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PREVALENCE AND RISK FACTORS FOR MEDICATION ADMINISTRATION ERRORS: A STUDY AT THE TAMALE TEACHING HOSPITAL

BY

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DECLARATION

I hereby declare that this thesis, titled "The prevalence and Risk Factors for Medication Administration Errors: A Study at Tamale Teaching Hospital", is the result of my own independent research work, carried out under supervision in partial fulfillment of the requirements for the award of Master of Philosophy in Nursing. All sources of information have been duly acknowledged, and no part of this work has been submitted for any other degree or qualification at this or any other institution.

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DEDICATION

I dedicate this thesis to my family—especially my siblings, whose unwavering support and encouragement have been a constant source of strength throughout my academic journey. To my mother, Grace Apasera, I love you.

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I am deeply grateful to my supervisors, Dr. Yvonne Nartey and Dr. Gloria Achempim-Ansong, for their invaluable guidance, unwavering support, and insightful mentorship throughout this research journey.

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LIST OF ACRONYMS/ ABBREVIATION

ADEs – Adverse Drug Events

AHRQ – Agency for Healthcare Research and Quality

AOR – Adjusted Odds Ratio

CI – Confidence Interval

GHS – Ghana Health Service

ICU – Intensive Care Unit

IOM – Institute of Medicine

LHIMS – Lightwave Health Information Management System

MAE – Medication Administration Error

MAEs – Medication Administration Errors

MA – Medication Administration

MAs – Medication Administrations

MEs – Medication Errors

NCC MERP – National Coordination Council for Medication Error Reporting and Prevention

NICU – Neonatal Intensive Care Unit

OPD – Out Patient Department

TTH – Tamale Teaching Hospital

WHO – World Health Organization

YCFF – Yorkshire Contributory Factors Framework

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ABSTRACT

Background:

Medication Administration Errors (MAEs) pose a critical challenge to patient safety globally, leading to adverse outcomes such as morbidity, mortality, and increased healthcare costs. Despite their significance, studies on MAEs in Northern Ghana remain limited, necessitating further research to address this gap and guide interventions for improved patient safety

Objective:

To assess the prevalence and identify risk factors of MAEs among nurses at the Tamale Teaching Hospital.

Method:

A quantitative cross-sectional study design was employed, using structured questionnaires to collect data on MAEs and their associated risk factors. Proportional stratified random sampling was used to recruit respondents from various units of the hospital, ensuring representation across different wards. Descriptive statistical methods were applied to determine prevalence rates and identify reasons contributing to MAEs. Logistic regression was used to find the association between individual factors and frequency of MAEs occurrence.

Results:

MAE prevalence was 82.8% in the preceding year, with wrong timing, monitoring, and assessment as the most frequent errors. Key risk factors included electronic system disruptions (LHIMS: 93%; unexplained failures: 88.8%), inadequate training (88.1%), and high workload (82.3%). Despite higher MAE rates in ICU/dialysis units, Welch's ANOVA showed no significant difference across units [$F(8, 70.67) = 1.42$, $p = 0.203$]. Nurses with Certificate/Diploma qualifications had higher odds of MAEs compared to BSc/Master's holders [AOR = 2.07; 95% CI: 1.42–3.03], while those aged 40–49 had 51% lower odds than the 20–29 age group [AOR = 0.49; 95% CI: 0.24–0.97]. Training on medication administrations reduced MAEs odds by 59% [AOR = 0.41; 95% CI: 0.28–0.61].

Conclusion:

MAEs at TTH are driven by systemic issues like workflow disruptions and training gaps. Prioritizing staffing optimization, targeted training, and health information system improvements could mitigate errors and enhance safety.

Keywords: Medication Administration Errors, Prevalence, Risk Factors, Patient Safety

CHAPTER ONE

INTRODUCTION

The chapter provides a brief overview of Medication Administration Errors (MAEs). Thus, it provides an understanding of MAEs, causes and its prevalence in the healthcare setting. It also, states the objective, purpose and, significance of the study. Additionally, it gives an explanation to the problem that this study seeks to address, and provides operational definitions for some key terms that feature prominently in this work.

1.1 Background of the study

Quality healthcare is a fundamental right of every individual. Accordingly, all healthcare facilities strive to deliver it to their clients. Nonetheless, achieving quality is partly dependent on patient safety as the World Health Organization (WHO, 2019) and Ghana Health Service (GHS, 2004) list patient safety as a key component of quality healthcare, without which no quality can be achieved. The Institute for Safe Medication Practices Canada (ISMP, 2015), notes, "safety is the foundation upon which quality is built". Stressing that, safety can exist without quality but not the reverse. It is therefore not surprising that the WHO (2019) recognize patient safety as a global health priority, emphasizing that delivering health services without compromising the safety of the patient is crucial to achieving quality care. Nonetheless, patient safety is threatened by various types of medical errors with medication errors (MEs) being the most significant and pervasive issue (The National Patient Safety Agency Report, 2004; IOM 2007; Tariq et al., 2024).

Globally, MEs are considered as a leading cause of adverse drug events (ADEs), which can result in significant morbidity and mortalities(IOM, 2007). According to the Agency for Healthcare Research and Quality (AHRQ), medication error is a potential harm to a patient's health resulting from exposure to an inappropriate drug (AHRQ, 2019). Also, it is defined by the National Coordination Council for Medication Error Reporting and Prevention (NCC MERP, 2020) as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in control of the healthcare professional, patient, or consumer". It continues that "these events may relate to professional practice, healthcare products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use". These errors can occur at any stage of the medication process,

including prescribing, dispensing, and administration (WHO, 2022). Among these stages, MAEs, which occur at the point of administering medication to a patient, are particularly alarming. MAEs involve errors such as incorrect dosage, timing, or route of administration among others, and they are especially critical because they occur at the final point of contact between the healthcare provider, mostly the nurse, and the patient (Tariq et al., 2020).

The prominence of medical errors came into the spotlight after the Institute of Medicine (IOM) in 1999 released its landmark report, "To Err is Human: Building a Safer Health System". The report revealed that an estimated 98,000 people died annually in the United States due to medical errors, with MEs being a significant contributor. The economic impact of these errors was staggering, costing the United States of America's (U.S.A) healthcare system up to $29 billion each year (IOM, 1999). Further research has in recent times maintain that medication errors are among the most prevalent types of medical errors globally with dire consequences (WHO 2022). For instance, the WHO (2016) estimates that MEs result in an annual global economic burden of approximately $42 billion and medication harm is responsible for over half of the preventable harm in medical care worldwide, with an estimated annual cost of €4.5–21.8 billion in Europe alone (WHO, 2022). Beyond its economic impact, it has several debilitating effects on individuals, including morbidity, disability, medico-legal issues, high healthcare costs, and psychological stress (Alzoubi et al., 2023; Brabcová et al., 2023). Specifically, the United Kingdom (UK) records approximately 237 million medication errors annually, resulting in about 637 deaths per year (WHO, 2022). In the U.S.A, reports of medication errors to the poison control unit increased by 69.8% between 2000 and 2012 (Brophy et al., 2014). Similarly, Studies in other regions, such as Australia and the Middle East, give more credence to the global nature of this issue. For example, the incidence of MEs recorded in an Australian healthcare facility within a period of four years was 1.05 per 100 patients on admission (Isaacs et al., 2021). Furthermore, a study in the Middle East in an Iranian Hospital reported an alarming rate of 10.9% (Isfahani et al., 2024).

MAEs, defined as deviations from the prescriber's medication order as written on the patient's chart, manufacturers' preparation/administration instructions, or relevant institutional policies (Keers et al., 2013), account for 50% to 70% of all MEs (Elliott et al., 2021). Therefore, its consequence which include but not limited to prolonged hospital stays, and, in extreme cases, death (Tariq et al., 2020) cannot be ignored. Factors found to be contributing to the occurrence of MAEs include interruption during medication administration, high workloads,

insufficient staffing, inadequate training, and systemic failures within healthcare facilities (Asefa et al., 2021).

In response to these findings, various strategies have been recommended to reduce MAEs, including the use of "Do Not Interrupt" vests for nurses during medication administrations, implementing double-check systems, and enhancing the use of technology such as barcoding systems (Biron et al., 2009a; Keers et al., 2013; Küng et al., 2021). Nonetheless, the rates of MAEs remain alarmingly high, underscoring the need for continued attentiveness and research (WHO, 2016). While these global statistics highlight the prevalence, risk factors, and outcomes of MAEs including their significant economic burden, there is a notable gap in the literature concerning Ghana, which may be facing its own unique set of challenges.

In Ghana, particularly in the Northern Region, the healthcare system is obviously challenged by resource constraints and workforce shortages making the issue of MAEs especially pressing, as their occurrence further deteriorates the quality of life for patients in an already resource-limited setting (Amo-Antwi et al., 2022). Moreover, the dearth of focused research in this area underscores the need for targeted studies. The Tamale Teaching Hospital (TTH), which is a major healthcare provider in Northern Ghana, offers a critical opportunity for investigating the prevalence and risk factors associated with MAEs. Understanding these factors will greatly help improve patient safety and ensure the provision of quality healthcare in the region and beyond.

This study, therefore, aims to investigate MAEs at the TTH with emphasis on prevalence and risk factors among nurses. By examining the frequency, type, and risk factors for MAEs, this research seeks to provide understanding into the extent of the problem and offer evidence-based recommendations to enhance medication safety, thereby contributing to improved healthcare outcomes in Ghana.

1.2 Problem statement

In June 2023, a Facebook flyer titled “Help Rachel Get Her Life Back Again” spotlighted a tragic case of MAEs. A more detailed post explained that Rachel Okem Otchere, a 29-year-old pharmacist, wife, and mother, suffered life-altering consequences when Atracurium, a potent anesthetic, was wrongly administered instead of the prescribed Anti-D vaccine. This error caused her body to “shut down”, resulting in prolonged oxygen deprivation, paralysis, and the need for expensive health care abroad (Delalie, 2023). Rachel’s story

highlights the profound impact of MAEs, which include severe patient harm, prolonged hospital stays, and economic burdens for families and healthcare systems (WHO, 2022).

Globally, MAEs are a significant cause of preventable patient harm, with nearly 1 in 10 patients affected annually outlining the irony that air travel is safer than seeking care in healthcare facilities (WHO, 2016). In Iran, for instance, nurses reported an average of 19.5 medication errors in just 90 days, leading to adverse outcomes such as death, extended stay at the hospital and possible birth defects (Glavin, 2010; Mutair et al., 2021). These errors have both human and economic consequences, costing the global healthcare system billions of dollars annually.

Within Ghana, particularly in the northern regions, even though, there have been speculated incidents of MAEs and hospital incident reports indicating the occurrence of MAEs and their associated ADEs, there is limited empirical evidence to substantiate these claims. This gap between anecdotal reports and documented research prompts the need for comprehensive studies to uncover the true prevalence and risk factors of MAEs. Ghana's healthcare system–as a whole–faces unique challenges, such as understaffing, high workloads, and limited resources, which may exacerbate the risk of errors (MOH, 2024). However, without evidential local data, policymakers and healthcare providers are left without the insights needed to implement effective interventions. This study, therefore, seeks to address this critical gap by investigating the prevalence and risk factors of MAEs at the TTH. By identifying the situational and organizational factors as well as the local working conditions that present risks for these errors, the study provides evidence-based recommendations to improve medication safety, reduce patient harm, and inform national strategies for safer healthcare delivery. The findings of this research could serve as a foundation for nationwide efforts to enhance patient safety and quality care in Ghana.

1.3 Aim of the study

The aim of this study is to explore the prevalence and risk factors for MAEs among nurses

1.4 Main objective

To assess the prevalence and risk factors of medication errors among nurses at the Tamale Teaching Hospital

1.5 Specific objectives:

1. To evaluate the prevalence of Medication Administration Errors at Tamale Teaching Hospital.
2. To identify the situational factors that contribute to Medication Administration Errors at Tamale Teaching Hospital.
3. To examine the local working conditions that lead to Medication Administration Errors at Tamale Teaching Hospital.
4. To determine the organizational factors influencing Medication Administration Errors at Tamale Teaching Hospital.

1.6 Research hypotheses

- H_{01}: The prevalence rates of MAEs do not significantly vary across different hospital units.
- H_1: The prevalence rates of MAEs significantly vary across different hospital units.

- H_{02}: Training on medication administration has no effect on the risk of MAEs.
- H_2: Training on medication administration lowers the risk of MAEs.

- H_{03}: There is no significant association between educational level and the prevalence of MAEs among nurses.
- H_3: Educational level is significantly associated with the prevalence of MAEs among nurses

1.7 Significance of the Study

The study provides valuable insight into the prevalence and risk factors associated with MAEs among nurses at the TTH. This will enhance understanding of the specific challenges faced by nurses at TTH, which can be extended to hospitals in similar settings. Also, the findings of this study will inform policymakers on the prevalence and nature of MAEs, providing a clear basis for the development of strategies and interventions aimed at minimizing these errors. This will help guide decisions on allocating resources, designing safety protocols, and implementing training programs to reduce errors and improve patient safety. Additionally, the findings will make healthcare managers and nurse leaders aware of specific areas where errors are prevalent, giving them opportunities to take targeted action for improvement. Finally, the results will help prepare nurses and managers on the importance of error prevention measures in achieving better organizational performance and improved patient outcomes.

1.8 Operational definition of terms

- **Wrong medication:** Administering a medication that was not intended and has not been prescribed to a patient.
- **Wrong dose:** Medication dose or quantity different from that the prescribed dose.
- **Overdose:** when a drug is administered in excess of the prescribed or standard specification
- **Underdose:** When the administered drug dose is less than the prescribed standard dose.
- **Wrong route:** The actual route of medication administration differs from the recommended or prescribed route of medication administration.
- **Wrong time:** Administration of medications 30 minutes earlier or later from its scheduled administration time.
- **Wrong education error:** Administering medication without informing the patient about the medication being administered.
- **Wrong assessment:** Not assessing the patient properly before or after the drug administration as required
- **Wrong evaluation:** When the patient is not properly evaluated after medication is administered.
- **Wrong documentation (documentation error):** Incorrect or incomplete or no documentation after drug administration.
- **Omission:** failing to administer a prescribed drug to a patient

- **Risk factors:** incidents/situations that contribute to MAEs
- **Prevalence:** the rate or frequency of occurrence of MAEs

CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.0 Introduction

The chapter provides a comprehensive review of the existing literature on MAEs. It begins with a detailed explanation of the theoretical model guiding the review, including the rationale for its selection. Subsequently, the chapter examines literature from a global perspective, covering regions such as Europe, Asia, North America, and Africa particularly Ghana. This broad approach offers an overview of current knowledge, identifies key trends, and highlights research gaps that require further exploration.

The review is structured into two primary areas: prevalence and risk factors. The discussion of risk factors is further categorized based on the main domains of the chosen theoretical framework, the Yorkshire Contributory Factors Framework.

2.1 Theoretical Framework

The researcher came across the following two models and one framework that all seemed applicable in this study;

1. Reason's Accident Causation Model
2. The Swiss Cheese Model
3. **The Yorkshire Contributory Factors Framework (YCFF)**

2.1.1 Reason's Accident Causation Model

The Reason's Accident Causation Model was developed by James Reason in 1990. It is part of the broader safety literature and it emphasizes that errors result from latent conditions (example: inadequate training, design flaws) and active failures (example: mistakes or procedural violations by frontline workers). The model provides a robust framework for understanding how latent and active failures contribute to medication errors. For example, insufficient staff training (latent condition) can lead to dosage miscalculations (active failure). Nonetheless, this framework is highly general and focuses more on categorizing types of errors rather than exploring specific variables such as demographic or situational risk factors. Therefore, it was not considered suitable for my objectives.

2.1.2 The Swiss Cheese Model

The Swiss Cheese Model, originally developed by James Reason in 1990, explains that accidents result from multiple systemic failures rather than a single human error. It is a visual representation of the "defense" in Reason's Human Error Model, using the metaphor of Swiss cheese slices with holes to represent weaknesses in various layers of measures (defenses) that should prevent an error from occurring. It explains that errors occur only when the "holes" in these layers align, allowing failures to progress through all defenses (example: policies, procedures) and result in an adverse event.

The model explains how gaps in organizational layers, such as inadequate policy enforcement, insufficient training, or poor workload management, contribute to medication errors. These errors are multifactorial, arising not from individual shortcomings alone but from a combination of failures across multiple layers. It emphasizes that vulnerabilities in a single layer are rarely sufficient to cause an adverse event like MAEs; instead, multiple failures across different areas must align for an error to occur. This model is often applied in healthcare to understand how systemic failures collectively contribute to MAEs. It suggests that while individual nurses may make mistakes, these are influenced or compounded by broader systemic issues, such as lack of resources, inadequate training, or flawed processes.

While the Swiss Cheese Model addresses errors from a systemic standpoint, it is more generalized in examining complex interactions rather than focusing specifically on risk factors contributing directly to MAEs. Therefore, it is not considered suitable for this study which is seeking detailed breakdown of specific factors (example: educational level or unit-specific variations).

2.1.3 The Yorkshire Contributory Factors Framework (YCFF)

The YCFF is a comprehensive model used to identify and analyze the factors that contribute to MAEs in healthcare settings. It was developed by the Yorkshire Quality and Safety Research Group in 2012, and aims to identify the risk factors associated with patient safety incidents (PSIs). The development involved a systematic process that integrated research findings, expert input from risk managers, clinicians and human factors experts to provide a structured approach to understanding the complexities surrounding MAEs.

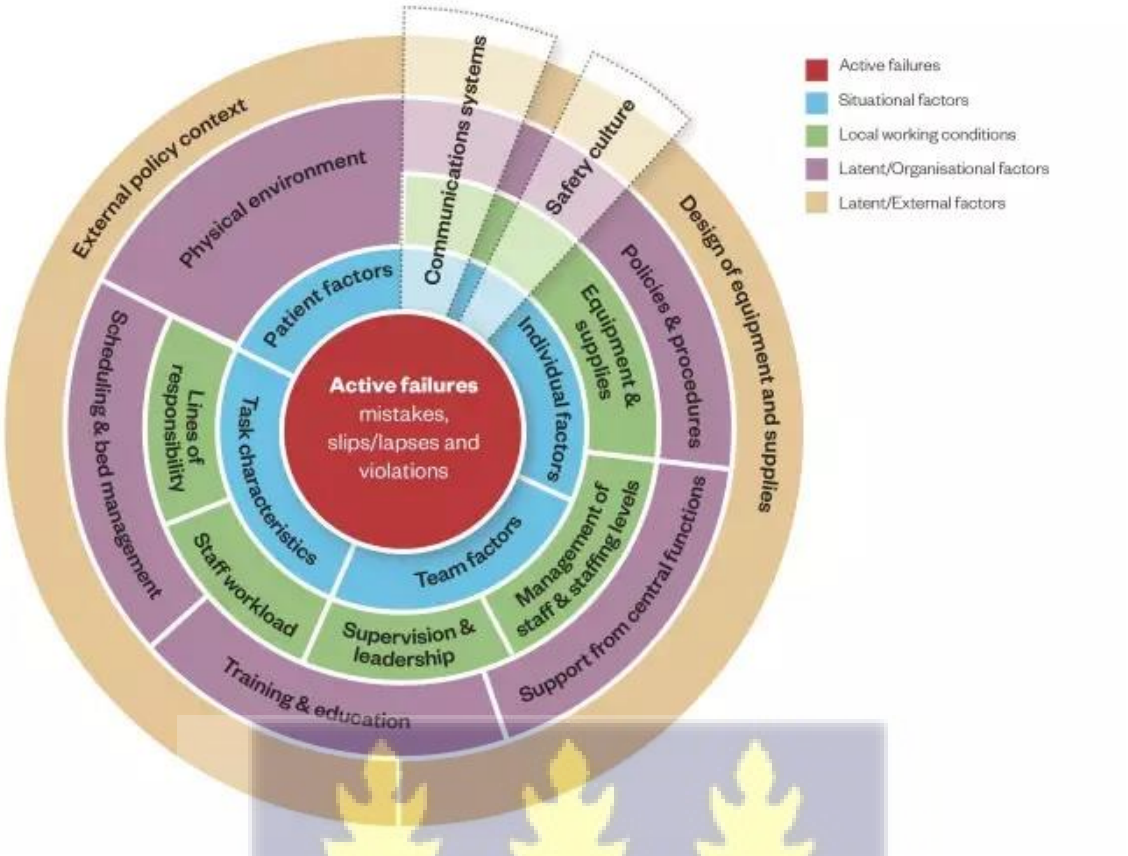


Figure 2.1: The Yorkshire Contributory Factors Framework (YCFF)

The YCFF categorizes contributory factors herein referred to as risk factors into five main domains with sub domains. They are;

2.1.3.1 Situational Factors

These factors include: Team Factors, Individual Factors, Task Characteristics and Patient Factors.

2.1.3.1.1 Team factors

Team factors, encompass the factors that are associated with teamwork such as poor delegation of work, conflicting team goals, lack of respect for colleagues and absence of feedback among team members. It is described by the developers as any factors associated with the functioning of various professions within a team that they can modify to enhance patient safety (Lawton et al., 2012).

2.1.3.1.2 Individual factors

Individual factors include characteristics such as fatigue and inexperience among others of the individual (nurse) involved in administering the medication which may pose some degree of risk for MAEs (Lawton et al., 2012). Other individual factors explored in this study, include demographic characteristics such as age, gender, educational level, years of nursing practice (experience).

2.1.3.1.3 Task characteristics

Task characteristics as described by Lawton et al., (2012) include the features of tasks that may contribute to MAEs. They include, unfamiliar tasks, complexity or the monotonous nature of the task.

2.1.3.1.4 Patient factors

Patient factors are described as the characteristics of patients that make their care more challenging and increase the likelihood of MAEs (Lawton et al., 2012). Such factors may include language barrier, uncooperativeness, complex medical histories, or intoxication (Lawton et al., 2012)

In this study, this domain, Situational Factors, is used to assess individual factors (such as educational background, level of experience), task characteristics (such as difficult and unfamiliar tasks) and contributing factors that may result from the patient such as language barrier and intoxication among others.

2.1.3.2 Local Working Conditions

This domain assesses activities involving high unit workload, staffing issues and leadership problems that may contribute to the occurrence of MAEs. The sub domains are:

2.1.3.2.1 Workload and staffing issues

These refer to the workload-related activities that may contribute to the commission of MAEs. Thus, the "level of activities and pressure on time during a shift" (Lawton et al., 2012). Such factors may include high unit workload, insufficient staffing allocation to the unit or some staff being unwell (Lawton et al., 2012).

2.1.3.2.2 Leadership, Supervision and Roles

These include leadership activities such as remote supervision, inappropriate delegation and unclear responsibilities which have the tendencies of contributing to MAAEs (Lawton et al., 2012).

2.1.3.2.3 Drugs, Equipment and Supplies

This refers to the challenges in obtaining the right drug and functioning equipment; hence, posing risks for MAEs (Lawton et al., 2012). In this study, the possibility of equipment such as the functionality of electronic system and internet connectivity, contributing to MAEs are assessed.

The study used this domain, Local Working Conditions, to assess the respondents' perspective about the likelihood of factors such as workload, insufficient staff at work and LHIMS disruptions posing risks for MAEs within the unit.

2.1.3.3 Organizational Factors

Organizational factors, considered as latent factors, include risks arising from the structure or systems established within a healthcare facility. These factors include aspects such as the physical environment, scheduling and bed management, and staff training and education, all of which can contribute to MAEs (Lawton et al., 2012). They include the following:

2.1.3.3.1 Physical Environment

The physical environment refers to workplace characteristics that may hinder an effective and error-free workflow, thereby increasing the likelihood of MAEs. Examples include poor layout, insufficient lighting or visibility, lack of adequate space, and extreme environmental factors such as excessive heat, cold, or noise (Lawton et al., 2012). These factors can distract or impair nurses' ability to administer medications accurately.

