in the last 6 months

Characteristic	Overall (n=64) % (n)	Having made a medication error in the last 6 months		P-Value
		Yes	No	
Gender Male	40.6% (n=26)	65.4% (n=17)	34.6% (n=9)	0.324
Female	59.4% (n=38)	61.5% (n=24)	38.5% (n=14)	

Highest qualifications				
Higher Diploma	65.6%(n=44)	66.7%(n=28)	33.3%(n=14)	0.375
BSN / Degree nurse	31.3%(n=20)	55%(n=11)	45%(n=9)	
MSN and Above	3.1%(n=2)	100%(n=2)	0	
Special training on Microinfusion medication				
Yes	28.1%(n=18)	66.7%(n=12)	33.3%(n=6)	0.786
No	71.9%(n=46)	63%(n=29)	37%(n=17)	
Ever made medication administration errors (MAEs) in the last 6 months				
Yes	64.1%(n=41)			
No	35.9%(n=23)			

The study revealed that there was no statistical significant between the demographic data and the incidences of Microinfusion medication administration errors at a $P < 0.05$ with no significant chi square values. Therefore, the researcher accepted the null hypothesis (H_0) and rejected the alternative (H_1) hence, showing that there was another source of Microinfusion administration errors other that Demographic Characteristics as shown in table 2.

4.3 Critical nurse competency in use of infusion pump to administration medication and micro infusion medication administration errors in the last 6 months

Respondents who reported making prescription checks always were 29.7% (n=19) while those who were not always making the checks 28.1% (n=18), those who reported making prescription checks often were 17.2 % (n=11). Among those who reported not having made prescription checks they had a high number of errors at 88.9% (n=16).

On calculations of medication, those who were doing the calculations individually were 56.2% (n=36) those who cross checked the calculations with another nurse 43.7% (n=28). Most of the respondents said that they were taking part in preparing the infusions 76.6% (n=49) as compared with 23.5 % (n=15). Amongst those who were not preparing the infusion

medications 22 % (n=9) reported Microinfusion medication administration errors in the last six months.

Those respondents who were checking medication with the second registered nurse before administration were 15.6% (n=10) compared to those who confirmed 84.4% (n=54). None of the respondents said that he/she always checks with the second registered nurse before administration of infusion medications. Amongst those who were not making the checks with the second registered nurse before administration 87.8% (n=36) reported Microinfusion medication administration errors in the last six months compared with 12.2% (n=5) who said that they were checking quite often with the second registered nurse before administration medications.

Most of the respondents said that they were monitoring medication infusions 71.9% (n=46) unlike 28.1% (n=18) who said that they were not monitoring.

Table 3: Critical nurse competency in planning the use of infusion pump to administration medication

Characteristic	Having made a medication error in the last 6 months n(%)		OR	95% CI		X ² value (df)	P- Value
	Yes	No		Lower limit	Upper limit		
Prescription checks							
Seldom	16(88.9)	2(11.1)	.0	.000	17.9	1	0.008
Quite often	9(56.3)	7(43.8)	1.1	.073	110.1	1	
Very often	3(27.3)	8(72.7)	1.4	.019	2	1	
Always	13(68.4)	6(31.6)					
Calculation of medication							
Seldom	9(60)	6(40)	4.0			1	0.701
Quite often	9(69.2)	4(30.8)	1.0	.0	22.5	1	
	5(50)	5(50)	5.5	.0		1	

Very often	18(69.2)	8(30.8)		.0			
Always							
Preparation of infusion medications. Seldom	5(83.3)	1(16.7)	.0	.0		1	0.395
Quite often	4(44.4)	5(55.6)	1.3	.1	23.2	1	
Very often	10(58.8)	7(41.2)	2.0	.3	15.3	1	
Always	22(68.8)	10(31.3)					
Second registered nurse checks Seldom	18(66.7)	9(33.3)	.439	.029	6.6	1	0.601
Quite often	18(66.7)	9(33.3)	.752	.054	10.5	1	
Very often	5(50)	5(50)					
Monitoring during administration Seldom	2(40)	3(60)	45694	0.0			0.252
Quite often	9(69.2)	4(30.8)	4679.2	0.4		1	
Very often	15(55.6)	12(44.4)	2.6	.1	19.4	1	
Always	15(78.9)	4(21.1)	1.872		26.2	1	

The study revealed that there was statistical significance between critical care nurses competence levels in the use of Microinfusion pumps and administration errors at a $P < 0.05$ with a chi square values of (0.008) on prescription checks. Therefore, the researcher rejected the null hypothesis (H_0) and accepted the alternative (H_1) hence it's a source of Microinfusion medication administration errors as shown on table 3.

Those who were titrating the infusions and reported Microinfusion medication administration errors were more 56.1% (n=23) unlike 43.9% n=18) who were not titrating and reported Microinfusion medication administration errors.

Most of the respondents said that they are able to safely discontinue the infusion medication 79.7 % (n=51) compared with 20.3% (n=13) who were not sure.

On post administration monitoring of patient, most of the respondents were monitoring 60.9% (n=39) compared with 37.6% (n=34).

On safe disposal of administrative devices 89.1% (n=57) were always disposing the wastes while the rest 11% (n=7) were not. On supervision, most of the respondents said that there were supervision and trainings at work place 73.4% (n=47).

Reporting and documentation for Microinfusion medication administration errors was at 17.2% (n=11), those who did not seem to know the guidelines and the process of reporting Microinfusion medication administration was 82.8% (n=53), those respondents who were carrying identification checks was 87.6% (n=56) those who did not 12.5% (n=8).

Majority of the respondents were carrying out prescription checks 90.7% (n=58) while 9.3% (n=6) did not. On checking of patient weight before drug administration those who estimated the patient weight were 84.4% (n=51) while those who confirmed 15.6% (n=13). Most of the respondents agreed that there was need for continuous monitoring and observation during administration of infusion medications 68.8% (n=47). Those who were not sure represented 31.3% (n=20).

The researcher found out that 56.2% (n=36) respondents reported that it was necessary to have knowledge on the medication, the expected effects and how to manage the expected outcome before administering the drug.

