IDENTIFYING MEDICATION ERRORS IN THE NEONATAL INTENSIVE CARE UNIT IN TWO HOSPITALS IN RWANDA: A CROSS-SECTIONAL STUDY

By

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A dissertation submitted in partial fulfillment of the requirement for the degree of master's nursing sciences in Neonatology

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DECLARATION

Noella NYIRAMABARUSHIMANA, I hereby declare that this work submitted in partial fulfillment of the requirements for the degree of Master of Science in Nursing (Neonatology) to the University of Rwanda is my work and has not been presented elsewhere in a higher institution degree. All sources of information have been acknowledged by references.

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DEDICATION

This work is dedicated to my lovely husband and children,

To all my brothers, sisters, and friends,

To all people who contribute to this work.

ACKNOWLEDGEMENTS

I thank God for his care through this progressing course of the master's program. I would like to express my inmost gratitude to my supervisors Dr. Pamela Meharry and Rose Mukarubayiza for their valuable support through time, patience and collaboration, and mentorship throughout this project.

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May almighty God bless you!!

ABSTRACT

Background: Medication errors remain to be a main health problem causing avoidable morbidity and mortality in most populations. Medication errors are the principal cause of incidents in patient safety and result in severe injury, disability, and death. Prescription and medication administration errors appear to be the most prevalent. There is limited information about medication errors in Rwanda, particularly among hospitalized neonates.

Aim of the study: This study aimed to identify prescription and medication administration errors among neonatal files at two selected neonatal units in Rwanda.

Method: Retrospective cross-sectional research was done on two neonatal intensive care units at two hospitals over a three-month period. Demographic information, drug information, and the total number of prescriptions for each neonate were extracted from medical records and assessed. The instrument was developed from the literature, and descriptive and inferential statistics were used to analyze the data.

Results: A total of 256 medical records were checked for prescription and administration errors. The most common medication errors were lack of time of order in the prescription phase 184(71.9%) and dosing intervals were not respected in the administration phase or failure to give drugs on time and 42(17%), which is the higher number.

Conclusion The most common medication error was not giving the drug to the patient, including the dosing interval in Neonatal units, there was often a lack of time on the order in prescription. To reduce medication errors in newborn units, health care providers must enhance their knowledge in medication errors prevention.

Keywords: Neonate, Neonatal intensive care unit, Rwanda, Medication errors,

LIST OF SYMBOLS AND ABBREVIATIONS

CHUK: Centre Hospitalier Universitaire de Kigali

HCP: health care provider

ICUs: Intensive care units

IRB: Institutional Review Board

ME: Medication errors

MScN: masters of Science in Nursing

NICU: Neonatal Intensive Care Unit

%: Percent

RA: Research assistant

RMH: Rwanda Military Hospital

RNs: Registered Nurses

SPSS: Statistical Package for the Social Sciences

WHO: World Health Organization

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CHAPTER I: INTRODUCTION

1.1 INTRODUCTION

Medication errors and unsafe medication practices are avoidable problems burdening the healthcare systems worldwide, according to the World Health Organization.(1). Errors can happen at any time during the medication process, though errors during prescription and administration stages are the most prevalent(2). Nurses and midwives are in a prime position to make a difference and prevent many medication errors before patients are harmed. However, few studies in Rwanda focus on medication errors and their contributing factors in pediatric, and none assess prescribing and administration errors quantitatively.

1.2 BACKGROUND

Medication errors are among the most significant and preventable types of medical errors, resulting in the mismanagement of medication or patient injury(3). Medication errors may cause or lead to incorrect medication use or patient injury while the medication is in the control of the healthcare provider (HCP), patient, or consumer(4). The literature reports that in 100 admissions in neonatal care unit, 13-91 medication error may happen (3). Medication errors frequently occur in ICU because patients in critical care requiring high-intensity care frequently require more medications and are at risk for iatrogenic harm(5).

Medication error rates are frequent and continuing problems that pose a important risk to neonates (2). A systematic review of medication errors among pediatric patients showed that the rates in the NICU ranged from 4 - 35.1 per 1000 patient-days, and from 5.5 to 77.9 per 100 medication orders (2). Neonates are mainly susceptible to medication errors due to their low birth weight, physiological immaturity, inadequate compensatory abilities, and prolonged contact to medication in the NICU(6).

Neonates also have quick changes in body weight, and inability to communicate with healthcare providers (7). Furthermore, neonates are in a fragile state and cannot to metabolize and eliminate medications completely placing them at risk an of adverse drugs (8).

Medication errors can happen at any of the four steps in medication process, including prescription, distribution, transcription, and administration, are susceptible to medication errors.

However, most medication errors happen in the prescription and administration stage (2). Some studies done in developed countries shown that medication errors mainly occurred mainly in the prescribing phase (4)-(9).

A study in the US reported that nearly half (47%) of medication errors in the Neonatal intensive care units were medical errors (10). Also, 18-56.0% of hospitalized patients are impacted by administration medication errors (11). A common prescribing error is the drug dosage, whereas common administration errors relate to the frequency and method of administration.(9)

In clinical practice the causes of medication errors can be distributed into two; human and/or system errors. (12) Human errors consist of a performance deficit, a procedure not respected, absent-mindedness, and miscommunication with health care personnel. Other human errors include improper documentation, knowledge deficit, and miscalculations. Human errors in the healthcare professional are often related to a heavy workload, anxiety, fatigue and sleep deprivation (13) Increased workload of nurses, causes them to become less attentive to recheck drugs before administering (5).

The knowledge of staffs changes with practice and experience; for instance, the major errors may be made by novice nurse rather than a more experienced RN.(14).

Factors contributing to system errors consist of drugs with similar names, complex or poorly recorded. Also, the access to drugs with non-pharmacy personnel, medication distribution system errors, and computer are among the cause of medication errors associated to the system. Lack of precaution in medication error prevention are frequent (11).

In addition to the significant harm to patients, medication errors and unsafe medication practices account for $42 billion per year in unnecessary healthcare costs worldwide. Medication errors are associated with weak medication structures and/or human influences**.** (1). In response, in 2017, the second Global Ministerial Patient Safety Summit aimed to decrease medication errors by 50% in the next five years (1). This international aim is a call to action to all nurses and midwives to do their part and reduce medication errors, particularly to vulnerable neonates. The purpose of this reading is to identify prescriptions and administration errors in neonatal files and the relationship between neonatal demographic characteristics in neonatal units at the two Rwandan hospitals.

1.3. PROBLEM STATEMENT

Medication errors are preventable, but they continue to affect patients in healthcare systems, and they cause significant morbidity and mortality to patients(1). Studies that reported on medication errors indicate that between 13 and 91 medication errors in 100 patient admissions may occur in the Neonatal intensive care unit .(3-11). Medication errors can cause significant unnecessary harm to neonates, and delays in NICU discharge. A systematic review of 35 studies from 17 globally-diverse countries reported that prescription and administration errors were the furthermost common forms of medication errors among neonatal and pediatric populations (2). Furthermore, during clinical supervision of students, the researcher discovered that nurses and midwives in Neonatal units do not have a common understanding during drug administration.

In Rwanda, there is a scarcity of published studies on drug errors. Identifying the different forms of medication errors could assist HCPs to identify a potential problem among neonates and take practical stages to prevent medication errors and harm to neonates, ultimately improving patient safety. This study investigated the types of prescription and administration medication errors among files of previously hospitalized neonates.

1.4. AIM OF THE STUDY

To identify prescription and administration medication errors among patient files in two selected Rwandan neonatal units

1.5. OBJECTIVES

1. To identify the type of prescription and administration medication errors in neonatal file at two Rwandan hospitals.
2. To determine the frequency of prescription and administration medication errors found in neonatal files at the two Rwandan hospitals.
3. To measure the relationship between demographic characteristics related to neonate and medication errors in neonatal units at the two Rwandan hospitals.

1.6. RESEARCH QUESTIONS

1. What are the types of prescription and administration medication errors among neonatal files at two Rwandan hospitals?
2. What is the frequency of prescription and administration errors found in neonatal files at the two Rwandan hospitals?
3. What is the relationship between demographic characteristics related to neonate and medication errors in neonatal units at the two Rwandan hospitals?

1.7. SIGNIFICANCE OF THE STUDY

This study will contribute to the following different categories of health care system.

In nursing practice, the results from this project will contribute to decrease or eliminate medication errors and they will help HCPs to verify prescription before administration.

In nursing education, they will also support the nurse educators in improvement and strengthening prescriptions in nursing curriculum and put emphasis on the prevention of medication administration errors and patient well-being.

In nursing research, the results will help other researchers to work on medication administration errors in other units.

Finally, the feedback will be addressed to the Ministry of Health to evaluate how it can develop the strategies and policies to avoid medication errors.

1.8. DEFINITION OF CONCEPTS

Neonatal intensive care unit: is a specialized intensive care unit of ill or premature newborn infants.

Neonatology: is a sub-branch of pediatrics in the care of newborns.

Neonatal refers to the first 28 days after birth.

Medication error is any activity that may be avoided that leads to the failure of appropriate medication use or causes harm to the patient while the medication is in the control of the health care provider, patient or consumer (11).

Medication prescription error: it consists of an error in the choice or administration of drugs for patient including incorrect dose or, incorrect route of administration.