2.1.3.3.2 Scheduling and Bed Management

Issues related to scheduling and bed management can create time pressures and resource constraints that contribute to errors. For instance, delays in patient care, difficulties in transferring patients to appropriate wards, or challenges in finding available beds can disrupt

workflows and increase the risk of MAEs (Lawton et al., 2012). These pressures often lead to rushed decision-making or interruptions during critical medication administration tasks.

2.1.3.3.3 Staff Training and Education

The level and quality of training that nursing staff receive are obviously critical determinants of their ability to administer medications accurately. Inadequate training and lack of regular updates on medication protocols, or inconsistencies in training standards can compromise a nurse's technical competence leading to the risk of MAEs (Lawton et al., 2012). Continuous education is essential to keep nurses informed about best practices, new medications, and updated protocols, hence reducing the likelihood of errors in the medication administration process.

In this study, this domain of the YCFF is used to analyze the organizational factors that put nurses at risk of committing MAEs. Specifically, the study examines the association between nurses' participation in training on medication administration protocols and the frequency of medication errors they commit. This analysis provides understanding into how organizational improvements in training can mitigate risks of MAEs and enhance patient safety.

2.1.3.4 External Factors

These factors extend beyond the confines of the healthcare facility, encompassing external influences such as guidelines and regulations from regulatory agencies, as well as broader societal impacts.

2.1.3.4.1 National Policies

National policies are intended to guide healthcare practices, but when they are unclear, contradictory, or poorly implemented, they can increase the risk of medication administration errors (Lawton et al., 2012). Examples include national nursing standards or emergency department protocols, which, if flawed or inconsistently applied, may negatively affect safe and effective medication administration.

While this domain provides valuable insights into external factors that can influence healthcare practices, this study did not focus on this area. Instead, the study concentrates on organizational, situational and local working conditions within the healthcare setting that contribute to MAEs.

2.1.3.5 Communication and Safety Culture

This domain of the framework looks at poor communication among workers and the lack of safety culture within the facility which may cause or increase the risk of MAEs.

2.1.3.5.1 Safety culture

This assesses the presence or absence of safety culture in a healthcare facility and its potential contribution to MAEs (Lawton et al., 2012). However, this study did not evaluate the facility's safety culture or its impact on MAEs; therefore, this domain was not utilized.

2.1.3.5.2 Communication

This assesses the effectiveness of the procedures and structure in place for effective exchange of information among healthcare staff, patients, and other departments (Lawton et al., 2012). Challenges such as miscommunication between staff, the use of unclear abbreviations, and failure to properly hand over important information during shift changes are common issues outlined by the YCFF as contributing to MAEs.

Although communication and safety culture are distinct domains, it is evident from the model (Fig.1) that they intersect with the other domains, suggesting that these issues permeate multiple areas. In this study, "communication" is incorporated as sub-domain within organizational factors to evaluate communication challenges in the work environment that may contribute to MAEs among nurses at Tamale Teaching Hospital. Issues with "safety culture" are not assessed in this study.

In a nutshell, the YCFF explains the multifaceted nature of MAEs and provides a structured approach for identifying and addressing the diverse risk factors in healthcare settings.

2.2 Justification for using YCFF

The YCFF was selected for this study because it provides a broad and comprehensive perspective on the factors contributing to errors in healthcare settings, particularly MAEs. Unlike other theoretical frameworks, such as the Swiss Cheese Model, the YCFF recognizes that an individual factor can directly lead to an error while also acknowledging that the risk factors for MAEs are multidimensional. These factors can arise from various domains, including local working conditions, organizational dynamics, and situational influences, making the YCFF highly suited for exploring such complexities. Such detailed categorization of risk factors enables the identification of specific areas requiring targeted interventions, such as improving communication, addressing workload issues, or refining training programs.

Furthermore, the YCFF is specifically designed for the healthcare environment, to identify factors contributing to patient safety incidents in hospital settings. Therefore, it is widely recognized in contemporary healthcare research for its utility in studying errors and patient safety. For instance, in the field of medicine, (Mushtaq et al., 2018) used the YCFF to identify factors contributing to surgical incidents. In public health, (Giles et al., 2015) applied the framework to examine factors contributing to patient incidents in primary care and to develop a contributory factors framework for primary health care. In Mental health, the adapted Yorkshire Contributory Factors Framework – Mental Health (YCFF– MH) has been used by studies such as (Berzins et al., 2018, 2020)) to identify safety issues in mental health services in the UK.

By employing this framework, the study aligns with current research trends and facilitates a deeper exploration of the intricate and systemic nature of MAEs. This strengthens the study's analytical consistency, enhances the credibility and relevance of its findings within the scientific community.

2.3.0 Conceptual Framework

Even though the YCFF is very suitable for this study, it appears so complex without directional arrows to guide the reader. Therefore, a conceptual framework was derived from the YCFF to provide clarity. It defines both the independent and dependent variables for this study. The independent variables encompass various risk factors highlighted in the YCFF (such as environmental factors, workload, communication, and individual staff factors), while the

dependent variable is the occurrence of MAEs. This clear differentiation aligns with the study's objectives and research questions.

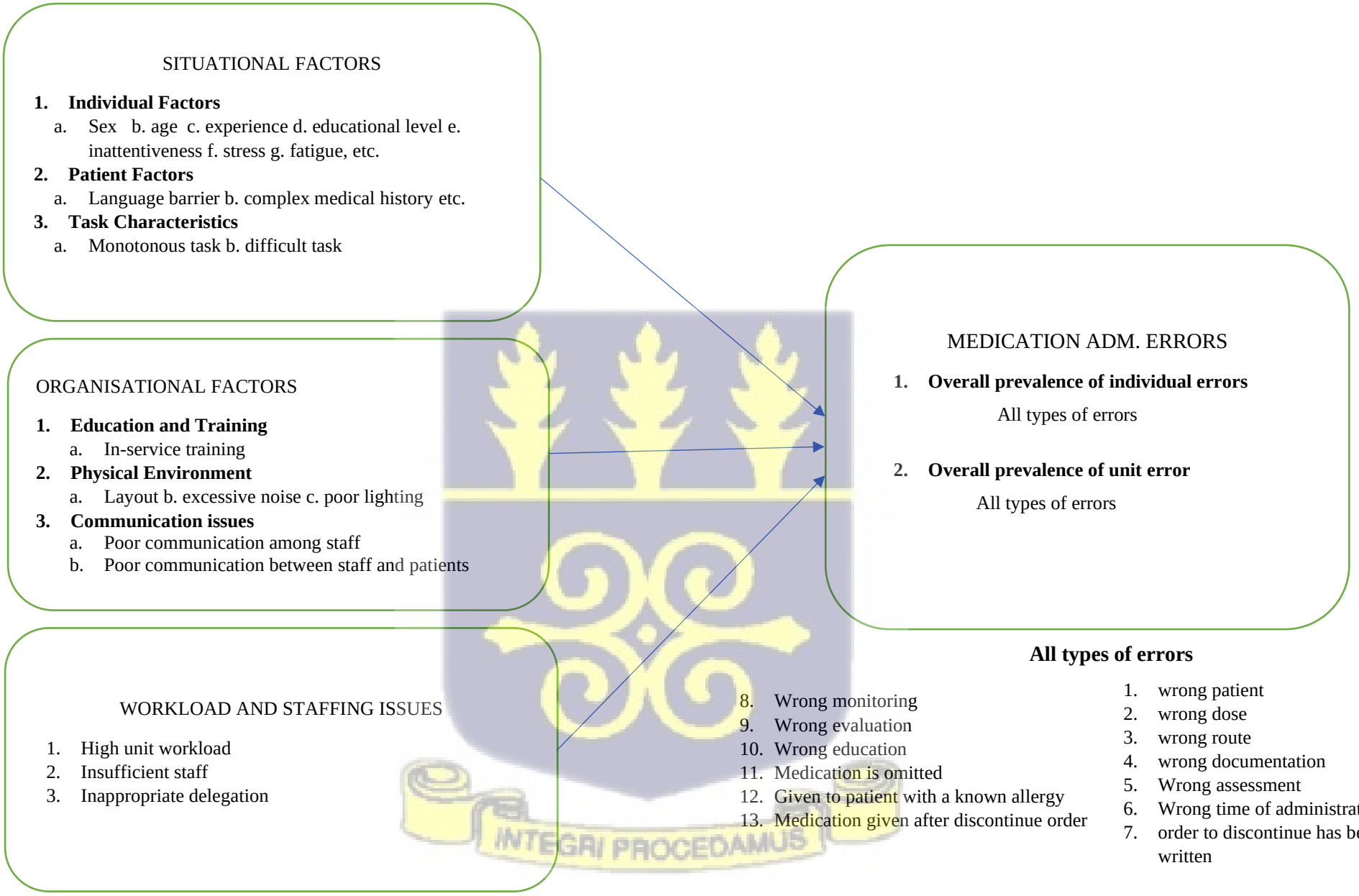


Figure 2.2: Conceptual Framework for MAEs (from the YCFF)

2.4 Literature review

MAEs are a significant concern in healthcare settings globally, posing serious risks to patient safety. While considerable research has been conducted on the prevalence and risk factors for MAEs in various regions, there is a notable gap in the literature specific to Northern Ghana. This review examines existing studies on MAEs, with a particular focus on identifying the gaps that the current study aims to address.

2.4.1 Prevalence of MAEs

MAEs remain a significant global concern with studies highlighting persistently high prevalence rates across various regions and study sites. For example, in England, an estimated 237,287,788 medication errors occur annually, of which 61.4% are attributed to MAEs, with omission errors being the most prevalent type (Elliott et al., 2021). Similarly, Saudi Arabia reports MAEs prevalence rate of 72.1% among nurses, further highlighting the global burden of MAEs (Alandajani et al., 2022). However, while some studies suggest alarming high rates of MAEs, prevalence rates appear lower in European context compared to developing regions. For instance, studies in the Netherlands and Brazil reports rates of 13.7% and 36.2%, respectively (Assunção-Costa et al., 2022; Jessurun et al., 2023). These variations may reflect differences in healthcare infrastructure, safety protocols, reporting practices or variations in study methodologies.

In Africa, the situation is particularly worrying, with high prevalence rates of MAEs often attributed to system failures and patient-related factors (Alemu & Cimiotti, 2023). In Ethiopia, a review of 5,661 prescription sheets and 5,552 medication administrations reported a MAE rate of 57.6% (Endalamaw et al., 2020). Similarly, a study in the Amhara region found a comparable prevalence rate of 57.7%, with significant contributors including interruptions and poor communication (Alebachew et al., 2020). Other studies in Ethiopia report prevalence rates ranging from 56.4% to 68.1% (Feleke et al., 2015; Mohammed et al., 2022; Wondmieneh et al., 2020). In Northern Ghana, a single study recorded a prevalence rate of 65% among pediatric patients, highlighting the pressing need for more localized research in the region (Kwaku Wuni et al., 2024).

MAEs are not confined to clinical settings; they are also a concern in nursing homes. For instance, in England, 41.7% of the reported 237,287,788 medication errors occurred in care homes, with a 21.2% error rate reported when using automated medication dispensing

systems (van den Bemt et al., 2009; Gandhi & Lee, 2010). These findings highlight the systemic nature of MAEs across diverse healthcare settings.

Regarding types of errors, studies across diverse healthcare settings highlight variations in the most prevalent types of errors. While omission errors are consistently emerging as the most common in most settings–particularly–outside of Africa, their prevalence varies widely. For example, in English NHS hospitals, omission rates range from 0% to 64% (average 30%) disproportionately affecting surgical wards and patients prescribed multiple medications (Rostami et al., 2019). In contrast, other settings report distinct dominant errors types. For instance, wrong dosage was the most frequently reported error in Saudi Arabia's Jeddah hospital (46.9%), while technique-related errors were the most common in a Brazilian university hospital (15.5%) (Alandajani et al., 2022; Assunção-Costa et al., 2022). Similarly, Tan et al. (2025) identified wrong rate of IV medication administration as the most common type in the emergency unit. In Africa, errors related to timing, documentation, and dosage are the most frequently reported types (Feleke et al., 2015; Wondmieneh et al., 2020). Example, a study in Egypt, identified incorrect dosage as the most frequently reported error (Shehata et al., 2016), whereas studies in South Africa, Ethiopia and most African countries report wrong timing as the most occurring errors, often accompanied by documentation issues (Blignaut et al., 2016; Asefa et al., 2021; Mahammed et al., 2022).

2.4.2 Risk Factors

This section reviews the multifaceted risk factors contributing to MAEs under the domains of the YCFF.

2.4.2.1 Situational Factors

Individual Staff Factors

The role of individual factors such as experience, level of education, stress, and fatigue among others in contributing to MAEs is widely studied, yet findings are inconsistent. Studies by Mohammed et al. (2022) and Alebachew et al. (2020) indicate that nurses with less than 10 years of experience are more prone to errors. This finding is supported by Kerari & Innab (2021) who also identified experience to be associated with reduced risk of MEs. Conversely, Baraki et al. (2018) reported that nurses with less than 12 months of experience were 63% less likely to commit errors as compared to those with more experience, suggesting that, more experience in their study was associated with increased risk for MAEs. Such discrepancies call

for further investigation into how experience may interact with other factors like educational level and unit type to influence MAEs.

Moreover, while higher educational attainment is often associated with reduced error rates (Kerari & Innab, 2021), (Baraki et al. (2018) found that nurses with bachelor's degrees were 1.5 times more likely to commit errors compared to those with diplomas. This finding challenges the assumption that higher education always equates to fewer errors and raises questions about curriculum effectiveness and its alignment with patient safety practices. Additionally, other individual factors such as negligence, stress and fatigue contribute significantly to MAEs (Bucknall et al., 2019; Ehsani et al., 2013; Mekonen et al., 2020). For instance, lack of attention and poor calculation alone was found to have contributed to 80% of MAEs committed at a university hospital in Brazil (Assunção-Costa et al., 2022).

Also, age and sex play a role in MAEs, with younger nurses and males being more prone to errors as compared to older nurses and females respectively (Kerari & Innab, 2021; Feleke et al., 2015). Specifically, Alandajani et al., (2022) noted that nurses who were less than 25 years and between the ages of 25 -35 years were more associated with MAEs than their older colleagues. Gaps remain in-understanding how individual factors such as age, sex and educational level interrelate with MAEs.

Distraction and Interruptions

Studies in Ethiopia (Feleke et al., 2015; Mekonen et al., 2020; Mohammed et al., 2022; Tsegaye et al., 2020), Australia (Bucknall et al., 2019) and Czech Republic (Brabcová et al., 2023) among others have consistently identified interruptions during medication administrations as a significant risk factor. Common sources of these distractions and interruptions–identified–include patient alert bells, doctors reviewing other patients during medication administration, shift handovers and co-nurses interrupting to discuss other patients.

Future studies could investigate strategies to reduce distractions during medication administration, such as regulating alert bells or rescheduling non-urgent activities to different times. However, this study focuses on determining whether nurses at TTH also perceive these distraction and interruptions as significant risk factors associated with MAEs.

Communication Issues

Poor communication among healthcare staff, particularly between nurses and physicians, is a recurrent problem in existing literature (Wondmieneh et al., 2019; Alebachew et al., 2019). Issues such as illegible prescriptions, reluctance to clarify instructions are frequently cited (Blignaut et al., 2017, 2020; Nkurunziza et al., 2020).

While electronic prescribing systems are recommended as a solution to illegible prescription orders, their implementation and effectiveness in reducing errors in low-resource settings remain underexplored. Furthermore, although handwritten prescriptions have been phased out at TTH, MAEs obviously persist, suggesting that communication issues extend beyond prescription methods and require a broader analysis. This study assesses the possibility of transcription errors and electronic system failures and their impact on MAEs.

2.4.2.2 Local Working Conditions

Workload and Staffing Issues:

High nurse-to-patient ratios, unit workload and poor scheduling are critical contributors to MAEs (Parry et al., 2015: Blignaut et al. 2019: Mohammed et al., 2022). These issues are particularly pronounced in fast-paced units like the emergency unit during peak periods, such as pandemics, where error rates tend to spike (Tsegaye et al., 2020; Achempim-Ansong, 2022; leading to high prevalence rates in the unit (Tan et al., 2025). However, the literature lacks detailed explanations of how poor scheduling contributes to MAEs. For example, does poor scheduling lead to insufficient staff on a shift or a situation where less experienced staff are put together on a particular shift thereby leading to the risk of MAEs? Addressing these questions would help clarify how scheduling influences error rates and guide policy reforms.

Drugs and Equipment

The frequent substitution of drugs, similarities in drug names and appearances, and equipment malfunctions are common risk factors for MAEs (Biskin Cetin & Cebeci, 2021). In Ghana, Opoku-Danso et al. (2024) identified unfamiliar drugs to be the most common risk factor for MAEs. Nonetheless, there is limited research regarding the specific equipment malfunctions which contribute to MAEs. The study explores respondents' views on the impact of electronic system and network challenges, such as unexplained electronic system (example: LHIMS) disruptions on MAEs.

2.4.2.3 Organizational Factors

Physical Environment

Environmental factors such as poor lighting particularly around the nurses' station, poor layouts, and excessive noise are well-documented contributors to MAEs (Biron et al., 2009b; Bucknall et al., 2019). However, in Ghana, only a minority of respondents (27.3%) acknowledged these as significant contributors (Opoku-Danso et al., 2024). This suggests either a lack of awareness or a focus on more immediate concerns such as staffing and workload. Further research is needed to assess the indirect impact of environmental conditions on nurse performance and patient safety.

Staff Training and Education

In-service staff training and education are crucial in reducing MAEs. An integrative study examining the influence of the nurses' characteristics on MAEs found that nurses who attended training courses on MAEs had a reduced likelihood of committing errors (Kerari & Innab, 2021). Corroborating these findings, others studies worldwide on the subject of MAEs reported that lack of training in medication administration significantly increased the risk of MAEs among nurses in various clinical settings with odds ratios ranging from 2.20 to 3.16 (Alebachew et al., 2020; Tsegaye et al., 2020; Wondmieneh et al., 2020). Similarly, Alandajani et. al., (2022) stipulated that, nurses with no history of attending any medication errors training courses were associated with higher MAEs. By inferences, health facilities that invest in training their staff on safe medication practices are likely to record lower rates of MAEs. This study examines the association between attending training on safe medication administration protocols and the occurrence of MAEs. It also to assess whether the hospital provides such training opportunity for its staff and whether nurses independently seek out these trainings when they are not organized by the hospital.

2.5 Gaps and Implications for Research

In spite of the extensive body of research, several gaps and limitations in the literature are evident. To begin with, the wide range of reported prevalence rates (41.5% to 96%) reflects inconsistencies in study methodologies, data collection tools, and healthcare systems. For instance, some of the studies relied on self-reports, which are prone to under reporting, whereas others used direct observation or retrospective reviews, leading to varied findings. These inconsistencies hinder cross-study comparability and the ability to generalize findings globally.

Also, while there is substantial research regarding MAEs in developed regions like Europe and North America, studies in resource-constrained areas, such as Africa–particularly in Ghana–remain sparse. Within Ghana, there is a notable dearth of comprehensive research on this topic, especially in the northern regions. This gap limits the understanding of unique local prevalence and risk factors.

Furthermore, some of the studies reviewed only emphasized on certain types of error (example: causes of omission errors) without adequately exploring others. Therefore, the findings of such narrow focus cannot be generalized as factors contributing to all other types of MAEs.

Besides, while some studies identified risk factors like workload and interruptions, only a few delved into other contributors such as patient factors (example: uncooperating patients, patient being absent from the ward). Meanwhile, a comprehensive understanding of these factors is critical for designing effective interventions.

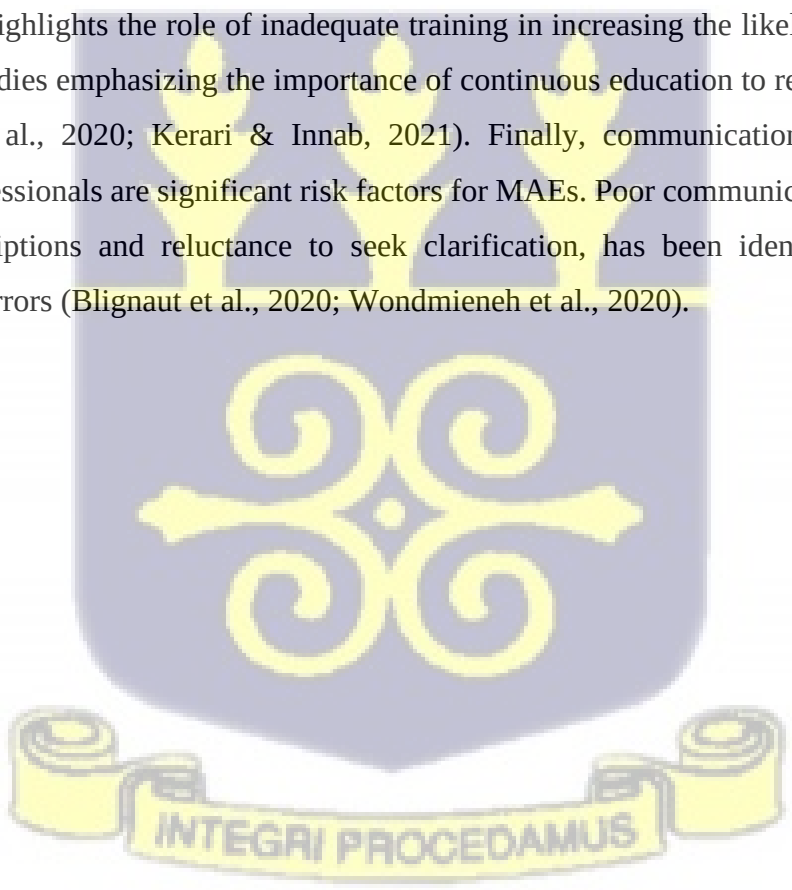
Moreover, units such as the NICU, paediatric unit, dialysis, and emergency, which are particularly susceptible to medication errors, have received limited attention in existing literature. This study includes all these units and evaluates the differences in prevalence across them.

Lastly, although interventions like electronic prescribing have been implemented, MAEs persist at facilities like TTH. This suggests underlying issues that are not addressed by current strategies, necessitating a more in-depth investigation. This study seeks to understand whether other factors such as transcription errors or electronic system break downs may influence the rates of MAEs.

2.6 Summary of Literature Review

MAEs remain a prevalent issue across various healthcare settings, including hospitals, nursing homes, and primary care facilities. The prevalence of these errors varies depending on the healthcare environment and the detection methodologies used. Globally, studies show prevalence rates ranging from 41.5% to 96%, with high rates reported in countries such as Saudi Arabia (Alandajani et al., 2022) and Ethiopia (Feleke et al., 2015; Wondmieneh et al., 2020), while lower rates, such as 13.7%, were observed in Dutch hospitals (Jessurun et al., 2023).

Factors contributing to MAEs are multifaceted and are classified by the YCFF into various categories including situational (example: individual), organizational, and local working conditions among other. Individual factors such as work experience and education level are consistently linked to error rates. Studies show that nurses with less than 10 years of experience are more prone to errors (Mohammed et al., 2022; Alebachew et al., 2020), while younger nurses and males are identified as being at higher risk for errors (Kerari & Innab, 2021; Feleke et al., 2015). In Brazil, poor calculation skills and inattentiveness account for 80% of MAEs (Assunção-Costa et al., 2022). Also, environmental factors such as interruptions during medication administration are significant contributors to errors (Mohammed et al., 2022; Bucknall et al., 2019; Tsegaye et al., 2020). High patient acuity and poor scheduling also exacerbate the risk of errors (Blignaut et al., 2020). Furthermore, organizational factors including high workloads, increased nurse-to-patient ratios, night shifts and staffing shortages are frequently cited as major causes of MAEs (Parry et al., 2015; Blignaut et al., 2019). The literature also highlights the role of inadequate training in increasing the likelihood of errors, with several studies emphasizing the importance of continuous education to reduce error rates (Alebachew et al., 2020; Kerari & Innab, 2021). Finally, communication issues among healthcare professionals are significant risk factors for MAEs. Poor communication, including illegible prescriptions and reluctance to seek clarification, has been identified as a key contributor to errors (Blignaut et al., 2020; Wondmieneh et al., 2020).



