PERIOPERATIVE MEDICATION ERRORS AMONG ANAESTHESIA SERVICE PROVIDERS IN NAMIBIA - A RETROSPECTIVE SURVEY

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT

FOR THE DEGREE OF

MASTER OF MEDICINE IN ANESTHESIOLOGY, CRITICAL CARE AND PAIN MANAGEMENT

OF

THE UNIVERSITY OF NAMIBIA

BY

OYINBO O.M.

220069204

APRIL 2025

MAIN SUPERVISOR: Professor Ambrose Rukewe (University of Namibia)

ABSTRACT

INTRODUCTION

Medication administration errors are widespread across the healthcare system resulting in huge human and financial costs. Notably, drug administration errors are a major reason for malpractice claim against anaesthesia service providers. The outcomes of medication errors range from no harm and to the grievous events such as intensive care admissions or death, nonetheless they are preventable. The study was aimed to determine the prevalence and characteristics of the common perioperative medication administration errors among anaesthesia service providers in Namibia, identify the contributing factors and assess their outcomes on patients.

METHODOLOGY

This was a descriptive, retrospective survey among specialist anaesthesiologists, anaesthesia registrars and medical officers across the 34 public hospitals and 18 private hospitals in Namibia over a period of one month. A confidential, self-administered structured questionnaire was shared with participants via the email, phone and as a web-based survey.

RESULTS

Out of 122 questionnaires shared, 112 (92%) anaesthesia providers responded. There were slightly more female participants, 58 (52%) than males and mostly medical officers (56%). Among the respondents, 88 (79%) indicated that they had committed one or more medication errors during their anaesthesia practice. The commonest type was omission (46%), followed by the administration of a wrong drug (27%). In 69% cases, there was no harm to the patients while 6% had HDU/ICU admissions and 1 (0.9%) died.

CONCLUSION

This index study found a high prevalence of medication administration errors among the practitioners, comparable with many studies. Majority of patients did not suffer any harm. Most respondents blamed the occurrence of errors on distractions/fatigue. It is important to increase awareness and training for prevention as well as set up a nationally coordinated incident reporting system for perioperative drug administration errors in Namibia.

Key words: Medication administration errors, perioperative events, anaesthesia service providers in Namibia, associated factors, outcomes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

1	**MAE**	Medication Administration Error
2	**WHO**	World Health Organization
3	**AMEs**	Adverse medication events
4	**ASN**	Anaesthesiologists' Society of Namibia
5	**DEC**	Decentralised Ethical Committee
6	**EWTD**	European Working Time Directive
7	**ISMP**	Institute for Safe Medication Practices
8	**ASTM**	American Society for Testing and Materials
9	**PTSD**	Post-traumatic stress disorder

ACKNOWLEDGEMENT

The completion of this academic undertaking could not have been possible without the participation, support and contributions of many people whose names may not all be enumerated here. Importantly, I would like to thank God for granting me good health, knowledge, wisdom and strength to pull through this rigorous and demanding academic pursuit.

I would also like to express my sincere and profound gratitude towards my supervisor and tutor, Prof A. Rukewe for your consistent and impactful teachings, outstanding guidance and selfless dedication throughout my studies and particularly going through this challenging and hectic pathway of completing this dissertation. Thank you for the motivation and support and clearly your teachings have laid a solid foundation in my career journey. Your depth of knowledge, professionalism and focus remains inspiring.

Furthermore, I would like to appreciate you, Mr A.S. Adejugbagbe for your selfless effort in conjunction with Prof. Rukewe in sorting out the data analysis for this research.

My appreciation also goes to all the faculty and departmental staff whose resources and assistance are acknowledged. I want to also thank my fellow registrars, our learning was always a team effort, thank you to all the commitment invested to each other's development.

I am also deeply thankful for my family especially my daughter, Adeshewa, who had to cope with my absence throughout this period. To my wife, Nelago, your "push", understanding, and immense support are invaluable.

Finally, to all the research participants/ Respondents, the research could not have been a success without your involvement in this study. Thank you.

DEDICATION

I dedicate this study to the lovely memory of my late parents, Mr and Mrs Ayodele Steven Oyinbo, your age long sacrificial investments in me are still yielding undeniable results till this day.

DECLARATION

I, Oyinbo Olumuyiwa Manuel, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

No part of this thesis may be reproduced, stored in any retrieval system, or transmitted in any form, or by means (e.g. electronic, mechanical, photocopying, recording or otherwise) without the prior permission of the author, or The University of Namibia in that behalf.

I, Oyinbo Olumuyiwa Manuel, grant The University of Namibia the right to reproduce this thesis in whole or in part, in any manner or format, which The University of Namibia may deem fit.

Oyinbo Olumuyiwa Manuel		29 October 2024
Name of Student	**Signature**	**Date**

CHAPTER ONE

1. INTRODUCTION

1.1 Orientation to the study

The widespread occurrence of medication administration errors across the health care system with a huge toll such as human, social and financial costs on the health system. It is a notable reason for malpractice claim against anaesthesia service providers across the world. The consequences of medication administration errors ranges from no harm to grievous adverse events such as death, and these are preventable with appropriate attention and efforts.[1,2] The setting in a typical hospital's surgical theatre is both mentally and physically demanding with lots of multi tasking unlike the situation with primary care, the patient is exposed to the increased risk of medication administration error arising from the intricate and delicate perioperative medication administration in the theatre.[3]

One of the many definitions of medication administration error is "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labelling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use". (National Coordinating Council for Medication Error Reporting and Prevention).