A majority of the respondents 96.8% (n=62) said that using the correct diluents can help reduce Microinfusion medication administration errors.

Proper labeling of medication infusions in accordance to local policy was one of the major ways the respondents reported 89% (n=57) used to reduce medication administration errors.

Those respondents who were able to identify Microinfusion medication administration errors early were the majority 82.8% (n=53).

A higher proportion of the respondents 59.4% (n=38) said that there is need for continuous treatment of anaphylaxis when a Microinfusion medication administration errors occur.

Table 4: Nurse Competency in the use of infusion pumps during administration of Microinfusion medication.

Characteristics	Overall (n=64) n(%)	Having made a medication error in the last 6 months		95% C.I. for EXP(B)	Df	P- Value
		Yes	No			
Monitoring post administration						
Seldom	4(6.3)	0	4(100)	0.0(0.0)	1	0.037
Quite often	20(31.3)	12(60)	8(40)	5.5(0.0)	1	
Very often	26(40.6)	17(65.4)	9(34.6)	0.0(0.0)	1	
Always	13(20.3)	11(84.6)	2(15.4)	1(0.0)	1	
Reporting and documenting in case of an error						
Never	30(46.9)	17(56.7)	13(43.3)	39800.0(0.0)	1	0.009
Seldom	23(35.9)	20(87)	3(13)	0.2(0.0)	1	
Quite often	10(15.6)	3(30)	7(70)	0.0(0)	1	
Very often	1(1.6)	1(100)	0		1	
Weight check						
Never	33(51.6)	16(48.5)	17(51.5)	0.0	1	0.019
Seldom	21(32.8)	18(85.7)	3(14.3)	0.0	1	
Quite often	10(15.6)	7(70)	3(30)	0.0	1	
Use of correct diluents						
Never	1(1.6)	0	1(100)	1.0(0.0)	1	0.023
Seldom	1(1.6)	1(100)	0	1.0(0.0)	1	

Quite often	15(23.4)	9(60)	6(40)		1	
Very often	21(32.8)	9(42.9)	12(57.1)		1	
Always	26(40.6)	22(84.6)	4(15.4)			
Early identification						
Never	1(1.6)	0	1(100)	0.0	1	
Seldom	10(15.6)	6(60)	4(40)	0.0	1	0.022
Quite often	14(21.9)	10(71.4)	4(28.6)	0.0	1	
Very often	21(32.8)	18(85.7)	3(14.3)	0.0	1	
Always	18(28.1)	7(38.9)	11(61.1)	0.0		
Communication with multidisciplinary team						
Never	11(17.2)	10(90.9)	1(9.1)	1.0(0.0)	1	
Seldom	17(26.6)	8(47.1)	9(52.9)	1.0(0.0)	1	
Quite often	22(34.4)	20(90.9)	2(9.1)	0	1	0.000
Very often	12(18.8)	2(16.7)	10(83.3)	0.3	1	
Always	2(3.1)	1(50)	1(50)	>1	1	

The study revealed that there was statistical significance between critical care nurses competence levels in the use of Microinfusion pumps and administration errors at a $P < 0.05$ with significant chi square values of (0.009, 0.019, 0.023, 0.022, 0.000) on reporting and documenting in case of an error, weight check, use of correct diluents, early identification, communication with a multi disciplinary team. Therefore, the researcher rejected the null hypothesis (H_0) and accepted the alternative (H_1) hence this amounts to a source of Microinfusion medication administration errors as shown on table 4.

4.4 Institutional factors and micro infusion medication administration errors

Lack of supportive supervision on drug administration was evident with a 65.6% (n=42) who said that they have never been supervised. On the frequency of supervision a higher percentage said that supervisory visits were less often 17.2% (n=11) followed by those who said supervision was monthly 9.4% (n=6) and only one respondents who said that it was hourly 1.6% (n=1).

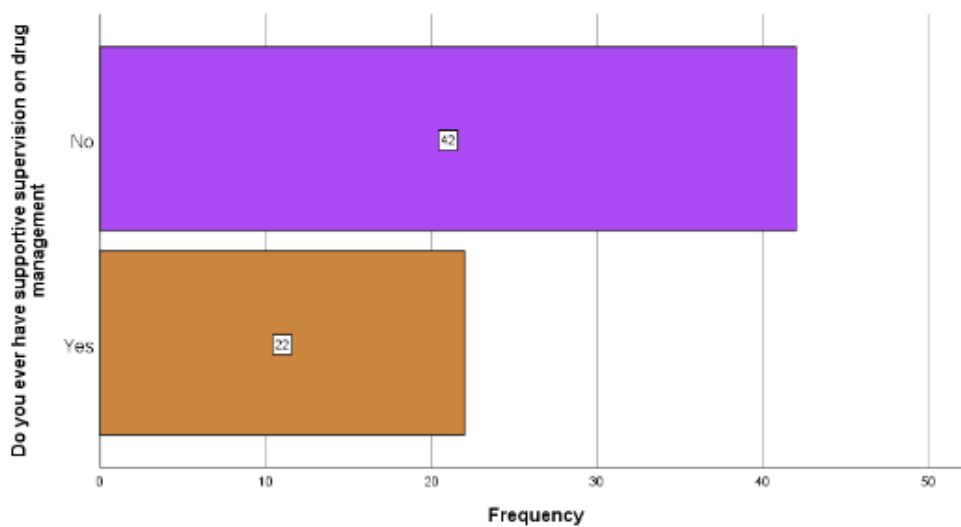


Figure 7: Nurses who had supportive supervision on drug management

As shown on the figure above 65.6% (n=42) of the participants had no supportive supervision while 34.4% (n=22) reported to have supportive supervisions.