CHAPTER THREE

RESEARCH METHODS

3.0 Introduction

This chapter outlines the research design, setting, target population, inclusion and exclusion criteria, as well as the methods used for sampling participants, collecting, and managing data. It also addresses the validity and reliability of the data collection tool and the data analysis process. Additionally, this chapter provides details on ethical clearance and other ethical considerations.

3.1 Study Design

A quantitative descriptive cross-sectional study design was used, utilizing a self-administered questionnaire. This design is appropriate for assessing prevalence and identifying potential correlations between variables of interest.

3.2 Study Setting

The study was conducted among nurses working at the TTH.

The TTH is a premier healthcare institution located in Tamale, the capital of the Northern Regional of Ghana. It is located along the main Tamale-Salaga Road, with its front facing the road and the Nursing Training College adjoining its rear, sharing a common wall. It serves as the primary referral center for all the regions of northern Ghana—Northern, North East, Savannah, Upper East, and Upper West Regions. Established in 1974, initially as a regional hospital, it was later upgraded in 2008 to function as a teaching and research facility, playing a vital role in training medical, nursing, and allied health professionals, especially those from the University for Development Studies (UDS) and the nursing training colleges within the region. Hence, in addition to its clinical services, TTH is integral to medical and nursing education and research, particularly through its affiliation with the School of Medicine and Health Sciences at UDS and the Nursing and Midwifery Training College, Tamale. TTH provides clinical rotations for medical, nursing, and physician assistant students.

The hospital has a bed capacity of approximately 400, which are distributed across various departments, including Surgery, Internal Medicine, Pediatrics, Obstetrics and Gynecology, Emergency, and ICU. TTH offers a wide range of services, from general medical consultations to specialized services such as orthopedic surgery, neurosurgery, and cardiology.

Given the hospital's status as the main referral point for a vast geographic area, the strain on its facilities is considerable, and this impacts the quality of care and response times (World Bank, 2023).

This hospital was chosen because of its unique status as a teaching hospital being the primary referral point for all the regions of the north yet under-resourced to provide adequate quality care.

3.3 Target Population

Target population consisted of the nurses working in various wards at TTH

3.3.1 Inclusion criteria

- Nurses with a minimum of 12 months of work experience in any ward within the hospital

3.3.2 Exclusion criteria

- Nurses who were on annual leave
- Nurses who were on study leave
- Nurses who were not willing to consent to the study

3.4 Sample Size Determination

The formula below, attributed to Yamane (1967), is derived from statistical principles and it is commonly used for sample size calculation in proportion-based studies (Cochran, 1977). Given that this research focused on assessing the prevalence of an event—MAEs—this formula was deemed appropriate for the study.

Therefore, the sample size is calculated as;

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

n : required sample size
p : estimated prevalence rate = 55% = 0.5
z : Z-score = 1.96 (for 95% confidence level)
E = margin of error = 0.05
$1 - p$ = the complement of the estimated prevalence

The estimated prevalence rate of MAEs in this study is 55%. This estimate is derived from a review of existing studies, particularly the ones conducted in the African region which report very high rates. Consequently, it was the researcher's belief that the observed prevalence rate would align with estimated percentage rate. Therefore, the sample size is calculated as follows;

$$n = \frac{Z^2 x\ p\ x\ (1-p)}{E^2}$$

$$n = \frac{(1.96)^2 \text{ x } 0.55 \text{ x } (1- 0.55)}{(0.05)^2}$$

$$= \frac{(3.8416) \text{ x } 0.55 \text{ x } 0.45}{0.0025}$$

$$= \frac{3.8416 \text{ x } 0.2475}{0.0025}$$

$$= \frac{0.950688}{0.0025}$$

$$= 380.2752$$

$$\approx 381$$

Given that there will be a non-response rate of 10%, then;

$$\text{Adjusted Sample Size} = \frac{\text{Initial Sample Size}}{1 - \text{Non-Response Rate}}$$

$$= \frac{381}{1 - 0.10}$$

$$= \frac{381}{0.90}$$

$$= 423.33$$

$$\approx 424$$

Therefore, the sample size used was 424 participants.

3.5 Sampling Technique

The study employed proportional stratified random sampling technique to recruit respondents from various units of the hospital for structured questionnaire responses. Thus, the various units within the hospital were treated as strata and proportions of participants were randomly chosen to meet the desired number. This technique ensured unbiased representation across different wards thereby, enhancing the generalizability of findings to the entire population. A total of 460 questionnaires were distributed and a total of 436 retrieved. However, a total of 429 responses were considered valid and used for the analyses.

3.6 Data Collection Tool and Method

A structured self-administered questionnaire, "The Medication Administration Error Reporting Survey," originally developed by Wakefield et al. (1993.) from Iowa University, was used to collect data. With the necessary permissions and proper authorization, the tool was adapted to fit the context of this study and aligned with the YCFF. The survey has been widely used in similar studies globally, demonstrating its reliability and relevance in examining MAEs.

The data collection tool included three main sections:

- **Demographic Data and Work Experience:** This section collected participants' demographic characteristics (example: sex, age range, educational level, years of experience).
- **Risk Factors for Medication Errors:** This part focused on various factors that may contribute to medication errors (example: high unit workload, illegible physician handwriting).
- **Prevalence of Medication Administration Errors (MAEs):** The final section gathered data on the frequency of MAEs.

The tool was printed out and administered to respondents to manually complete it and return same to the researcher or assistant. Attached to each questionnaire were a letter of authorization from the hospital, information and inform consent sheet. National service personnel (nurses) and some unit heads were recruited to assist in administering and retrieving the questionnaires. They received training that covered the objectives of the study, the importance of accurate data collection, and the broader societal impact of the research. Also, they were instructed on maintaining the principles of privacy and confidentiality. They were

also advised to inform potential participants about their right to participate or opt out of the study, emphasizing the confidentiality of shared information and the protection of participant identities. To ensure comprehension, a pre-test was conducted with staff from a hospital different from the primary data collection site, and any identified issues were addressed before beginning the main data collection.

3.7 Data management

Completed questionnaires were examined for logical accuracy and completeness. Any misunderstandings regarding a response were immediately clarified with the respondent where applicable. Questionnaires with inaccuracies that could not be rectified were excluded. The valid questionnaires were then coded and entered into SPSS for analysis. Any missing data found at the time of data entry were checked for pattern and mechanism and were handled using the most appropriate method. After entry, the data was securely stored and will be retained for at least five years before destruction.

3.8 Data Processing and Analysis

Data were manually cleaned, coded, and entered into the Statistical Package for the Social Sciences (*SPSS 22.0*.) for analysis. Descriptive statistics—including frequencies, proportions, crosstabulations, and summary statistics (mean, median, and standard deviation)—were employed to characterize the study population and the prevalence of MAEs. These results are presented in tables and graphs. Graphs were created using Excel for enhanced visual presentation.

The normality of the MAE percentages reported in each unit was assessed using the Shapiro-Wilks test (appendix I), whereas Levene's test (appendix II) was employed to evaluate the assumption of homogeneity of variances. Based on these preliminary test results, Welch's ANOVA was used, followed by the Games-Howell post hoc test, to compare MAE prevalence across various hospital units.

Logistic regression analyses were conducted to identify associated risk factors for MAEs, with 95% confidence intervals and statistical significance set at a p-value < 0.05. Socio-demographic confounders—specifically age group, gender, marital status, educational level, and religion—were selected based on prior literature and preliminary analyses, and were adjusted for to ensure robust and reliable results. Similarly, work-related factors such as experience, duration in the unit, other specialty, and training on MA were also controlled for.

3.9 Validity and Reliability

To ensure data quality, the structured questionnaire was adapted from previous studies. The reliability of the instrument was verified by checking the coefficient alpha and/or Cronbach's alpha, and its content validity was evaluated by comparing the constructs and items with the available literature. Before the actual study, the questionnaire was pretested at Mathia Catholic Hospital in the Bono East Region, and modifications were made where necessary in consultation with my supervisors.

Participants were encouraged to complete the questionnaires themselves. Additionally, the research assistants (data collectors) were trained to check each questionnaire at the point of collection to ensure that all items were completed, reducing the risk of missing data. Each questionnaire was then double-checked by the principal researcher for completion before coding.

3.10 Ethical consideration

Ethical clearance was sought from the Navrongo Health Research Centre Institutional Review Board (NHRCIRB) before the commencement of data collection. Permission was also obtained from the Tamale Teaching Hospital Research Department to proceed with the study, and from the various unit heads before beginning data collection in each unit. Informed consent was obtained from each respondent before they responded to the questionnaire. To maintain confidentiality, participants were instructed not to write their names on the questionnaire. It was also explained to them that participation was voluntary and that they could opt out at any time if they felt uncomfortable continuing.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents the findings of the study on the prevalence and risk factors for MAEs among nurses at TTH. The results are presented in several sections that align with the main objective of the study. These sections include the prevalence of MAEs and the risk factors for MAEs. These main sections are further divided to align with some specific objectives. Thus, the variations of errors across different hospital units, the influence of individual factors (nurse characteristics) on error rates, and the correlation of some organizational factors (training on MA) on error rates.

Hypotheses were formulated to investigate the influence of nurse characteristics, patient factors, and unit type on the prevalence of errors. To test these hypotheses, multiple statistical analyses were conducted, including descriptive statistics and logistic regression analysis, providing an in-depth understanding of the factors that contribute to MAEs.

4.1 Sociodemographic Characteristics

Table 4.1 shows the sociodemographic characteristics of respondents. A total of 429 nurses with a mean age of 32.1 (Standard deviation (SD): 5.1) years were included in this study. Majority of the respondents were females (238; 55.5%) and most were aged between 30 and 39 years (258; 60.1%). Regarding marital status, 133 (31.0%) were single, 285 (66.4%) married, 4 (0.9%) divorced, 4 (0.9%) widowed, and 2 (0.5%) indicated 'other'. Educational levels among respondents showed that 35 (8.2%) held a certificate, 150 (35.0%) had a diploma, 232 (54.1%) possessed a Bachelor of Science degree (BSc), and 12 (2.8%) held a Master's degree. Relative to religion, 216 (50.3%) practiced Christianity, 202 (47.1%), Islam, 4 (0.9%), were traditionalist, and 7 (1.6%) either had no religion or practiced Rastafarianism.

Table 4.1: Sociodemographic Characteristics

Characteristic	Frequency (n=429)	Percentage (%)
Age group (years)		
20 – 29	129	30.1
30 – 39	258	60.1
40 – 49	42	9.8
Mean:32.1, SD =5.1 (min.:21, max.:49)		
Gender		
Male	191	44.5
Female	258	55.5
Marital status		
Single	133	31.0
Married	285	66.4
Divorced	4	0.9
Widowed	4	0.9
Other	2	0.5
Educational level		
Certificate	35	8.2
Diploma	150	35.0
BSc	232	54.1
Master's degree	12	2.8
Religion		
Christianity	216	50.3
Islam	202	47.1
African Traditional religion	4	0.9
Other*	7	1.6

Abbreviations: SD: Standard deviation; Min.: Minimum; Max. Maximum

Other: No religion, Rastafarianism*

4.2 Work-Related Characteristics

As shown in Table 4.2; most respondents (242, 56.4%) had 1–5 years of nursing experience, followed by 117 (27.3%) with 6–10 years, 70 (16.3%) with 11 or more years of experience (Table 4.2). Also, 66 (15.4%) held qualifications in other specialties, and 363 (84.6%) did not have. Distribution across units included Medical (79, 18.4%), Accident and Emergency (61, 14.2%), Surgical (87, 20.3%), Obstetrics (69, 16.1%), Pediatrics (69, 16.1%), NICU (14, 3.3%), ICU (16, 3.7%), Dialysis (7, 1.6%), and other units (27, 6.3%). In terms of duration in their current units, 341(79.5%) reported working 1– 5 years, 79 (18.4%) for 6–10 years 9(2.1%) for 11 or more years. Notably, 141(32.9%) had received training on MA while 288 (67.1%) had not. Additionally, 106(75.2%) of those who had had training on MA had the training organized by the hospital whereas 35(28.5) sought it from outside the hospital.

Table 4.2: Work-related characteristics

Characteristic	Frequency (n=429)	Percentage (%)
Nursing experience		
1 – 5	242	56.4
6 – 10	117	27.3
11+	70	16.3
	Mean:6.27, SD: 4.2 (min.:1, max.: 21)	
Other specialty		
Yes	66	15.4
No	363	84.6
Unit of respondent		
Medical	79	18.4
Accident and Emergency	61	14.2
Surgical	87	20.3
Obstetrics	69	16.1
Pediatrics	69	16.1
NICU	14	3.3
ICU	16	3.7
Dialysis	7	1.6
Other	27	6.3
Duration in the unit		
1 – 5	341	79.5
6 – 10	79	18.4
11+	9	2.1
	Mean: 1.2, SD: 0.5 (min.: 1, max.: 3)	
Training on MAs		
Yes	141	32.9
No	288	67.1
Training organized by Hospital *		
Yes	106	75.2
No	35	24.8

Abbreviations: SD: Standard deviation; min.: minimum; max: maximum; MA: Medication administrations; NICU: Neonatal intensive care unit; ICU: Intensive care unit
Question applied to only respondents who had training on MA

4.3 Prevalence of MAEs

4.3.1 The overall prevalence rate of MAEs at TTH

As shown in figure 4.1, the overall prevalence of MAEs at the TTH within a month prior to the study was 76.9% and 82.8% in the preceding year.

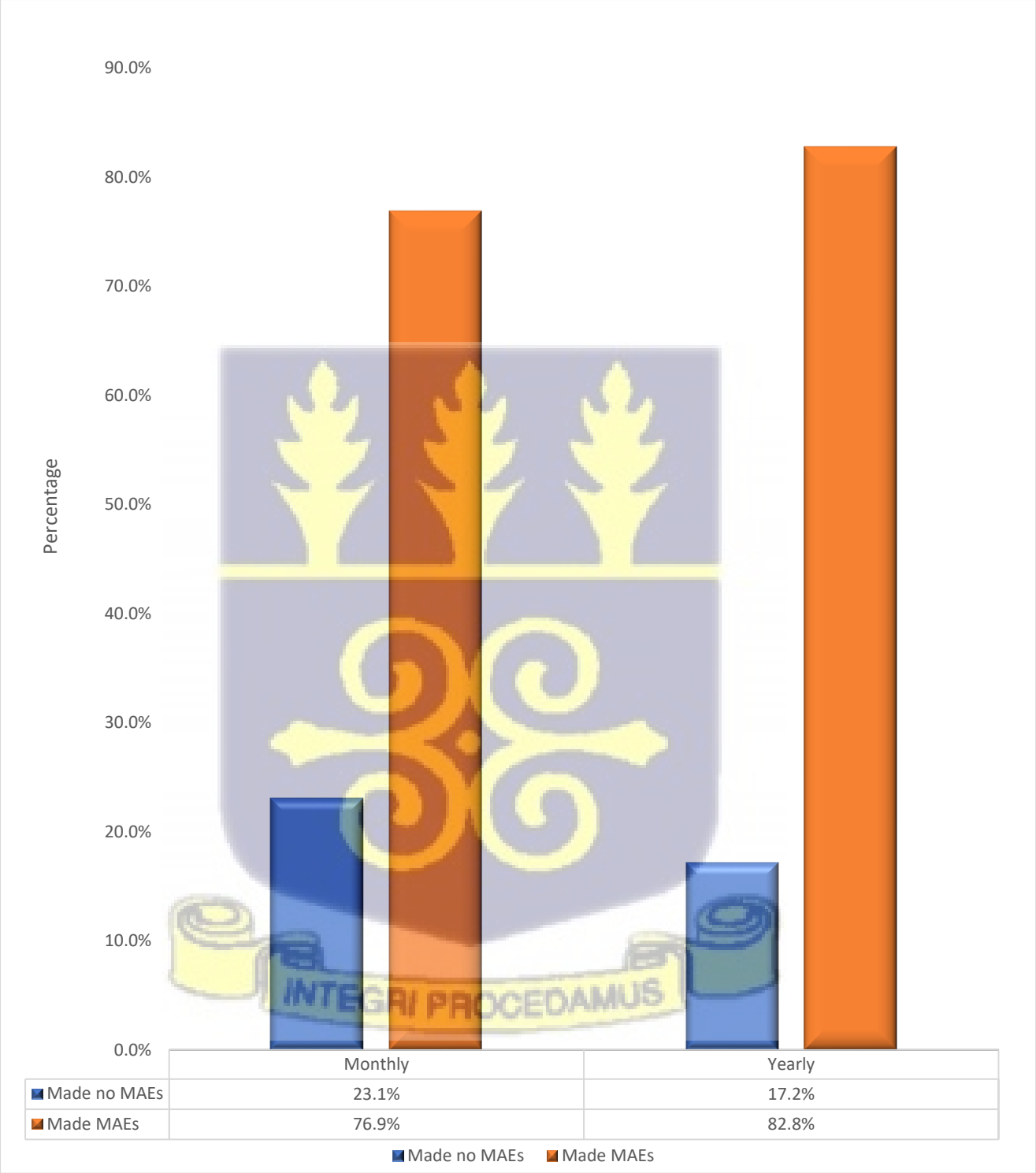


Figure 4.1: The overall prevalence of MAEs

4.3.2 The distribution of MAEs among demographic characteristics

Table 4.3 below, describes the distribution of MAEs among nurses over both a one-month and a 12-month period across various demographic characteristics, including age, gender, educational level, specialty, training on MAs, years of nursing practice, and duration in the ward.

Relating to age group, the results show that within a one-month period, nurses aged 20–29 years recorded the highest proportion of MAEs, with 111(86.0%) committing MAEs compared to only 18(14.0%) who committed none. Among nurses aged 30-39, 67 (26.0%) did not commit MAEs within same period, while 191 (74.0%) did. In the 40-49 age group, 14 (33.3%) did not commit MAEs, whereas 28 (66.7%) did. Over a 12-month period, 16 (12.4%) of nurses aged 20-29 committed no such errors, while 113 (87.6%) did. Among nurses aged 30-39, 45 (17.4%) committed no MAEs, whereas 213 (82.6%) did commit at least one. In the 40-49 age group, 13 (31.0%) committed no MAEs, while 29 (69.0%) committed.

In terms of gender, the findings reveal that 46 (24.1%) of male nurses committed no MAEs in the month preceding the study, whereas 145 (75.9%) did commit various types of MAEs. Among the female nurses, 53 (22.3%) committed no MAEs within the same period while 185 (77.7%) did. During a 12-month period, 34 (17.8%) of male nurses and 40 (16.8%) of female nurses committed no MAEs, while 157 (82.2%) and 198 (83.2%), respectively, did commit.

Regarding the distribution of MAEs based on educational category, 62 (25.4%) of those with a Certificate/Diploma committed no MAEs in a period of one month, while the remaining 182 (74.6%) committed at least one MAEs. Similarly, a lesser proportion of the group with a BSc/Master's degree, 37 (20.0%) committed no MAE whereas the remaining 148 (80.0%) committed some within the stipulated period. In a period of 12-months prior to the study, 48 (19.7%) among those with a Certificate/Diploma, did not commit any MAEs, while a greater proportion 196 (80.3%) committed MAEs. Also, 26 (14.1%) of nurses with a BSc/Master's degree committed no MAEs, whereas the other 159 (85.9%) did commit.

Also, as illustrated in the table, within a period of one-month, 15 (22.7%) of the 66 nurses with other specialties (such as paediatric nursing) committed no MAEs, compared to 51 (77.3%) who committed at least one MAEs. Among the 363 nurses without other specialties, 84 (23.1%) did not commit errors, while 279 (76.9%) of them committed MAEs. Within a 12-month period, 12 (18.2%) of those with other specialties did not commit any MAEs, whereas

54 (81.8%) did. For the nurses without any specialties, 62 (17.1%) did not commit MAEs but the remaining 301 (82.9%) did.

Concerning nurses who had received training on MAs and those who had not; only 47 (33.3%) out of the 141 nurses who had received training, did not commit any MAEs in a month, while 94 (66.7%) did. Within the same period, 52 (18.1%) of the 288 nurses without training, committed no MAEs, whereas 236 (81.9%) did record some MAEs. And, in 12 months, 31 (22.0%) of the trained nurses committed no MAEs, while 110 (78.0%) committed. Among the untrained nurses, 43 (14.9%) of them committed no MAEs. Nonetheless, the rest of the 245 (85.1%) did commit at least one of the various types of MAEs.

Also, the table shows that, based on years of nursing practice, 45 (18.5%) of the nurses with 1-5 years of experience did not commit any MAEs within the month prior to the study, while 198 (81.5%) did. Also 33 (28.2%) of those with 6-10 years of experience and 21 (30.4%) of nurses with 11+ years of experience committed no MAEs, whereas and 84 (71.8%), and 48 (69.6%) respectively, committed. Over a period of 12 months before the commencement of the study, 33(13.6) of nurses with 1 – 5 years of experience as well as 24(20.5%) of those with 6 – 10 years of experience did not commit MAEs whereas 209 (86.4) and 93(79.5) respectively did. Also, 17(24.6) of the nurses with 11+ did not commit MAEs while the remaining 52 (75.4) did.

Moreover, as shown in the table, the distribution of MAEs based on the duration nurses had spent in their ward at the time of the study suggest that; in the one-month period before the study, 76(22.3%) of nurses who had spent between 1 and 5 years in their ward and 22 (27.8%) of those with 6-10 years committed no MAEs; however, 265 (77.7%) and 57 (72.2%), respectively, did. Additionally, 1(11.1%) of nurses with 11 or more years in their ward did not commit any MAEs while 8(88.9) did. Within 12 months, 54 (15.8%) of nurses who had spent 1 – 5 years in their ward and 17 (21.5%) of those with 6-10 years committed no MAEs, whereas 287 (84.2%) and 62 (78.5%), respectively, did commit. For nurses with 11 or more years in their ward, only 3 (33.3%) of did not commit any MAEs, while 6 (66.7%) committed at least one MAEs.

Table 4.3: The distribution of MAEs among demographic characteristics

Characteristics	Made MAEs N = 330 n (%) (In a month)	Made MAEs N = 355 n (%) (In 12 months)
Age groups		
20 – 29	111 (86.0)	113 (87.6)
30 – 39	191 (74.0)	213 (82.6)
40 – 49	28 (66.7)	29 (69.0)
Gender		
Male	145 (75.9)	157 (82.2)
Female	185 (77.7)	198 (83.2)
Educational level		
Certificate/Diploma	182 (74.6)	196 (80.3)
BSc/Master's	148 (80.0)	159 (85.9)
Other specialty		
Yes	51 (77.3)	54 (81.8)
No	279 (76.9)	301 (82.9)
Training on MAs		
Yes	94 (66.7)	110 (78.0)
No	236 (81.9)	245 (85.1)
Years of nursing practice		
1 – 5	198 (81.5)	209 (86.4)
6 – 10	84 (71.8)	93 (79.5)
11+	48 (69.6)	52 (75.4)
Duration in units		
1 – 5	265 (77.7)	287 (84.2)
6 – 10	57 (72.2)	62 (78.5)
11+	8 (88.9)	6 (66.7)

Abbreviations: MAs: Medication administrations

4.3.9 Prevalence of non-IV MAEs

As shown in Table 4.4, most frequently reported non-IV MAEs were administering medication at the wrong time, with 62.2% of participants indicating that this error occurred between 21% to 100% of the time and 37.8% reported it occurring within the 0% to 20% range. Other prominent types of MAEs were errors to wrong monitoring (57.1%), failure to acknowledging a patient's right to refuse (55.5%), wrong assessment (54.3%), and wrong evaluation and documentation (52.7% each). These errors were reported as occurring in 21 – 100% of medication administration instances by respondents while the minority reported them within 0 – 20% of cases. The least common non-IV errors included wrong patient identification (19.1%), wrong route of administration (21.2%), wrong drug selection (29.1%), administering to a patient with a known allergy (31%), and administering unprescribed medication (35.0%), with most reports indicating occurrences within the 0% to 20% range.