The aim of the global safety challenge of World Health Organization (WHO) is a fifty percent reduction in the burden of iatrogenic medication-related harm within 5 years globally and this is a validation of the significant impact of medication errors.[4] The critical roles of the anaesthesia service providers in the perioperative period entails multiple tasks such as drug prescription, drug preparation, dilution and drug administration, and simultaneously recording and monitoring of the medication and the patient either alone or with support from a few staff in the theatre.

The study's aim was to determine the prevalence and characteristics of the common perioperative medication errors among anaesthesia service providers in Namibia as well as identify the contributing factors and assess their outcomes on patients.

1.2 Statement of the problem

The public health significance of the burden of medication administration error is deservedly getting more attention globally because of the toll it exerts on the patients, service providers and health institutions.[4,5] Accidentally prescribing or administering the incorrect medication to a patient or experiencing a near-miss could lead to contrition, self condemnation and crisis of confidence in the anaesthesia service providers aside the potential consequence of litigations.[1] This has shown that the patient is not the only one impacted by medication administration error but also the service providers, and which can be described as the "secondary victim", and it can have potentially lethal sequel to both the life and professional experience of the provider.

Furthermore, since very few medical practitioners are as deeply involved in the detailed exercise of medication administration as the anaesthesiologists either within or outside the surgical theatre. they are very prone to making these medication administration errors during routine anaesthesia service delivery. In compared to past decades, anaesthesia is now much safer and routine, nevertheless evidence has revealed that anaesthesiologists are still prone to making medication administration errors with its complications that are more grievous than those of other doctors who work outside the theatre.[5]

In addition, when conducting the literature search using subject headings and key words revealed a dearth of data on MAEs amongst anaesthesia service providers in Namibia, but going by the experience of the patients in resource poor nations like Namibia it has been revealed that they encounter MAEs and the adverse events two or more times more than those in high-income countries.[5,6,7] Studies done in some countries have shown a high incidence of drug errors related to anaesthesia in Canada (85%), South Africa (94%), and New Zealand (94%). It has been estimated that for every 133 anaesthetics administered, there is one medication error and 1% of them cause harm to the patient.[5]

The majority of adverse medication events (AMEs) resulting from perioperative medication errors though are largely harmless but can be significant, life threatening or fatal such as severe hypoglycaemia, severe skin rashes, acute kidney injury, arrhythmias, cardiac arrest.[6] While many perioperative AMEs, for example a remarkable hypotension, arrhythmias, bronchospasm, are amenable during the perioperative period, the available evidence reveals they can have lasing effects after the surgical operation, for example, cases of post-traumatic stress disorder (PTSD) amongst anaesthesia service providers who were involved.[6,7]

1.3 Objectives of the study

The main objective of this study was to determine the prevalence and characteristics of the perioperative medication errors among anaesthesia service providers in Namibia, identify the contributing factors and assess their outcomes on patients.

Specific objectives

i. To determine the frequency of perioperative medication errors among anaesthesia service providers in Namibia.

ii. To identify the contributing factors for the occurrence of medication errors among anaesthesia service providers in Namibia.

iii. To investigate the adverse events due to medication errors on patients.

1.4 Significance of the study

Medication error reporting is one of the stated WHO's strategies to improve patients' safety and overall quality of healthcare. The three priority areas of medication safety mentioned were high-risk situations, polypharmacy, and transition of care. Perioperative anaesthetic management of patient encompasses all these three areas.[4]

To effectively manage the prevalence of medication errors among anaesthesia service providers in Namibia, the insufficiency of the current data on the procedure and various phases of medication administration in the operating theatre, during intensive care or management of would be needful. Though commendable but the current individualised efforts to manage medication administration error will remain inadequate until a comprehensive and centralised incident reporting management systems are established. This study is a valuable step to determine the extent and the nature of the problem in our practice environment. Currently, there is a dearth of publications in the country that address drug medication errors which makes it imperative to conduct such a survey among anaesthesia providers on the occurrence, predisposing factors and adverse effects of errors on patients. The findings of this survey would be of immense benefit in the effort of the government to improve the quality of health care service delivery at both public and private hospitals across the country.

1.5 Limitations of the study

As a survey designed to evaluate errors in administration of medications by anaesthesia providers there might be some reluctance in giving full disclosure when self-reporting an untoward medical event. This is largely because an average medical practitioner usually sees this type of survey as an assessment of their professional competence despite the assurances of confidentiality.

Typical a major challenge with retrospective self reporting surveys is recall bias. Efforts will be made to limit the effect of recall bias on quality of data by including an self explanatory cover letter of introduction to serve as information leaflet (to stimulate memory of the participants, refresh their knowledge and allowing good response time) and availing the participants a list of possible clear and comprehensive responses for some of the questions.

Lastly, the response rate to the completion of the study questionnaire by medical professionals is usually challenging because of the busy work schedules associated with the anaesthesia service providers.

1.6 Delimitations of the study

The study population is limited to anaesthesia service providers (specialists, medical officers, and registrars), currently providing anaesthesia services in both private and public (government owned) secondary and tertiary hospitals in Namibia. Any anaesthesia service provider that is not currently offering services will not be included in this study. This retrospective cross-sectional survey will cover an unlimited period of years of respondents' provision of anaesthesia services.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Introduction

The level of safety during the perioperative phase of anaesthesia remains a major concern and a challenge.[6,7] During this strategic period identification and notification of the occurrence of MAEs is one of the ways of improving quality of care and patient's safety. The following are examples of preventive strategies, clear drug labelling, standardized syringe colour coding system, accurate calculation of dosages, and double checking of medications, and the impact is quite good when these are implemented in the context of local hospital realities and evidences.[7-9] More precise estimation of the burden and causes of MAEs towards improving patients' safety is very possible with adequate motivation of the anaesthesia service providers to embrace the confidential self-reporting as in this study or other established reporting systems like incident reporting system.[8,9]