Medication transcription error: Failure in data entry that is typically done by a human.

Medication dispensing error: is the discord between drug prescribed and the medicine delivered by the pharmacist

Medication administration error: is incorrect administration of a medicine to a patient that occurs compared to either the prescription or local hospital policy.

Dosing medication error: The dispensing or administration of a medication dose to a client that is over or less than the amount ordered by the physician or administration of multiple doses.

1.9. STRUCTURE OF THE STUDY

This thesis has five chapters, first chapter provides the background, problem statement, study's significance, aim, objectives, and research questions. Second chapter focuses on the literature review related to medication errors in the NICU and the conceptual framework. Chapter three provides details on methodology of the project. Chapter four presents results of the study, which was displayed in tables and figures. Chapter five provides the discussion of the study, which is an interpretation of the results, with supporting or contrasting documentation, include the conclusion, recommendations, and references.

1.10. CONCLUSION

Globally, medication errors remain a persistent problem among HCPs that can cause great harm to patients of all ages. As a result of their immaturity, physiology, and development, neonates are especially vulnerable. The errors affect not only patients, but also HCPs and institutions. There are numerous contributing factors to medication errors. Medication administration is one of the key responsibilities of nurses and it is their main duty to prevent and reduce these errors.

Finding medication errors will aid in delivering high-quality care and enhancing patient outcomes. The purpose of this project was to assess prescriptions and administration medication errors among patient files in two selected Rwandan neonatal unit.

CHAPTER 2: LITERATURE REVIEW

2.0. INTRODUCTION

Medication errors can occur at any step of medication process; however, prescribing and administration errors are the most common(1). Medication errors have been studied and reviewed for many years and have recently received more attention due to the focus on the quality of care and client safety. The importance of safe medication administration has been clarified; barriers to safe medication administration have been identified, and development of preventative measures for medication errors have been determined. This literature review used various electronic databases including Cochrane Library, HINARI, PUBMED Central, and Google Scholar. Vancouver referencing style is used throughout the proposal.

2.1. THEORITICAL LITTERATURE

2.1.1 DEFINITION OF MEDICATION ERROR

A medication error is an action that leads to the failure of appropriate medication use or causes harm to the patient while the medication is in control of the health care provider, patient or consumer (11) A medication error is a global challenge, and 18.7%-56% of hospitalized patients face medication administration errors (11) According to data currently available, the neonatal intensive care unit may experience 13–91 drug mistakes for every 100 patients (NICU) (3).

The rates of medication errors in neonatal intensive care units ranged between 4 to 35.1 for every 1000 patient-days (2).

In 1995, the United States Pharmacopeia Convention (USP) developed "the National Coordinating Council for Medication Error Reporting and Prevention: Leading national health care organizations are meeting, collaborating, and cooperating to address the interdisciplinary causes of errors and to promote the safe use of medications". The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) is an independent source of 27 national organizations(15) stated that such procedures may be related to professional practice, health care products, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use (15).

For supporting the global strategy to reduce medication errors by 50%, it is important to understand the significance of the problem and medication errors related factors to the care of

neonates admitted to the NICU (2) (16). Furthermore, medication errors negatively impact patients outcome and increase the length of stay of hospitalization, which is costly for patients, families, hospitals, and insurance companies (3) (11).

2.1.2 TYPES OF MEDICATION ERRORS

Medication errors may happen at any step of the medication process, which includes prescribing the drug by a physician or other HCP, dispensing, transcribing the order by another person, processing, and administering the drug to the patient (4). A recent study in Iran in 2019 reported that the furthermost medication errors were in prescribing phase with the wrong dosage by physicians (n=142 errors, 28%) and the administration phase due to the nurse not giving the medication (n=146 errors, 29%).(3) The following provides more details about the specific medication errors;

1. **Prescription errors**

The prescription errors are well-defined as incorrect dosage, route of administration, and/or incorrect intervals. The study conducted in South Africa in 2017 at a tertiary academic hospital showed 47% of prescribing errors (4), while in Egypt in 2018, prescription error constituted 39.1% of all errors (7). The study conducted in Iran showed that prescribing errors accounted for 42% of all medication errors in the NICU (3). This type of medication error is the first focused area in this study.

A study conducted in Ethiopia in 2020 on prescription errors done in pediatrics showed that Omission mistake or missing vital information and commission error or adding incorrect information are the two basic types of prescribing errors. The most medication error in prescription was wrong dosage at 48.6%. (17)The study done in Brezil 2015 on prescription errors in NICU reported that prescription rate was at 43.5% which was in dosing interval and frequent in preterm newborn (18).

In the present study, each medication was assessed for prescription errors; wrong dosage, route of administration, and medication interval. In addition, other questions in relation to assess the quality of the prescription was investigated as these can lead to errors in the administration of the medication indirectly. Four other prescription questions assess the illegibility of the prescription,

failure to specify the unit measurement of the medication, failure to record the date and time of the order, and failure to record the name and signature of the prescriber.

2. Dispensing error

The dispensing error is related to the wrong preparation, mislabeling, wrong route, and wrong frequency in the process of administration. A study done in South Africa showed that pharmacy was responsible for 16 dispensing errors in the NICU, equal to 2% of errors (4). Another study conducted in Egypt showed that dispensing errors compromise 3.8% of total errors (7). Dispensing errors are not part of this study because we focused on what was attainable; similar to the Iranian study (Eslami) considering this master's study with limited time and resources.

3. Transcribing error

Transcription errors occur when the medicine order written by the HCP does not match the patient's medical records. According to a study done in Egypt, transcription and prescription errors are more common followed by administration errors.

It showed that transcription error is at 34.9% (7). Transcribing errors are not part of this study because we focused on what was attainable; given the fact that this is a master's thesis with limited time and resources

4. Administration error

Medication errors occur during the administration and usually related to the bedside nurse or midwife. This medication error is the second focused area of this study. Medication errors in this area happen when one of the six rights of drug administration is violated (15). Therefore, it is important to verify the following before administering medications: correct patient, drug, dose, preparation, time, and route. And following administration, correctly document the required medication information.

Administration errors occur by failing to administer medication, giving the incorrect dose to the client, giving the wrong medication to the neonates, or missing the route of administration ordered by the physician (3). The study conducted in Iran that identified medication errors in the neonatal units showed that the administration errors sub type of omission of the drug was 29% (3). A study conducted in South Africa on analysis and identification of medication errors in NICU showed a rate of administration error sub-type of medication given at incorrect time was

at 17.1% (4). Another done in Spain 2016 on medication errors in neonatal units has found 68% of administration error.(5)

In the present study, the administration was assessed for the following errors: wrong patient, medication, dose, route, medication interval, and failure to give medication on time, administered the medication after discontinuation, and medication given and not prescribed.

2.2.2. PREVENTION OF MEDICATION ERRORS IN NICU

In 2018 in Spain, Capino et al. suggested that a preventive educational intervention after searching the different causes of medication error will help the health providers (19). A study conducted in Australia in 2018 showed that medication errors could be reduced through several interventions by improving medication use process (20). The process includes electronic medication prescribing and automated dose checking, computerized physician order entry, an electronic tool to verify parental nutrition orders, and IV technology (20), more research are necessary to evaluate the intervention on medication safety to facilitate decisions and application in clinical practice (20). Another study done on medication safety in NICU in the same country suggested that integrating a clinical pharmacist into the treating team strategies and collaboration of HCPs (doctors, nurses, pharmacists) will helps to overcome medication error (9).

The study conducted in Iran in 2019 showed that 43% of medication errors are related to doctors, nurses, and pharmacists (3). Among the practical steps of preventing medication errors, there is the preparation of a predesigned medication sheet, the presence of a pharmacist frequenting the NICU, and training of doctors and nurses (4). A study conducted in Pakistan 2016, emphasis on the role of nursing schools in education of novice nurses by developing their clinical competence in prevention of medication errors (21). Furthermore, WHO suggest the integration of guide to good prescription in nursing curriculum and be applied for nurses and the guide for medical students in order to provide essential information for rational prescription (22).

The National Association of Neonatal Nurses (NANN) recognizes those challenges and proposed a revised and updated report on "Medication Safety in the Neonatal Intensive Care Unit," suggests precautions and practices for medication safety in the Neonatal intensive care unit .(23)

A systematic review done in UK 2022 on nursing intervention to reduce medication in neonates suggest the same strategies include prescriber computer order entry, smart pump technology,

participation of clinical pharmacists in ward rounds, are all suggestions for preventing prescription errors.(18)

Generally, there are few data on medication errors in developing countries, mostly in Africa (3). There does not appear to be any studies conducted on medication errors in NICU in Rwanda. Such studies are important as the basis for understanding where improvements could be made in patient care. The present study focused on types of prescription and administration medication errors in NICUs.

2.2.3. CRITICAL REVIEW AND IDENTIFICATION OF RESEARCH GAP

After reviewing the literature on medication errors in the NICU, the studies showed some weaknesses, types, and rates of different medication errors done in care process. There does not appear to be any available data on medication errors in the NICU to date in Rwanda. The strength of this research is that the researcher identified types of prescription and administration medication errors, and their relationship to demographic characteristics related to the neonates.

2.2 EMPIRICAL LITERATURE

A medication error is any preventable mistake that happens through the medication use process. Medication errors can arise in the process of prescription , dispensing , transcription, preparation, and administration phase, but the focus of this study is on prescription and administration errors (9).