From the response received most 62.5% (n=40) respondents knew mechanisms in place to respond to report med errors while another proportion who said that there were no mechanisms 37.5% (n=24). Communication during drug medication was coordinated and this was according to 90.6% (n=58) of the respondents

Table 5: Association between Institutional factors and micro infusion medication administration errors

Characteristic	Overall (n=64) n(%)	Having made a medication error in the last 6 months		95% C.I.for EXP(B)	df	P-Value
		Yes	No			
Have you ever had supportive supervision						
Yes	22(34.4)	15(68.2)	7(31.8)	1.5[0.4-5.5]	1	0.619
No	42(65.6)	26(61.9)	16(38.1)			
Do you have mechanisms for reporting medication errors						
Yes	40(62.5)	30(75)	10(25)	0.2[0.1-0.8]	1	0.019
No	24(37.5)	11(45.8)	13(54.2)			
Communication during administration of microinfusion medication						
Coordinated	58(90.6)	37(63.8)	21(36.2)	1.1[0.2-7.2]	1	0.889
Uncoordinated	6(9.4)	4(66.7)	2(33.3)			

The study revealed that there was statistical significance between critical care nurses competence levels in the use of Microinfusion pumps and administration errors at a $P < 0.05$ with significant chi square value of (0.019) on availability of mechanisms for reporting mediations errors. Therefore, the researcher rejected the null hypothesis (H_0) and accepted the alternative (H_1) hence this amounts to a source of Microinfusion medication administration errors as shown on table 5

The nurses who participated on the study gave varied views on their explanation on which mechanism they were using to report the medication errors, some said they were reporting to their immediate supervisors, while others said they would report to the doctor on call as well

as some said they would document on the error report book. This view demonstrated that there was no uniform mechanism by which the staffs were trained on reporting errors.

4.5 Structural factors and medication administration error

Most respondents 54.7% (n=35) reported that the ICU was well designed to for management of supplies and medication compared with 45.3% (n=29) who felt it was not well designed.

Table 6: Structural factors and medication administration errors

Characteristic	Overall (n=64) n(%)	Having made a medication error in the last 6 months		95% C.I.for EXP(B)	Df	P-Value
		Yes	No			
Do you think the ICU is well designed	35(54.7)	23(65.7)	12(34.3)	1.0(0.3-2.9)	1	0.762
Yes	29(45.3)	18(62.1)	11(37.9)			
No						
Are work and responsibilities well planned	52(81.3)	36(69.2)	16(30.8)	0.3(0.1-1.1)	1	0.073
Yes	12(18.8)	5(41.7)	7(58.3)			
No						
Is the ICU staffing ratios adequate for handling MAEs	9(45.3)	17(58.6)	12(41.4)	1.8(0.6-5.5)	1	0.409
Yes	35(54.7)	24(68.6)	11(31.4)			
No						

The study revealed that there was no statistical significant between structural factors and Microinfusion medication administration errors at a $P < 0.05$ with no significant chi square values. Therefore, the researcher accepted the null hypothesis (H_0) and rejected the alternative (H_1) hence, showing that there was another source of Microinfusion administration errors other that Demographic Characteristics as shown on table 6.

Those respondents who said that work and responsibilities were well planned and distributed in readiness for management of patients in ICU on Microinfusion medications were 81.3%(n=52) however when this was subjected to test of significant as shown on table 6 this is not statistically significant(p value = 0.073)

More than half of the respondents 54.7%n= 35 said that the ICU staff ratio was not adequate for handling micro infusion medications administration procedures as stipulated by the nursing council of Kenya and best practice. Those who said that the staffing ratio was okay represented 45.3%n=29. However this was not statistically significant as shown on table 6

4.6 Practice of critical care nurses on administration of Microinfusion medication.

The researcher sought to find out the practice of critical care nurses on the administration of Microinfusion medication, using a participatory observational checklist to assess the nurses and clinician interaction, a majority of the critical care nurses did not discuss the diagnosis and treatment plan with the clinician 59.4% (n=38). Those who were discussing the treatment plan were 40.6% (n=26). Treatment options were not being discussed in most of the cases 87.5% (n=56) as compared to 12.5% (n=8) where clinicians said that they were discussing

and ensuring that the treatment plan is well understood.

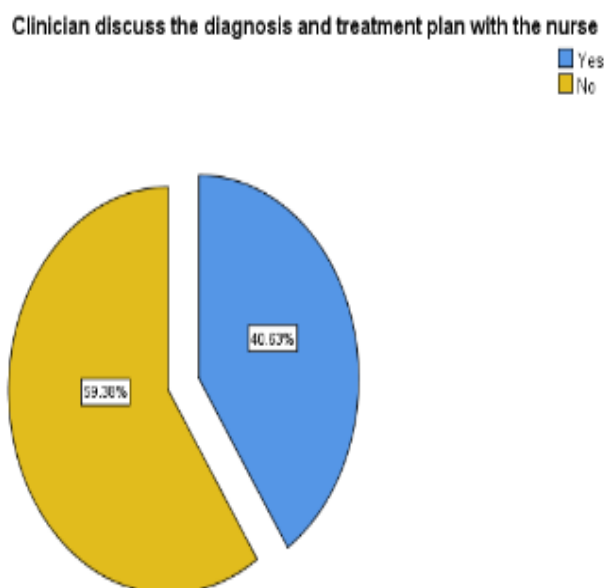


Figure 8: Clinician discusses the diagnosis and treatment plan with the nurse

Most of the nurses were asking questions and seeking clarifications 68.8% (n=44) against 31.3% (n=20) who did not.

Trolleys were not being prepared with the right medication in most cases 84.4% (n=54). It was only in 15.6%(n=10) of the instances where trolleys were being disinfected with the right disinfectant. A higher percentage of nurses were washing hands before and after procedures 78.1% (n=50) as compared to those who were not 21.9%(n=14). Most nurses did not identify Patients using the correct method of identification 65.6% (n=42) while the nurses who were identifying the patient correctly were 34.4%(n=22).

In most instances 78.1% (n=50) the original medication prescription in the file was not being confirmed with the one prepared before starting the infusion. However in 21.9% (n=14) the prescriptions were being confirmed. Nurses who were not introducing themselves to patients were 71.9% (n=46) those who were introducing themselves were 28.1% (n=18)

Most 81.3% (n= 52) of the nurses observed were not explaining to the patient the medication they were about to give as compared to those who were explaining 18.8% (n=12).