The World Health Organization (WHO) launched the Global Patient Safety Challenge in March 2017, which is a concerted effort towards mobilizing both human and other resources to reduce medication administration errors globally. This is the 3rd time WHO will be galvanizing commitment and action globally focused on the reduction by 50% in 2022 the burden medication-related injuries due to challenges in healthcare systems. To ensure the success of this campaign all countries have been advised by WHO to commit to a robust incident reporting systems.[4]

Despite the acknowledgement of the foremost role of the field of anaesthesiology in patient safety, there is still high prevalence of MAEs globally in the practice anaesthesia as revealed by recent evidence.[7-9] According to their training and job descriptions anaesthesia service providers are routinely carry out the clinical assessment, diagnosing, and the determination of the pharmacologic and other treatment modalities of a problem including medication administration. The critical and the demanding nature of this multi tasking workflow makes to very prone to medication administration errors.[9,10] The experience of the patients in resource poor nations like Namibia revealed that they encounter MAEs and the adverse events two or more times more than those in high-income countries.[5,10]

2.1 Types and definitions of medication administration errors.

There is presently no consensus definition of a medication administration error. Elliot et al report in a systematic review study that about 26 different terminologies employed to refer to a medication error in the health care systems.[11,12] While there are multiple interpretations of what constitutes a medication error in anaesthesia, this study will use the definition of 'medication error' approved by the National Coordinating Council for Medication Error Reporting and Prevention: "a medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient or consumer." This events according to the definition above may be associated with the cadre and the experience of the service providers, the many stages of medication administration(such as drug prescription, order communication, labelling and packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use), the health care products, procedures, and systems,.[13,14] The Council admonishes medication errors researchers, software developers, and institutions to use this standard definition to identify errors to ensure data harmony and comparability of the studies on MAEs.[12,15,16]

Types of errors and adverse effects following medication errors

1. **Omission:** drug not administered/ forgotten.
2. **Wrong drug**: administration of a drug other than the one intended/prescribed.
3. **Repetition:** extra dose of an intended drug. Incorrect route: wrong route of an intended drug.
4. **Wrong time:** drug administered at wrong time.
5. **Wrong dosage:** wrong concentration, amount, or rate of infusion.
6. **Incorrect side:** an injection intended for one side of a patient administered into the other side (usually for a regional block).
7. **Incorrect label:** wrong label used to identify medication.
8. **Near miss:** an event that had the potential to develop into a medication error but was prevented by chance.
9. **Adverse medication event (AME):** An event involving harm to a patient associated with the administration of a medication (or the failure to administer an indicated medication). An AME may or may not be associated with error.
10. **No harm:** Error reached the patient but did not cause harm; error reached the patient and resulted in the need for additional monitoring or tests but no harm
11. **Low reversible harm:** A harmful effect that was mild, temporary and short-term; no treatment or only minor treatment was required.

12. **High morbidity reversible harm:** A harmful effect that required more than minor treatment (including procedural treatment) or required an unplanned hospital admission or prolonged hospital stay.
13. **High morbidity irreversible harm:** Symptoms required major treatment to save the patient's life or caused major permanent or long-term harm.
14. **HDU/ICU admission:** patient's clinical condition requires critical care with admission at the High dependency unit or the Intensive care unit.

Types of Medication Administration Errors.

There are several ways to categorise medication administration errors. One of them is based on the steps in the chain of the drug administration process, such as the occurrence of MAEs during drug prescription, order transcription, dispensing, administration or monitoring. In addition, a second classification method for MAEs is to broadly divide MAEs into two main types of errors: errors of commission or errors of omission.[1,11-13] The definition of commission errors is when an incorrect medication or action was taken (e.g. wrong medication, syringe exchange, wrong route, etc.) and while errors of omission are an error related to inaction (e.g. omission, missing Documentation).[1,14,15]

Additionally, Acheampong et al. in a direct cross-sectional observational study conducted, a trained third party watched nurses in the emergency room of a hospital in Accra, Ghana, as they prepared and administered medications. A total 338 patients were included in the 1332 observations, and it was discovered that the most frequent MAEs in the hospital were omissions (78%), followed by incorrect time (16%).[17] In contrast, some researchers examined 3372 reports from the Norwegian Incident Reporting System from 2016 to 2017 and discovered that the most common medication administration errors in Norway were dosage errors (38%), omission errors (23%), and the use of incorrect medications (15%).[18] Härkänen and his colleagues discovered that omission errors are the most common type of MAEs when they analysed the recorded medication errors reported in the National Reporting and Learning System for England and Wales from 2007 to 2016.[19]

2.2 Methods of study of Medication administration errors.

A review of the literature reveals several types of methodologies apart from the retrospective self reporting method used in this index survey, are self-reporting through the use of the incident form system, prospective population study, direct observation of practice (by 3rd party), large database review (national audit projects).[14,15]

Bratch et al[14] conducted a systematic review of the literature on MAEs to determine which methods are used to investigate errors in perioperative medication administration and attempted to estimate the frequency of MAEs. This review of thirty (30) studies that included five types of methods found large differences in MAEs rates and most common error types in each of the studies. Study methods were retrospective self-report surveys, an incident reporting system, a prospective direct observation study, and large databases. In some studies that used retrospective self-report, 20% of anaesthesiologists reported making a medication error during the course of their practice. In self-reported prospective studies, the rate was 1 in 200 anaesthetic procedures.