Table 4.4: Prevalence of non-IV MAEs (N = 429)

Number of MAEs committed / Characteristic	0 – 20 n(%)	21 – 30 n(%)	31 – 40 n(%)	41 – 50 n(%)	51 – 60 n(%)	61 – 70 n(%)	71 – 80 n(%)	81 – 90 n(%)	91 – 99 n(%)	100 n(%)
Wrong route of administration	338(78.8)	40(9.3)	16(3.7)	20(4.7)	6(1.4)	3(0.7)	1(0.2)	1(0.2)	3(0.7)	1(0.2)
Wrong time	162(37.8)	84(19.6)	51 (11.9)	39 (9.1)	35 (8.2)	25(5.8)	14(3.3)	9 (2.1)	7 (1.6)	3 (0.7)
Wrong patient	347(80.9)	33 (7.7)	23 (5.4)	12 (2.8)	5 (1.2)	4 (0.9)	1 (0.2)	0 (0.0)	2 (0.5)	2 (0.5)
Wrong drug	304 (70.9)	55 (12.8)	30 (7.0)	15 (3.5)	11 (2.6)	2(0.5)	1(0.2)	5 (1.2)	3 (0.7)	3 (0.7)
Wrong dose	225 (52.4)	82 (19.1)	41 (9.6)	31 (7.2)	20 (4.7)	4 (0.9)	7(1.6)	11(2.6)	6(1.4)	2(0.5)
Wrong assessment	196 (45.7)	79 (18.4)	48 (11.2)	38 (8.9)	38 (8.9)	15 (3.5)	15 (3.5)	8 (1.9)	6 (1.4)	5 (1.2)
Wrong evaluation	203(47.3)	75 (17.5)	41 (9.6)	32 (7.5)	21 (4.9)	21 (4.9)	17 (4.0)	10 (2.3)	9 (2.1)	0 (0)
Wrong documentation	203(47.3)	80(18.6)	45(10.5)	24(5.6)	28(6.5)	14(3.3)	8(1.9)	14(3.3)	6(1.4)	7(1.6)
Wrong monitoring	184(42.9)	97(22.6)	41(9.6)	36(8.4)	24(5.6)	11(2.6)	16(3.7)	10(2.3)	7(1.6)	3(0.7)
Not acknowledging patient's right	191(44.5)	191(44.5)	43(10.0)	33(7.7)	22(5.1)	25(5.8)	16(3.7)	14(3.3)	10(2.3)	9(2.1)
Med given but not ordered by physician	279(65.0)	55(12.8)	35(8.2)	22(5.1)	8(1.9)	7(1.6)	8(1.9)	5(1.2)	6(1.4)	4(0.9)
Wrong education	208 (48.5)	66(15.4)	43(10.0)	27(6.3)	16(3.7)	23(5.4)	11 (2.6)	15(3.5)	9(2.1)	11(2.6)
Med given after discontinue order	215 (50.1)	80(18.6)	36(18.6)	33(7.7)	20(4.7)	17(4.0)	7(1.6)	7(1.6)	8(1.9)	6(1.4)
Medication is omitted	205(47.8)	79(18.4)	79(18.4)	24(5.6)	34(7.9)	11(2.6)	10(2.3)	10(2.3)	5(1.2)	6(1.4)
Medication to patient with a known allergy	296(69.0)	47(11.0)	38(8.9)	12(2.8)	11(2.6)	7(1.6)	4(0.9)	6(1.4)	5(1.2)	3(0.7)

4.3.10 Prevalence of IV MAEs

As presented in Table 4.5 below, the most prevalent IV MAEs were administering medications at the wrong time (54.9%), wrong monitoring (49.9%), omission error (49.7%), wrong evaluation (47.6%), wrong rate (46.6%), wrong assessment (45.7%) and wrong education (44.8%), with these errors reported as occurring within 21% to 100% of the time. The remaining respondents reported these errors within the 0% to 20% range. The least common IV errors included wrong patient identification (only 20% of respondents observed this error in >21% of cases), followed by wrong drug (24.7%), administering to a patient with a known allergy (25.4%), wrong method of administration (27.5%), and administering unprescribed IV medications (30.1%). The majority of these errors were reported to occur in 0–20% of instances. Overall, most MAEs fell within this lower frequency range, with fewer instances documented at higher percentages.

Table 4.5: Prevalence of IV MAEs (N = 429)

Number of MAEs committed / Characteristic	0 – 20 n(%)	21 – 30 n(%)	31 – 40 n(%)	41 – 50 n(%)	51 – 60 n(%)	61 – 70 n(%)	71 – 80 n(%)	81 – 90 n(%)	91 – 99 n(%)	100 n(%)
Wrong method	311(72.5)	63(14.7)	22(5.1)	16(3.7)	6(1.4)	4(0.9)	1(0.2)	3(0.7)	2(0.5)	1(0.2)
Wrong time	196(45.1)	104(24.2)	40(9.3)	30 (7.0)	20(4.7)	13(3.0)	8(1.9)	9(2.1)	6(1.4)	3(0.7)
Wrong patient	343 (80.0)	52(12.1)	17(4.0)	6(1.4)	5(1.2)	1(0.2)	2(0.5)	2(0.5)	1((0.2)	0(0.0)
Wrong dose	266(62.0)	74(17.2)	35(8.2)	29(6.8)	7(1.7)	7(1.7)	1(0.2)	4(0.9)	6(1.4)	0(0.0)
Wrong drug	323 (75.3)	52(12.1)	22(5.1)	10(2.3)	7(1.6)	3(0.7)	4(0.9)	3(0.7)	4(0.9)	1(0.2)
Med is omitted	216 (50.3)	81(18.9)	50(11.7)	30(7.0)	15(3.5)	10(2.3)	5(1.2)	14(3.3)	5(1.2)	3(0.7)
Med not ordered	296(69.0)	63(14.7)	32(7.5)	13(3.0)	6(1.4)	6(1.4)	5(1.2)	4(0.9)	3(0.7)	1(0.2)
Med given after discontinue order	254(59.2)	67(15.6)	42(9.8)	25(5.8)	13(3.0)	5(1.2)	8(1.9)	3(0.7)	6(1.4)	6(1.4)
Given to patient with known allergy	318(74.1)	49(11.4)	29(6.8)	13(3.0)	8(1.9)	4(0.9)	2(0.5)	3(0.7)	2(0.5)	1(0.2)
Wrong fluid	285(66.5)	55(12.8)	36(8.4)	26(6.1)	12(2.8)	3(0.7)	3(0.7)	2(0.5)	7(1.6)	0(0.0)
Wrong rate	229(53.4)	91(21.2)	29(6.8)	19(4.4)	25(5.8)	9(2.1)	6(1.4)	10(2.3)	7(1.6)	4(0.9)
Wrong education	237(55.2)	75(17.5)	37(8.6)	24(5.6)	15(3.5)	12(2.8)	7(1.6)	14(3.3)	7(1.6)	1(0.2)
Wrong assessment	233(54.3)	78(18.2)	32(7.5)	30(7.0)	17 (4.0)	11(2.6)	6(1.4)	12(2.8)	10(2.3)	0(0.0)
Wrong monitoring	215(50.1)	97(22.6)	34(7.9)	33(7.7)	18(4.2)	6(1.4)	11(2.6)	7(1.6)	6(1.4)	2(0.5)
Wrong evaluation	225(52.4)	72(16.8)	37(8.6)	35(8.2)	20(4.7)	17(4.0)	11(2.6)	7(1.6)	5(1.2)	0(0.0)

4.4 Comparison of MAEs Across Units

4.4.1 Mean Percentage Differences of MAEs in Units

As indicated in figure 4.2, the mean percentage of MAEs varied across different units, with the ICU recording the highest mean percentage at 2.88, followed by dialysis unit at 2.43, indicating a relatively high frequency of MAEs. The medical unit reported mean percentage difference of 2.39, while the Accident and Emergency (A & E) and NICU each reported a mean of 2.36 each. The Surgical unit, obstetrics, pediatrics reported mean percentages of 2.22, 2.16 and 1.83 respectively. Other units, including the OPD, Mental health unit, collectively reported a mean percentage of 1.67.

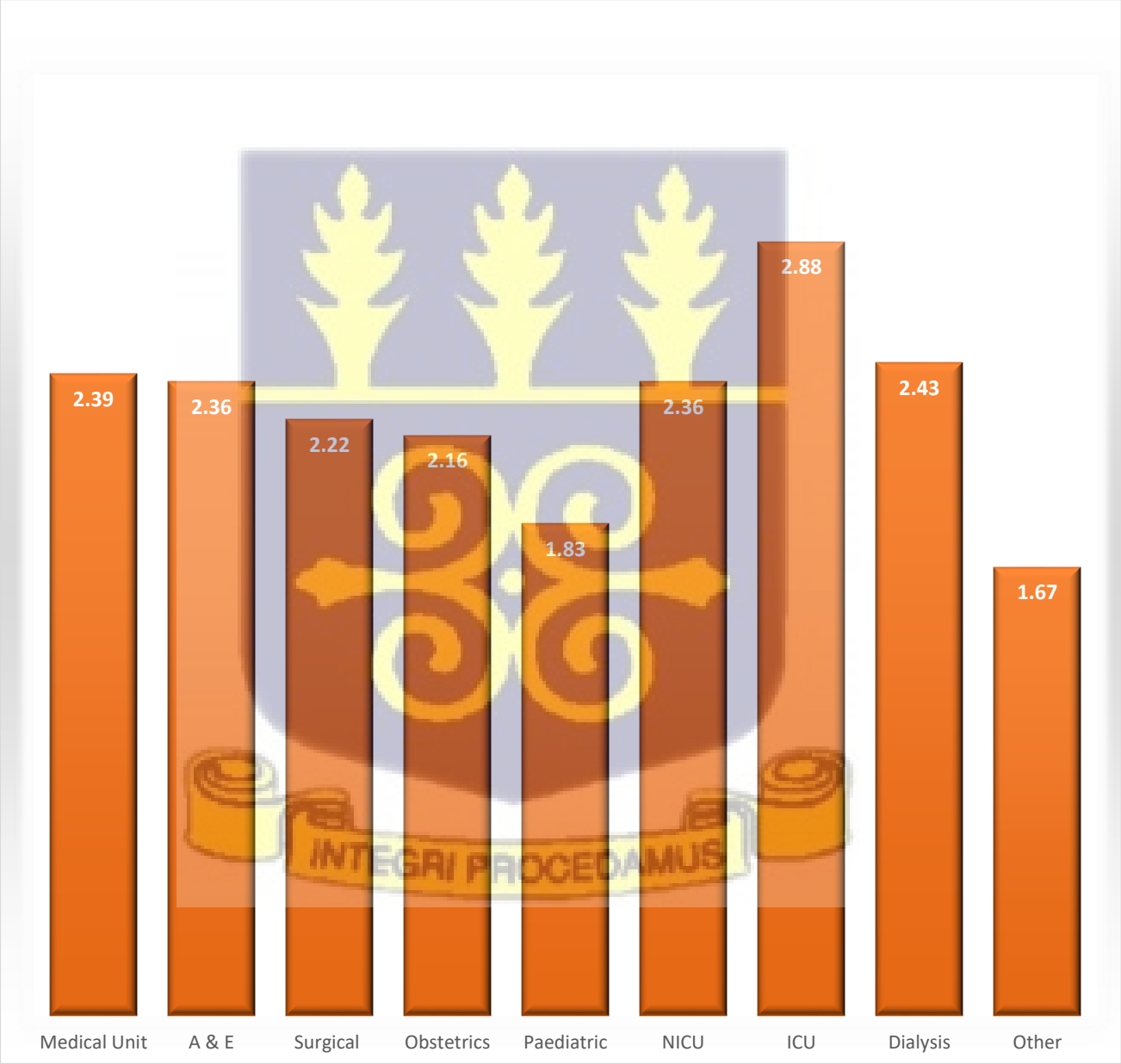


Figure 4.2: Unit mean percentage difference

4.4.2 Welch's Anova for MAEs across different units

To assess whether there were significant variations in the number of MAEs committed across various hospital units, Welch's ANOVA was conducted due to unequal variances among groups. The results indicated no statistically significant differences in MAEs across units, Welch's F(8, 70.67) =1.42, p = 0.203 (Table 4.6).

Table 4.6: Welch's Anova for MAEs across units

Robust test of Equality of Means	**Statistic[a]**	***p* - value**
Welch	1.421	0.203

4.4.3 Games-Howell Post Hoc Test

Post-hoc analysis using Games-Howell test was conducted to examine pairwise differences in MAEs among units. The results revealed that no statistically significant differences were observed between any unit pairs (all p-values > 0.05) (Table 4.7).

Table 4.7: Games-Howell post hoc test for MAEs across units

(I) Unit	(J) Unit	Mean difference (I – J)	95% CI (Lower – Upper)	*p* - value
Accident and Emergency	Medical	0.26	(-0.78 – 1.31)	0.997
	Surgical	0.08	(-0.98 – 1.13)	1.000
	Obstetrics	-0.15	(-1.43 – 1.13)	1.000
	Pediatrics	0.29	(-0.80 – 1.37)	0.996
	NICU	-0.33	(-2.71 – 2.05)	1.000
	ICU	0.85	(-0.45 – 2.14)	0.460
	Dialysis	0.96	(-1.98 – 3.89)	0.897
	Other	-0.12	(-2.00 – 1.75)	1.000
NICU	Medical	0.59	(-1.75 – 2.94)	0.990
	Accident and Emergency	0.33	(-2.05 – 2.71)	1.000
	Surgical	0.41	(-1.94 – 2.75)	0.999
	Obstetrics	0.18	(-2.24 – 2.60)	1.000
	Pediatrics	0.62	(-1.74 – 2.97)	0.988
	ICU	1.18	(-1.24 – 3.60)	0.739
	Dialysis	1.29	(-1.99 – 4.56)	0.881
	Other	0.21	(-2.49 – 2.90)	1.000
ICU	Medical	-0.59	(-1.78 – 0.61)	0.778
	Accident and Emergency	-0.85	(-2.14 – 0.45)	0.460
	Surgical	-0.77	(-1.97 – 0.42)	0.460
	Obstetrics	-1.00	(-2.38 – 0.39)	0.345
	Pediatrics	-0.56	(-1.78 – 0.66)	0.839
	NICU	-1.18	(-3.60 – 1.24)	0.739
	Dialysis	0.11	(-2.84 – 3.05)	1.000
	Other*	-0.97	(-2.90 – 0.96)	0.768

Only selected comparisons shown for concision. Full results available in Appendix III
Abbreviations; NICU: Neonatal intensive care unit, ICU: Intensive care unit; CI: confidence interval
**OPD, Mental health unit*

4.5 Risk factors for MAEs

4.5.1 Frequency of risk factors

Tables 4.8 – 4.11, present the reasons for MAEs as indicated by respondents. As indicated in table 4.8, the primary factor contributing to MAEs, reported by 93.0% of respondents, was network-related LHIMS disruptions. Unexplained electronic system disruptions followed closely, with 88.8% of respondents indicating it as a cause. Also, as shown in table 4.10, insufficient training on new medications was cited by 88.1% as a risk factor for MAEs whereas high workload intensity in units was noted by 82.3% of respondents. Additionally, Table 4.9 shows that poor communication between nurses and physicians was indicated by 79.5% of respondents as a major contributor, with 76.5% pointing to poor communication among nurses as a further risk factor. Other frequently reported factors contributing to MAEs at the TTH as indicated by respondents included distractions in the work environment and understaffing, each identified by 79.3% (Table 4.8, 4.10). Also, equipment malfunctions was reported by 78.8% as a risk factor, fatigue (77.6%), transcriptions errors (errors within the LHIMS) (76.5%), interruptions during medication administration (75.3%), and poor documentation (74.8%). Opinions were divided on the impact of intoxicated patients, with 50.1% of respondents acknowledging it as a risk for MAEs. Less frequently cited factors included non-adherence to approved medication administration procedures (26.3%), excessive noise (31.9%), lack of accessible information on medications in the unit (36.8%), and incorrect labelling by the pharmacy (37.3%).

Table 4.8: Reasons for MAEs (Individual and Patient factors)

Characteristics	Frequency (n=429)	Percentage (%)
Individual factors		
Nurses interrupted during medications		
Yes	323	75.3
No	106	24.7
Distraction		79.3
Yes	340	79.3
No	89	20.7
Inexperience of respondent		
Yes	267	62.2
No	162	37.8
Fatigue		
Yes	333	77.6
No	96	22.4
Stress		
Yes	355	82.8
No	74	17.2
Inattentiveness of respondent		
Yes	272	63.4
No	157	36.6
Poor calculation		
Yes	305	71.1
No	124	28.9
Patient factors		
Language barrier between nurse and patient		
Yes	300	69.9
No	129	30.1
Uncooperative patient		
Yes	301	70.2
No	128	29.8
Intoxicated patient		
Yes	215	50.1
No	214	49.9
Patient with complex medical history		
Yes	247	57.6
No	182	42.4
Patients are off the ward for other care		
Yes	263	61.3
No	166	38.7

Table 4.9: Reasons for MAEs (communication issues and task characteristics)

Characteristics	Frequency (n=429)	Percentage (%)
Communication issues		
Medication orders are not clearly understood		
Yes	298	69.5
No	131	30.5
Change orders frequently		
Yes	273	63.6
No	156	36.4
Abbreviations are used instead of writing the orders in full		
Yes	232	54.1
No	197	45.9
Verbal orders given		
Yes	252	58.7
No	177	41.3
Poor communication between nurses and physicians		
Yes	341	79.5
No	88	20.5
Poor communication among nurses		
Yes	328	76.5
No	101	23.5
Unable to contact correct staff for clarification		
Yes	261	60.8
No	168	39.2
No easy way in the unit to look up for information on medication		
Yes	158	36.8
No	271	63.2
Handing over problems		
Yes	310	72.3
No	119	27.7
When scheduled meds are delayed, time is not communicated		
Yes	248	57.8
No	181	42.2
Poor documentation		
Yes	321	74.8
No	108	25.2
Task characteristics		
Unfamiliar task		
Yes	264	61.5
No	165	38.5
Monotonous task		
Yes	242	56.4
No	187	43.6
Administering med prepared by another nurse		
Yes	243	56.6
No	186	43.4

Table 4.10: Reasons for MAEs (education/training, physical environmental factors, Workload and staffing issues)

Characteristics	Frequency (n=429)	Percentage (%)
Education and Training		
No enough in-service training on new medications		
Yes	378	88.1
No	51	11.9
Non adherence to approved medication administration procedure		
Yes	113	26.3
No	316	73.7
Physical environment factors		
Excessive noise		
Yes	137	31.9
No	292	68.1
Poor lightning/visibility		
Yes	219	51.0
No	210	49.0
Workload and staffing issues		
High unit workload		
Yes	353	82.3
No	76	17.7
Insufficient staff in the unit		
Yes	340	79.3
No	89	20.7
Inappropriate delegation of staff		
Yes	269	62.7
No	160	37.3
Nurses get pulled between teams and other units		
Yes	182	42.4
No	247	57.6
Administer medication prepared by another		
Yes	243	56.6
No	186	43.4
Type of shift		
Morning	145	33.8
Afternoon	60	14.0
Night	135	31.5
Equal risk	89	20.7

Table 4.11: Reasons for MAEs (External factors, Tools/Equipment)

Characteristics	Frequency (n=429)	Percentage (%)
External factors		
Pharmacy does not label the meds correctly		
Yes	160	37.3
No	269	62.7
The names of medications are similar		
Yes	202	47.1
No	227	52.9
Different medications look alike		
Yes	276	64.3
No	153	35.7
The packaging of many meds are similar		
Yes	273	63.6
No	156	36.4
Many patients are on the same or similar meds		
Yes	299	69.7
No	130	30.3
Tools/Equipment		
Equipment malfunctions		
Yes	338	78.8
No	91	21.2
Errors are made on the LHIMS		
Yes	328	76.5
No	101	23.5
LHIMS disruptions due to network		
Yes	399	93.0
No	30	7.0
Unexplained electronic system disruptions		
Yes	381	88.8
No	48	11.2

Abbreviations: LHIMS: Lightwave Health Information Management System

4.5.2 Logistic regression analysis of demographic factors and risk of MAEs

Table 4.12 below, shows the unadjusted and adjusted odds ratios (ORs) for the association between various demographic characteristics and the likelihood of committing MAEs.

Regarding gender, male respondents had similar odds of committing MAEs compared to females, with no statistically significant difference observed in both the unadjusted [OR = 0.99 (95% CI: 0.70–1.40)] and adjusted models [AOR = 0.90 (95% CI: 0.62–1.30)]. The confounders considered in these analyses were age, educational level, and religion.

For age, those in the 30–39years age group showed a non-significant reduction in the odds of MAEs [OR = 0.71 (95% CI: 0.48–1.05); AOR = 0.83 (95% CI: 0.55–1.24)]. Notably, respondents aged 40–49 had significantly lower odds of committing MAEs compared to the 20–29 group. In the unadjusted model, they had 66% reduced odds [OR = 0.34 (95% CI: 0.18–0.66)], and after adjusting for gender, educational level and religion they had 51% reduced odds [AOR = 0.49 (95% CI: 0.24–0.97)]. The 95% CI indicate that the true reduction in odds could range from 34% to 82% (unadjusted) and 3% to 76% (adjusted), suggesting that older individuals may be less prone to committing MAEs.

With education, respondents with Certificate/Diploma had 2.3 times higher odds of committing MAEs in the unadjusted analysis [OR = 2.30 (95% CI: 1.63–3.33)]. This association persisted after adjusting for gender, age, and religion [AOR = 2.07 (95% CI: 1.42–3.03)], indicating 2.07 times higher odds of MAEs. The 95% CI suggest that the elevated odds range from 1.42 to 3.03 times, implying that higher educational qualifications might play a protective role against MAEs.

Regarding religion, after adjusting for gender, age, and educational level, the analysis indicate that Islam/Others did not show a statistically significant association with the likelihood of committing MAEs [AOR= 1.26 (95% CI: 0.75 – 2.11). This indicates that, nurses' religion has no effect on the odds of MAEs.

Table 4.12: Logistic regression model on the association between demographic factors and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Gender				
Female	40 (16.8)	198 (83.2)	1.00	1.00
Male	34(17.8)	157(82.2)	0.99 (0.70 – 1.40)	0.90 (0.62 – 1.30)
Age				
20 -29	16 (12.4)	113 (87.6)	1.00	1.00
30 -39	45 (17.4)	213 (82.6)	0.71 (0.48 – 1.05)	0.83 (0.55 – 1.24)
40 - 49	13 (31.0)	29 (69.0)	0.34 (0.18 – 0.66)	0.49 (0.24 – 0.97)*
Education				
BSc/Masters	48 (19.7)	196 (80.3)	1.00	1.00
Certificate/Diploma	26 (14.1)	159 (85.9)	2.3 (1.63 – 3.33)	2.07 (1.42 – 3.03)*
Religion				
Christianity	41 (19.0)	175 (81.0)	1.00	1.00
Islam/Others	33 (15.5)	180 (84.5)	1.28 (0.77 – 2.11)	1.26 (0.75 – 2.11)

Note: 1.00; reference category Others: Traditionalist, No religion, and Rastafarianism

**Significant association*

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval; BSc: Bachelor of Science

4.5.3 Logistic regression analysis of work-related factors and risk of MAEs

Table 4.13 presents the unadjusted and adjusted odds ratios (ORs) for work related factors associated with the occurrence of MAEs. In the analysis, the predictors examined were, years of experience, length of stay (duration) in a particular ward, having a background in another specialty, and whether the respondent had received training on medication administrations (MAs).