On correct calculation of the infusion rates and confirmation with the second nurse, the nurses who were confirming were 62.5% (n=40) while those who did not confirm 37.5% (n=24). Most of the nurses were not discussing the side effects and special considerations with patients when necessary 87.5% (n=56).

Most of the nurses 78.1 % (n=50) were labeling of medication before mounting on the pump, 31.9% (n=20) did not label. Those nurses who were using the infusion pump with ease were more 78.1 % (n=50) than those who had some difficulties 21.9 % (n=14)

Table 7: Relationship between the observed practices of critical care nurses on administration of Microinfusion medication

Characteristic	What was observed n(%)		Odds Ratio (95% CI)	X ² value (df)	p-value
	Yes	No			
Clinician discuss the diagnosis and treatment plan with the nurse	26(40.6)	38(59.4)	0.3[0.0-2.4]	1	.476
Treatment options discussed	8(12.5)	56(87.5)	0.1[0.0-2.4]	1	.491
Nurse empowered to ask questions and seeks clarification.	44(68.8)	20(31.2)	0.4[0.1-2.5]	1	.032
Prepares the trolley with the right medication	10(15.6)	54(84.4)	1.7[0.3-10.8]	1	.771
Performs hand hygiene	50(78.1)	14(21.9)	1.2[0.1-12.2]	1	.215

Correctly identifies patient using the correct method of identification	22(34.4)	42(65.6)	0.5[0.1-2.3]	1	.296
The original medication prescription in the file confirmed with the one prepared before starting the infusion	07(21.9)	25(78.1)	4.7[0.5-47.5]	1	.984
The nurses introduce themselves	19(28.1)	46(71.9)	1.4[0.2-13.5]	1	.375
Nurse explain to the patient the Microinfusion medication they are about to give	12(18.8)	52(81.3)	4.7[0.4-59.6]	1	.260
Correctly calculates the infusion rates and confirms with second nurse.	40(62.5)	24(37.5)	2.5[0.3-19.1]	1	.840
The nurses discuss the side effects / special considerations with patient PRN	8(12.5)	56(87.5)	0.7[0.0-12.9]	1	.094
Correctly labels medication before mounting on the pump	50(78.1)	14(21.9)	0.4[0.0-3.4]	1	.542
Second nurse discuss and witness the administration of the medication	10(31.3)	22(68.8)	0.7[0.1-4.2]	1	.648
Using the infusion pump with ease	50(78.1)	14(21.9)	0.5[0.1-4.1]	1	.542
Documents immediately/within 10 minutes or before leaving the activities of that bed	26(40.6)	38(59.4)	8.0[0.6-98.0]	1	.380
Clears medical waste and leaves the patient comfortable.	54(84.4)	10(15.6)	0.3[0.0-2.2]	1	.084

The researcher found out that more nurses observed 59.4% (n=38) were documenting within 10 minutes before leaving the bed side after any activity performed while 40.6% (n=26) did not document within 10minutes, Most of the nurses observed 84.4% (n=54) left the patient comfortable after a procedure while 15.6% (n=10) who did not ensure patient comfort by

making the environment clean were seen to leave some of the remaining from the procedures and could remove them later or were removed with someone else.

4.7 Testing the hypothesis

The researcher had proposed that there was no relationship among the Institutional related factors, structural related factors, nurses' competency and prevalence of drug errors to administration of Microinfusion medications by critical care nurses at KNH's ICU. From the study the researcher concluded that there was significance in the results from the study to demonstrate that the significant statistics with a $P < 0.005$ used, could amount to a medical error in the ICU. Therefore, rejected the null hypothesis (H_0) and accepted the alternate hypothesis (H_1).

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter there is discussion of the findings of this study while relating it to the overall aim of the study which is to determine the prevalence of drug errors, competency level, institutional and structural related factors influencing the administration of Microinfusion medication by critical care nurses at KNH's ICU. The most significant findings of this study were discussed further; comparing them to other studies carried elsewhere in other institutions and countries to determine the similarity and differences associated with factors influencing the administration of Microinfusion medication by critical care nurses in the ICU.

The first attribute that the researcher sought to determine in this study was the prevalence of medication Administration Errors (MAEs). This study has established that out of the 64 respondents interviewed in this study, only 35.9% had not made any medication administration error in the past six months and the rest 64.1% had made some errors that ranged from one to eight in number. This finding raises the concern that on the safety of patients in our hospitals bearing in mind that they have unstable healthy. This findings support recommendations by a study conducted by(Karavasiliadou and Athanasakis, 2014), (Faye *et al.*, 2010)and Joint Commission International Accreditation, (2011) that emphasized the need for having emergency measures in place at all times and immediate interventions to save life

5.2 Demographic Characteristics of the Respondents and micro infusion medication administration errors

The higher incidence of Microinfusion medication administration errors were more among male nurses. This is an indication that Microinfusion medication administration errors are

expressed differently between sexes though the margin was narrow. No any other publication has ever shown such a relationship. A number of studies(Wallace, 1996; Patel and Balk, 2007; World Health Organisation (WHO), 2008; Neil, 2017; Schutijser *et al.*, 2018) had found strong associations between age of respondents and Microinfusion medication administration errors as due to memory lapses but this study did not align to this findings. Any advance in age indicates decreased incidence of Microinfusion medication administration errors. This could have been attributed to experience that the respondent gain at work place, making them to be more careful when discharging their duties.

5.3 Critical care nurses competency and micro infusion medication administration errors

The department had the most experienced nurses at the time of the study with most of them having experience of more than ten years. The level of education had no direct relationship with Microinfusion medication administration errors since majority of the respondents had a higher diploma and degree in nursing but still more than sixty percent reported Microinfusion medication administration errors during their practice. Those nurses who were new in the department or newly employed with little experience higher chances of having Microinfusion medication administration errors and this result were same as those released in a study by(Morrison *et al.*, 1994) that indicated that new nurses with low level experience were at increased chances of having Microinfusion medication administration errors while administering medications.