However, medication errors were documented for nearly all anaesthesia in the observed practice; this is the highest number when compared to the reported medication error rates for all other methods listed above.[14] Approximately 10% of all reported incidents in large databases were MAEs. The most frequent error types identified in the studies employing any of the five approaches were incorrect drug and wrong dosage. Because of the variations in design and methodology, it is challenging to compare the findings of these studies, and it is therefore uncertain how frequently medication errors actually occur. To guarantee more consistent databases for improved research, it is evident that hospitals and researchers must standardize their error reporting procedures.

2.3 Prevalence of perioperative medication administration errors.

Expectedly, the prevalence of medication errors varies across countries and hospitals but in addition this variability also extends to the type of study methodology used. Retrospective studies done in some countries have shown a high incidence of drug errors related to anaesthesia in Canada (85%), South Africa (94%), and New Zealand (94%). It has been estimated that for every 133 anaesthetics administered, there is one medication error and 1% of them cause harm to the patient.[5]

Direct observation appears to be the most accurate and reliable method for identifying and estimating the burden of MAEs as observed in several studies.[10,11] Consequently, it is not surprising that these MAE and ADE rates are greater than those found in studies in which the main method of detection of MAEs was self-reporting.

Using various study methodologies, studies from some African nations also reported high rates of medication administration errors in various hospital scenarios, though largely focusing on general medical care rather than perioperative anaesthesia care.[9–11] In low-income countries, inadequate staffing and poor drug management systems are the primary causes of medication administration errors (MAEs), which impact medication prescription, transcription, dispensing, administration, and monitoring.[12,13] There is currently little research on the drugs used, patient outcomes, and contributing factors to these medication errors.[14]

Most anaesthesiologists (64%) admitted medication administration errors (MAEs), according to a multicentre retrospective web-based survey of 108 anaesthesiologists from 8 teaching hospitals in Ethiopia. The survey had a 42% response rate.[1] This finding is consistent with findings and observations from a similar study conducted in Saudi Arabia, which revealed that 69% of participants had made at least one medication error while giving anaesthesia. Nonetheless, research from Canada and India revealed greater prevalences of 85% and 76%, respectively.[4,5,8]

Another retrospective study of 90 respondents in Brazil also revealed that 86% of them acknowledged making errors when administering their medications. The majority of those who experienced MAEs (95%) did so one to five times. Drug substitution was the most frequent MAE (52%), followed by omission (23%). The most often mentioned contributing factor (54%) was fatigue, which was followed by reading the label or vial incorrectly (24%). Out of the 77 professionals who reported medication errors, 60 of them administered the wrong medication into the neuraxis.[6]

In a prospective direct observational study by Nanji and colleagues, 193 errors were committed in 3,671 drug administrations during 277 surgeries.[11] Of the errors, 65% were serious, 33% were significant, and 2% were life-threatening. Zhang et al. reported a medication error rate of 0.7% (179 errors during 16,496 anaesthetics) in a prospective incident surveillance study in China. The largest category was omissions, incorrect doses, and substitutions, which together accounted for more than 65% of all errors.[12] These resulted in serious complications in at least two patients and inadvertent ICU admissions in five patients. The above figures show different rates of MAEs, and this is due not only to the underreporting prevalent in all healthcare systems, but also to the methodology used in analysing the MAEs.

2.4 Contributory factors to the occurrence of medication administration errors

A comprehensive knowledge of the various factors that contribute to the occurrence of medication administration error is essential to its prevention, improvement of health care quality and policy formulation. The are many common factors that dominated the list of likely causes of MAEs and some are as follows, medication or equipment unavailability, staff factors such as distraction, poor knowledge, fatigue, patient factors (absenteeism, refusal), prescription, dispensing (drug labelling and packaging), unfavourable working environments (drug bay poor lightening) and communication problems.[20-22] Kim et al reported in their study that the common contributing factors are look-alike medications, fatigue, haste and distraction, improper the storage of medications in the wrong sections or next to similarly looking medications, having multiple anaesthesia service providers involved in the patient care simultaneously, forgetting to double check the medication.[21]

In Nigeria, Ogunleye and his colleagues in a national retrospective survey study involving 2,386 health care professionals (females (61%), nurses (46%), medical and dental practitioners (45%), and pharmacists (9%), reported that the foremost contributory factors to the occurrence of MAEs were overwork and tiredness followed by respondents who gave no reason for the occurrence of MAE in their practice.[9]

In Saudi Arabia, Aldossary and his colleagues reported that factors the participants considered had led to most MAEs were the following, unfamiliarity with medication, poor labelling of syringe, heavy workload and haste, poor communication with colleagues, fatigue and inadequate sleep, inadequate experience, and dependency on co-workers.[2] Jessurun and his colleagues in their study's multivariable analyses found no significant associations for factors such as the day of the week, the ratio of patient to nurse, distractions and staff demographics other than status of educational.[23]

2.5 Adverse medication events

Nanji and his colleagues. found that AMEs without MAE and patient harm accounted for 21% of their events, with the remaining MAEs having a low threat of harm or being linked to an observed or potential adverse drug event. When developing strategies to improve patient medication safety, potential adverse medication events (AMEs) as well as preventable and observed AMEs should be taken into cognizance. An AME is any harm or injury to a patient triggered by medication, regardless of whether a MAE occurred or not.[11,12] One example of an MAE that led to an AME is the administration of an analgesic, such as morphine, to a patient who has a known morphine allergy, which can cause a potentially fatal allergic reaction. It is crucial essential to keep in mind that AME can occur without MAE. For instance, even after taking preventative antiemetics, a patient may still have postoperative nausea and vomiting.