2.2.1. IDENTIFY THE TYPES AND RATE OF MEDICATION ERRORS

The types of medication errors include prescription, dispensing or transcription, preparation, and incorrect administration (3). The study conducted in Iran shown that the most common medication errors were done by the physician by wrong dosage in prescription phase at 28% and failure to administer drugs by nurses at 29%.(3). In Egypt, the most common errors were prescription and transcription followed by administration errors. This situation was due to overwork, and insufficiency medication information as the highest risk factors of prescribing and transcription errors (7).

A study conducted in the UK in 2019 showed that prescribing and administration medication errors were the most common errors; and dosing errors was the most frequent. [10]. Another prescription errors was observed in the study done in Brazil 2015 at the rate of 43.5%(16).The study conducted in South Africa reported the various types of medication errors; the incorrect

dose was the most frequent (34%), the omission of medication (19%), incorrect time (12%), incorrect frequency (7.9%), and poor preparation of medication (7.8%) (4). Other less frequent errors included mislabeling (6.7%), incorrect medication (4%), absence of the route (3.2%), incorrect duration of treatment (1.7%), and no frequency prescribed (1%).(4).

A systematic review done on 2016 in Australia on medication safety in Neonatal patients showed that prescription and administration were mostly identified with 47% of errors in neonates (6)

A retrospective cross sectional study done in USA 2010 on identification of medication errors in NICU reported that in 48.2% of all medication administering errors were implicated. The prescribing phase accounted for 14% of errors, 11.9 percent in the dispensing phase, and 18.4 percent in the transcribing phase. Monitoring errors were mentioned in only a few cases with 1.4 % (10).

2.1.3 HUMAN ERROR THEORY

James Reason's theory described the problem of human error in two aspects of approaches; system approach and personnel approach. The personal approach consists of individual errors like absent-mindedness, carelessness, not respecting the protocol, poor communication, improper documentation, and miscalculation. Whereas the system approach consists of conditions in which people are working to eliminate errors such as poorly designed technology, lack of system safeguard, and HCPs workload (4-(12).

This theory explores how errors were made, and not who did them. The theory also explains three types of errors: firstly slips and lapses; slips and lapses occur when the activities planned are not achieved, such as poor information of medication indication, side effects, patient allergies, and contraindication. Slips happen when someone plans to do something one way, but 'slips up' and do something else instead. In comparison, lapses are related to memory failure. Secondly, mistakes occur when the planned behavior does not realize the projected outcome. Lastly violations which occur when a person is aware of the stated guidelines but fails to follow them. Hence, there are two categories; intentional (violations) and unintentional errors (slips and lapses and mistakes), and consequently, have various solutions (12).

Some other reasons for medication errors include medication packaging and labeling, abbreviations that are not standard for the facility, poor medication knowledge, and dosage miscalculation. The pharmacist can play an significant role in dispensing the correct medication by identifying errors before dispensing to the nurse to administer (24). In this study the

researcher highlighted the two most types of medication errors occur in NICUs; namely, prescription and administration.

2.2.4 CONCEPTUAL FRAMEWORK

This study was conducted by James Reason's theory, which described the problem of human error in two aspects of approach; personnel approach and system approach (14), and a high-quality study conducted by Eslami et al (3) on prescription and administration medication errors in two NICUs in Iran. Physicians may use abbreviations in prescriptions that are not in the formulary, or their writing is not legible. Pharmacists may dispense the wrong medication. Unless nurses know the correct the medication, they may not notice errors by the physician and pharmacist. Furthermore, there are many other possibilities where nurses could commit medication errors, including incorrect calculations (24). In this study, the researcher emphasized on contributing factors to medication errors in NICU.

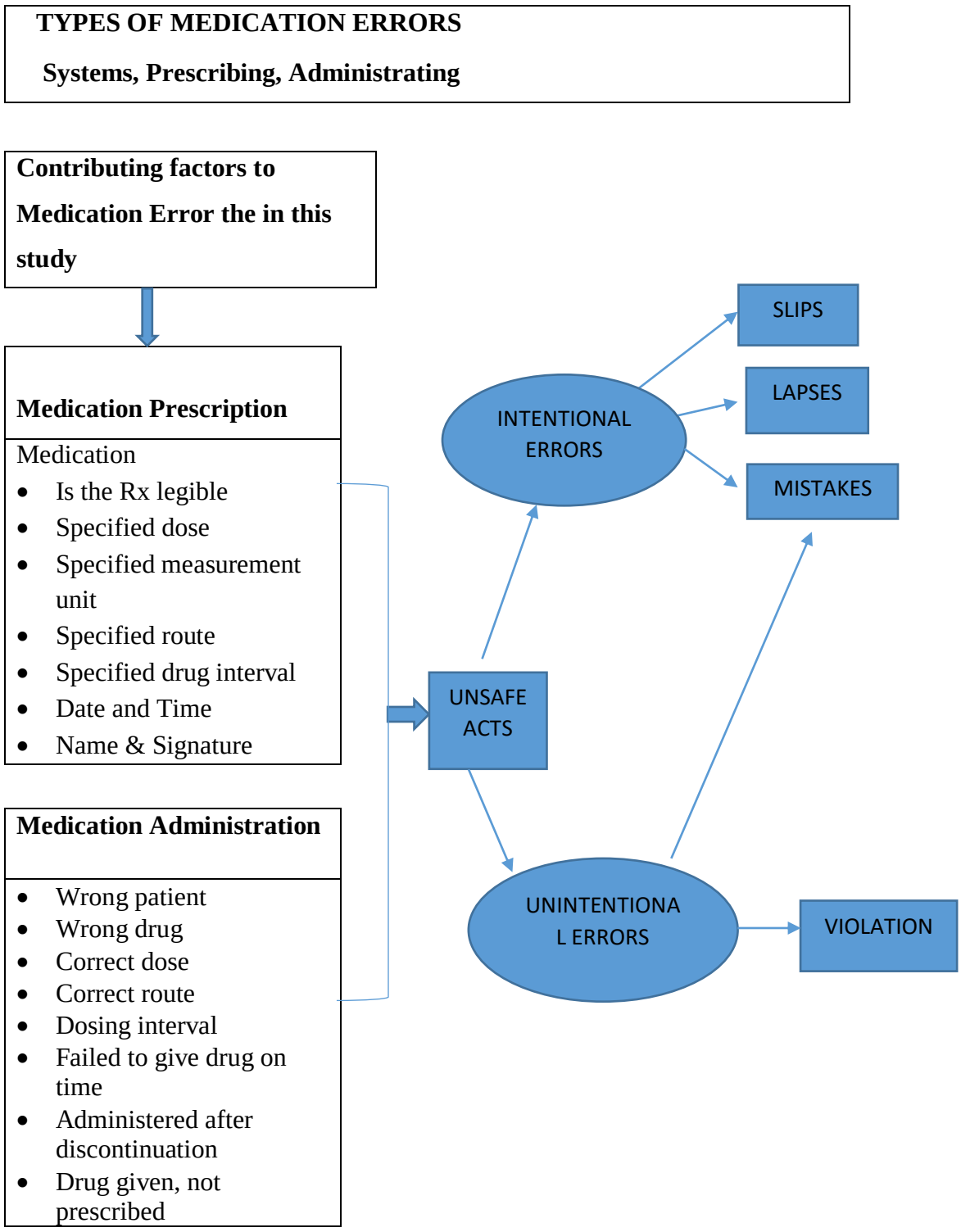

Figure 1: Conceptual Framework of medication errors was adapted from the Human Error Theory (12), and a study (3) on prescription and administration medication error

CHAPTER 3. METHODOLOGY

3.1. INTRODUCTION

This section identifies the methodology used which include research approach and design, setting, population, inclusion and exclusion criteria, sampling strategy and sample size validity and reliability of instrument, data collection, analysis, and ethical considerations.

3.2. RESEARCH APPROACH

Quantitative approach used in this study was to identify the types and frequency of medication errors that occur during prescription and administration in the NICU at two selected referral hospitals in Rwanda.

3.3. RESEARCH DESIGN

This study was a retrospective cross-sectional design to identify the types and of prescription and administration errors found in neonatal files at two selected Rwandan referral hospitals.

3.4. RESEARCH SETTING

This study was conducted in the NICUs at the University Teaching Hospital of Kigali (CHUK) and the Rwanda Military Hospital (RMH) situated in Kigali City. The CHUK is a Level 3, 24-bed NICU, with two attending pediatricians that visit all neonates daily. The NICU admits preterm and term infants born in the hospital and outside the hospital. The RMH is a Level 2, 7-bed NICU, admits a few infants born in the hospital; however, almost all are born out of the hospital. Two attending pediatricians visit patients daily. These two referral hospitals were selected because of the high number of newborns hospitalized, and presence of neonatal nursing and medical experts. The data in these facilities are recorded electronically using Open MRS (Open Medical Record System) and a medical chart for every patient, making data retrieval possible.

3.5. STUDY POPULATION

In 2020, there were 682 neonates who were hospitalized in the NICUs (CHUK and RMH) at some time between 1 January to 31 December, and this number comprised the study population. Of the total population of 682 admissions, 432 were hospitalized at CHUK, and 250 at the RMH.