This study showed the need for monitor patients after drug administration always so as to be able to identify any a deviations in dynamics and to also note the errors and therefore initiate immediate medical response to prevent further injuries to patients. These results are consistent with studies published by(College and Association of Registered Nurses of Alberta, 2014)

A number of studies by (Medical Product Agency, 2014) and (Edwards and Axe, 2015) have found strong associations between reporting and documenting care provided timely and Microinfusion medication administration errors whenever they occur. This was also evident from in this study with those respondents who reported fewer incidences of errors being the ones who were always reporting and documenting errors and carrying out reviews to prevent future occurrences. This can reduce cost of hospitalization and reduce morbidity and mortality in critical care patients (Ebrahimipour *et al.*, 2014)

Previous studies by (Moyen, Camiré and Stelfox, 2008a) and (Katzung and Trevor, 2015) have emphasized need to take weight of patients always check patient weight for drug calculations and for monitoring critical care patients progress. This has been consistently replicated in this current study as it had a strong association with Microinfusion medication administration errors. Those respondents who were not keen at taking weight of patients had difficulties getting drug dosages and reported more medication errors. This study showed that it was important to have all beds be able to take weight of patients to reduce errors.

This study also investigated the relationship between using the right diluents, having mechanisms for reporting Microinfusion medication administration errors and the need for early identification. Results indicated that these factors could predict the likelihood of having MAEs and thus can help in reducing them and even preventing them.

5.4 Institutional factors and micro infusion medication administration errors

Like most previous studies, the problem of Microinfusion medication administration errors is a systemic problem that affect many institutional and need s to be addressed both at managerial and at the functional level. This study established that supportive supervision was lacking in some department and in areas that it was present it was irregular Becker and MERP, 2017. The need for having mechanism in place for managing and reporting Microinfusion medication

administration errors were evident from this current study. Communication which is coordinated among nurses has been identified in this study as a key factor that can prevent error at work place as also cited by (Kim *et al.*, 2014) and (Cloete, 2015).

Working in one department for a longer period of time without a changeover was associated with increased chances Microinfusion medication administration errors and this affected service delivery. Therefore this study supports regular structured staff rotation at work place. Some errors were cutting across and more common than others. This study showed that it was difficult for an individual to always commit one type of error always. The type of Microinfusion medication administration errors and having prescription checks were associated with the prevalence of Microinfusion medication administration errors. These results are consistent with previous studies and guidelines that support the need for verification and confirmation before giving out drugs to patients. These results never pointed the most common error as of other studies by (Ojerinde and Adejumo, 2014) that indicated that most common error was Drug overdose.

In understanding the etiology of Microinfusion medication administration errors, we cannot ignore the role of staffing of nurses and other health workers. This study reported many Microinfusion medication administration errors in medication that was observed and reported by nurses. These errors were have been attributed by lack of a balance between workload vs. Staffing as also indicated in a study by ministry of health in Kenya (Services, 2010) and (Zampieri *et al.*, 2018).

5.5 Structural factors and medication administration error and micro infusion medication administration errors

In the present study, the design of working environment was key in work associated errors and accidents regardless of other factors. This is similar to findings from studies conducted by

(Girardis *et al.*, 2009), (Calligaris *et al.*, 2009) and (Calabrese *et al.*, 2017) that indicated that the complex working environment at the ICU should be understood by all workers. Therefore there is need for sharing responsibilities at the ICU for efficient service delivery as supported by results in the current study.

5.6 Observational checklist on medication administration error

There were no correlation between what was observed and what the respondents reported on MAEs. Some of the factors that contribute to medication errors were evident through observation checklist by a participatory observer. The clinicians were not discussing the diagnosis, treatment options with other health care providers creating a window for guessing, struggling and confusion when the nurses are not familiar with micro infusion medications that are to be infused.

Most of the MAEs could have been attributed by lack of proper patient identification and failure by all nurses to introduce themselves to patients. This are results are similar to findings by (Al-shara, 2011) and (Cloete, 2015). Other observations that were noted include failure to label medications before mounting them on the pump, witnessing and discussing administration of medication despite most of them using the pump with ease. Immediate documentation and clearing the working area was also lacking in some instances. This gaps were also identified in studied that were done in other area by (Al-shara, 2011) and were identified as some of the key areas that if improved will lead to minimal medication error.

5.7 Conclusions

The researcher came up with a summary of conclusions as follows.

1. The prevalence of Microinfusion medication administration errors MAEs is high at 64.1% this are not acceptable levels in ICU where the patients have high risks of

complications that could compromise patient safety. The role of the nurse comes into sharp focus on medication administration and hence, the need to ensure patient safety as both significant and also complex part in health management. Various identified contributing factors can be considered separately or in combination of the factors each comprising the risk of Microinfusion medication administration in the ICU.

2. Most of the nurses had adequate skills with the care and safety of patients in ICU, however they had challenges with the technology for drug administration, that is, use of Microinfusion pumps. When a nurse is struggling with use of technology most of the time is spent on the stress that comes with the new skills that should be acquired to better manage the patients
3. Institutional factors that posed as a challenge in administration of Microinfusion medication included; The lack of supportive supervision which was evident from the reports of the majority of the respondents demonstrated the need to integrate time to time institutional reviews aimed at improving service delivery and make the working conditions better for the care providers in the ICU and ensuring that work is as well coordinated.
4. Structural related factors that posed as challenges to the administration of Microinfusion medication by critical care nurses included; good working environment with well-defined roles and policies in place that guide all operations which prove key to any functioning organization. Effective communication and coordination are also essential ingredients.

5.8 Recommendations

Following the conclusions outline the researcher recommends the following:-

- a) Regular and supported trainings on medication administration devices, management of adverse drug reactions and the institutions administrations should monitor or

verify that the users of such equipment have the knowledge and the skills required and that they demonstrate that they poses such competency regarding the device proper operation and limitation.