According to the majority of anaesthesiologists (61%), patients were not harmed. Morning shift workers were more likely to make serious mistakes (38%). 55% of the most serious MAEs were made during maintenance phase of anaesthesia. In terms of error detection time, 83% of anaesthesiologists stated that the error was identified right away and twelve instances (16 percent) of late error detection were reported.[5]

This study, along with other comparable retrospective studies, demonstrated that most participating anaesthesiologists had previously made some kind of MAEs; however, the majority of the errors reported caused little harm and a low level of concern for the patients' morbidity. Medication errors were associated with two patients' death (3%).[1,2,4,5,711]

Non administration of a medication can be as deadly as administration of a wrong drug or at a wrong dose, and more attentiveness needs to be given to omissions. The dangers of delay or omission of drugs have been classified by the English National Patient safety Agency (NPSA), which suggests that omission of medications such as insulin, anticonvulsants, anticoagulants and anticancer agents, can lead to major or calamitous long-term complications for the patient.[19,21,24] Fatigue and distraction, Staff shortages and delays in medication dispensing, patients' inability to take the medicine, or medication unavailability are a few of adduced reasons for medication error.[19]

It is imperative to note that the frequency of error was not expressed as a percentage of the overall number of drugs administered, but rather as the percentage of patients who experienced at least one error (the frequency per “anaesthetic medication"). It is also essential to recognise that each of these studies has a different focus; some incorporated process errors like incorrect drug labelling or record keeping, while others focused on actual performance errors of drug administration that affected the patient, like giving the wrong medication.[11.14]

2.6 Preventive strategies

Though MAEs occurs often across several hospitals they are largely preventable, and to do decrease the occurrence of medication administration errors their must be a health system approach wholistically. The health care system needs to actively promote strategies that can lead to positive changes in preventing medication administration errors. Robust health information management system including the Incident reporting system has been identified as a strategy that can reduce medication errors and improve the efficiency and quality of care at all levels of medication administration. The colour coding of syringes, bar code technology, intravenous infusion safety systems, unique ports for route of administration, and electronic medication administration records are a few of the effective strategies that could prevent errors in medication dispensing and administration.[25,26] In addition, promoting the culture of non-punitive reporting of MAEs and adverse events by staff will go along way in reducing MAEs, staff training, standardized labelling policy, and other similar strategies have been reported to reduce MAEs rates.[23,27-29]

McCawley and his colleagues revealed that in 84% of reported MAEs, another second anaesthesia service provider was not available to do the double-checking before the medication was administered and this remains a challenge in resource poor settings.[30]

A recent study by Firde indicated a strong association between double-checking medications before administration and a lower risk of errors among anaesthesia providers. Furthermore, anaesthetists who didn't always verify their anaesthetic drugs faced a threefold higher chance of making MAEs. Confirming medications before use can help prevent both internal errors (happened with just a person) and external errors (resulting from a 3rd party, like illegible labelling or prescription).[1,4,5] Furthermore, Aldosarry et al in another study corroborated these findings, with respondents agreeing that double-checking medications and using color-coded syringes are vital safety measures reported in Saudi Arabia.[2] It is clear that a quick double-check can go a long way in keeping patients safe from MAEs and the adverse events.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

This was a descriptive, retrospective survey. A confidential, anonymous self-administered structured questionnaire was shared with anaesthesia providers in both government and private hospitals in Namibia as a web-based document, via the email, and phone. Participants were sent regular and scheduled reminders during the survey period.

3.2 Population of the study

The survey was carried out among anaesthesia service providers in all public and private (tertiary and secondary) health facilities in Namibia. All specialist anaesthesiologists, anaesthesia registrars and medical officers involved in perioperative anaesthesia services constituted the study population.

The sampling frame for this study was sourced from the Ministry of Health and Social Services, Management of both Katutura and Central Hospitals and the registry of Anaesthetists Society of Namibia (ASN). There are currently 29 District Hospitals, 4 Intermediate Hospitals and 1 National Referral Hospital (Central Hospital). There currently 18 Private Hospitals offering anaesthesia services in the country. There are 92 service providers from the Government Hospitals and 30 from Private (total 122) that were eligible to participate in the survey.

Inclusion criteria

- Anaesthesia service providers in Public and Private Hospitals.

Exclusion criteria

- Those providers who are not involved in medication administration practice and/or those serving in administrative positions solely.
- Anyone who refused to give consent

3.3 Sample size calculation

Sample size calculation for a cross-sectional study using the formula:

n= 〖〖Z_(1-α/2)〗^2 p q〗_( )/e^2

Where, n = Sample size

Z1-α/2 = Standard normal deviate corresponding to the probability of type I error (α) at 5% =1.96

p= 0.5

q= 1-p

e= margin of error (0.1)

n= 〖〖(1.96)〗^2 (0.5) (0.5)〗_( )/〖(0.1)〗^2

n= 3.84 x 0.25_ = 96

0.01

Assuming 10% non-response rate (NR),

Minimum sample size, N = 100 x n / 100 - NR

Where NR= non-response rate (10%)

N = 100 x 96/100-10 = 107

Minimum sample size = 107

3.4 Research instruments

For the data collection a web-based structured self-administered questionnaire (with input from previous studies)[2,5,6] was prepared, pre-tested and was used to collect data on socio-demographic characteristics (e.g. age and years of practice and experience, type of health institution, an educational award, etc.), work-related factors (presence of written guideline for medication administration, reporting systems, training on medication administration, communication with other providers, etc.)

3.5 Data collection methods/procedures

The electronic copies of the questionnaire were uploaded using google forms with the link easily accessible and responsive. The electronic copies loaded on the google forms were shared with participants through the communication structure of the Ministry of Health and Social Services, Management of the Regional/District Health Offices, Anaesthesiologist Society of Namibia (ASN) and Anaesthesia service providers at various private hospitals across the country. Phone, social media, and email communication were used to distribute the tools.