3.6. SAMPLING

3.6.1. SAMPLING STRATEGY

This study used a systematic random sampling strategy to select medical files for the sample. The first file was randomly selected, and subsequent files were selected based on a systematic interval and based on the sample size every 3rd file was selected.

3.6.2. SAMPLE SIZE

The sample size was related to the study population of neonatal admissions to the two NICUs during the year 2020 and equal to 682. The calculation of sample size was based on a statistical formula by Taro Yamane and a population size of 682, 95% confidence interval and a 5% margin of error.

n is the sample size

N is the population size (682)

e is level of precision (0.05)

$$n = \frac{N}{1 + N(e)^2}$$

N = 682/ (1 + 682 [0.05]2)

N = 682/ (1+ 682) (0.0025)

N = 682/ (1+ 1.705)

N = 682/ (2.705)

N = 252

N = 252 files, rounded to 260 files to minimize bias and generalize data.

3.6.3 INCLUSION AND EXCLUSION CRITERIA

- **INCLUSION CRITERIA**

The study focused on the medical records of neonates admitted to neonatal units for 24 hours or longer in year 2020

- **EXCLUSION CRITERIA**

All files of neonates hospitalized for less than 24 hours, or had no therapeutic drug administered and documented in the file. Other exclusions will be files other than the selected 3rd file.

3.7. DATA COLLECTION

3.7.1. DATA ABSTRACTION INSTRUMENT

This study was a cross-sectional design adapted from a similar one used to evaluate the forms and occurrence of prescription and administration medication errors in the NICU by Eslami and colleagues in Iran(3). Permission to use parts of the instrument was requested from two of the study Iranian authors (3) by the researcher and supervisor, but both authors have not responded to multiple emails. Perhaps the instrument was only written in Farsi; therefore, we have developed the instrument based on the information written in the English publication. However, the instrument was also adapted based on numerous other studies based on the literature review and reviewed by two expert researchers.

The data abstraction instrument includes socio-demographic characteristics of the mother and the neonate, and prescriptions and administration and medications variables. These socio demographic variables are important to the study to possibly show associations between e.g. prescription errors and neonatal age, weight, and length of stay as in other studies.

These variables (27 items) are divided into three sections:

Section 1: Socio demographic characteristics (12 items). Maternal factors; age, educational level, marital status, religion, occupation, GTPAL, and delivery type. Neonatal factors; gender, gestational age (preterm, or term), birth weight (below 2.5 kg or greater than 2.5 kg), age at admission (< 7 days, or ≥ 7 days) and hospital stay (below 7 days, or greater than 7 days).

Section 2: Medication prescriptions (7 items); wrong dosage, route of administration, drug interval, illegibility of the prescription, failure to specify the unit measurement of the medication, failure to record date and time of the order, and failure to record the name and signature of the prescriber.

Section 3: Medication administration (8 items): wrong patient, drug, dose, route, dosing interval, and failure to give medication on time, administered the medication after discontinuation, and medication given and not prescribed. The results one was stand for CHUK and two for RMH

3.7.1. VALIDITY AND RELIABILITY OF RESEARCH INSTRUMENTS

Validity refers to how well an instrument covers the construct domain and includes an acceptable sample of items for the construct being measured.

The instrument indicates content validity as the objectives (and items) covered are primarily based on a high-quality study from a peer-reviewed journal, an exhaustive literature review, and input from neonatal experts. The face validity of instrument used in this study was validated by the researcher's supervisors, who confirmed that the questions are clear, relevant, reasonable and connected to the topic.

The instrument has face validity based on the constructs of the conceptual framework, input from three content experts, and reflection of relevant current research on NICU medication errors in peer-reviewed journals. The researcher selected 25 neonatal files which represent 10% of the simple size and which met the inclusion criteria to test validity.

Reliability of the tool referred to the degree to which a tool is consistent. The instrument was pre-tested in pilot test at one hospital with similar characteristics to test its feasibility. There were two midwives; the researcher and a trained research assistant, and both was involved in the pilot study to check for inter-rater reliability. This were checked by both raters reviewing the same charts independently and then comparing the consistency of the data extracted using the study instrument.

3.7.2. DATA COLLECTION

Data collection started following the Institutional Review Board (IRB) permission and from the two referral hospitals (RMH and CHUK). There were two data collectors; the researcher and the research assistant (RA). The files were accessed in Neonatal care departments of the hospitals during the regular time the areas were open for data collection. The instrument was used to extract data from the neonatal files of neonates hospitalized during 2020. Information of the medication prescriptions and administration was extracted from the files (as per items identified in Sections 2-3 of the instrument) and recorded. Items were assessed or interpreted at the time of data collection. Data sheets were coded at the time extracting the information from the file and so there was no personal identifying information collected to compromise the confidentiality or anonymity of the neonates. The results one was stand for first prescription and two for second prescription.

3.8. DATA ANALYSIS

The data were described using the mean and standard deviation; and statistical analysis was done with Statistical Package for the Social Sciences (SPSS) for Windows, version 21. The determinants of ME were subjected to univariate analysis, followed by a multivariate analysis using binary logistic regression. $P < 0.05$ was considered as statistically significant.

3.9. DATA MANAGEMENT

The data collected was entered from the data abstraction instrument into the personal computer of the researcher. Information from each file was entered into SPSS using the assigned study code at the time of data collection. The data were then assessed to ensure if data were clean and accurate before analysis. After analysis, data was stored in the researcher personal computer with a protected password to ensure confidentiality, although no personal identifying information was collected. The researcher has kept the completed instruments in a locked cupboard. All study materials were kept for the allotted time of seven years and then destroyed.

3.10. DATA DISSEMINATION

The results will be submitted and presented to University of Rwanda, School of nursing and midwifery, master's program, at RMH, CHUK, and through publication in journal.

3.11. ETHICAL CONSIDERATION

The Institutional Review Board (IRB) of the University of Rwanda's College of Medicine and Health Sciences granted permission for data collection.

The patients 'names and other personal identifying information were not recorded on the data abstraction instrument. Instead, a study code was assigned to files, and this confidentiality method provided anonymity to all patients' medical files.

3.12. STUDY LIMITATAION

The main limitation of retrospective studies is increased possibility of missing data in the files. This study was conducted at only two referral hospitals, consequently, the results may only be generalized to similar referral settings in Rwanda. Another limitation is inability to identify the medication errors during the administration phase and its rate from the file, and insufficient information about possible side effects of administration errors.

3.13. CONCLUSION OF CHAPTER THREE

Chapter three provided the details of the methodology for the study. The study was a retrospective cross-sectional design to assess medication errors using a data abstraction instrument. The study was conducted in 2021 in two selected referral hospitals in Rwanda.

CHAPTER IV: RESEARCH FINDINGS AND ANALYSIS

4.1. Presentation of results

This study used a descriptive cross sectional research approach. The purpose of this study was to assess prescription and administration medication errors among patient's medical records in neonatal units of two selected Rwandan neonatal units. The first objective was to identify the type of prescription and administration medication errors among neonatal file at two Rwandan hospitals.

The second was to determine the frequency of prescription and administration medication errors found in neonatal files and the third was to measure the relationship between demographic characteristics related to neonate and medication errors in neonatal units at the two Rwandan hospitals.

The research instrument was used for data collection. The data collection period ran from 7/10/2021 up to 12/12/2021. The calculated sample size was 260 medical records and all were available in archive of both hospitals which translate the response rate of 100%. The presentation of results is arranged according to three sections: maternal and neonatal demographic data, type of prescription and type of administration. The results presented here were conducted in selected neonatal units in Rwanda as follows:

4.1. Maternal characteristics

The maternal characteristics include age group, marital status, religion, occupation and delivery type (table 1).The frequency distribution of demographic data of the study population showed the age groups with the majority 84(32.3%) aged 32-37 years, and others included 78(30%) aged 26-31 years, 76(29.2%) aged 20-25 years, and 22(8.5%) of mothers were 38 years or older.

Their marital status showed 164(63.1%) were married, and 92(35.4%) were single. Their religious affiliation showed the majority 93(35.8%) protestant, 90(34.6%), catholic 17(6.5%) Adventist, 26(10%) Islam, and 30(11.5%) ADEPR. The variable of occupation showed that the majority 134(51.5%) were merchants or traders, followed by 37(14.2%) tailors, 28(10.8%) educators, 33(8.8%), 23 (8.8%) in agriculture, 17 (6.5%) students, and 2 (0.8%) nurses. This variable had the largest amount of missing data at 19 (7.3%). Concerning the variable of mode of delivery, the majority 133(51.2%) had a spontaneous vaginal delivery, while the remaining (48.8%) had surgery (caesarian section-CS); 80(30.4%) had an emergency CS, 47(18.1%) elective CS.