- b) Any orders made and are not complete or are illegible or poses any concern should be clarified before being taken using the already established processes for resolving issues.
- c) There is need to establish and use patient safety technology to enhance the safety of medication administration by the use of computer order entry, bar codes, and smart pumps.
- d) In the overall medication use system an aspect of checks should be performed and this is done immediately just before medication administration, so as to ensure the right medication for the right patient, in the right dose, using the right route at the right time given for the right reason expecting the right response with both desired and potential adverse effects all in mind while giving the patients the right education and the documenting every detail.
- e) The critical care nurses should only administer medications that are properly labeled and the labels should be easily be read during such steps as when reaching for or preparing the medication; immediately before administering the medication, when discarding the container or replacing unused medication into its storage location. All these are very important in medication administration.
- f) There is need to strengthen quality assurance systems where there are regular audits and re-audits of the nursing staff. This will ensure that the right procedures are adhered to hence patient safety and minimize chances of litigation/ medico-legal cases in the institution

5.9 Recommendations for future research

There are three recommended areas under which further recommendations of study are made and firstly it's in doing a descriptive study on prevalence of technology associated error on patient health, to find out if the technology used has some level of medication administration errors associated with its use and what are the consequences of such errors to the patient and their care givers, also finding out how this can be identified and appropriate measures taken.

This study was done in a public, tertiary level facility. There is need for more studies to be done in mission, private and even other public, county facilities to get a more generalizable picture.

Secondly in the reviewing of Microinfusion medication administration safety policies and processes created by KNH and The Ministry of health, this would be to confirm the similarity in issues that exist and that innovations such as the use of technology in recording and record keeping which could be an important step in improving medication safety and reduction in medical errors. Thirdly the study clearly identifies that further studies are required to explore the culture of medication safety in hospitals' ICU.

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APPENDICES

APPENDIX I: BUDGET

ITEM	QUANTITY	UNIT PRICE	AMOUNT (KSH)
STATIONERY			
Lap top	1	50,000	50,000
Printing papers	4 reams	500	2,000
Printer	1	6,500	6,500
Biro pens (one dozen)	180	180*1	180
Rubbers (3)	10	10*3	30
Folders (3)	3	100*3	300
Flash disks	1	1*1,600	1,600
CD rom (for data storage & submission of final dissertation)			500
Sub total			61,100
COMMUNICATION SERVICES			
Communication with supervisors (Airtime)	1500minutes	1500*4	6,000
Internet services, browsing	45GB Data bundles	45*1000	45,000
Sub total			51,000
HUMAN RESOURCE			
transport & meal allowances to & fro the study site	45days	45*600	27,000
Pretesting of questionnaire	250	2*250	500

Biostatistician			35,000
Data collection	500	2*500	1,000
Sub total			39,200
PRODUCTION COST OF FINAL DISSERTATION			
Printing & Binding			2,000
Photocopying, Binding			4,000
Ethical review fee	1	2000	2,000
Publication of manuscript in peer reviewed journals			20,000
Subtotal			28,000
Grand subtotal			179,300
Contingency (10% of the total cost.)			17,930
GRAND TOTAL			197,230

APPENDIX II: TIME FRAME

Activity	October 2017 - December 2017	Jan 2018- March 2018	April 2018- June 2018	July 2018 – October 2018
Topic Identification				
Researching & Proposal Preparation				
Proposal Writing				
Proposal Presentation				
Submission of the proposal to ERC				
Data Collection				
Data Analysis				
Report Preparation, Presentation & Defense				
Final Report writing & submission				

APPENDIX III: CONSENT EXPLANATION FORM

My name is Onwongá Isaac Nyabuto, a student at the University of Nairobi pursuing a master's degree in critical care. As part of my course work, I will be carrying out a study to investigate the challenges in administration of Microinfusion medication by critical care nurses at KNH ICU.

Purpose of study

The purpose of this study is to identify the challenges in administration of Microinfusion medication by critical care nurses at KNH ICU. This will help in formulating strategies to minimize medication error and increase patient safety. The findings of this study will also benefit academicians, as it will add the body of knowledge.

Study procedures

The study will use both a questionnaire and an observation checklist. The participants will be required to fill the questionnaire while the researcher or research assistant will complete the checklist. Trainings will be carried out to the research assistants and the research participants to ensure that they understand their role in the study and alleviate any suspicions on the use of data collected.

Anonymity

If you are willing to participate in the study, you will be required to give a written consent on the form provided. You will then go ahead and fill the given questionnaire, which has instructions on how to do it. You reserve the right to withdraw from the study at any point

without any form of victimization. It will take about 15 minutes for you to complete this questionnaire.

Confidentiality

To maintain confidentiality and anonymity, your name or any other information that may identify you will not be required. However, you shall be assigned a code number which shall be used in the report.

Potential Risks

There are neither risks nor harm anticipated on the participants when filling self assessment questionnaires as the study aims to use honest personal experiences of the participants which will be self reported in anonymity of the actual information given to protect their right to anonymity in the study. However, there may be chances of risk and harm to the patients in this study, when a nurse under observation risks the patient to harm, the principal investigator will stop the nurse from carrying out the procedure consult and rectify the participant and record it as an error. This participant will not be eligible to continue in an observational study as they will be aware they are being observed. No invasive procedures will be employed by the investigator or participant during this study.

Voluntariness of participation and Benefits

Participation is voluntary and there shall be no monetary benefits involved. Study findings will be made available to the Kenyatta National Hospital Staff and entire management on how to increase patient safety and reduce adverse drug reactions. This will be through reduction of medication errors.

Investigator's statement

This study seeks to find information from individual nurses on various topics that surround them when administering Microinfusion medications in ICU. Honest responses on personal experiences will be encouraged so that the study reflects on a true picture on the current practices, so that to clearly identify the gaps that are there in practice and find mechanisms under which practice can be improved.

Thank you so much for your time and devotion in answering this questionnaire and building a strong foundation in studies of Microinfusion medication administration.

In case of any clarification contact the following;

Researcher: **Onwongá Isaac Nyabuto**

Mobile: **0720807599/07222675878**

Supervisors: Hannah Inyama, RN, PhD (c)

MScN (Critical Care Nursing), BScN, RN/CHN,

Lecturer, School of Nursing Sciences

University of Nairobi

Eve R. Rajula PhD (c)

PhD (c), Fellow Global Health (Imp. Sc.), MBA MPH BScN

Lecturer, School of Nursing Sciences

University of Nairobi

KNH Secretary: Kenyatta National Hospital /University of Nairobi

Ethics and research committee (02)726300 extension no. 44102

APPENDIX IV: CONSENT FORM

I understand that my participation is voluntary without any monetary compensation, and I may withdraw my consent and stop participating at any point without any penalty. The purpose of the study and method to be applied has been explained to me.