Reminders was sent to all participants four times during the one month's span of data collection. In addition, hard copies of the questionnaire were made available for use to improve response rate. The google forms online was passworded and the analysed data was stored in a secured personal computer.

Budget/funding.

This was entirely self-sponsored research.

Timeline

The survey was kept open for responses for one month.

3.6 Data analysis

Data was recorded in Microsoft® Excel (2013) and analysed using IBM SPSS statistics for Windows, version 22, Armonk, NY: IBM Corp. The findings of the descriptive statistics for nominal categorical variables were summarized as numbers, frequencies, and percentages, while ordinal categorical variables were displayed as numbers and percentages, etc.

3.7 RESEARCH ETHICS

Ethical clearance was obtained from the Decentralised Ethical Committee (DEC) of the University of Namibia, (Reference number SOM20/2024 Date: 17/05/2024).

Informed consent

A detailed information leaflet was provided for all the participants with the phone contact and email address of the Principal Investigator displayed. Consent was obtained from participants and the option to decline or withdraw participation without any consequences at any time during the study period clearly stated.

Voluntary participation

All participants were assured that their participation was voluntary, and they could withdrawal their participation at any time without any consequences.

Confidentiality of data

Responding to web-based self-administered questionnaire ensured confidentiality as cookies were not used at survey completion. To maintain confidentiality of information collected from research participants only the principal investigator could identify the responses (the returned self-administered questionnaire) or had any form of contact with the participants. After the study, the data was carefully stored electronically (e.g. completed questionnaire) through the use of password protected files, and stored documents within locked locations.

Anonymity

There was no part of this survey or during publication that participants' name, phone number or their hospital's contact details was revealed. Furthermore, as a web-based survey all responses remained anonymous once completed and submitted.

Beneficence to participants

This study's findings will be used to advocate for improvement of the perioperative anaesthetic safety. The anaesthesia providers in Namibia will be availed with details of the prevalence, contributing factors and consequences of perioperative medication errors on patients.

Non-maleficence to participants

This questionnaire-based study was at no cost or risk to the participants. Their participation was limited to the confidential completion of the structured questionnaire.

CHAPTER 4

RESULTS OF THE STUDY

Introduction

In this chapter, the data obtained from the survey was analysed and presented as texts, tables, pie charts and graphs in line with the objectives. From 122 self-administered structured questionnaires shared among anaesthesia providers in Namibia, 112 (92%) responded.

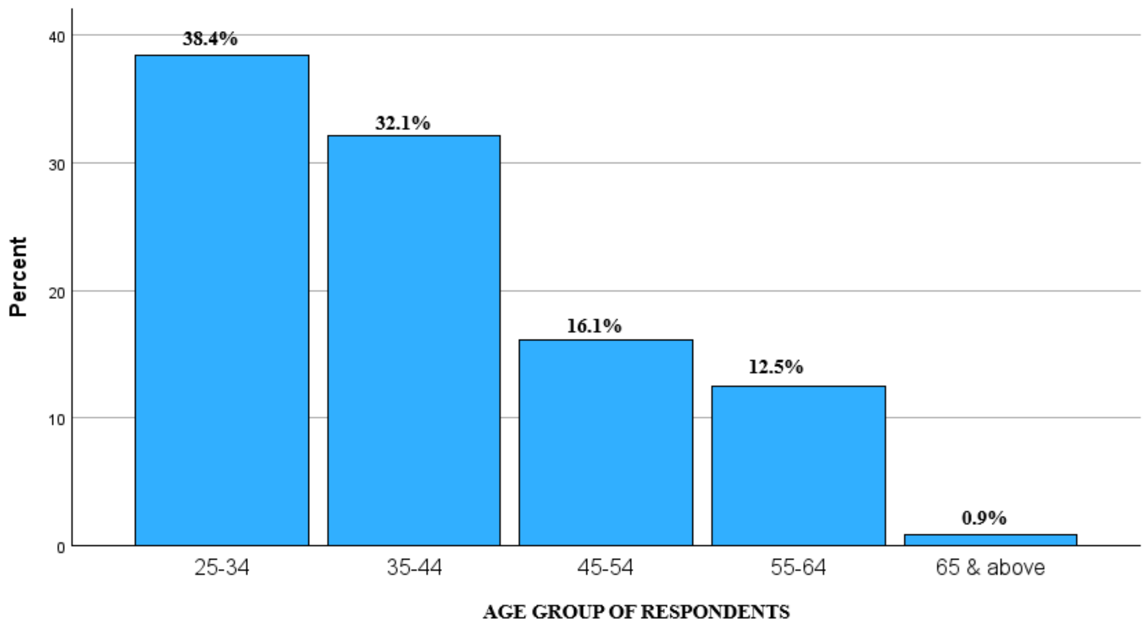
4.1 Demographic characterisation of the participants

This section will display the demographic data of the respondents: age, gender, professional status, place of work, years of experience, and other fields of practice.

4.1.1 Age distribution of respondents

According to Figure 1, most participants 43 (38%) were of the age-group 25-35 years, followed by 36 (32%) in the age group 35-44 years.

Figure 1: Age distribution of the study participants



4.1.2 Gender distribution of respondents.

There were slightly more female participants 58 (52%) than males, as shown in Table 1.

Table 1: Gender distribution of the study participants

Gender	Frequency	Percentage
Male	54	48.2
Female	58	51.8
Total	112	100

4.1.3 Professional status of respondents

Most anaesthesia service providers surveyed were medical officers, 63 (56 %) while the least were specialists (Figure 2).

Table 2: Professional status of study participants.