Table 1: Maternal characteristics

Variables		n	%
Marital status	married	164	63.1
	single	92	35.4
	separated	0	.0
	divorced	0	.0
	widow	0	.0
	others	0	.0
	NS	4	1.5
Religion of participant	protestant	93	35.8
	Catholic	90	34.6
	Adventist	17	6.5
	Islam	26	10.0
	ADEPR	30	11.5
	other	0	.0
	NS	4	1.5
Occupation of participant	Agriculture	23	8.8
	educator	28	10.8
	nurse	2	.8
	merchant or trader	134	51.5
	tailor	37	14.2
	other	0	.0
	NS	19	7.3
	student	17	6.5
Delivery type	SVD	133	51.2
	instrument delivery	0	.0
	elective Caesarian	47	18.1
	emergency CS	79	30.4
	C/S	1	.4
Age group	20-25	76	29.2
	26-31	78	30.0
	32-37	84	32.3

Variables		n	%
Marital status	married	164	63.1
	single	92	35.4
	separated	0	.0
	divorced	0	.0
	widow	0	.0
	others	0	.0
	NS	4	1.5
Religion of participant	protestant	93	35.8
	Catholic	90	34.6
	Adventist	17	6.5
	Islam	26	10.0
	ADEPR	30	11.5
	other	0	.0
	NS	4	1.5
Occupation of participant	Agriculture	23	8.8
	educator	28	10.8
	nurse	2	.8
	merchant or trader	134	51.5
	tailor	37	14.2
	other	0	.0
	NS	19	7.3
	student	17	6.5
Delivery type	SVD	133	51.2
	instrument delivery	0	.0
	elective Caesarian	47	18.1
	emergency CS	79	30.4
	C/S	1	.4
Age group	20-25	76	29.2
	26-31	78	30.0
	32-37	84	32.3
	38 and above	22	8.5

4.2: Neonatal characteristics

The neonatal characteristics include the gender of neonate, gestational age, weight, age at admission, and length of stay in the NICU (table 2).The table shows that the majority 132 (50.8%) was males, whereas 128(49.2%) were female. In relation to gestational age, the majority of 177(68.1%) were considered preterm, and 83(31.9%) were term at ≥ 38 weeks. The age of admission to the NICU indicated the majority of 254(97.7%) were < 7 days, and 6(2.3%) were ≥ 7 days of age. The majority of neonates were LBW weighing ≤ 2.499 grams, and the remaining 116(44.6%) neonates weighed ≥ 2.5 grams. As for the length of stay in the NICU, the majority 135(51.9%) stayed ≥ 7 days, and 125 (48.1) stayed < 7 days in the NICU.

Table 2: Neonatal characteristics

	Variables	**n**	**%**
Gender of participant	Female	128	49.2
	male	132	50.8
Gestational age	< 37.6 weeks	177	68.1
	>= 38 weeks	83	31.9
neonatal weight	<= 2.499	144	55.4
	>=2.5	116	44.6
age at admission	< 7 days	254	97.7
	>= 7 days	6	2.3
length of stay in NICU	< 7 days	125	48.1
	>= 7 days	135	51.9

4.3 Type of prescription medication errors and frequency among neonatal file at two Rwandan hospitals

Table 4.3 presents the frequency distribution of the following variables related to the prescription errors (1) which represent first prescription, and (2) represent second prescription. The variables that were identified on the data abstraction instrument included the Specified route, Specified drug interval, Date and Time, and Name and Signature.

For the prescription errors (1) and specified route 241(91%) was yes where there were no errors, and 15(5.9%) no with errors. For the specified drug interval on prescriptions, 246(96.1%) had no errors, and 10 (3.9%) had errors. For the date and time on prescriptions, 252(98.4) had no errors, and 4(1.6%) had errors. For the name and signature on prescriptions, 174(68%) had no errors, and 82(32%) had errors.

The prescription errors (2) and specified route, 238(97.1%) had no errors, and 7(2.9%) had errors. The specified drug interval on prescriptions, 242(99.6%) had no errors, and 3 (1.2%) had errors. The date and time on prescriptions, 244(99.6%) had no errors, and 1(0.4%) had errors.

The name and signature on prescriptions, 188(76.7%) had no errors, and 57(23.3%) had errors.

Table 3: Prescription medication errors and frequency among neonatal file at two Rwandan hospitals

Prescription errors (1) N=256		**n**	**%**
Specified route	Yes	241	94.1
	No	15	5.9
Specified drug interval	Yes	246	96.1
	No	10	3.9
Date and time	Yes	252	98.4
	No	4	1.6
Name and signature	Yes	174	68
	No	82	32
Prescription errors (2) N=245		**n**	**%**
Specified route	Yes	238	97.1

Prescription errors (1) N=256		n	%
Specified route	Yes	241	94.1
	No	15	5.9
Specified drug interval	Yes	246	96.1
	No	10	3.9
Date and time	Yes	252	98.4
	No	4	1.6
Name and signature	Yes	174	68
	No	82	32
Prescription errors (2) N=245		**n**	**%**
	No	7	2.9
Specified drug interval	Yes	242	98.8
	No	3	1.2
Date and time	Yes	244	99.6
	No	1	0.4
Name and signature	Yes	188	76.7
	No	57	23.3

4.4 Administration medication errors and frequency among neonatal file at two Rwandan hospitals

Table 4 presents the frequency distribution of the variables related to the administration errors (1), administration errors (2). The variables that were identified as administration errors and included in the data abstraction instrument included the wrong drug, the dosing interval and failed to give drug on time.

The results of the administration errors (1) and wrong drug show 0(0%) had error, and 256(100%) had no error. The results of the administration and dosing interval showed 72(28.1%) had errors, while 184 (71.9%) had no error. The results of the administration and failed to give drug on time showed 70(28%) had errors, and 184(71.9%) had no error.

The results of the administration errors (2) and wrong drug show 0(0%) had an error, and 245(100%) had no error. The results of the administration and dosing interval showed 70(28.5%)

had errors, while 175 (71.5%) had no error. The results of the administration and failed to give drug on time showed 42(17.0%) had errors, and 203(83.0%) had no error.

Table 4: Administration medication errors and frequency among neonatal file at two Rwandan hospitals

Administration errors (1) N=256		**n**	**%**
Wrong drug	Yes	0	0
	No	256	100
Dosing interval	Yes	72	28.1
	No	184	71.9
Failed to give drug on time	Yes	72	28.1
	No	184	71.9
Administration errors (2) N=245		**n**	**%**
Dosing interval	Yes	70	28.5
	No	175	71.5
Failed to give drug on time	Yes	42	17
	No	203	83

5. Association between Prescription errors and neonatal characteristics

Table 5. A Chi-square test was conducted to test the Association between the Prescription error *Specified Route* and neonatal characteristics. There was a significant association (p=0.046) between the Prescription error *Specified Route* and the neonatal weight in the neonatal units. The association was technically significance, though borderline, so perhaps a larger sample size may indicate a greater significance. The other variables indicated no significant association with *Specified Route* errors (p>0.05).

Table 5. Association between Prescription error of *Specified Route* and neonatal characteristics (n=256)

Variables	**Prescription error**		χ^2	*p*
	Specified Route			
	Yes n (%)	**No n (%)**		
Gender			0.030	0.863
Female	7 (5.6)	118 (94.4)		
Male	8 (6.1)	123 (93.9)		
Gestation age (weeks)			1.059	0.303
< 37.6	12(6.9)	162 (93.1)		
≥ 38	3 (3.7)	79 (96.3)		
Neonatal weight (grams)			**4.000**	**0.046**
≤ 2499	12 (8.5)	129 (91.5)		
≥ 2500	3 (2.6)	112 (97.4)		
Age at admission (days)			0.382	0.536
< 7	15 (6.0)	235 (94.0)		
≥ 7	0 (0)	6 (100)		
Length of stay in NICU (days)			5.021	0.525
< 7	3 (2.4)	120 (97.6)		
≥ 7	12 (9.0)	121 (91.0)		

Table 5 continued

Variables	Description errors		Chi-square test	P-Value
	Specified drug interval			
	Yes	No		
Gender			0.006	0.940
Female	120(96%)	5(4%)		
Male	126(96.2%)	5(3.8%)		
Gestation age			0.692	0.406
< 37.6 weeks	166(95.4%)	8(4.6%)		
≥ 38 weeks	80(97.6%)	2 (2.4%)		
Neonatal weight			0.102	0.750
≤ 2.499 kg	135(95.7%)	6(4.3%)		
≥ 2.5 kg	111(96.5%)	4(3.5%)		
Age at admission			0.250	0.617
< 7 days	240(96%)	10(4%)		
≥ 7 days	6(100%)	0(0%)		
Length of stay in NICU			0.016	0.900
< 7 days	118(95.9%)	5(4.1%)		
≥ 7 days	128(96.2%)	5(3.8%)		

Table 5 continued

Variables	Description errors		Chi-square test	P-Value
	Date and time			
	Yes	No		
Gender			4.259	0.039
Female	121(96.8%)	4(3.2%)		
Male	131(100.0%)	0(0.0%)		
Gestation age			1.915	0.166
< 37.6 weeks	170(97.7%)	4(2.3%)		
≥ 38 weeks	82(100%)	0 (0.0%)		
Neonatal weight			0.652	0.419
≤ 2.499 kg	138(97.9%)	3(2.1%)		
≥ 2.5 kg	114(99.1%)	1(0.9%)		
Age at admission			0.098	0.755
< 7 days	246(98.4%)	4(1.6%)		
≥ 7 days	6(100%)	0(0%)		
Length of stay in NICU			0.006	0.937
< 7 days	121(98.4%)	2(1.6%)		
≥ 7 days	131(98.5%)	2(1.5%)		

Table 5 continued

Variables	Description errors		Chi-square test	P-Value
	Name and signature			
	Yes	No		
Gender			0.078	0.781
Female	39(31.2%)	86(68.8%)		
Male	43(100.0%)	88(0.0%)		
Gestation age			2.285	0.131
< 37.6 weeks	61(35.1%)	113(64.9%)		
≥ 38 weeks	21(25.6%)	61 (74.4%)		
Neonatal weight			0.098	0.754
≤ 2.499 kg	44(31.2%)	97(68.8%)		
≥ 2.5 kg	38(33%)	77(67%)		
Age at admission			0.666	0.414
< 7 days	81(32.4%)	169(67.6%)		
≥ 7 days	1(16.7)	5(83.3%)		
Length of stay in NICU			3.934	0.047
< 7 days	32(26%)	91(74%)		
≥ 7 days	50(37.6%)	83(62.4%)		

4.6 Association between demographic characteristics related to neonate and administration errors in neonatal units

Association between demographic characteristics related to neonate and administration errors in neonatal units was carried out and the results showed that gender and gestation age were statistically associated with wrong drug, gender associated with date and time, gestation age and length and stay associated with dosing interval, gender, gestation age, neonatal weight associated with failed to give drug on time (P-value < 0.05).