I hereby freely consent to take part in the study.

..... Date:

Participant's signature

..... Date:

Researcher's signature

APPENDIX V: QUESTIONNAIRE

STUDY TITLE: CHALLENGES IN ADMINISTRATION OF MICROINFUSION MEDICATION BY CRITICAL CARE NURSES AT KENYATTA NATIONAL HOSPITAL'S ICU

Date: _____

Code: _____

Instructions

- Do not write your name or any other identification anywhere on the questionnaire.
- The questionnaire has three sections.
- Kindly complete all the sections.
- Respond by ticking the most appropriate response.

PART ONE: NURSES PERSONAL ASSESSMENT

SECTION A: DEMOGRAPHIC INFORMATION

Instructions Please fill in the following information requested.

1. Gender Male Female Prefer not to say
2. Age in Years
3. Years of experience?
4. What is your highest qualification?
 - a) Diploma Nurse
 - b) Higher Diploma Nurse
 -

c) BSN / Degree nurse

d) MSN and Above

5. Do you have any special training on Microinfusion medication?

a) Yes b) No

6. How long have you worked in the current department?

7. a) Have you ever made medication administration errors (MAEs) in the last 6 months

a) Yes b) No

b) If yes how many times

8. Which type of medication administration error on microinfusion medication have you made at your place of work in the past 6 months? (you can have more than one option)

a) Wrong patient

b) Wrong dose

c) Wrong route

d) Wrong time

e) No documentation

f) Wrong medication calculation

g) Failure to confirm with a colleague your calculated findings

h) Wrong medication due to illegible handwriting

i) Wrong settings on the infusion pump machine

j) Failure to label the infusion medication fully

k) Others (specify).....

SECTION B: CRITICAL NURSE COMPETENCY IN USE OF INFUSION PUMP TO ADMINISTRATION MEDICATION

The following question refers to your ability to administer microinfusion medication using the guideline below. Tick where applicable.

Ability to perform the following in a safe and professional manner	Never	Seldom	Quite often	Very often	Always
9. Process of planning and administration in critical care and the importance of working within your own scope of practice:					
a) Prescription checks					
b) Calculation of medication					
c) Preparation of infusion medications					
d) second registered nurse checks					
e) Monitoring during administration					
f) Titration of medications to optimize outcomes					
g) Safe discontinuation of medications/infusion					

h) Monitoring post administration					
i) Safe disposal of administration devices.					
j) Supervision and training of others					
k) Reporting and documenting in case of an error					
10. Adherence to the following practices used in critical care to minimize the risk of harm to the individual or reduce the risk of error in Microinfusion medication and fluid administration:					
a) Identity check					
b) Prescription check					
c) Weight check					
d) Required and/or continuous monitoring and observation during administration					
e) Knowledge of the medication and the expected effects on the patient and preparation for management of expected outcome before administration.					

11. When preparation of medications: a) Demonstrate competence in mathematical calculations in line with local policy					
b) Use of correct diluents.					
c) Configuring in the infusion machine the correct infusion rate and time.					
d) Label medication/infusion in accordance with your local policy					
12. Identify and manage signs of adverse drug reactions and give appropriate intervention: a) Early identification					
b) Communication with multidisciplinary team					
c) Continuous monitoring and re evaluation					
e) On-going treatment of anaphylaxis					

f) Reporting of anaphylaxis, in line with local policy					
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SECTION C: INSTITUTIONAL FACTORS

13. Do you ever have supportive supervision on drug management?

a) Yes b) No

If yes how often

14. Do you have mechanisms in place for reporting medication errors?

a) Yes b) No

If yes which one?.....

15. How is communication during administration of Microinfusion medication?

a) Coordinated b) Uncoordinated

SECTION D: STRUCTURAL FACTORS

16. Do you think the ICU is well designed for management of supplies and medication for patients on Microinfusion medications?

a) Yes b) No

17. Do you think that work and responsibilities are well planned and distributed in readiness for management of patients in using Microinfusion medication?

a) Yes b) No

18. Is the ICU staffing ratios adequate for handling Microinfusion medication administration procedures as stipulated by the nursing council of Kenya and best practices?

a) Yes b) No

PART 2: OBSERVATIONAL CHECK LIST BY A PARTICIPATORY OBSERVER (As adopted from JICA 2014)

STUDY TITLE: CHALLENGES IN ADMINISTRATION OF MICROINFUSION MEDICATION BY CRITICAL CARE NURSES AT KENYATTA NATIONAL

N/B each aspect will be observed three times on the same participant

		Report what is observed (Yes/No)	Comment on what is observed.
INFUSION MEDICATION PLANNING	Clinician discuss the diagnosis and treatment plan with the nurse		
	Treatment options discussed		
	Nurse empowered to ask questions and seeks clarification.		
INFUSION MEDICATION ADMINISTRATION	Prepares the trolley with the right medication		
	Performs hand hygiene		
	Correctly identifies patient using the correct method of identification		
	The original medication prescription in the file confirmed with the one prepared before starting the infusion		
	The nurses introduce themselves		
	Nurse explain to the patient the Microinfusion medication they are about to give		
	Correctly calculates the infusion rates and confirms with second nurse.		
	The nurses discuss the side effects / special considerations with patient PRN		
	Correctly labels medication before mounting on the pump		
	Second nurse discuss and witness the administration of the medication		
	Using the infusion pump with ease		
	Documents immediately/within 10 minutes or before leaving the activities of that bed		
POST INFUSION ADMINISTRATION	Clears medical waste and leaves the patient comfortable.		

**APPENDIX VI: LETTER SEEKING PERMISSION TO CONDUCT STUDY IN
KENYATTA NATIONAL HOSPITAL**

Onwongá Isaac Nyabuto

School of Nursing Sciences

University of Nairobi

The CEO,

Kenyatta National Hospital

Dear Sir/Madam,

REF: PERMISSION TO CARRY OUT A RESEARCH IN YOUR INSTITUTION

I am a student at University of Nairobi undertaking a course for the conferment of a master's degree in critical care in Nursing. I am seeking approval to conduct study on the challenges in administration of Microinfusion medication by critical care nurses at Kenyatta National Hospital. The study findings will help in developing strategies that will help in reducing medication errors during the administration of Microinfusion medication.