Professional status of respondents	Frequency	Percentage
Medical officers	63	56.3
Registrars	26	23.2
Specialist	23	20.5
Total	112	100.0

4.1.4 Years of anaesthesia practice of respondents

The clinical experience of respondents ranged from 1 to 14 years, most of them (71%) less than 5 years, according to Table 2.

Table 2: Years of anaesthesia practice of respondents

Number of years of anaesthesia practice	Frequency	Percentage
<5	80	71.4
5 – 9	15	13.4
10 – 14	17	15.2

4.1.5 Workplace of respondents

Most of the participants 80 (71%) worked in government hospitals, as shown in Table 3.

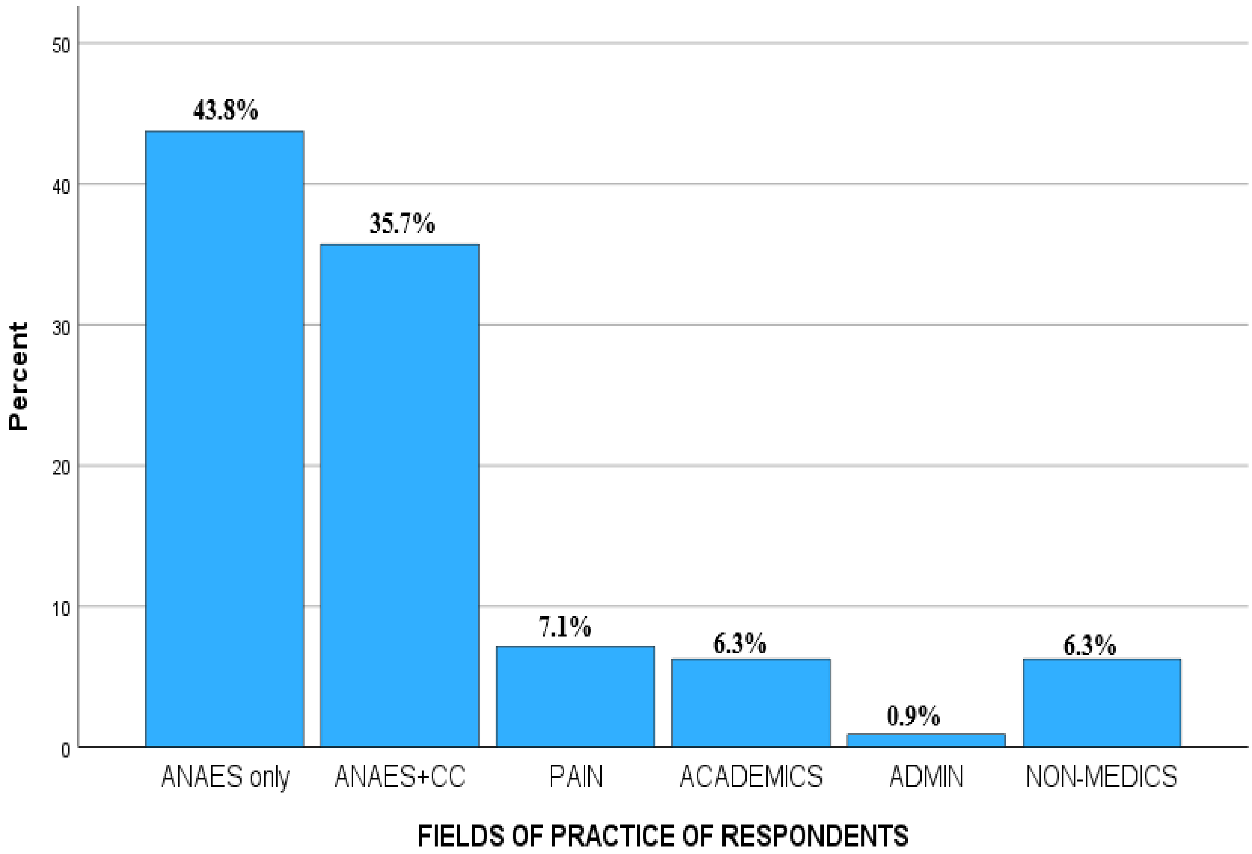
Table 3: Workplace of the study participants

Place of work	Frequency	Percentage
Government institution	80	71.4
Private practice	15	13.4
Government & Private	17	15.2
Total	112	100

4.1.6 Field of practice of respondents

Forty-nine (44%) participants practiced anaesthesia only while 40 (36%) combined anaesthesia services with critical care, according to Figure 3.

Figure 3: Field of practice of respondents



Anaes = Anaesthesia
Anaes + CC = Anaesthesia and Critical care
Admin = Administration

4.1.7. Hours of daily work

Majority of the respondents worked for more than 8 hours daily, according to Table 4.

Table 4: Hours of daily work.

Daily work hours (Hr)	Frequency	Percentage
>8	89	79.5
N<8	23	20.5
Total	112	100

4.2 Prevalence and characteristics of medication administration error among participants

4.2.1 Prevalence of medication administration error among participants

Among the respondents, 88 (79%) indicated that they had experienced one or more MAEs during their anaesthesia practice, as shown in Table 5. On the frequency of occurrence of MAEs, 33% have experienced only one overall while 28% admitted one MAE yearly and another 27% reported once every 3 months. Furthermore, 11% reported once monthly and one respondent indicated few MAEs per month.

For most of the participants (55%), the occurrence of medication error was not related to a particular shift duty. However, the result showed that MAEs occurred more at nights (38%) than day shifts (7%).