Table 6. Association between demographic characteristics related to neonate and administration errors in neonatal units

Variables	Administration errors		Chi-square test	P-Value
	Wrong drug			
	Yes	No		
Gender			10.029	0.002
Female	(0%)	128(100%)		
Male	0(0%)	132(100%)		
Gestation age			4.529	0.033
< 37.6 weeks	9(5.3%)	160(94.7%)		
≥ 38 weeks	0(0%)	82 (100%)		
Neonatal weight			0.357	0.550
≤ 2.499 kg	4(2.9%)	132(97.1%)		
≥ 2.5 kg	5(4.3%)	110(95.7%)		
Age at admission			0.250	0.617
< 7 days	240(96%)	10(4%)		
≥ 7 days	6(100%)	0(0%)		
Length of stay in NICU			0.016	0.900
< 7 days	118(95.9%)	5(4.1%)		
≥ 7 days	128(96.2%)	5(3.8%)		

Table 6 continued

Variables	Administration errors		Chi-square test	P-Value
	Dosing interval			
	Yes	No		
Gender			2.238	0.135
Female	67(27.3%)	178(72.7%)		
Male	6(100%)	130(0%)		
Gestation age			13.578	0.000
< 37.6 weeks	136(80.5%)	33(19.5%)		
≥ 38 weeks	34(41.5%)	48(58.5%)		
Neonatal weight			0.895	0.344
≤ 2.499 kg	33(24.3%)	103(75.7%)		
≥ 2.5 kg	34(29.6%)	81(70.4%)		
Age at admission			2.238	0.135
< 7 days	67(27.3%)	178(72.7%)		
≥ 7 days	6(100%)	0(0%)		
Length of stay in NICU			5.435	0.020
< 7 days	41(33.3%)	82(66.7%)		
≥ 7 days	26(20.3%)	102(79.7%)		

Table 6 continued

Variables	Administration errors		Chi-square test	P-Value
	Failed to give drug on time			
	Yes	No		
Gender			17.614	0.000
Female	29(24%)	92(76%)		
Male	7(5.4%)	123(94.6%)		
Gestation age			20.392	0.000
< 37.6 weeks	36(21.3%)	133(78.7%)		
≥ 38 weeks	0(0%%)	82(100%)		
Neonatal weight			7.336	0.007
≤ 2.499 kg	27(19.9%)	109(80.1%)		
≥ 2.5 kg	9 (7.8%)	106(92.2%)		
Age at admission			1.029	0.310
< 7 days	36(14.7%)	209(85.3%)		
≥ 7 days	0(0%)	6(100%)		
Length of stay in NICU			0.350	0.554
< 7 days	16(33.3%)	107(66.7%)		
≥ 7 days	20(15.6%)	108(84.4%)		

4.7Association between Prescription error *Date and Time* and neonatal characteristics

Table 7. A Chi-square test was conducted to test the Association between the Prescription error *Date and Time* and neonatal characteristics. A statistical significant association between prescription error *Date and* Time and newborn gender (p=0.039) on the neonatal units was observed. There were no other statistically significant associations between *Date and Time* and the neonatal characteristics (p> 0.05).

Table 7. Association between Prescription error *Date and Time* and neonatal characteristics (n=256)

Variables	**Prescription error *Date and Time***		χ^2	*p*
	Yes n (%)	**No n (%)**		
Gender			4.259	0.039
Female	121 (96.8)	4 (3.2)		
Male	131 (100)	0 (0)		
Gestation age (weeks)			1.915	0.166
< 37.6	170 (97.7)	4 (2.3)		
≥ 38	82 (100)	0 (0)		
Neonatal weight (grams)			0.652	0.419
≤ 2499	138 (97.9)	3 (2.1)		
≥ 2500	114 (99.1)	1 (0.9)		
Age at admission (days)			0.098	0.755
< 7	246 (98.4)	4 (1.6)		
≥ 7	6 (100)	0 (0)		
Length of stay in NICU (days)			0.006	0.937
< 7	121 (98.4)	2 (1.6)		
≥ 7	131 (98.5)	2 (1.5)		

Table 8. A Chi-square test was conducted to test the Association between the Prescription error *Name and Signature* and neonatal characteristics. There were no statistically significant associations between Prescription error *Name and Signature* and other neonatal characteristics ($p>0.05$).

Table 8. Association between Prescription error *Name and Signature* and neonatal cha

Variables	**Prescription error**		χ^2	*p*
	Name and signature			
	Yes n (%)	**No n (%)**		
Gender			0.078	0.781
Female	39 (31.2)	86 (68.8)		
Male	43 (100)	88 (0.0)		
Gestation age (weeks)			2.285	0.131
< 37.6	61 (35.1)	113 (64.9)		
≥ 38	21 (25.6)	61 (74.4)		
Neonatal weight (grams)			0.098	0.754
≤ 2499	44 (31.2)	97 (68.8)		
≥ 2500	38 (33.0)	77 (67.0)		
Age at admission (days)			0.666	0.414
< 7	81 (32.4)	169 (67.6)		
≥ 7	1 (16.7)	5 (83.3)		
Length of stay in NICU (days)			3.934	0.347
< 7	32 (26.0)	91 (74.0)		
≥ 7	50 (37.6)	83 (62.4)		

9. Association between Administration errors and neonatal characteristics.

Table 9. Chi-square test was conducted to test the Association between the Administration errors *Wrong Medication* and neonatal characteristics. The results showed that gender (p=0.002) and gestation age (p=0.033) were statistically associated with *Wrong Medication* given on the neonatal units. There were no statistically significant associations between other neonatal characteristics (p>0.05).

Table 9. Association between Administration error of *Wrong Medication* and neonatal characteristics (n=256)

Variables	**Administration error**		χ^2	*p*
	Wrong Medication			
	Yes n (%)	**No n (%)**		
Gender			**10.029**	**0.002**
Female	9 (7.4)	112 (92.6)		
Male	0 (100)	130 (100)		
Gestation age (weeks)			**4.529**	**0.033**
< 37.6	9 (5.3)	160 (94.7)		
≥ 38	0 (0.0)	82 (100)		
Neonatal weight (grams)			0.357	0.550
≤ 2499	4 (2.9)	132 (97.1)		
≥ 2500	5 (4.3)	110 (95.7)		
Age at admission (days)			0.0.16	0.900
< 7	240 (96.0)	10 (4.0)		
≥ 7	6 (100)	0 (0.0)		
Length of stay in NICU (days)			3.934	0.347
< 7	118 (95.9)	5 (4.1)		
≥ 7	128 (96.2)	5 (3.8)		

Table 10. Chi-square test was conducted to test the Association between the Administration error *Dosing interval* and neonatal characteristics. The results showed that Gestation age (p=0.000) and Length of stay in the NICU (days) (p=0.020) were statistically associated with an error in the *Dosing interval* on the neonatal units. There were no statistically significant associations between other neonatal characteristics (p>0.05).

Table 10. Association between Administration error of *Dosing Interval* and neonatal characteristics (n=256)

Variables	**Administration error**		χ^2	*p*
	Dosing interval			
	Yes n (%)	**No n (%)**		
Gender			2.238	0.135
Female	67 (27.3)	178 (72.7)		
Male	6 (100)	130 (0.0)		
Gestation age (weeks)			**13.578**	**0.000**
< 37.6	136 (80.5)	33 (19.5)		
≥ 38	34 (41.5)	48 (58.5)		
Neonatal weight (grams)			0.895	0.344
≤ 2499	33 (24.3)	103 (75.7)		
≥ 2500	34 (29.6)	81 (70.4)		
Age at admission (days)			2.238	0.135
< 7	67 (27.3)	178 (72.7)		
≥ 7	6 (100)	0 (0.0)		
Length of stay in NICU (days)			**5.435**	**0.020**
< 7	41 (33.3)	82 (66.7)		
≥ 7	26 (20.3)	102 (79.7)		

Table 11. Chi-square test was conducted to test the Association between the Administration errors, *Failed to Give Medication on Time* and neonatal characteristics. The results showed that gender (p=0.000), gestation age (p=0.000) and neonatal weight (p=0.007) were statistically associated with *Failed to Give Medication on Time* on the neonatal units. There were no statistically significant associations between other neonatal characteristics (p>0.05).