Regarding years of nursing practice, nurses with 6–10 years of experience were 37% less likely to commit MAEs compared to those with 1–5 years of experience [OR = 0.63 (95% CI: 0.42–0.94)]. However, after adjusting for potential confounders, this association got diminished and was no longer statistically significant [AOR = 0.72 (95% CI: 0.44–1.18)]. Yet, nurses with 11 years or more of experience had 59% reduced odds of committing MAEs in the unadjusted analysis [OR= 0.41 (0.25 – 0.69)] and 55% reduced odds after adjustment [AOR = 0.45 (95% CI: 0.25–0.82)]. This indicates that the true reduction in odds for the adjusted model ranges from 18% to 75% (95% Cl) suggesting that longer work experience may be protective against MAEs.

When comparing respondents based on the duration of stay in their current units, neither the 6–10 years group [AOR = 1.06 (95% CI: 0.61–1.83)] nor the group with 11 or more years of stay in a particular unit [AOR = 0.81 (95% CI: 0.21–3.30)] showed statistically significant differences in MAE occurrence compared to nurses who had only worked for 1 to5 years. The results indicate that the length of stay in a particular unit does not have a protective effect against MAEs.

Similarly, "Other Specialty" did not show a significant association with MAEs, as nurses with a background in other specialty had an AOR of 0.86 (95% CI: 0.51–1.44) compared to those without such a background.

Noticeably, training on MAs was significantly associated with lower odds of MAEs. Nurses who had received training had 61% reduced odds in the unadjusted model [OR = (0.39 (95% Cl: 0.27–0.58)] and 59% lower odds after adjustment [AOR = 0.41 (95% CI: 0.28–0.61)] compared to those who had not received such training. We are 95% confident that true reduction ranges from 39% to 72%, implying that training on MAs reduces the odds of MAEs occurrence among nurses.

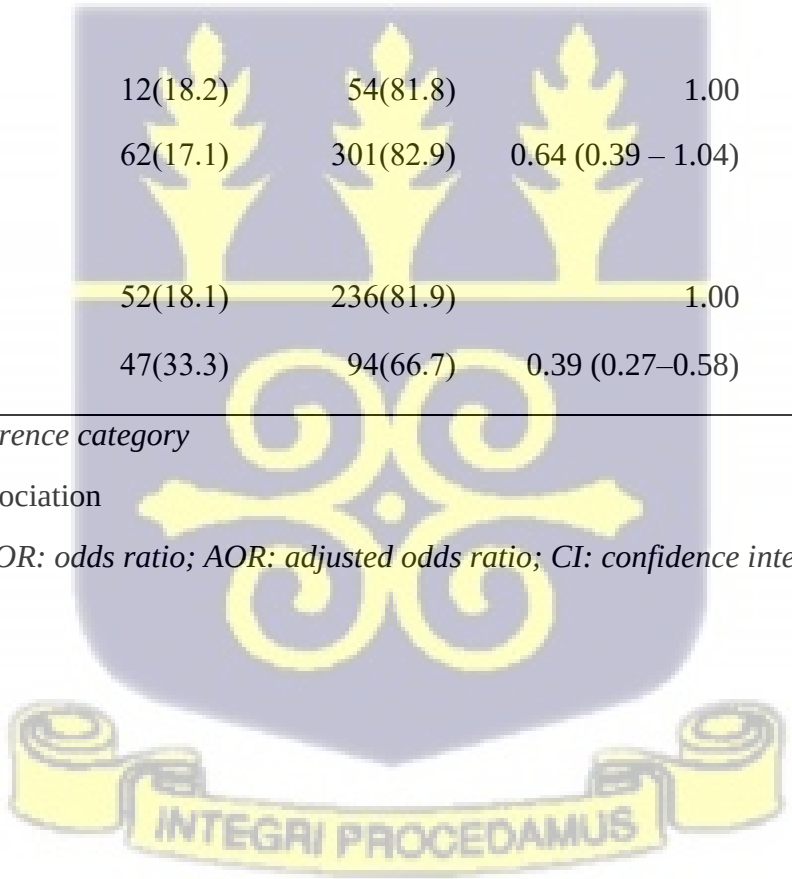
Table 4.13: Logistic regression model on the association between work related factors and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Experience				
1 – 5	33(13.6)	209(86.4)	1.00	1.00
6 – 10	24(20.5)	93(79.5)	0.63 (0.42 – 0.94)	0.72 (0.44 – 1.18)
11+	17(17.3)	52(75.4)	0.41 (0.25 – 0.69)	0.45 (0.25 – 0.82)*
Duration				
1 – 5	54(15.8)	287(287)	1.00	1.00
6 – 10	17(21.5)	62(78.5)	0.78 (0.50 – 1.22)	1.06 (0.61 – 1.83)
11+	3 (33.3)	6(66.7)	0.43 (0.13 – 1.50)	0.81 (0.21 – 3.30)
Other specialty				
No	12(18.2)	54(81.8)	1.00	1.00
Yes	62(17.1)	301(82.9)	0.64 (0.39 – 1.04)	0.86 (0.51 – 1.44)
Training on MAs				
No	52(18.1)	236(81.9)	1.00	1.00
Yes	47(33.3)	94(66.7)	0.39 (0.27–0.58)	0.41 (0.28 – 0.61) *

Note: 1.00; reference category

*Significant association

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval



4.5.4 Logistic regression analysis of reported causes and risk of MAEs

Tables 4.14–4.21 present the logistic regression model analyzing the association between respondents' stated reasons for MAEs and their likelihood of committing MAEs.

As shown in Table 4.15, nurses who perceived patients leaving the ward for other treatments as a risk factor had 1.69 times (69%) higher odds of MAEs compared to those who did not [AOR: 1.69 (95% CI: 1.12–2.54)], with 95% confident that the true increase in odds ranges from 12% higher to 2.54 times higher.

Communication-related issues, as shown in Table 4.13, revealed that nurses who indicated poor documentation as a contributing factor had 38% lower odds of MAEs compared to those who thought poor documentation was not associated with MAEs [AOR: 0.62 (95% CI: 0.39–0.98)]. We are 95% confident that the true reduction in odds rages from 2% to 61%.

Relative to task characteristics (Table 4.18), nurses who attributed MAEs to carrying out unfamiliar tasks had 65% higher odds of MAEs [AOR: 1.65 (95% CI: 1.08–2.51)] and the true increase in odds ranges from 8% higher to 2 and half times higher with 95% confidence.

Table 4.19 highlights the association between environmental factors and the likelihood of committing MAEs. Nurses who identified excessive noise as a cause of MAEs had over 2 times higher odds of MAEs compared to their counterparts who did not share this opinion [AOR: 2.03 (95% CI: 1.35–3.03)]. We are 95% confident that the true effect is likely between 35% increase and 2 times higher odds.

Table 4.20, examines nurses' perceptions of the respondents about factors regarding workload and staffing issues that contribute to MAEs and their possibilities of making errors. As indicated in the table, nurses who reported being pulled between teams as a contributing factor had 49% increased odds of MAEs [(AOR: 1.49; 95% CI: 1.02–2.17)]. This suggests that, nurses who hold the opinion that switching between teams contributes to MAEs had 49% higher odds of MAEs as compared to those who did not, with a 95% confidence interval of 1.02 to 2.17.

Additionally, nurses who perceived morning shifts as riskier had 79% increased odds of MAEs AOR: [1.79 (95% CI: 1.08–2.95)]. Thus, nurses who perceive the morning shift as riskier have 1.79 times higher odds of MAEs compared to those who perceived all shifts as equally risky, with 95% confidence interval of 1.08 to 2.95. Also, nurses who stated that afternoon shifts were riskier had 2.8 times higher odds of MAEs, compared to those who indicated that all shifts were equally risky [AOR: 2.80 (95% CI: 1.51–5.19)]. The true increase in odds ranges from 51% higher to 5.19 times higher.

In Table 4.21**,** the logistic regression analysis suggests no statistically significant difference between nurses who perceived disruptions in the LHIMS system due to network connectivity as a reason for MAEs and those who did not [AOR = 0.72 (95% CI: 0.30–1.73)]. Similarly, nurses who attributed MAEs to unexplained network disruptions did not have significantly higher odds of committing errors as compared to those who did not agree with them [AOR = 0.89 (95% CI: 0.43–1.83)].

No significant variations were observed for the other reasons stated in relation to the odds of committing MAEs.

It is important to note that while respondents were asked to indicate reasons they perceived as causes of MAEs and to report the number of errors they personally committed, the data collection tool did not assess whether respondents directly experienced these factors during their duties. Therefore, the perceived causes may not necessarily predict the actual occurrence of MAEs.

Table 4.14: Logistic regression model on the association between reasons for MAEs (individual factors) and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Interrupted to perform other duties				
No	20(18.9)	86(81.1)	1.00	1.00
Yes	54(16.7)	269(83.3	1.35 (0.90–2.04)	1.20 (0.75–1.92)
Distractions				
No	19(21.3)	70(78.7)	1.00	1.00
Yes	55(16.2)	285(83.8)	1.53 (0.99 – 2.36)	1.39 (0.85–2.26)
Inexperience				
No	19(21.3)	70(78.7)	1.00	1.00
Yes	55(16.2)	285(83.8)	1.11 (0.77 – 1.58)	1.19 (0.77–1.83)
Fatigue				
No	18(18.8)	78(81.3)	1.00	1.00
Yes	56(16.8)	277(83.2)	1.00 (0.66 – 1.52)	0.98 (0.57–1.70)
Stress				
No	14(18.9)	60(81.1)	1.00	1.00
Yes	60(16.9)	295(83.1)	0.87 (0.55 – 1.38)	0.76 (0.42–1.38)
Inattentiveness				
No	25(15.9)	132(84.1)	1.00	1.00
Yes	49(18.0)	223(82.0)	1.01 (0.70 – 1.45)	0.95 (0.62–1.47)
Poor calculation				
No	21(16.9)	103(83.1)	1.00	1.00
Yes	53(17.4)	252(82.6)	1.01 (0.69 – 1.48)	0.93 (0.60–1.46)

Note: 1.00; reference category

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

Table 4.15: Logistic regression model on the association between reasons for MAEs (patient factors) and MAEs

Characteristic	Made no MAEs N=74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Language barrier (nurse-patient)				
No	29(22.5)	100(77.5)	1.00	1.00
Yes	45(15.0)	255(85.0)	1.47 (1.00–2.15)	1.32 (0.86–2.02)
Uncooperative patient				
No	28(21.9)	100(78.1)	1.00	1.00
Yes	46(15.3)	255(84.7)	1.11 (0.75–1.66)	0.85 (0.54–1.34)
Intoxicated patient				
No	40(18.7)	174(81.3)	1.00	1.00
Yes	34(15.8)	181(84.2)	1.20 (0.83–1.74)	0.88 (0.57–1.36)
Complex medical history				
No	40(22.0)	142(78.0)	1.00	1.00
Yes	34(13.8)	213(86.2)	1.38 (0.96–1.97)	1.17 (0.78–1.75)
Patients off the ward				
No	41(24.7)	125(75.3)	1.00	1.00
Yes	33(12.5)	230(87.5)	1.72 (1.19–2.64)	1.69 (1.12–2.54)*

Note: 1.00; reference category

**Significant association*

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

Table 4.16: Logistic regression model on the association between reasons for MAEs (communication issues) and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Orders not understood				
No	26(19.8)	105(80.2)	1.00	1.00
Yes	48(16.1)	250(83.9)	1.20 (0.82 – 1.76)	1.05 (0.68–1.64)
Frequently changed orders				
No	25(16.0)	131(84.0)	1.00	1.00
Yes	49(17.9)	224(82.1)	1.04 (0.68–1.40)	0.90 (0.60–1.36)
Use of abbreviations				
No	33(16.8)	164(83.2)	1.00	1.00
Yes	41(17.7)	191(82.3)	1.12 (0.74–1.46)	0.96 (0.64–1.44)
Verbal orders				
No	27(15.3)	150(84.7)	1.00	1.00
Yes	47(18.7)	205(81.3)	1.25 (0.92–1.69)	1.13 (0.75–1.71)
Poor communication between nurses and physicians				
No	14(15.9)	74(84.1)	1.00	1.00
Yes	60(17.6)	281(82.4)	1.26 (0.86–1.85)	1.38 (0.80–2.38)
Poor communication among nurses				
No	22(21.8)	79(78.2)	1.00	1.00
Yes	52(15.9)	276(84.1)	1.55 (1.03–2.35)	1.38 (0.80–2.38)
Unable to clarify orders				
No	34(20.2)	134(79.8)	1.00	1.00
Yes	40(15.3)	221(84.7)	1.4 (1.02–2.05)	1.24 (0.82–1.89)

Note: 1.00; reference category

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

Table 4.17: Logistic regression model on the association between reasons for MAEs (communication issues) and MAEs (continued)

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
No easy way to access information				
No	52(19.2)	219(80.8)	1.00	1.00
Yes	22(13.9)	136(86.1)	1.27 (0.88–1.83)	1.13 (0.77–1.64)
Handover problems				
No	21(17.6)	98(82.4)	1.00	1.00
Yes	53(17.1)	257(82.9)	1.25 (0.89–1.70)	1.11 (0.71–1.74)
No communication about scheduled medications				
No	42(23.2)	139(76.8)	1.00	1.00
Yes	32(12.9)	216(87.1)	1.49 (1.05–2.13)	1.46 (0.98–2.17)
Poor documentation				
No	19(17.6)	89(82.4)	1.00	1.00
Yes	55(17.1)	266(82.9)	0.89 (0.51–1.55)	0.62 (0.39–0.98)*

Note: 1.00; reference category

**Significant association*

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

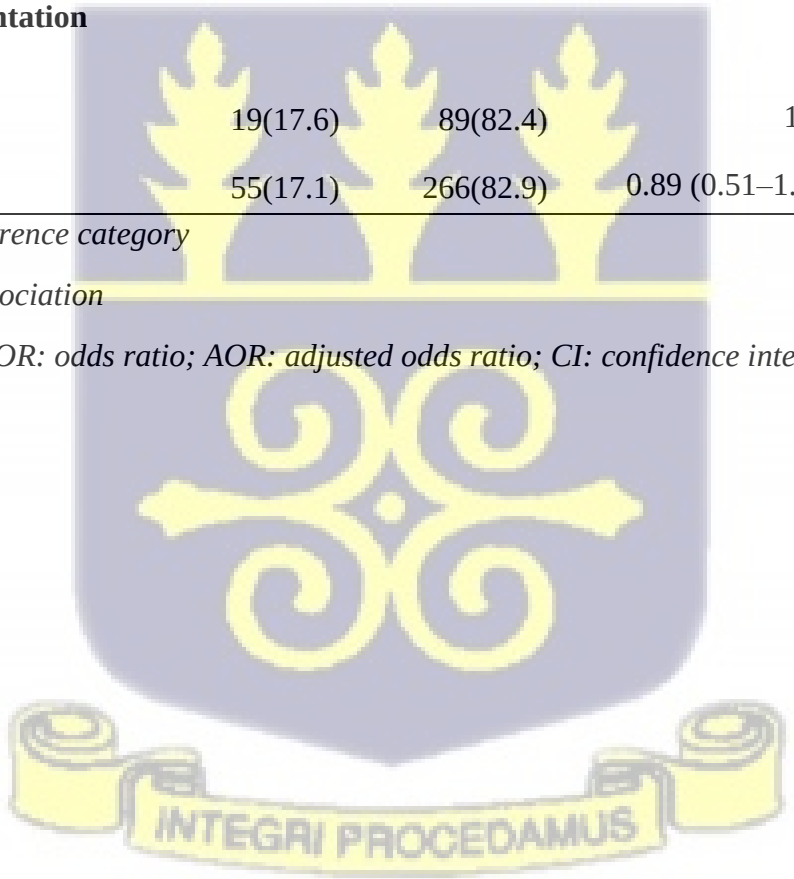


Table 4.18: Logistic regression model on the association between reasons for MAEs (task characteristics) and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Monotonous task				
No	39(20.9)	148 (79.1)	1.00	1.00
Yes	35(14.5)	207(85.5)	1.35 (0.95–1.94)	1.24 (0.83–1.86)
Unfamiliar task				
No	39(23.6)	126(76.4)	1.00	1.00
Yes	35(13.3)	229(86.7)	1.57 (1.09–2.38)	1.65 (1.08–2.51)*
Medication prepared by another				
No	29(15.6)	157(84.4)	1.00	1.00
Yes	45(18.5)	198(81.5)	0.89 (0.51–1.56)	0.78 (0.53–1.15)

Note: 1.00; reference category

**Significant association*

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

Table 4.19: Logistic regression model on the association between reasons for MAEs (education/training and environmental factors) and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
No training on new medication				
No	12 23.5)	39 (76.5)	1.00	1.00
Yes	62(16.4)	316(83.6)	1.37 (0.79–2.26)	1.36 (0.77–2.39)
Non-adherence to approved medication protocols				
No	56(17.7)	260(82.3)	1.00	1.00
Yes	18(15.9)	95(84.1)	0.93 (0.63–1.44)	0.75 (0.49–1.15)
Excessive noise				
No	62(21.2)	230(78.8)	1.00	1.00
Yes	12(8.8)	125(91.2)	2.12 (1.45–3.09)	2.03 (1.35–3.03)*
Poor lighting				
No	43(20.5)	167(79.5)	1.00	1.00
Yes	31(14.2)	188(85.8)	1.47 (1.03–2.32)	1.18 (0.80–1.74)

Note: 1.00; reference category

**Significant association*

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

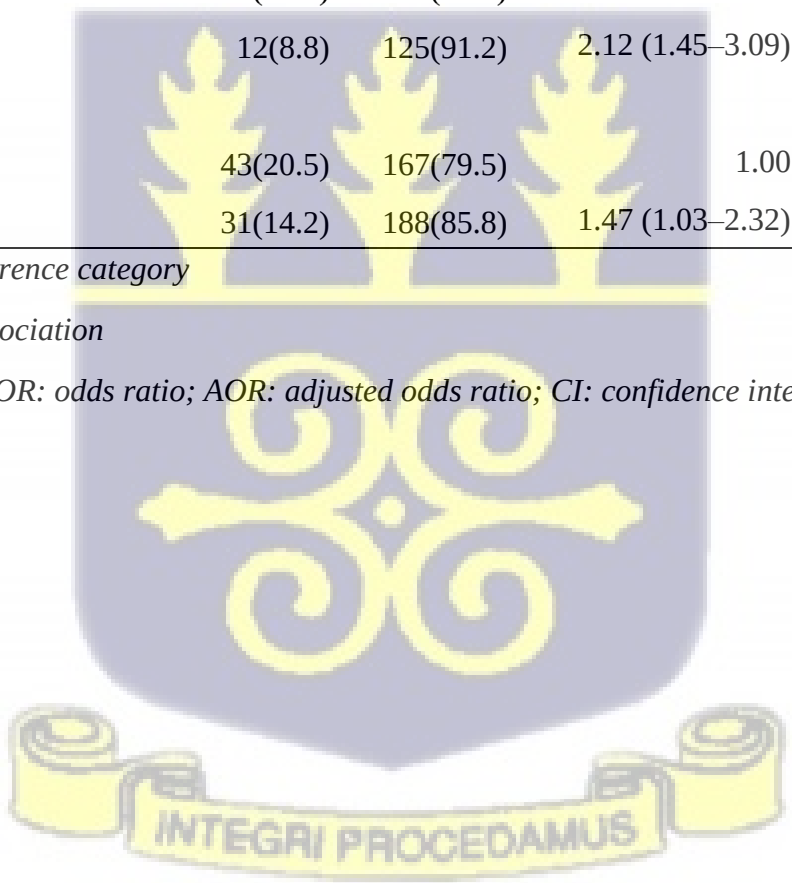


Table 4.20: Logistic regression model on the association between reasons for MAEs (workload and staffing issues) and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Workload				
No	18(23.7)	58(76.3)	1.00	1.00
Yes	56(15.9)	297(84.1)	1.17 (0.73–1.90)	0.86 (0.51–1.45)
Insufficient staff				
No	21(23.6)	68(76.4)	1.00	1.00
Yes	53(15.6)	287(84.4)	1.37 (0.89–2.47)	1.17 (0.72–1.89)
Inappropriate delegation				
No	29(18.1)	131(81.9)	1.00	1.00
Yes	45(16.7)	224(83.3)	1.28 (0.92–1.92)	1.13 (0.75–1.70)
Pulled between teams				
No	46(18.6)	201(81.4)	1.00	1.00
Yes	28(15.4)	154(84.6)	1.62 (1.14–2.47)	1.49 (1.02–2.17)*
Medication prepared by another person				
No	29(15.6)	157(84.4)	1.00	1.00
Yes	45(18.5)	198(81.5)	0.89 (0.51–1.56)	0.78 (0.53–1.15)
Shift type				
No difference in shift	24 (27.0)	65(73.0)	1.00	1.00
Morning	19(13.1)	126(86.9)	1.89 (1.15–3.10)*	1.79(1.08–2.95)*
Afternoon	6(10.0)	54(90.0)	3.13 (1.71–5.74)*	2.80 (1.51–5.19)*
Night)	25(18.5)	110(81.5)	1.24 (0.75–2.04)	1.11 (0.66–1.85)

Note: 1.00; reference category

**Significant association*

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

Table 4.21: Logistic regression model on the association between reasons for MAEs (drugs/external factors and tools/equipment issues) and MAEs

Characteristic	Made no MAEs N= 74 n(%)	Made MAEs N=355 n(%)	Unadjusted OR (95% CI)	AOR (95% CI)
Wrong label from pharmacy				
No	50(18.6)	219(81.4)	1.00	1.00
Yes	24(15.0)	136(85.0)	1.11 (0.78–1.57)	0.92 (0.62–1.37)
Similar drug name				
No	43(18.9)	184(81.1)	1.00	1.00
Yes	31(15.3)	171(84.7)	1.44 (1.02–2.04)	1.41 (0.92–2.17)
Look-alike medication				
No	29(19.0)	124(81.0)	1.00	1.00
Yes	45(16.3)	231(83.7)	1.25 (0.87–1.82)	0.96 (0.60–1.54)
Similar packaging				
No	30(19.2)	126(80.8)	1.00	1.00
Yes	44(16.1)	229(83.9)	1.31 (0.94–1.84)	0.99 (0.61–1.61)
Many patients with similar meds				
No	33(25.4)	97(74.6)	1.00	1.00
Yes	41(13.7)	258(86.3)	1.58 (1.08–2.34)	1.47 (0.92–2.34)
Equipment malfunctions				
No	19(20.9)	72(79.1)	1.00	1.00
Yes	55(16.3)	283(83.7)	1.01 (0.58–1.76)	0.99 (0.63–1.55
Errors in LHIMS				
No	21(20.8)	80(79.2)	1.00	1.00
Yes	53(16.2)	275(83.8)	1.36 (0.88–2.09)	1.16 (0.75–1.81)
LHIMS disruptions (network issues				
No	6(20.0)	24(80.0)	1.00	1.00
Yes	68(17.0)	331(83.0)	0.69 (0.32–1.49)	0.72 (0.30–1.73)
Unexplained LHIMS failure				
No	9(18.8)	39(81.3)	1.00	1.00
Yes	65(17.1)	316(82.9)	0.78 (0.47–1.27)	0.89 (0.43–1.83)

Note: 1.00; reference category

Abbreviations: OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval; LHIMS: Lightwave Health Information

CHAPTER FIVE

DISCUSSION

5.0 Overview of Findings

This study aimed to assess the prevalence and risk factors associated with MAEs at the TTH. The results revealed that MAEs remain a significant concern, with a range of error types reported at varying rates. The prevalence rate in the year prior to the study was 82.8%.