I hereby request for your permission to proceed.

Yours faithfully

Onwongá Isaac Nyabuto

APPENDIX VII: LETTER SEEKING PERMISSION TO CONDUCT A PILOT STUDY IN MACHAKOS HOSPITAL

Onwongá Isaac Nyabuto

School of Nursing Sciences

University of Nairobi

The Hospital Medical Superintend,

Machakos County Referral Hospital.

Dear Sir/Madam,

REF: PERMISSION TO CARRY OUT A PILOT STUDY IN YOUR INSTITUTION

I am a student at University of Nairobi undertaking a course for the conferment of a master's degree in critical care in Nursing. I am seeking approval to conduct pilot study on the challenges in administration of Microinfusion medication by critical care nurses at Machakos Hospital's ICU. The study findings will help in fine-tuning the study tool and techniques of data collection that will be used to carry out a study in Kenyatta National Hospital which will be developing strategies that will help in reducing medication errors during the administration of Microinfusion medication.

I hereby request for your permission to proceed.

Yours faithfully

Onwongá Isaac Nyabuto

APPENDIX VIII: LETTER SEEKING AUTHORITY FROM ETHICAL COMMITTEE

Onwongá Isaac Nyabuto

School of Nursing Sciences

University of Nairobi

The Secretary,

KNH/UoN ERC

NAIROBI

Dear Sir/Madam,

Ref: Letter of Authorization

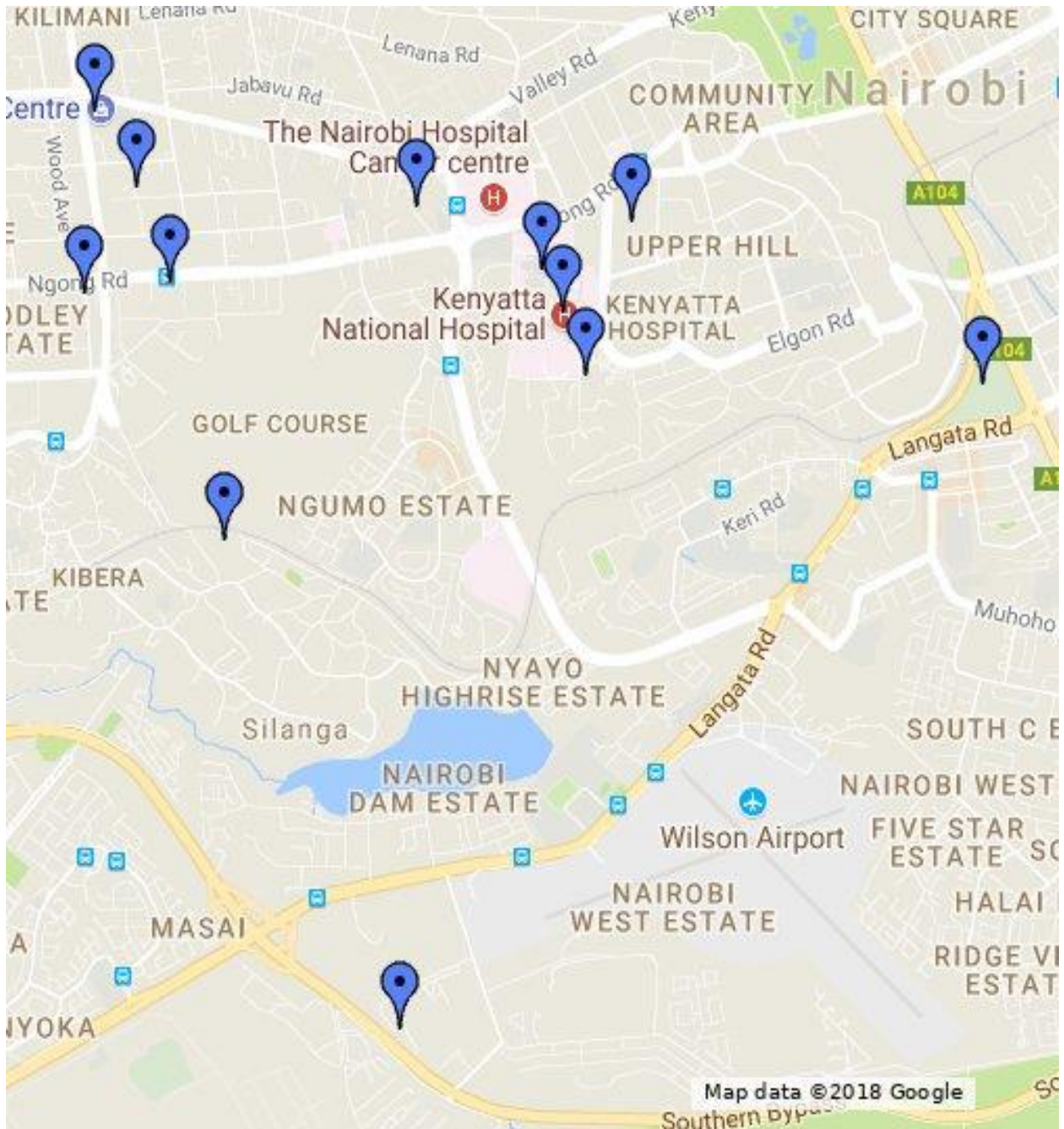
I am a student at University of Nairobi undertaking a course for the conferment of a master's degree in critical care nursing. I am seeking approval to conduct study on the challenges in administration of Microinfusion medication by critical care nurses at Kenyatta National Hospital

The study findings will help in developing strategies that will increase patient's recovery and reduce medication error. I am looking forward to your comments and suggestions for improvement on the proposed study.

Yours faithfully,

Onwongá Isaac Nyabuto

APPENDIX IX: Directional Map of KNH



Appendix X: Picture of KNH