Table 11. Association between Administration error*, Failed to Give medication on Time* and neonatal characteristics (n=256)

Variables	**Administration the error**		χ^2	*p*
	Failed to Give Medication on Time			
	Yes n (%)	**No n (%)**		
Gender			**17.614**	**0.000**
Female	29 (24.0)	92 (76.0)		
Male	7 (5.4)	123 (94.6)		
Gestation age (weeks)			**20.392**	**0.000**
< 37.6	36 (21.3)	133 (78.7)		
≥ 38	0 (0.0)	82 (100)		
Neonatal weight (grams)			**7.336**	**0.007**
≤ 2499	27 (19.9)	109 (80.1)		
≥ 2500	9 (7.8)	106 (92.2)		
Age at admission (days)			1.029	0.310
< 7	36 (14.7)	209 (85.3)		
≥ 7	0 (0.0)	6 (100)		
Length of stay in NICU (days)			0.350	0.554
< 7	16 (33.3)	107 (66.7)		
≥ 7	20 (15.6)	108 (84.4)		

12. Results of multiple logistic regression analysis of demographic characteristics related to neonate and medication errors.

Table 12. Variables that showed significant association were recruited in multiple logistic regression analysis and the results revealed that an error in the Prescribing phase *Date and Signature* was significantly higher in patients with Length of stay in NICU of more than seven days than those of less than seven days (OR=1.713; p=0.048**).** In the Administration phase there was an 83.3% reduction in the odds of failure to give drug on time in male neonates (OR=0.167; p=0.000**).**

Table 12. Results of multiple logistic regression analysis of demographic characteristics related to neonate and medication errors (n=256)

Variables	**OR**	**95%CI**	***p***
	Specified route		
Neonatal weight			
≤ 2.499 kg (Ref)		the	
≥ 2.5 kg	0.441	0.110-1.76	0.247
	Date and time		
Gender			
Female (Ref)			
Male	5.345	1.045-7.650	0.996
the			
	Date and signature		
Length of stay in NICU			
< 7 days (Ref)			
≥ 7 days	**1.713**	**1.004-2.923**	**0.048**
	Wrong drug		
Gender			
Female (Ref)			
Male	0.745	0.145-4.650	0.396
Gestation age			
< 37.6 weeks (Ref)			
≥ 38 weeks	1.245	0.945-4.650	0.496
	Failed to give drug on time		
Gender			
Female (Ref)			
Male	**0.167**	**0.068-0.4**	**0.000**
Gestation age (weeks)			
< 37.6 (Ref)			
≥ 38	2.235	1.945-4.640	0.396
Neonatal weight (grams)			
≤ 2.499 (Ref)			
≥ 2.5	1.604	0.631-4.078	0.321

CHAPTER 5: DISCUSSION

5.1. Introduction

The chapter five summarizes results from the study done on identifying medication errors in the neonatal intensive care unit in two hospitals in Rwanda and its association with other studies. The study aims were to identify type of prescription and administration medication errors, to determine the frequency of prescription and administration medication errors and to measure the relationship between demographic characteristics relate to neonate medication errors in neonatal units at the two Rwanda hospitals.

Objective 1. Identification of the type of prescription and administration medication errors among neonatal file at two Rwandan hospitals.

This study sought to identify the type of prescription and administration medication errors. The results revealed that the prescription medication errors reported in this study were; legible treatment or drug, specified dose, specified route specified dose interval date and time of prescription and the name and signature of the prescribing personnel. The results revealed that specified route was 15(5.9%) and 7(2.9%), specified drug interval 10(3.9%) and 3(1.2%), date and time 4(1.6%) and 1(0.4%), name and signature 82(32%)) and 57(23.3%). Compare to the result from the study conducted by Kaveh Eslami where the most frequent medication errors were wrong dosage in prescription phase at 28% by physicians and of failing to give medication was 29% by nurses, this was high rate of this error (20). In this regard, the most common errors was lack of time and/or date of order.

F. Nawwar et al.'s study described administration error to be 3.7% and 3.4%; respectively and is lower than the result from our study(4). Failing to give the medication can be due overwork by nurses in NICUs (average of 8 to 10 infants per one nurse) which is different from the global standards.

Objective 2.To determine the frequency of prescription and administration medication errors found in neonatal files at the two Rwandan hospitals.

The frequency distribution of prescription and administration medication errors 1and 2, the name and signature result from the present study was ; for the prescription errors (1) errors of specified route were 15(5.9%) and 7(2.9%) , about specified drug interval was 10 (3.9%) and3(1.2%), date and time only 4(1.6%) and 1(0.4%) ; name and signature, represented 82(32%) and 57(23.3%), were the frequency of prescription and administration errors in this study. In accordance with the result form study conducted by Nkurunziza Aimable on factors contributing

to medication administration errors and nurses 'barriers to self- reporting showed that types of administration errors mostly focused on seven rights (right patient, right drug, right dose, right time, right route, right reason and right documentation). With this regards the types of administration error, the wrong time was most dominant in this study. Overworked was the main factor to medication administration errors. The same frequency of prescription and administration errors was found in the result form the study conducted by Mohamed, the lack of the name and /or signature of the physician associated to the illegibility of drug on the order were 0.1 and 0.2%, respectively, then in Truter A' study, they were 8.5%, which is inconsistent with our results(4). The recent study done in showed failing to administer the medication nurses was 29%, which indicates the relatively high rate of this type of error. In the present study the most significant was failed to give drug on time 184(71.9%) and 42(17%). Which is higher number. However our findings was higher compared to the previous reports.

Objective 3. To measure the relationship between demographic characteristics related to neonate and medication errors in neonatal units at the two Rwandan hospitals.

In multivariate analysis 3 factors; gender, gestation age and neonatal weight were statistically associated with the variables tested where the (P-value 0.000) for gender, (P-value 0.000) for gestational age, and for neonatal weight was (P-value 0.007) respectively. The multiple logistic regression analysis in this study revealed the significant association between the tested variables and prescribing phase date and signature error was significantly higher in patients with length of stay in NICU of more than seven days to the patient who stay in NICU less than seven days (OR=1.713; P-value=0.048**).** In the administering phase there was an 83.3% reduction in the odd of failure to give drug on time in male (OR=0.167; P-value=0.000**).** This result is opposite to the result from the study conducted by David Palmero, where the multivariate analysis was based on two factors in increasing risk of medication errors, number of drugs prescribed (incidence rate ratio, 1.19; $p < 0.01$) and gestational age < 32.0 weeks (compared to gestational age > 37.0 weeks (incidence rate ratio, 1.61; $p = 0.04$).

CHAPITER VI: CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

Based on the interpretation of collected and analyzed data which all aimed assessment of prescription and medication administration errors among neonatal files at two selected neonatal units in two hospital Rwanda. The most common medication errors were wrong drug prescribed dosing interval, failed to give drug on time. Medication delivery is a complex, multi-disciplinary process. Errors can occur at any phase of the medication delivery. Errors must be reported in order to identify system failures and individual causes leading to the errors. Medication error reporting aids prevent error and thus decreases rate of medical errors that will occur in the future. System factors such as lack of hospital management support, unavailability of reference material, lack of clinical protocols etc. and human factors such as level of experience, low morale, illegible handwriting, lack of teamwork and fatigue contribute to medication errors. These factors must be addressed in a nonpunitive manner that encourages staff to embrace a culture of reporting. Leadership and managerial support play a critical role in increasing the rate of medication error reporting.

The present study revealed that medication errors occur in our neonatal units. The most common medication errors were lack of time of drug prescription and not administrating the medication on time by nurses. The findings of this study will help health professionals to raise awareness in reducing medication errors in neonatal units**.**

6.2 Recommendations

The findings of this study can be used to carry out further research on medical errors and their impact in public institution and suggest their reduction to be provided. Recommendation to reduce medication include training of nurses, physicians on aspect identified in this study (eg: prescription should be well noted including time and date and respect od administration time of drugs.)

Regular discussion on identifying medication errors in NICU among multidisciplinary team should be initiated for further research to reduce the frequency on medication errors.

Voluntary and individual self- reporting of errors done is the greatest way of gathering data related to errors but with poor reporting of errors it might be necessary for the hospital to design an instrument for measuring medication errors in the hospital. Close monitoring and evaluation are necessary in the field of medical errors.

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APPENDICES

APPENDIX 1: ETHICAL CLEARENCE FROM IRB UNIVERSITY OF RWANDA

UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES
DIRECTORATE OF RESEARCH & INNOVATION

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 9th /6/2021

Ref: CMHS/IRB/192/2021

Noella NYIRAMBARUSHIMA NA
School of Nursing and Midwifery, CMHS, UR

Dear Noella NYIRAMBARUSHIMA NA

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance for the study entitled ***"Identifying Medication Errors in the Neonatal Intensive Care Unit in Two Hospitals in Rwanda: A Cross Sectional Study".***

Having reviewed your application and been satisfied with your protocol, your study is hereby granted ethical clearance. The ethical clearance is valid for one year starting from the date it is issued and shall be renewed on request. You will be required to submit the progress report and any major changes made in the proposal during the implementation stage. In addition, at the end, the IRB shall need to be given the final report of your study.

We wish you success in this important study.