Notably, the most frequently reported non-IV MAE involved administering medication at the wrong time. This was reported within 21% - 100% of all medications administered by 62.2% of respondents. Other common errors which were reported largely between 21 – 100% of the time included wrong monitoring (57.1%), failure to acknowledge a patient's right to refuse medication (55.5%), wrong assessment (54.3%) and wrong evaluation and documentation (52.7% each). Among the non-IV MAEs, the least commonly reported were wrong patient identification (80.9% of respondents reported this in only 0 – 20% of cases) and wrong route of administrations (78.8% reported similarly low occurrence). Similarly, the most prevalent IV MAE was wrong time with 54.9% of the respondents reporting occurrence within 21 – 100% of medication administration incidents. Other common IV related MAEs were wrong monitoring (49.9%), omission error, wrong evaluation (47.6%), wrong rate (46.6%), and wrong assessment (45.7%). Administering medication to the wrong patient was the least reported IV MAE with only 20% reporting within the 21–100% range. These findings align with global trends–especially in African contexts –where wrong timing and monitoring errors are consistently reported as part of the most frequent occurring MAEs (Mohammed et al., 2022; Wondmieneh et al., 2020).

Meanwhile, the prevalence of MAEs showed no statistically significant variations across different hospital units.

Regarding risk factors, the study identified network-related LHIMS disruptions (93%), unexplained electronic system failures (88.8%), insufficient training on new medications (88.1%), and high workload (82.3%) as the most commonly reported contributors. Logistic regression analysis further revealed that the lack of training on MA and educational level among others were significant predictors of MAEs. These findings are consistent with other studies such as those conducted by Mohammed et al. (2022) and Blignaut et al. (2019).

5.1 Prevalence of MAEs

5.1.1 Over all prevalence

The results indicate that the overall prevalence of MAEs and the various types of errors at TTH are similar to findings in other regions, although there are notable discrepancies. Specifically, the study found that the prevalence of MAEs at TTH was 76.9% in the month preceding the study and 82.8% over the past year. This high prevalence rate aligns with findings from other studies; for example, research in Ethiopia and Saudi Arabia reported prevalence rates of 68.1% and 72.1%, respectively (Feleke et al., 2020; Alandajani et al., 2022). However, slight differences in prevalence rates may stem from variations in healthcare systems, available resources, and safety protocols. These discrepancies highlight the importance of context-specific interventions, as challenges vary across different countries and healthcare settings.

Similarly, a study examining the prevalence of MAEs in the pediatric unit of a regional hospital in Northern Ghana reported an incidence rate of 65.9% (Wuni, 2024). Although this rate is somewhat lower than that observed at TTH, it's important to note that, the study focused solely on one unit. Besides factors such as patient demographics—namely age and care type—may influence error prevalence. Also, it is possible that nurses exercise greater diligence in pediatric care, knowing that these patients are more susceptible to adverse outcomes. This further underscores the need for this study and additional research in this area.

The high prevalence of MAEs at TTH may also point to frequent network failures and unexplained electronic system issues, along with insufficient staffing and stress, which were all identified as significant risk factors in this study. Additionally, the high patient load and the demands on staff, compounded by resource limitations (World Bank, 2023), may further contribute to these rates. These observations are consistent with existing literature that identifies these factors as contributors to MAEs.

5.1.2 Types of errors

Relative to the types of errors, the prominence of "wrong time" as the most common error for both non-IV and IV MAEs align closely with findings from studies by Wondmieneh et al. (2020), Asefa et al. (2021), and Mohammed et al. (2022), all of which also highlighted timing errors as a primary issue. This consistency is particularly evident in studies conducted in Africa, where wrong timing repeatedly emerges as the leading error. This pattern suggests a potential systemic issue in medication administration practices within these settings, possibly influenced by contextual factors. For example, patient availability for medication administration may be disrupted by other service engagements (such as diagnostic investigations) requiring them to

leave the unit to other department as was found in this study. This practice obviously, may impact the ability of nurses to adhere strictly to prescribed schedules. The recurrence of errors related to "wrong monitoring," "wrong assessment," and "wrong evaluation" further supports the notion that inadequate follow-through in the medication administration process is a widespread concern. Tsegaye et al. (2020) also identified wrong assessment and wrong evaluation among the top medication errors, specifically ranking them as the second and third most common types respectively. These findings suggest that a gap may exist in monitoring practices and assessment protocols across similar healthcare settings, emphasizing a potential need for enhanced training and system improvements to address these aspects of medication safety. In contrast, studies in other regions perhaps with different organizational structures reveal distinct priorities and error patterns. For instance, studies in the UK (Cavell & Mandaliya, 2021) and Saudi Arabia (Alandajni et al., 2022) found that wrong dosing was the most common type, suggesting that in some settings, dosing accuracy might be more to be overlooked than timing. This discrepancy could stem from differences in clinical protocols emphasize dosing precision, or from variations in workflows that impact dosing accuracy.

Furthermore, Alemu et al. (2017) reported poor documentation as the most prevalent type of MAEs, highlighting another area where procedural consistency may differ depending on institutional policies or healthcare system requirements. Good documentation practices are crucial for safe medication administration, and the discrepancy here could indicate that some healthcare settings may prioritize record-keeping more than others, which may help reduce other types of MAEs but potentially elevate documentation errors. Also, Assunção-Costa et al. (2022) reported technique errors as most frequent in a Brazilian hospital, contradicting the findings of this study. This gives indication that geographical and cultural contexts may influence which error types are most prevalent. Moreover, Brabcova et al. (2023) found omitted medications to be the highest-occurring non-IV medication error, and "wrong rate" of administration as the most common IV error, followed by the wrong method and wrong timing.

Notably, this study found the error pattern for IV medication administrations very similar to the non-IV, with wrong timing leading in frequency for IV MAEs, reported by 54.9% of respondents within the 21%-100% range, followed by wrong monitoring (49.9%), wrong evaluation (47.6%), and wrong rate of administration (46.6%) with wrong method of administration ranking among the least frequently committed errors. These findings also suggest the various "rights" of medication administrations are given priorities differently depending on contextual factors and orientation.

These discrepancies may also reflect differences in sample sizes, nurse-to-patient ratios, and institutional priorities, as well as cultural attitudes toward time, which may influence timing-related errors more frequently in African contexts.

5.1.3 Comparison of the prevalence of MAEs across units

The study found that units such as the ICU and Dialysis reported higher mean percentages of MAEs, suggesting a potentially higher error rate in these units. However, results from Welch's test and the Games-Howell post hoc test indicate that MAEs occur at similar rates across different hospital units, with no statistically significant differences in error frequency. This finding contradicts previous literature, which suggests that high-acuity units (example: Accident and Emergency) may have higher error rates due to complex patient conditions and fast-paced environments (Bucknall et al., 2019; Tsegaye et al., 2020). A possible explanation for the lack of statistical significance in this study could be the similar nurse-to-patient ratios across units, uniform hospital policies on medication administration, or heightened vigilance in traditionally high-risk units.

5.2 Risk Factors for MAEs

5.2.1 Situational Factors

5.2.1.1 Individual Factors (Sociodemographic and Work-Related Influences)

This study identified several factors that significantly influenced the occurrence of MAEs. Notably, nurses with lower academic qualifications (Certificate/Diploma) were at significantly greater risk of committing MAEs compared to those with BSc/Master's degrees. In the unadjusted analysis, Certificate/Diploma nurses had 2.3 times the odds (95% CI: 1.63–3.33) of committing MAEs—a 130% increased risk—compared to their higher-educated counterparts. After adjusting for factors such as age, years of nursing practice, and other work-related and demographic variables, this association remained significant, with Certificate/Diploma nurses showing 2.07 times the odds (95% CI: 1.415–3.034) of committing MAEs, corresponding to a 107% increased risk. This finding suggests that higher educational levels may equip nurses with better clinical judgment and skills, thereby reducing the likelihood of errors. It, thus, aligns with Kerari and Innab (2021), who reported fewer errors among more highly qualified nurses, although it contrasts with Baraki et al. (2018), who observed higher MAE rates among nurses with advanced education. This discrepancy may be due to differences in sample sizes, study populations, or survey methods.

Regarding age, the results show that older nurses have a significant less likelihood of committing MAEs. These findings agree with studies by Feleke et al. (2015), Kerari & Innab (2021), and Alandajani et al. (2022), which reported that younger nurses were more prone to MAEs. One possible explanation is that older nurses may adopt a more cautious approach to medication administration, including proactively clarifying any doubts.

In terms of gender, no significant association was observed with MAEs frequency. When male nurses were compared to their female counterparts, the unadjusted OR was 0.99 (95% CI: 0.70–1.40) and the adjusted OR was 0.90 (95% CI: 0.62–1.30), suggesting no difference in risk. This result contrasts with previous studies, such as those by Feleke et al. (2015) and Kerari & Innab (2021), which suggested that male nurses might be more prone to errors compared to females.

Relating to years of nursing practice, nurses with 6–10 years of experience were 37% less likely [OR = 0.63 (95% CI: 0.42–0.94)] to commit MAEs compared to those with 1–5 years of experience. However, after adjusting for ward duration, medication administration training, and specialty area, this significance was no longer observed [AOR = 0.72 (95% CI: 0.440 – 1.182)]. In contrast, nurses with 11 years or more of experience had a 59% reduced

risk of committing MAEs in the unadjusted analysis and a 55% reduced risk after adjustment [AOR = 0.45 (95% CI: 0.247–0.819)]. This suggests that increased years of nursing experience is associated with a reduced rate of MAEs. These results align with findings by Alebachew et al. (2020), Kerari & Innab (2021), and Mohammed et al. (2022), but they differ from Baraki et al. (2018), who reported reduced rates MAEs among less experienced nurses. These mixed findings underscore the need for further research on the influence of experience on MAEs.

Additional individual-level risk factors prominently mentioned by respondents included stress (82.8%), fatigue (77.6%), insufficient knowledge in dosage calculation (71.1%), and inattentiveness (63.4%). These observations are consistent with studies from Iran, Australia, Ethiopia Nigeria and Brazil (Ehsani et al., 2013; Bucknall et al., 2019; Mekonen et al., 2020; Nkurunziza et al., 2020; Assunção-Costa et al., 2022). On these grounds, it may be beneficial for healthcare institutions to offer voluntary training in dosage calculations and institute pragmatic measures to promote stress management, reduced workloads, and favourable scheduling that allows for adequate rest to further lower MAEs rates.

5.2.1.2 Distractions and Interruptions

Distractions—particularly those caused by patients' relatives (reported by 79.3% of respondents) and interruptions during medication administration for other duties (75.3%)—were other identified risk factors for MAEs. Similar findings have been reported in studies from Ethiopia, Australia, the Czech Republic and other regions (Feleke et al., 2015; Bucknall et al., 2019; Tsegaye et al., 2020; Mekonen et al., 2020; Mohammed et al., 2022; Brabcová et al., 2023). However, despite the high perceived risk, the regression analysis showed no statistically significant difference in the likelihood of committing MAEs between nurses who identified these as causes and those who did not. For instance, for distractions, the adjusted odds ratio was 1.39 (95% CI: 0.85–2.26), indicating no statistically significant association, and for interruptions the adjusted odd ratio was 1.20 (95% CI: 0.75–1.92), which is also not statistically significant. This may suggest that though, nurses recognize these factors as causes of MAEs, they might be implementing effective measures to control or prevent them, resulting in error rates similar to other nurses who do not perceive these factors as contributing to MAEs.

5.2.1.3 Task Characteristics

Finally, task-related factors were examined. While 56.6% of nurses indicated that administering medication prepared by another nurse could cause MAEs, this factor did not significantly affect the likelihood of errors in the logistic model. Conversely, 61.5% of respondents indicated that carrying out unfamiliar tasks contributed to MAEs, and regression

analysis showed that these nurses were 65% more likely to commit errors compared to those who did not view unfamiliar tasks as a risk factor. This underscores the need for proper orientation and clear protocols when assigning unfamiliar tasks, as well as encouraging nurses to seek clarification when needed.

Overall, these situational factors underscore the multifaceted nature of MAEs, suggesting that several sociodemographic and work-related influences contribute to the risk. Future studies should continue to explore these complex interactions, possibly incorporating qualitative insights to further explain some unexpected findings, such as the role of distractions and the protective effect observed with certain practices

5.2.1.4 Patient Factors

Patient-related factors, though less explored by previous studies, were also identified. Specifically, 69.9% of respondents noted that language barriers increase the risk of MAEs, 70.2% indicated that uncooperative patients contribute to errors, 57.6% reported that complex medical histories elevate the risk, and 61.3% believed that patients leaving the ward for other medical services further increase the likelihood of MAEs. Particularly, nurses who identified patients leaving the ward as a risk factor were 69% more likely to commit MAEs [AOR = 1.69 (95% CI: 1.12–2.54)] compared to those with differing opinions. These findings may indicate that circumstantial factors related to patient behavior and movement influence error rates. Thus, while some nurses may frequently encounter situations where patients leave the unit for services such as physiotherapy, laboratory tests, or surgery—thereby increasing the associated risks—others may have less exposure to these scenarios and may not fully appreciate the potential impact on MAE occurrence. In any case, these results suggest that factors related to patient behavior and movement may influence error rates. These findings may inform future studies to focus on exploring the relationship between patient-related factors and MAEs to clarify the underlying associations.

5.2.2 Local Working Conditions

5.2.2.1 Workload and Staffing Issues

High workload and staffing shortages emerged as key contributors to MAEs, corroborating findings from Parry et al. (2015), Blignaut et al. (2019), and Mohammed et al. (2022). When nurses are overstretched, errors are more likely to occur, underscoring the critical need to maintain manageable workloads and adequate staffing to ensure patient safety.

Additionally, 33.8% of respondents indicated that the morning shift posed a greater risk for MAEs, while 31.5% ranked the night shift as the second riskiest. These findings disagree with some literature that suggest night shifts are most error-prone (Parry et al., 2015; Blignaut et al., 2019). Yet, logistic regression analysis revealed that, compared to those who perceived equal risk across all shifts, nurses who considered the morning shift as riskier were 79% more likely to commit MAEs [AOR = 1.79 (95% CI: 1.08–2.95)], and those who believed the afternoon shift carried greater risk had even higher likelihood (180%) [AOR = 2.80 (95% CI: 1.51–5.19)]. However, those who believed that the night shift was riskier did not show any significant difference in likelihood [AOR = 1.11 (95% CI: 0.66–1.85)]. These results suggest that perceptions of shift-related risk may or may not be associated with actual MAE occurrence, Therefore, further shift-focused studies are needed to determine the true association with MAEs.

5.2.3 Organizational Factors

5.2.3.1 Physical Environment

Regarding the physical environment, only 31.9% of participants attributed excessive noise to MAEs, suggesting it may be a less prominent risk factor in this context than in other regions. This finding diverges from studies by Biron et al. (2009) and Bucknall et al. (2019), which identified noise as a significant contributor to MAEs. Logistic analysis indicated that nurses who perceived excessive noise as a risk factor had a 103% increased risk [AOR = 2.03 (95% CI: 1.35–3.03)] of committing MAEs. This suggests that some nurses may be more adversely affected by excessive noise than others. Alternatively, it may be that certain nurses are less exposed to noise—and therefore less aware of its potential impact—resulting in a lower risk of MAEs. Nonetheless, since the tool used in this study did not assess respondents' actual exposure to excessive noise, the regression results is interpreted with caution. In that, they do not conclusively indicate that an excessively noisy environment predicts higher MAE rates, but rather reflect respondents' perceptions, which may be influenced by their exposure levels. Contrariwise, poor lighting was cited by 51% of respondents as a risk factor, aligning with

previous research emphasizing the importance of adequate lighting in work environments, such as at the nurses' station. However, there was no significant difference in MAEs occurrence between those who perceived poor lighting as a risk factor and those who did not.

5.2.3.2 Staff Training and Education

A clear association emerged between training and reduced MAEs. Nurses who had received training on medication administrations (MAs) were 69% less likely to commit errors in the unadjusted analysis [OR = 0.39 (95% CI: 0.27–0.58)] and 59% less likely after adjustment [AOR = 0.41 (95% CI: 0.275–0.607)], compared to those who had not received such training. These findings are consistent with previous studies (Wondmieneh et al., 2020; Alebachew et al., 2020). Despite this, 67.1% of participants reported not having received training on medication administration, and 34% of those who did receive were trained outside the hospital. This highlights the need for consistent, in-service training programs to enhance the protective effect and improve patient safety. Furthermore, although 88.1% of respondents indicated that insufficient training—especially on new medications—contributes to MAEs, nurses who identified training deficits did not show a statistically significant difference in error likelihood [AOR = 1.36 (95% CI: 0.77–2.39).

Additionally, 42.4% of nurses indicated that being pulled between teams contributed to MAEs. Being pulled between teams increases exposure to interruptions and multitasking, which can lead to cognitive overload and task fragmentation. These factors may contribute to lapses in attention or memory, increasing the likelihood of errors (probably such as incorrect timing or omissions) in medication administration. Frequent transitions between teams may also force nurses to rapidly adapt to differing patient needs, priorities, and protocols, which can result in bypassing safety checks (example: incomplete verification of patient identity or dosage). Markedly, the subgroup of nurses who perceived being pulled between teams as a contributor to MAEs had 49% higher odds of committing such errors [AOR = 1.49 (95% 1.02–2.17)]. This could reflect their frequent exposure to organizational factors like staffing shortages or poor task allocation which necessitate frequent team-switching. In contrast, the group of nurses who did not report being pulled between teams as a cause of MAEs may have encountered fewer of such instances of having to switched between teams. This lower exposure may explain their decreased likelihood of committing MAE.

5.2.3.3 Communication Issues

Communication-related issues were widely reported, including reliance on verbal orders (58.7%), use of abbreviations in prescriptions (54.1%), poor communication among nurses (76.5%), poor nurse–physician communication (79.5%), poor documentation (74.8%), lack of communication regarding delayed medications (57.8%), and handover problems (72.3%). These findings corroborate previous studies (Wondmieneh et al., 2019; Alebachew et al., 2019; Mekonen, 2020) that have linked communication breakdowns with an increased risk of MAEs. Notably, nurses who perceived poor documentation as a risk factor exhibited a 38% [AOR = 0.62 (0.39–0.98)] reduced risk of committing MAEs compared to those who did not hold that view. This counterintuitive result may indicate that awareness of documentation shortcomings and the associated risks prompts more careful review and clarification among nurses. For the other communication-related factors, no significant associations were observed. Overall, these indicates that poor communication among healthcare professionals is a common challenge in ward environments, which in turn increases the likelihood of MAEs. This finding underscores the need for pragmatic interventions to strengthen communication among staff. Targeted strategies such as continuous professional education, structured training programs, and the adoption of standardized communication protocols may help reduce the incidence of MAEs and eventually improve patient safety.

CHAPTER SIX

SUMMARY, LIMITATIONS, CONCLUSION, AND RECOMMENDATIONS

6.1 Introduction

This chapter provides an overview of the study's aims, methods, and key findings. It outlines recommendations for the study centre, nursing practice, education, research, and policy making regarding MAEs. In addition, it discusses the study's strength and limitations and concludes with final remarks on the multifactorial nature of MAEs and the implications for future improvements and research.

6.2 Summary of the Study

The study aimed to investigate the prevalence and risk factors for MAEs among nurses at TTH. A proportional stratified random sampling method was employed to recruit respondents, and data were collected using a self-administered questionnaire. The findings revealed a high prevalence of MAEs, posing a significant challenge to patient safety. Major contributing factors included LHIMS disruptions due to network issues, unexplained electronic system failures, insufficient training, inadequate staffing, poor interprofessional communication, and interruptions during medication administration. In contrast, pharmacy-related issues, such as inadequate medication labelling, was not considered a major contributing factor.

Notably, the Intensive Care Unit (ICU) and dialysis units reported the highest rates of MAEs, highlighting particularly vulnerable areas within the hospital. The study underscored the multifactorial nature of MAEs, the use of the YCFF provided a comprehensive understanding of these contributing factors, emphasizing the need for systemic interventions beyond individual behaviours.

6.3 Implications of the Study

6.3.1 Implications for Nursing Practice

The study highlights several critical areas for improvement in nursing practice:

- Many nurses reported never receiving in-service training on MAs, a factor significantly associated with higher MAE rates. This implies that healthcare facilities may be placing less priority on training nurses on MAs. Also, the findings imply that, nurses are willing to seek such training on outside the hospital when given the opportunity since they acknowledge lack of training as a significant cause of MAEs. Therefore, it is imperative that continuing professional development programs on safe medication protocols be

prioritized. Such training should be mandatory, periodically updated, and integrated into conditions of service by nursing associations.

- Minimizing non-essential interruptions is crucial. Therefore, implementing "no interruption" zones or designated times for medication administration—supported by visual cues like "Do Not Disturb" barricades or vests—can help reduce errors.
- Effective communication is essential. Standardized handover protocols, regular team meetings, and structured communication exercises should be adopted to ensure that critical information is shared accurately among healthcare providers.
- Orientation programs for newly recruited nurses should include comprehensive training on MAs, best practices, and strategies to avoid common pitfalls.
- Given that stress is a significant risk factor for MAEs, hospitals must promote self-care by providing wellness programs and stress management resources, thereby fostering a supportive work environment.

6.3.2 Implications for Nursing Education

The findings call for reforms in nursing education to enhance medication safety:

- Curricula should include intensive modules on safe medication protocols, with detailed discussions on common errors, error prevention strategies, and the role of technology in medication management. The Nursing and Midwifery Council (NMC) should ensure these modules are an integral part of training.
- Simulation-based training exercises must be implemented to give students hands-on experience in realistic medication administration scenarios without risking patient safety. These simulations build competence and confidence in handling complex situations.
- The findings implies that there is a need for emphasized education on interprofessional collaborative practice. Role-playing exercises and collaborative training sessions among nursing, pharmacy, and medical students can foster effective communication and teamwork, which are crucial for preventing errors. Nurse educators should support and encourage students to build confidence to be able to address concerns or seek clarifications in complex situations.
- The findings suggest the need for nursing programs to incorporate critical thinking and decision-making modules to prepare students for real-world challenges in medication administration.
- The results reveal that training on safe medication protocols provides a significant protective effect. By implication, continuous professional development (CPD) through

workshops, seminars, and certification courses on medication safety are critical to minimize the rates of MAEs.

6.3.3 Implications for Nursing Research

This study lays the groundwork for further investigations into MAEs. Key research priorities include:

- Evaluating the effectiveness of interventions such as simulation-based training and CPD programs on reducing MAEs at TTH.
- Conducting qualitative studies to explore nurses' perspectives on barriers to safe medication practices, particularly in apparent high-risk units like the ICU.
- Investigating the presence or absence of a safety culture and its impact on MAEs.
- Assessing the broader effects of MAEs on patients, healthcare costs, and the economy, particularly in the Ghanaian context, with emphasis on Northern Ghana.
- Examining the psychological impact on nurses involved in MAEs to understand the professional and emotional consequences of such errors.
- Expanding research to include multiple hospitals to improve the generalizability of findings.
- Exploring the integration of technology (example: electronic health records, barcode scanning systems) in reducing MAEs, including barriers to implementation.
- Implementing longitudinal studies to monitor long-term trends and the sustainability of error-reduction strategies.