Dr Stefan JANSEN
Ag Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

Cc:

- Principal, College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate studies, UR

APPENDIX 2: LETTERS FOR REQUESTING DATA COLLECTION

NOELLA NYIRAMBARUSHIMANA

University of Rwanda/ College of Medicine and Health sciences

School of nursing and midwifery

TEL 0788624416/ 0728624416

EMAIL nyirambarushanoella@yahoo.fr

June 21, 2021

To: COMMENDANT OF RWANDA MILITARY HOSPITAL

Dear Sir,

Re: Request permission to conduct a research study

I hereby requesting permission to conduct a research study in your hospital.

Sir, I'm student in Masters Science in nursing (neonatology track) in the School of nursing and midwifery, College of medicine and health sciences/University of Rwanda. I would like to conduct my dissertation entitled" **Identifying medication errors in the neonatal intensive care unit in two hospitals in Rwanda".**

I sincerely requesting the permission to conduct this study in your hospital, intensive care unit this study will contribute a lot in identification of medication errors. Kindly find attached letter from CMHS/ Institutional Review Board for my research.

Your approval to conduct this research will be highly appreciated.

Your faithfully

Noella NYIRAMBARUSHIMANA
Student in Neonatal track

NOELLA NYIRAMBARUSHIMANA June 21, 2022

University of Rwanda/ College of Medicine and Health Sciences

School of nursing and midwifery

TEL 0788624416/ 0728624416

EMAIL nyirambarushanoella@yahoo.fr

TO: General Director of CHUK

Re: Request permission to conduct research at CHUK

Dear Sir,

We are requesting permission for **NOELLA NYIRAMBARUSHIMANA**, a student in the Master's Science in Nursing (Neonatology track) in the School of Nursing and Midwifery, College of Medicine and Health Sciences, University of Rwanda (UR), to conduct research at CHUK. The UR Institutional Review Board (IRB) has approved the research proposal, and this letter is to obtain permission from the research site.

The research project is entitled "**Identifying medication errors in the neonatal intensive care unit in two hospitals in Rwanda".** The other study site is the RMH. Data will be collected from the Neonatal Intensive Care Unit (NICU).

Your approval to conduct this research will be highly appreciated. Please get in touch with us if you need any other information. Kindly find attached the letter from the UR IRB.

Yours faithfully,

Noella NYIRAMBARUSHIMANA, BSc, RM

APPENDIX 3 APPROUVAL FOR CONDUCTING RESEARCH

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Quality Health Care Training & Research

Ethics Committee / Comité d'éthique

3rd Sep,2021 Ref.:EC/CHUK/104/2021

Review Approval Notice

Dear Noella NYIRAMBARUSHIMANA,

Your research project: ***" Identifying medication errors in the neonatal intensive care unit in two hospitals in Rwanda "***

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 3rd Sep,2021 to evaluate your request for ethical approval of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your research project.

You are required to present the results of your study to CHUK Ethics Committee before publication by using this link:www.chuk.rw/research/fullreport/?appid=424&&chuk.

PS: Please note that the present approval is valid for 12 months.

Yours sincerely,

Dr Emmanuel Rusingiza Kamanzi
The Chairperson, Ethics Committee,
University Teaching Hospital of Kigali

ETHICS COMMITTEE
CHUK

Scan code to verify.

" University teaching hospital of Kigali Ethics committee operates according to standard operating procedures (Sops) which are updated on an annual basis and in compliance with GCP and Ethics guidelines and regulations "

REPUBLIC OF RWANDA
RWANDA MILITARY HOSPITAL
Website: www.rwandamilitaryhospital.rw
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REF/172/RMH/COMDT/2021 September 08, 2021

NYIRAMBARUSHIMANA Noella
University of Rwanda
College of Medicine and Health Sciences
School of Nursing and Midwifery
Email: nyirambarushanoella@yahoo.fr
Tel: +250 788624416

RE: REVIEW NOTICE

1 In reference to your letter received on 25 August 2021, submitting your revised protocol, I am pleased to confirm that your research project entitled **"Identifying Medication Errors in the Neonatal Intensive Care Unit in Two Hospitals in Rwanda: A Cross Sectional Study"** have been reviewed and approved by the Rwanda Military Hospital Institutional Review Board (RMH/IRB).

2 Please note that approval of this protocol is valid for **12 months** from the date of this notice.

Sincerely,

Dr E. RURANGWA
Brig Gen
Commandant

CC:
- Clinical Services Division Manager, RMH

APPENDIX 4: DATA ABSTRACTION INSTRUMENT

Code: _____ Date ____/___/2021 Data collector initials _____

SECTION I (Tick box that applies to patients' file)

Maternal Factors

1. Age: _____ years

2. Educational level

a) No schooling	b) Primary	c) Secondary	d) University	e) Other

3. Marital status

a) Married	b) Single	c) Separated	d) Divorced	e) Widow	f) Other

4. Religion

a) Protestant	b) Catholic	c) Seventh-day Adventist	d) Islam	e) ADEPR	f) Other

5. Occupation

a) Agriculture	b) Educator	c) Nurse	d) Merchant or Trader	e) Tailor	f) Other

6. **Delivery type**

a) SVD	b) Instrument delivery	c) Elective Caesarian	d) Emergency CS

7. GTPAL

a) Gravidity	b) Term	c) Preterm	d) Abortion	e) Living children

Neonatal Factors:

8. Gender

a) Female	b) Male

9. Gestational age:

a) < 37.6 weeks	b) ≥ 38 weeks

10. Neonatal weight

a) ≤ 2.499 kg	b) ≥ 2.5 kg

11. Age at admission

a. < 7 days	b) ≥ 7 days

12. Length of stay in NICU

a) < 7 days	b) ≥ 7 days

SECTION II

13. Quality of Prescription

SECTION III

14. Administration error

1. PRESCRIPTION	**Yes**	**No**		**ADMINISTRATION**	**Yes**	**No**
a. DRUG:				a. Wrong patient		
b. Is the Rx legible?				b. Wrong drug		
c. Specified dose?				c. Correct dose		
d. Specified measurement unit?				d. Correct route		
e. Specified route?				e. Dosing interval		
f. Specified drug interval?				f. Failed to give drug on time		
g. DATE and TIME?				g. Admin. after discontinued		
h. NAME & SIGNATURE?				h. Drug given, not prescribed		

2. PRESCRIPTION	**Yes**	**No**		**ADMINISTRATION**	**Yes**	**No**
a. DRUG:				a. Wrong patient		
b. Is the Rx legible?				b. Wrong drug		
c. Specified dose?				c. Correct dose		
d. Specified measurement unit?				d. Correct route		
e. Specified route?				e. Dosing interval		
f. Specified drug interval?				f. Failed to give drug on time		
g. DATE and TIME?				g. Admin. after discontinued		
h. NAME & SIGNATURE?				h. Drug given, not prescribed		

3. PRESCRIPTION	**Yes**	**No**		**ADMINISTRATION**	**Yes**	**No**
a. DRUG:				a. Wrong patient		
b. Is the Rx legible?				b. Wrong drug		
c. Specified dose?				c. Correct dose		
d. Specified measurement unit?				d. Correct route		

e. Specified route?				e. Dosing interval		
f. Specified drug interval?				f. Failed to give drug on time		
g. DATE and TIME?				g. Admin. after discontinued		
h. NAME & SIGNATURE?				h. Drug given, not prescribed		

4. PRESCRIPTION	**Yes**	**No**		**ADMINISTRATION**	**Yes**	**No**
a. DRUG:				a. Wrong patient		
b. Is the Rx legible?				b. Wrong drug		
c. Specified dose?				c. Correct dose		
d. Specified measurement unit?				d. Correct route		
e. Specified route?				e. Dosing interval		
f. Specified drug interval?				f. Failed to give drug on time		
g. DATE and TIME?				g. Admin. after discontinued		
h. NAME & SIGNATURE?				h. Drug given, not prescribed		

5. PRESCRIPTION	**Yes**	**No**		**ADMINISTRATION**	**Yes**	**No**
a. DRUG:				a. Wrong patient		
b. Is the Rx legible?				b. Wrong drug		
c. Specified dose?				c. Correct dose		
d. Specified measurement unit?				d. Correct route		
e. Specified route?				e. Dosing interval		
f. Specified drug interval?				f. Failed to give drug on time		
g. DATE and TIME?				g. Admin. after discontinued		
h. NAME & SIGNATURE?				h. Drug given, not prescribed		

THE FORM FOR SUBMISSION OF THE DISSERTATION

UR-COLLEGE OF MEDICINE AND HEALTH SCIENCES
P.O.BOX 3286 KIGALI

DECLARATION AND AUTHORITY TO SUBMIT THE DISSERTATION

Surname and First Name of the Student **Noella NYIRAMBARUSHIMANA**

Title of the project: **Identifying medication errors in Neonatal care intensive units in two hospitals in Rwanda, A cross sectional study**

a. *Declaration by the Student*

I do hereby declare that this ***dissertation*** submitted in partial fulfilment of the requirements for the degree of **MASTERS OF SCIENCE** in **NURSING**, at the University of Rwanda/College of Medicine and Health Sciences, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

Date and Signature of the Student

b. *Authority to Submit the dissertation*

Surname and First Name of the Supervisor

MEHARRY, Pamela

In my capacity as a Supervisor, I do hereby authorize the student to submit her dissertation.

Date and Signature of the Supervisor

22 March 2022