6.4 Strengths and Limitations of the Study

6.4.1 Strengths of the study

- *Unique regional focus*: this study is one of the few conducted in Ghana–particularly in the Northern region–unearthing the unique factors that contribute to MAEs in this region.
- *Comprehensive framework:* The use of YCFF enabled an assessment of the wide range of contributory factors at different levels (example: individual, team, and organizational). This comprehensive approach is critical for understanding the complex, multifaceted nature of MAEs and helps identify modifiable factors, which in turn informs the design of targeted interventions to enhance patient safety.

- *Dual context of study site:* the study was conducted at a teaching hospital which is located in a deprived area of Ghana. This context enhances the generalizability of the findings, as it reflects both academic and resource-constrained setting.
- *Robust sample size:* The number of responses received exceeded the initial calculated sample size, which increases the robustness and reliability of the study results.

6.4.2 Limitations of the Study

While the study provides valuable insights, several limitations should be noted:

- The use of a structured questionnaire limited respondents to predefined items, potentially excluding other risk factors that nurses might have identified.
- Certain units, such as the oncology unit, were excluded; this may affect comparisons, such as whether the there would be a significant difference between some units if all were included.
- The survey tool did not assess actual exposure to the risk factors reported, which restricts the study's ability to draw definitive conclusions regarding their impact on MAEs. Future studies should incorporate measures of exposure to validate these associations.
- No triangulation was conducted using other alternative methods such as direct observation, to validate the reported prevalence and causes of MAEs.
- The reliance on self-administered survey tool makes the findings susceptible to self-reporting bias.

6.5 Conclusion

This study investigated the prevalence and risk factors of MAEs among nurses at TTH and revealed a high error rate that poses a substantial threat to patient safety. Key contributing factors included technological disruptions, high workload, insufficient training, poor communication, and interruptions during medication administration, with the ICU and dialysis units being particularly vulnerable. The multifactorial nature of MAEs was underscored by the interplay of situational, local working conditions and organizational factors. The YCFF facilitated a comprehensive analysis of these contributors, highlighting the urgent need for systemic interventions that address both individual practices and broader organizational structures. Future research should explore additional aspects, such as safety culture, to further inform evidence-based policies and practices.

6.6 Recommendations

Based on the study's findings, the following recommendations are proposed for policymakers, hospital management, nursing education, and nursing research:

6.6.1 Recommendations for Policymakers

1. *Provide Reliable Connectivity and System Upgrades:*
   Policymakers, particularly the Ministry of Health and the Ministry of Communication, should collaborate to ensure stable internet connectivity and regularly upgrade electronic systems in healthcare facilities. Implementing offline modes for critical systems can mitigate LHIMs disruptions during network failures.
2. *Develop and Enforce Staffing Policies*:
   Establish and enforce guidelines to maintain adequate nurse-to-patient ratios, especially apparent in high-risk areas such as ICUs and emergency units to reduce workload pressures and lower MAE rates.
3. *Invest in Healthcare Technology:*
   Prioritize investment in technologies such as electronic medication administration records (eMAR) and barcode medication administration (BCMA) systems to enhance accuracy in medication delivery. This could particularly minimize errors related to wrong patient identification, incorrect dosages, and wrong timing.
4. *Launch a National Awareness Initiative:*
   Establish a National Awareness Day on MAEs to educate the public and healthcare professionals about the risks and prevention strategies.
   On this day, National Commission for Civic Education (NCCE) should utilize media and community outreach to disseminate information in local dialects, engaging the public and healthcare institutions alike to raise awareness about the occurrence of MAEs and their grave impact on families and the national economy. Health training institutions and universities are encouraged to use this opportunity to educate nursing students, while healthcare facilities should evaluate MAE incidents and implement practical strategies—such as staff training and process improvements—to minimize the occurrences of such errors. By engaging the public, individuals would become more informed about MAEs, including understanding the importance of vigilance when visiting healthcare facilities and being aware of their own allergies, thereby assisting nurses in minimizing the risk of errors.

5. *Implement Mandatory Medication Administration Training:*
   The Nursing and Midwifery Council (NMC) should require that all nurses complete a course on MAs within a specified timeframe as a condition of license renewal.

6.6.2 Recommendations for the Hospital

1. *Ensure Reliable Network Connectivity:*
   Install a functioning backup power system and provide units with multi-network wireless connectivity to minimize electronic system disruptions.
2. *Implement Technology Solutions:*
   Adopt eMAR and BCMA systems to reduce errors related to patient identification, dosage, and timing.
3. *Regularly Discuss MAEs Incidents:*
   Conduct regular meetings or conferences to discuss MAEs incidents, analyse risk factors, and implement immediate corrective measures.
4. *Conduct Regular Audits and Provide Feedback:*
   Implement periodic audits of medication administration practices and provide timely feedback to nursing staff to reinforce safe practices.
5. *Improve Staffing Levels:*
   Increase nurse staffing to lower individual workload and error likelihood.
6. *Support Nurses' Educational Advancement:*
   Offer scholarships, study leave, or flexible work arrangements to encourage nurses to pursue further education, which is associated with lower MAEs rates.
7. *Enhance the Physical Environment:*
   Improve workspaces by ensuring adequate lighting, reducing excessive noise, and maintaining organized medication preparation areas.
8. *Include Medication Administration in Orientations:*
   Incorporate comprehensive training on safe medication practices into orientation programs for newly recruited nurses.
9. *Strengthen In-Service Training Programs:*
   Develop and mandate regular, updated in-service training sessions focusing on safe medication administration, interprofessional communication, and emerging best practices.

10. *Disseminate results to stakeholders:*

    The hospital management should share the results of this study to key stakeholders including policy makers and care givers, particularly nurses, to help gain their cooperation and supports for reforms that are aimed at preventing MAEs.

6.6.3 Recommendations for Nursing Education

1. *Reform Nursing Curricula:*

   The MNC should integrate comprehensive modules on medication safety, error prevention strategies, and the role of technology into nursing programs.

2. *Enhance Simulation-Based Training:*

   Educational institutions should adopt simulation-based exercises that replicate real-world medication administration scenarios to build competence and confidence.

3. *Promote Interprofessional Education:*

   Incorporate interprofessional role-playing exercises to improve collaboration among nurses, physicians, and pharmacists.

4. *Collaborate on Continuous Professional Development (CPD):*

   Partnerships between educational institutions and healthcare facilities are required to offer CPD opportunities on medication safety, ensuring that both students and practicing nurses remain updated on best practices.

6.6.4 Recommendations for Nursing Research

1. *Expand Research on MAEs:*

   Further studies are encouraged to evaluate the effectiveness of interventions, explore nurses' perspectives on MAE barriers, and investigate the broader impact of MAEs on patient outcomes, and healthcare economics.

2. *Research on the Impact of MAEs on the Well-being of Nurses:*

   Future research should explore the effects of MAEs on the psychological and professional well-being of nurses, particularly those involved in errors that result in severe patient outcomes. Such research could examine factors such as stress, burnout, job satisfaction, and long-term mental health impacts.

3. *Research on Self-Reporting:*

   Future research should examine nurses' attitudes toward reporting MAEs and identify the barriers that hinder self-reporting, such as fear of punitive action or legal

repercussions. Expanding on this, studies could explore strategies to foster a non-punitive culture that encourages transparency and continuous improvement in patient safety.

4. *Qualitative Research on Risk Factors:*
   Future qualitative research should delve deeper into the risk factors associated with MAEs. Utilizing methods such as interviews, or focus groups can provide richer, context-specific insights into the underlying causes of medication errors. This approach can reveal nuanced, interpersonal, and systemic issues that quantitative methods might overlook, ultimately informing more effective, targeted interventions for reducing MAEs.

5. *Investigate Safety Culture:*
   A longitudinal and qualitative research is necessary to assess the presence of a safety culture in healthcare settings and its influence on reducing MAEs.

6. *Use additional methods for triangulation:*
   Future studies should incorporate alternative data collection methods, such as direct observation or interviews, together with survey tools. This approach would enable triangulation of data and enhance the reliability and validity of the findings.

REFERENCES

Achempim-Ansong, G. (2022). *Exploring the COVID-19 experiences of emergency department nurses at a tertiary hospital in Ghana | Nursing World Conference 2022 | Nursing Conferences 2022 | NWC 2022*. https://nursingworldconference.com/program/scientific-program/2022/exploring-the-covid-19-experiences-of-emergency-department-nurses-at-a-tertiary-hospital-in-ghana

Alandajani, A., Khalid, B., Ng, Y. G., & Banakhar, M. (2022). Knowledge and Attitudes Regarding Medication Errors among Nurses: A Cross-Sectional Study in Major Jeddah Hospitals. *Nursing Reports*, *12*(4), 1023–1039. https://doi.org/10.3390/nursrep12040098

Alebachew, W., Tsegaye, D., Alem, G., & Tesema, Z. (2020). Wubet A. *Research Square*.

Alemu, W., & Cimiotti, J. P. (2023). Meta-Analysis of Medication Administration Errors in African Hospitals. *Journal for Health Quality*.

Alzoubi, M. M., Al-Mahasneh, A., Al-Mugheed, K., Barmawi, M. Al, Alsenany, S. A., & Abdelaliem, S. M. F. (2023). Medication Administration Error Perceptions Among Critical Care Nurses: A Cross-Sectional, Descriptive Study. *Journal of Multidisciplinary Healthcare*, *16*, 1503–1512. https://doi.org/10.2147/JMDH.S411840

Amo-Antwi, K., Agambire, R., Konney, T. O., Nguah, S. B., Dassah, E. T., Nartey, Y., Appiah-Kubi, A., Tawiah, A., Tannor, E. K., Peprah, A., Ansah, M. B., Sam, D., Akakpo, P. K., Ankobea, F., Djokoto, R. M., Idun, M. Y. K., Opare-Addo, H. S., Opoku, B. K., Odoi, A. T., & Johnston, C. (2022). Health-related quality of life among cervical cancer survivors at a tertiary hospital in Ghana. *PLoS ONE*, *17*(6 June). https://doi.org/10.1371/journal.pone.0268831

Asefa, K. K., Dagne, D., & Mekonnen, W. N. (2021). Medication Administration Error Reporting and Associated Factors among Nurses Working in Public Hospitals, Ethiopia: A Cross-Sectional Study. *Nursing Research and Practice*, *2021*. https://doi.org/10.1155/2021/1384168

Assunção-Costa, L., de Sousa, I. C., Silva, R. K. R., do Vale, A. C., Pinto, C. R., Machado, J. F. F., Valli, C. G., & de Souza, L. E. P. F. (2022). Observational study on medication administration errors at a University Hospital in Brazil: incidence, nature and associated factors. *Journal of Pharmaceutical Policy and Practice*, *15*(1). https://doi.org/10.1186/s40545-022-00443-x

Baraki, Z., Abay, M., Tsegay, L., Gerensea, H., Kebede, A., & Teklay, H. (2018). Medication administration error and contributing factors among pediatric inpatient in public hospitals of Tigray, northern Ethiopia. *BMC Pediatrics*, *18*(1). https://doi.org/10.1186/s12887-018-1294-5

Berzins, K., Baker, J., Brown, M., & Lawton, R. (2018). A cross-sectional survey of mental health service users', carers' and professionals' priorities for patient safety in the United Kingdom. *Health Expectations*, *21*(6), 1085–1094. https://doi.org/10.1111/hex.12805

Berzins, K., Baker, J., Louch, G., & Albutt, A. (2020). A qualitative exploration of mental health service user and carer perspectives on safety issues in UK mental health services. *Health Expectations*, *23*(3), 549–561. https://doi.org/10.1111/hex.13025

Biron, A. D., Loiselle, C. G., & Lavoie-Tremblay, M. (2009a). Work interruptions and their contribution to medication administration errors: An evidence Review. *Worldviews on Evidence-Based Nursing*, *6*(2), 70–86. https://doi.org/10.1111/j.1741-6787.2009.00151.x

Biron, A. D., Loiselle, C. G., & Lavoie-Tremblay, M. (2009b). Work interruptions and their contribution to medication administration errors: An evidence Review. *Worldviews on Evidence-Based Nursing*, *6*(2), 70–86. https://doi.org/10.1111/j.1741-6787.2009.00151.x

Biskin Cetin, S., & Cebeci, F. (2021). Perceptions of Clinical Nurses About the Causes of Medication Administration Errors: A Cross-Sectional Study. *Florence Nightingale Journal of Nursing*, *29*(1), 56–64. https://doi.org/10.5152/FNJN.2021.19135

Blignaut, A. J., Blignaut@nwu, A. A., Coetzee, S. K., Ellis, S. M., & Klopper, H. C. (2020). *Nurses' Perceptions of Medication Administration Safety in Public Hospitals in the Gauteng Province: A Mixed Method Study*. https://doi.org/10.21203/rs.3.rs-103155/v1

Blignaut, A. J., Coetzee, S. K., Klopper, H. C., & Ellis, S. M. (2017). Medication administration errors and related deviations from safe practice: an observational study. *Journal of Clinical Nursing*, *26*(21–22), 3610–3623. https://doi.org/10.1111/jocn.13732

Brabcová, I., Hajduchová, H., Tóthová, V., Chloubová, I., Červený, M., Prokešová, R., Malý, J., Vlček, J., Doseděl, M., Malá-Ládová, K., Tesař, O., & O'Hara, S. (2023). Reasons for medication administration errors, barriers to reporting them and the number of reported medication administration errors from the perspective of nurses: A cross-sectional survey. *Nurse Education in Practice*, *70*. https://doi.org/10.1016/j.nepr.2023.103642

Bucknall, T., Fossum, M., Hutchinson, A. M., Botti, M., Considine, J., Dunning, T., Hughes, L., Weir-Phyland, J., Digby, R., & Manias, E. (2019). Nurses' decision-making, practices and perceptions of patient involvement in medication administration in an acute hospital setting. *Journal of Advanced Nursing*, *75*(6), 1316–1327. https://doi.org/10.1111/jan.13963

Mushtaq, F., Driscoll, C. O., Smith, F. C. T., Wilkins, D., Kapur, N., & Lawton, R. (2018). *Contributory factors in surgical incidents as delineated by a confidential reporting system*. 401–405. https://doi.org/10.1308/rcsann.2018.0025

Cavell, G. F., & Mandaliya, D. (2021). Magnitude of error: A review of wrong dose medication incidents reported to a UK hospital voluntary incident reporting system. In *European Journal of Hospital Pharmacy* (Vol. 28, Issue 5, pp. 260–265). BMJ Publishing Group. https://doi.org/10.1136/ejhpharm-2019-001987

Ehsani, S. R., Cheraghi, M. A., Nejati, A., Salari, A., Esmaeilpoor, A. H., & Nejad, M. (2013). Medication errors of nurses in the emergency department. In *J Med Ethics Hist Med* (Vol. 6).

Elliott, R. A., Camacho, E., Jankovic, D., Sculpher, M. J., & Faria, R. (2021). Economic analysis of the prevalence and clinical and economic burden of medication error in England. *BMJ Quality and Safety*, *30*(2), 96–105. https://doi.org/10.1136/bmjqs-2019-010206

Endalamaw, A., Dessie Bahir, G., Biresaw, H., Belachew, A., Amare Bahir Dar University Yinager Workineh, D., Birhanu, M., Mulualem Belay, G., Wondim, A., Adugna Wubneh, C., Birhanu, Y., Asmare, Y., Wagnew, F., Minuye, B., Kefale, D., & Nigussie, Z. (2020). *Medication Errors in Ethiopia: Systematic Review and Meta-Analysis*. https://doi.org/10.21203/rs.3.rs-35808/v1

Feleke, S. A., Mulatu, M. A., & Yesmaw, Y. S. (2015). Medication administration error: Magnitude and associated factors among nurses in Ethiopia. *BMC Nursing*, *14*(1). https://doi.org/10.1186/s12912-015-0099-1

Gandhi, T. K., & Lee, T. H. (2010). Patient Safety beyond the Hospital. *New England Journal of Medicine*, *363*(11), 1001–1003. https://doi.org/10.1056/nejmp1003294

Ghana Health Service. (2004). *HEALTHCARE QUALITY ASSURANCE MANUAL WITH SUPPORT FROM DANIDA* (A. K. Offei, C. Bannerman, & K. Kyeremeh, Eds.).

Giles, S., Panagioti, M., Hernan, A., Cheraghi-sohi, S., & Lawton, R. (2015). *Contributory factors to patient safety incidents in primary care : protocol for a systematic review*. 1–7. https://doi.org/10.1186/s13643-015-0052-0

Glavin, R. J. (2010). Drug errors: Consequences, mechanisms, and avoidance. In *British Journal of Anaesthesia* (Vol. 105, Issue 1, pp. 76–82). Oxford University Press. https://doi.org/10.1093/bja/aeq131

Greenall, J. (2015). *Medication Error and Patient Safety: A Systems Approach Building the Foundation*. www.ismp-canada.org

Is, W., & Error, A. M. (2022). *(MEs) IN THE WHO EUROPEAN REGION WHAT IS A MEDICATION ERROR ? 18*(August), 2021–2023.

Isaacs, A. N., Ch'ng, K., Delhiwale, N., Taylor, K., Kent, B., & Raymond, A. (2021). Hospital medication errors: A cross-sectional study. *International Journal for Quality in Health Care*, *33*(1), 1–6. https://doi.org/10.1093/intqhc/mzaa136

Isfahani, P., Bazi, A., Alirezaei, S., Samani, S., Sarani, M., Boulagh, F., Poodineh Moghadam, M., & Afshari, M. (2024). Medication error rates in Iranian hospitals: a meta-analysis. *BMC Health Services Research*, *24*(1), 1–10. https://doi.org/10.1186/s12913-024-11187-6

Jessurun, J. G., Hunfeld, N. G. M., de Roo, M., van Onzenoort, H. A. W., van Rosmalen, J., van Dijk, M., & van den Bemt, P. M. L. A. (2023). Prevalence and determinants of medication administration errors in clinical wards: A two-centre prospective observational study. *Journal of Clinical Nursing*, *32*(1–2), 208–220. https://doi.org/10.1111/jocn.16215

Keers, R. N., Williams, S. D., Cooke, J., & Ashcroft, D. M. (2013). Causes of medication administration errors in hospitals: A systematic review of quantitative and qualitative evidence. In *Drug Safety* (Vol. 36, Issue 11, pp. 1045–1067). https://doi.org/10.1007/s40264-013-0090-2

Kerari, A., & Innab, A. (2021). The Influence of Nurses' Characteristics on Medication Administration Errors: An Integrative Review. In *SAGE Open Nursing* (Vol. 7). SAGE Publications Inc. https://doi.org/10.1177/23779608211025802

Küng, K., Aeschbacher, K., Rütsche, A., Goette, J., Zürcher, S., Schmidli, J., & Schwendimann, R. (2021). Effect of barcode technology on medication preparation safety: A quasi-experimental study. *International Journal for Quality in Health Care*, *33*(1). https://doi.org/10.1093/intqhc/mzab043

Kwaku Wuni, F., Suntaa Saanwie, A., Kofi Dzotsi, E., Aborah, S., Samuel Amoateng, S., Yakubu, Z., Anyoka, C., & Nbaltoe Unawari, P. (2024). Medication administration errors among children admitted at a Regional Hospital in Northern Ghana. *International Journal of Africa Nursing Sciences*, *21*. https://doi.org/10.1016/j.ijans.2024.100795

Lawton, R., McEachan, R. R. C., Giles, S. J., Sirriyeh, R., Watt, I. S., & Wright, J. (2012). Development of an evidence-based framework of factors contributing to patient safety incidents in hospital settings: A systematic review. In *BMJ Quality and Safety* (Vol. 21, Issue 5, pp. 369–380). https://doi.org/10.1136/bmjqs-2011-000443

Medication Errors and Adverse Drug Events | PSNet. (n.d.). Retrieved March 6, 2025, from https://psnet.ahrq.gov/primer/medication-errors-and-adverse-drug-events?utm_source=chatgpt.com

Mekonen, E. G., Gebrie, M. H., & Jemberie, S. M. (2020). Magnitude and associated factors of medication administration error among nurses working in Amhara Region Referral Hospitals,

Northwest Ethiopia. *Journal of Drug Assessment*, *9*(1), 151–158. https://doi.org/10.1080/21556660.2020.1841495

Ministry of Health. (2024). *Report Of The Mid-Term Review Of The Health Sector Medium Term Development Plan (2022 – 2025)* (Issue October 2024). https://www.moh.gov.gh/wp-content/uploads/2025/01/GHANA-HSMTDP-MTR-REPORT_FINAL_SIGNED.pdf

Mohammed, T., Mahmud, S., Gintamo, B., Mekuria, Z. N., & Gizaw, Z. (2022). Medication administration errors and associated factors among nurses in Addis Ababa federal hospitals, Ethiopia: A hospital-based cross-sectional study. *BMJ Open*, *12*(12). https://doi.org/10.1136/bmjopen-2022-066531

Mutair, A. Al, Alhumaid, S., Shamsan, A., Zaidi, A. R. Z., Mohaini, M. Al, Al Mutairi, A., Rabaan, A. A., Awad, M., & Al-Omari, A. (2021). The Effective Strategies to Avoid Medication Errors and Improving Reporting Systems. *Medicines*, *8*(9), 46. https://doi.org/10.3390/medicines8090046

National Coordinating Council for Medication Error Reporting and Prevention. (2020). *Building Medication Safety* (R. M. Gallagher & D. Melnyk, Eds.). www.NCCMERP.org

Nkurunziza, A., Chironda, G., Mukeshimana, M., Uwamahoro, M. C., Umwangange, M. L., & Ngendahayo, F. (2020). Factors contributing to medication administration errors and barriers to self-reporting among nurses: a review of literature. *Rwanda Journal of Medicine and Health Sciences*, *2*(3), 294. https://doi.org/10.4314/rjmhs.v2i3.14

Opoku-Danso, R., Love Otoo, V., & Asiedu, C. (2024). Medication Administration Errors among Nurses and Midwives in Ghana. *Open Journal of Nursing*, *14*(02), 77–92. https://doi.org/10.4236/ojn.2024.142006

Parry, A. M., Barriball, K. L., & While, A. E. (2015). Factors contributing to Registered Nurse medication administration error: A narrative review. In *International Journal of Nursing Studies* (Vol. 52, Issue 1, pp. 403–420). Elsevier Ltd. https://doi.org/10.1016/j.ijnurstu.2014.07.003

Preventing Medication Errors. (2007). https://doi.org/10.17226/11623

Rostami, P., Heal, C., Harrison, A., Parry, G., Ashcroft, D. M., & Tully, M. P. (2019). Prevalence, nature and risk factors for medication administration omissions in English NHS hospital inpatients: A retrospective multicentre study using Medication Safety Thermometer data. *BMJ Open*, *9*(6). https://doi.org/10.1136/bmjopen-2018-028170

Shehata, Z. H. A., Sabri, N. A., & Elmelegy, A. A. (2016). Descriptive analysis of medication errors reported to the Egyptian national online reporting system during six months. *Journal of the American Medical Informatics Association*, *23*(2), 366–374. https://doi.org/10.1093/jamia/ocv096

Tan, S., Teh, L. J., Mohd Mokhtaruddin, S., & Henry Basil, J. (2025). Prevalence and contributing factors of intravenous medication administration errors in emergency departments: a prospective observational study. *International Journal for Quality in Health Care*, *37*(1). https://doi.org/10.1093/INTQHC/MZAF012

Tariq, R. A., Vashisht, R., Sinha, A., & Scherbak Yevgeniya. (2024, February 12). *Medication Dispensing Errors and Prevention - PubMed*. Medication Dispensing Errors and Prevention. https://pubmed.ncbi.nlm.nih.gov/30085607/

The National Patient Safety Agency Report. (2004).

Tsegaye, D., Alem, G., Tessema, Z., & Alebachew, W. (2020). Medication administration errors and associated factors among nurses. *International Journal of General Medicine*, *13*, 1621–1632. https://doi.org/10.2147/IJGM.S289452

van den Bemt, P. M. L. A., Idzinga, J. C., Robertz, H., Kormelink, D. G., & Pels, N. (2009). Medication Administration Errors in Nursing Homes Using an Automated Medication Dispensing System. *Journal of the American Medical Informatics Association*, *16*(4), 486–492. https://doi.org/10.1197/jamia.M2959

Wakefield, B. J., Uden-Holman, T., & Wakefield, D. S. (n.d.). *Development and Validation of the Medication Administration Error Reporting Survey*.

Wondmieneh, A., Alemu, W., Tadele, N., & Demis, A. (2020). Medication administration errors and contributing factors among nurses: A cross sectional study in tertiary hospitals, Addis Ababa, Ethiopia. *BMC Nursing*, *19*(1). https://doi.org/10.1186/s12912-020-0397-0

World Health Organization. (2016). *Medication errors* (R. Payne, S. Slight, B. D. Franklin, & A. J. (Anthony J. Avery, Eds.).

World Health Organization. (2022). *KEY FACTS ABOUT MEDICATION ERRORS(MEs) IN THE WHO EUROPEAN REGION*. https://eaasm.eu/wp-content/uploads/ECAMET-White-Paper-Call-to-Action-March-2022-v2.pdf,

APPENDIX I: THE SHAPIRO-WILKS TEST RESULTS

The Shapiro-Wilks test

		Kolmogorov-Smirnov[a]		Shapiro-Wilk	
	Unit of repondent	**Statistic**	***p* - value**	**Statistic**	***p* - value**
Percentages of MAEs reported in unit	Medical	0.27	0.000	0.66	0.000
	Accident and Emergency	0.21	0.000	0.81	0.000
	Surgical	0.24	0.000	0.78	0.000
	Obstetrics	0.25	0.000	0.76	0.000
	Pediatrics	0.37	0.000	0.55	0.000
	NICU	0.36	0.000	0.66	0.000
	ICU	0.28	0.001	0.79	0.002
	Dialysis	0.28	0.117	0.80	0.041
	Other	0.37	0.000	0.66	0.000

a. Lilliefors Significance Correction

Abbreviations: NICU: Neonatal intensive care unit; ICU: intensive care unit

APPENDIX II: TEST FOR HOMOGENEITY OF VARIANCE RESULTS

Test for Homogeneity of Variance

Percentages of MAEs reported in unit	
Levene Statistic	***p* - value**
2.530	0.011

APPENDIX III: GAMES-HOWELL POST HOC TEST RESULTS

Games-Howell post hoc test for MAEs across units

(I) Unit	(J) Unit	Mean difference (I – J)	95% CI (Lower – Upper)	*p* - value
Medical	Accident and Emergency	-0.26	(-1.31 – 0.78)	0.997
	Surgical	-0.19	(-1.09 – 0.71)	0.999
	Obstetrics	-0.41	(-1.58 – 0.75)	0.971
	Pediatrics	0.02	(-0.92 – 0.97)	1.000
	NICU	-0.59	(-2.94 – 1.75)	0.990
	ICU	0.59	(-0.61 – 1.78)	0.778
	Dialysis	0.69	(-2.26 – 3.64)	0.975
	Other	-0.39	(-2.19 – 1.42)	0.998
Accident and Emergency	Medical	0.26	(-0.78 – 1.31)	0.997
	Surgical	0.08	(-0.98 – 1.13)	1.000
	Obstetrics	-0.15	(-1.43 – 1.13)	1.000
	Pediatrics	0.29	(-0.80 – 1.37)	0.996
	NICU	-0.33	(-2.71 – 2.05)	1.000
	ICU	0.85	(-0.45 – 2.14)	0.460
	Dialysis	0.96	(-1.98 – 3.89)	0.897
	Other	-0.12	(-2.00 – 1.75)	1.000
Surgical	Medical	0.19	(-0.71 – 1.09)	0.999
	Accident and Emergency	-0.08	(-1.13 – 0.98)	1.000
	Obstetrics	-0.22	(-1.39 – 0.95)	1.000
	Pediatrics	0.21	(-0.74 – 1.16)	0.999
	NICU	-0.41	(-2.75 – 1.94)	0.999
	ICU	0.77	(-0.42 – 1.97)	0.460
	Dialysis	0.88	(-2.07 – 3.83)	0.918
	Other	-0.20	(-2.01 – 1.61)	1.000
Obstetrics	Medical	0.41	(-0.75 – 1.58)	0.971
	Accident and Emergency	0.15	(-1.13 – 1.43)	1.000
	Surgical	0.22	(-0.95 – 1.39)	1.000
	Pediatrics	0.44	(-0.77 – 1.64)	0.966
	NICU	-0.18	(-2.60 – 2.24)	1.000
	ICU	1.00	(-0.39 – 2.38)	0.345
	Dialysis	1.10	(-1.83 – 4.04)	0.833
	Other	0.02	(-1.91 – 1.96)	1.000

Continue to next page

Abbreviations: NICU: Neonatal intensive care unit; ICU: intensive care unit

Games-Howell post hoc test for MAEs across units (continued)

(I) Unit	(J) Unit	Mean difference (I – J)	95% CI (Lower – Upper)	*p* - value
Pediatrics	Medical	-0.02	(-0.97 – 0.92)	1.000
	Accident and Emergency	-0.29	(-1.37 – 0.80)	0.996
	Surgical	-0.21	(-1.16 – 0.74)	0.999
	Obstetrics	-0.44	(-1.64 – 0.77)	0.966
	NICU	-0.62	(-2.97 – 1.74)	0.988
	ICU	0.56	(-0.66 – 1.78)	0.839
	Dialysis	0.67	(-2.28 – 3.63)	0.981
	Other	-0.41	(-2.23 – 1.41)	0.998
NICU	Medical	0.59	(-1.75 – 2.94)	0.990
	Accident and Emergency	0.33	(-2.05 – 2.71)	1.000
	Surgical	0.41	(-1.94 –2.75)	0.999
	Obstetrics	0.18	(-2.24 – 2.60)	1.000
	Pediatrics	0.62	(-1.74 – 2.97)	0.988
	ICU	1.18	(-1.24 – 3.60)	0.739
	Dialysis	1.29	(-1.99 – 4.56)	0.881
	Other	0.21	(-2.49 – 2.90)	1.000
ICU	Medical	-0.59	(-1.78 – 0.61)	0.778
	Accident and Emergency	-0.85	(-2.14 – 0.45)	0.460
	Surgical	-0.77	(-1.97 – 0.42)	0.460
	Obstetrics	-1.00	(-2.38 – 0.39)	0.345
	Pediatrics	-0.56	(-1.78 – 0.66)	0.839
	NICU	-1.18	(-3.60 – 1.24)	0.739
	Dialysis	0.11	(-2.84 – 3.05)	1.000
	Other	-0.97	(-2.90 – 0.96)	0.768
Dialysis	Medical	-0.69	(-3.64 – 2.26)	0.975
	Accident and Emergency	-0.96	(-3.89 – 1.98)	0.897
	Surgical	-0.88	(-3.83 – 2.07)	0.918
	Obstetrics	-1.10	(-4.04 – 1.83)	0.833
	Pediatrics	-0.67	(-3.61 – 2.28)	0.981
	NICU	-1.29	(-4.56 – 1.99)	0.881
	ICU	-0.11	(-3.05 – 2.84)	1.000
	Other	-1.08	(-4.13 – 1.98)	0.920

Continue to next page

Abbreviations: NICU: Neonatal intensive care unit; ICU: intensive care unit

Games-Howell post hoc test for MAEs across units (continued)

(I) Unit	(J) Unit	Mean difference (I – J)	95% CI (Lower – Upper)	*p* - value
Other	Medical	0.39	(-1.42 – 2.19)	0.998
	Accident and Emergency	0.12	(-1.75 – 2.00)	1.000
	Surgical	0.20	(-1.61 – 2.01)	1.000
	Obstetrics	-0.02	(-1.96 – 1.91)	1.000
	Pediatrics	0.41	(-1.41 – 2.23)	0.998
	NICU	-0.21	(-2.90 – 2.49)	1.000
	ICU	0.97	(-0.96 – 2.90)	0.768
	Dialysis	1.08	(-1.98 – 4.13)	0.920

Abbreviations: NICU: Neonatal intensive care unit; ICU: intensive care unit

APPENDIX IV: INFORMATION SHEET

INFORMATION SHEET

TITLE OF STUDY:

PREVALENCE AND RISK FACTORS FOR MEDICATION ADMINISTRATION ERRORS: A STUDY AT THE TAMALE TEACHING HOSPITAL

Introduction/Purpose of study

I am Prosper N. Apasera, an MPhil Nursing candidate at the School of Nursing and Midwifery, University of Ghana.

This study seeks to assess the prevalence and risk factors for Medication administration errors at the Tamale Teaching Hospital.

Study Procedure

- This study involves the use of a questionnaire to seek your views about the prevalence and risk factors for medication administration errors.
- **Time required**: The survey will take approximately 8 – 12 minutes to complete.
- **Inclusion criteria:** General nurses with a minimum of 12 months of work experience in the ward.
- **Exclusion criteria**: Nurses on annual or study leave and nurses not willing to consent
- **Procedure**: The tool contains questions that require you to respond by ticking/circling/underlining the appropriate response.

Benefits/Risks of the study

- **Benefits:** Though there are no direct personal benefits, this research will help to formulate policies that will help minimize medication administration errors and enhance patient safety. Besides, respondents may get more familiar with certain medication administration errors that are often overlooked in the course of practice.
- **Risks:** Whiles completing the questionnaire, there is the risk to re-call unfavorable events associated with past mistakes, which could be distressing.

Confidentiality

You are not to write your name or any form of identity on the questionnaire. We are committed to protecting your privacy. All responses will be kept confidential to the best of our ability. It is impossible to name you in any reports, other studies or conferences.

Compensation

- There will be no compensation for the completion of the questionnaire.

Withdrawal from study

- Participation is voluntary, and you have the right to withdraw at any time if you feel uncomfortable continuing with the study. There will be no penalty or unfair treatment towards you for your decision to withdraw from the study.

Questions

You have the right to ask questions and to receive satisfactory answers to such questions accordingly. For any questions, concerns or clarifications please contact:

1. Prosper Namkina Apasera (The researcher)

   Mobile: 024 326 8497 **Email:** pnapasera@st.ug.edu.gh

2. Dr. Yvone Nartey (Primary research supervisor)

   Email: ynartey@ug.edu.gh

3. The Administrator

   Navrongo Health Research Centre Institutional Review Board (NHRCIRB)

   Mobile: 059 115 2102 **Email**: irb@navrongo-hrc.org, nhrcirb@gmail.com

4. The research unit of the hospital at the second floor

   Mobile: 020 928 1020

APPENDIX V: MEDICATION ADMINISTRATION ERROR SURVEY TOOL

Medication Administration Error Survey

For any clarification, please contact:

Prosper Apasera on 0243 26 8497

Introduction:
The purpose of this survey is to seek input, based on your clinical experience as a nurse on the occurrence and risk factors for medication administration errors and the extent to which errors are reported on your unit and committed by you. This survey will take approximately 5 - 10 minutes to complete. All responses will be kept strictly confidential. Your honest and accurate responses will greatly impact the research findings.

Informed Consent:
☐ By completing and submitting this questionnaire, you acknowledge that you have read and understood the purpose of this research study. Your participation is voluntary, and you reserve the right to withdraw from the study. Your completion of this questionnaire indicates your consent to participate in this study. Thank you for your cooperation.

Instructions:
Please read each question carefully and select the most appropriate response(s). You may tick, circle or underline.

Definition of Medication Administration Errors (MAEs): For the purposes of this survey, MAEs are defined as mistakes made by nurses that deviate from the correct standards for drug administration (such as right drug, right patient, right assessment before drug administration etc.)

Types of Medication Administration Errors

1. **Wrong documentation:** Failure to document or incomplete documentation after giving a drug
2. **Wrong evaluation:** Failure to evaluate or not evaluating properly after administering a drug. (e.g. not finding assessing to see whether patient is relieved of pain after giving pain medication)
3. **Wrong assessment:** e.g. not checking a patient's pulse before giving prescribed digoxin
4. **Wrong education:** not giving the patient the right education about the drug
5. **Wrong route of administration**
6. **Wrong dose**
7. **Wrong medication**
8. **Wrong patient**
9. **Wrong time**
10. **Not acknowledging the patient's right to refuse or accept the drug**
11. **Giving a drug that the prescriber has ordered that it should be discontinued**
12. **Administering a drug to a patient with KNOWN allergy**

A. Biographic data (Please provide the answer in the space provided or circle the number that corresponds to your status)

1. Age…….

2. Gender: 1. Male 2. Female

3. Marital status (please circle or tick one)

1. Single
2. Married
3. Divorced
4. Widowed
5. Other……..

4. Ethnicity

1. Dagomba
2. Mamprusi
3. Gonja
4. Konkomba
5. Frafra
6. Akan
7. Dagaaba
8. Other (specify)……..

5. Religion

1. Christianity
2. Islam
3. Traditionalist
4. Other (specify)……..

B. Work experience

6. How long have you been practicing as a nurse? _____

7. How long have you been working in the current unit? _____

8. Which unit do you work in?

1. Medical
2. Accident and Emergency
3. Surgical
4. Obstetrics
5. Pediatrics
6. NICU
7. ICU
8. Mental Health
9. OPD
10. Other, please specify_____

9. What is your level of nursing education? (Circle one)

1. Certificate 2. Diploma 3. BSc 4. Master's degree

10. Do you have any other specialty (e.g. pediatric nursing, emergency nursing etc.)?

1. Yes (specify)…… 2. No

11. Have you attended any in-service training on Medication Administration before? 1. Yes 2. No.

12. If **yes,** was it provided by the hospital? 1. Yes 2. No

A. Reasons Why Medication Errors Occur. Please tick **"Yes"** if you agree that the following reasons contribute to medication errors on your unit, or **"No"** if you do not agree.

	1. Yes	2. No
Individual factors		
13. Nurses are interrupted while administering medications to perform other duties.		
14. Distractions (e.g. from patient relatives)		
15. Inexperience		
16. Fatigue		
17. Stress		
18. Inattentiveness		
19. Poor calculation		
Communication issues		
20. Physicians' medication orders are not clearly understood		
21. Physicians change orders frequently		
22. Abbreviations are used instead of writing the orders out completely.		
23. Verbal orders are used instead of written orders.		
24. Poor communication between nurses and physicians		
25. Poor communication among nurses		
26. Unable to contact correct staff for clarification		
27. On this unit, there is no easy way to look up information on medications		
28. Handing over problems		
29. When scheduled medications are delayed, nurses do not communicate the time when the next dose is due.		
30. Poor documentation		
Education and training		
31. No enough in-service training on new medications		
32. Nurses on this unit do not adhere to the approved medication administration procedure.		

Physical environment		
33. Excessive noise		
34. Poor lighting/visibility (especially at night)		
Workload and staffing issues		
35. High unit workload		
36. Insufficient staff in this unit		
37. Inappropriate delegation		
38. Nurses get pulled between teams and from other units		
Task characteristics		
39. Unfamiliar task		
40. Monotonous task		
41. Administering medication prepared by another nurse		
Drugs (external factors)		
42. Pharmacy does not label the medications correctly		
43. The names of many medications are similar		
44. Different medications look alike		
45. The packaging of many medications is similar		
46. Many patients are on the same or similar medications		
Patient factors		
47. Language barrier between nurse and patient		
48. Uncooperative patient		
49. Intoxicated patient		
50. Patient with complex medical history		
51. Patients are off the ward for other care		
Tools/equipment		
52. Equipment malfunctions or is not set correctly (e.g., IV pump, problems with infusion set)		
53. Errors are made on the computer (LHIMS)		
54. Electronic system (LHIMS) disruptions due to network and power outages		
55. Unexplained electronic system (LHIMS) failure/disruptions		
Others		
56. **Type of shift (**you can select only **one "Yes")**		
Morning		
Afternoon		
Night		

C. What percentage of each type of errors do you commit in your unit? Based on your experience, please indicate the number that best represents the percentage of each type of medication error you believe you make on your unit.

Types of Non-IV Medication Errors	Percentage Reported									
	0-20%	21-30%	31-40%	41-50%	51 - 60%	61 - 70%	71 - 80%	81 - 90%	91 - 99%	100%
57. Wrong **route** of administration	1	2	3	4	5	6	7	8	9	10
58. Wrong **time** of administration	1	2	3	4	5	6	7	8	9	10
59. Wrong patient	1	2	3	4	5	6	7	8	9	10
60. Wrong drug	1	2	3	4	5	6	7	8	9	10
61. Wrong dose	1	2	3	4	5	6	7	8	9	10
62. Wrong assessment	1	2	3	4	5	6	7	8	9	10
63. Wrong evaluation	1	2	3	4	5	6	7	8	9	10
64. Wrong documentation	1	2	3	4	5	6	7	8	9	10
65. Wrong monitoring	1	2	3	4	5	6	7	8	9	10
66. Not acknowledging patient's right to refuse med	1	2	3	4	5	6	7	8	9	10
67. Medication is given, but has not been ordered by the physician	1	2	3	4	5	6	7	8	9	10
68. Wrong education (Not providing the correct education to patient on medication or not providing it at all)	1	2	3	4	5	6	7	8	9	10
69. Medication administered after the order to discontinue has been written	1	2	3	4	5	6	7	8	9	10
70. Medication is omitted	1	2	3	4	5	6	7	8	9	10
71. Medication to patient with a **known** allergy	1	2	3	4	5	6	7	8	9	10

IV Medication Errors

Please indicate the percentage of Each Type of **IV Medication Errors** you commit

72. Wrong method of administration	1	2	3	4	5	6	7	8	9	10
73. Wrong time of administration	1	2	3	4	5	6	7	8	9	10
74. Wrong patient	1	2	3	4	5	6	7	8	9	10
75. Wrong dose	1	2	3	4	5	6	7	8	9	10

76. Wrong drug	1	2	3	4	5	6	7	8	9	10
77. Medication is omitted	1	2	3	4	5	6	7	8	9	10
78. Medication is given, but has not been ordered by the physician	1	2	3	4	5	6	7	8	9	10
79. Medication administered after the order to discontinue has been written	1	2	3	4	5	6	7	8	9	10
80. Given to patient with a known allergy	1	2	3	4	5	6	7	8	9	10
81. Wrong fluid	1	2	3	4	5	6	7	8	9	10
82. Wrong rate of administration	1	2	3	4	5	6	7	8	9	10
83. Wrong education	1	2	3	4	5	6	7	8	9	10
84. Wrong assessment	1	2	3	4	5	6	7	8	9	10
85. Wrong monitoring	1	2	3	4	5	6	7	8	9	10
86. Wrong evaluation	1	2	3	4	5	6	7	8	9	10

87. Based on your experience, what percentage of **all types of medication errors**, including IV and non-IV medication errors are actually reported on your unit by nursing staff? (please underline one)

0 - 20% 21 - 30% 31 - 40% 41 - 50% 51 - 60% 61 - 70% 71 - 80% 81 - 90% 91 - 99% 100%

Average number of Individual errors you commit

88. Based on your knowledge about **medication administration errors**, averagely how many **errors**, do you commit in a **month?** (please underline one)

(0) (1 – 10) (11 – 20) (21 – 30) (31 – 40) (41 – 50) (51 – 60) (61 – 70) 71 – 80) (81 – 90) (91 – 100) (100+)

89. Averagely, how many of **all types of errors**, including IV and non-IV did you comit during the last 12 months (please underline one)

(0) (1 – 10) (11 – 20) (21 – 30) (31 – 40) (41 – 50) (51 – 60) (61 – 70) 71 – 80) (81 – 90) (91 – 100) (100+)

90. In percentage terms, what percentage of all the medications you administer, including IV and non-IV, contain errors based on your knowledge about medication administration errors? (please underline one)

0 - 20% 21 - 30% 31 - 40% 41 - 50% 51 - 60% 61 - 70% 71 - 80% 81 - 90% 91 - 99% 100%

Thank you again for participating in this survey

APPENDIX VI: ETHICAL CLEARANCE

Navrongo Health Research Centre
Institutional Review Board (NHRCIRB)
Research & Development Division
Ghana Health Service
Post Office Box 114
Navrongo, UER – Ghana.

+233591152102 irb@navrongo-hrc.org nhrcirb@gmail.com UK-0043-7777

3 October 2024

My Ref.....

Your Ref.....

Mr. Prosper Namkina Apasera
School of Nursing,
University of Ghana,
Legon.

ETHICS APPROVAL ID: NHRCIRB656

Dear Mr. Apasera,

Approval of Protocol titled "Prevalence and Risk Factors for Medication Administration Errors: A study at Tamale Teaching Hospital".

I write to inform you that the Navrongo Health Research Centre Institutional Review Board (NHRCIRB) has reviewed your protocol and is happy to grant you approval.

The following documents were reviewed and approved;

- Study Protocol version 1.0 dated 30/08/2024
- Participant Information Sheet and Consent Form version 1.0 dated 30/08/2024
- Study Questionnaire version 1.0 dated 30/08/2024
- CVs of Investigators (Mr. Prosper Namkina Apasera and Dr. Yvonne Nartey)

Please, note that any amendment to these approved documents must receive prior NHRCIRB approval before implementation. This approval expires on **2nd October 2025.**

Kindly submit the findings of your study to the NHRCIRB before the expiration of this approval.

The Board wishes you all the best in your study.

Thank you.

Sincerely,

Dr. Thomas Anyorigiya

(Ag. Chairman)

Cc: The Director, NHRC, Navrongo

APPENDIX VII: PERMISSION LETTER FORM STUDY SITE

DEPARTMENT OF RESEARCH & DEVELOPMENT
TAMALE TEACHING HOSPITAL

In case of reply the number and date of this letter should be quoted

Tamale Teaching Hospital
P. O. Box 16
Tamale
E-mail: info@tth.gov.gh
Digital Address:NT-0101-5331
Website: www.tth.gov.gh

Te:03720-00180
Our Ref: TTH/R&D/SR/24/259
Your Ref:

27th August, 2024.

THE SUB-BMC/UNIT HEAD

PERMISSION TO CONDUCT RESEARCH IN TAMALE TEACHING HOSPITAL

I hereby introduce to you **Mr Prosper Namkina Apasera**, an MPhil student of the Department of Adult Health Nursing, School of Nursing and Midwifery, College of Health Science, University of Ghana-Legon.

Mr Apasera has been granted permission to conduct a study title **"Prevalence and Risk Factors for Medication Administration Errors: A Study at Tamale Teaching Hospital"**.

Please provide him with the necessary assistance to enable him to complete the study. If you have any doubts or concerns, kindly contact the Research Unit on the second floor of the administration block or on Telephone 0209281020. Additionally, please report any misconduct of the Researcher(s) promptly to the Research department for appropriate action.

As part of this authorization, PI(s) is/are required to adhere to the following guidelines and conditions during the research process.

1. Adhere to all the hospital policies and applicable research convention
2. Always maintain confidentiality and security of patient information
3. Liaise with the department head/ward staff to obtain necessary approvals before initiating any research activities
4. Report any unexpected incidences or deviations from the research protocol promptly to the research department

Furthermore, the candidate(s) is/are required to submit a copy of the final report to the hospital upon completion of the study

Please note that this approval is valid for a period of six months, from 28th August, 2024 to 27th February, 2025.

Thank you.

ALHASSAN MOHAMMED SHAMUDEEN.
(DEPUTY DIRECTOR AND HEAD, RESEARCH & DEVELOPMENT)