Table 5: Prevalence of medication administration error among participants

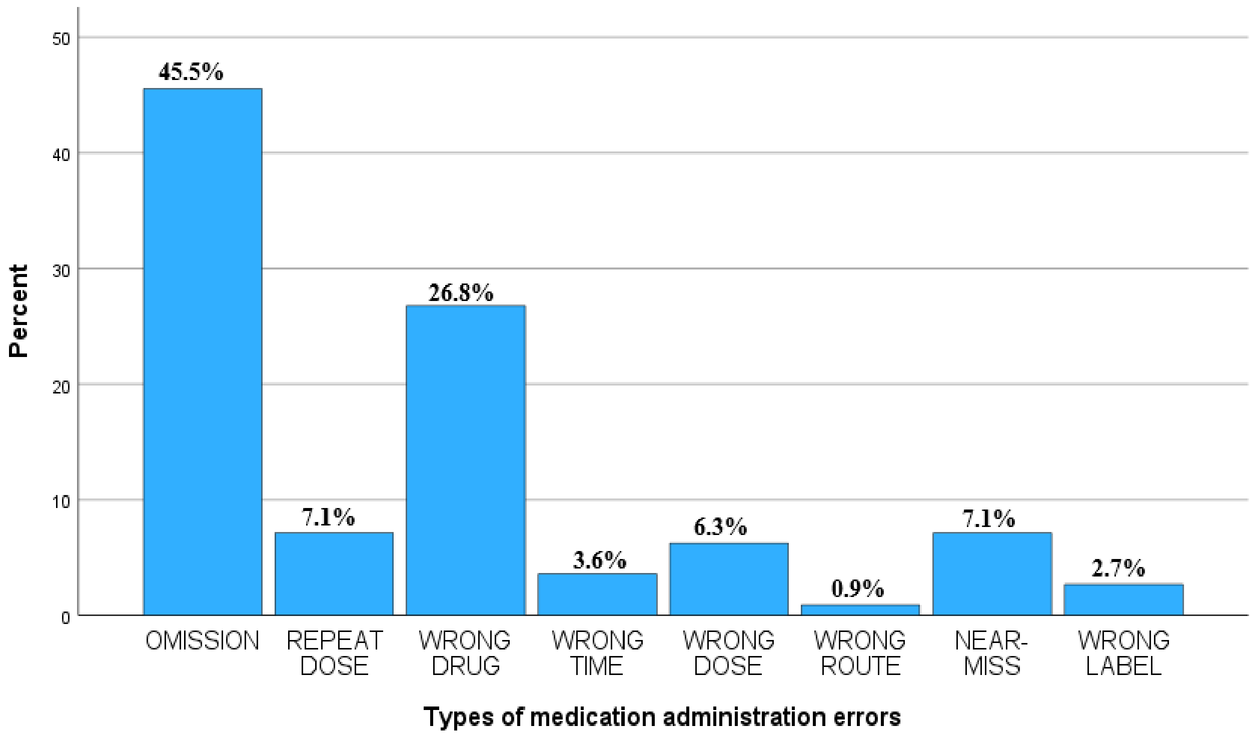
Have you experienced a medication administration error during your anaesthesia practice?	Frequency	Percentage

Yes	88	78.6
No	24	21.4
Total	112	100

4.2.2 Types of medication administration error among participants

The study participants indicated that failure to administer an intended medication when due (omission) was the most frequent type of MAE (45.5%), followed by the administration of a wrong drug, as shown in Figure 4.

Figure 4: Types of anaesthesia medication administration errors by respondents



4.2.3 Perioperative period and route of drug administration vis-a-vis the occurrence of medication administration errors

According to the respondents, the induction phase recorded the highest number of MAEs (44%) while the reversal phase was the least, as shown in Table 6. In addition, most respondents (87%) reported that the intravenous route was the most common route, followed by intrathecal injections.

Table 6: Perioperative period and route of administration that the medication administration errors occurred

IV= Intravenous, IM= Intramuscular, IT= Intrathecal.

4.2.4 Process of survey participants' medication administration errors

Variables	Response	Frequency	Percent
Perioperative period when the medication administration error occurred.	**Premed**	9	8.0
	Induction	49	43.8
	Maintenance	42	37.5
	Reversal	1	0.9
	Early postop	11	9.8
	Total	112	100.0
What was the route of drug administration when error occurred.	**Oral**	1	0.9
	IM	3	2.7
	IV	97	86.6
	IT	8	7.1
	Perineural	1	0.9
	Inhalational	2	1.8
	Total	112	100.0

Most of the respondents (64%) drew out their medications when providing anaesthetic services, while 30% said the specialist anaesthesiologist did on behalf of the service provider, as displayed in Table 7. Colour-coded syringes were not used by most respondents (87%) and 83% of them draw out the medications in a syringe before labelling. The detection of the occurrence of the MAEs was immediate in 80% cases (Table 7).

Table 7: Process of participants' medication administration errors

Variables	Response	Frequency	Percentage
Who draws up an anaesthetic drug in the syringe?	Aneas. Nurse	1	0.9
	Intern	1	0.9
	Medical officer	4	3.6
	Anaesthesiologist	33	29.5
	Self	72	64.3
	Can't say	1	0.9
	Total	112	100.0
Use of Colour coded syringes	YES	15	13.4
	NO	97	86.6
	Total	112	100.0
How do you draw anaesthetic drug into the syringe.	Label then draw	19	17.0
	Draw then label	93	83.0
	Total	112	100
How long did it take to detect your most severe error?	Immediate	89	79.5
	Late	9	8.0
	Suspected, unconfirmed	14	12.5
	Total	112	100.0

4.3 Contributory factors for the occurrence of medication administration errors

Majority of respondents (67%) blamed distraction and fatigue for the occurrence of medication administration errors in their anaesthesia practices while unspecified factors (9%) and wrong pump programming (8%) followed in that order, as shown in Figure 5.

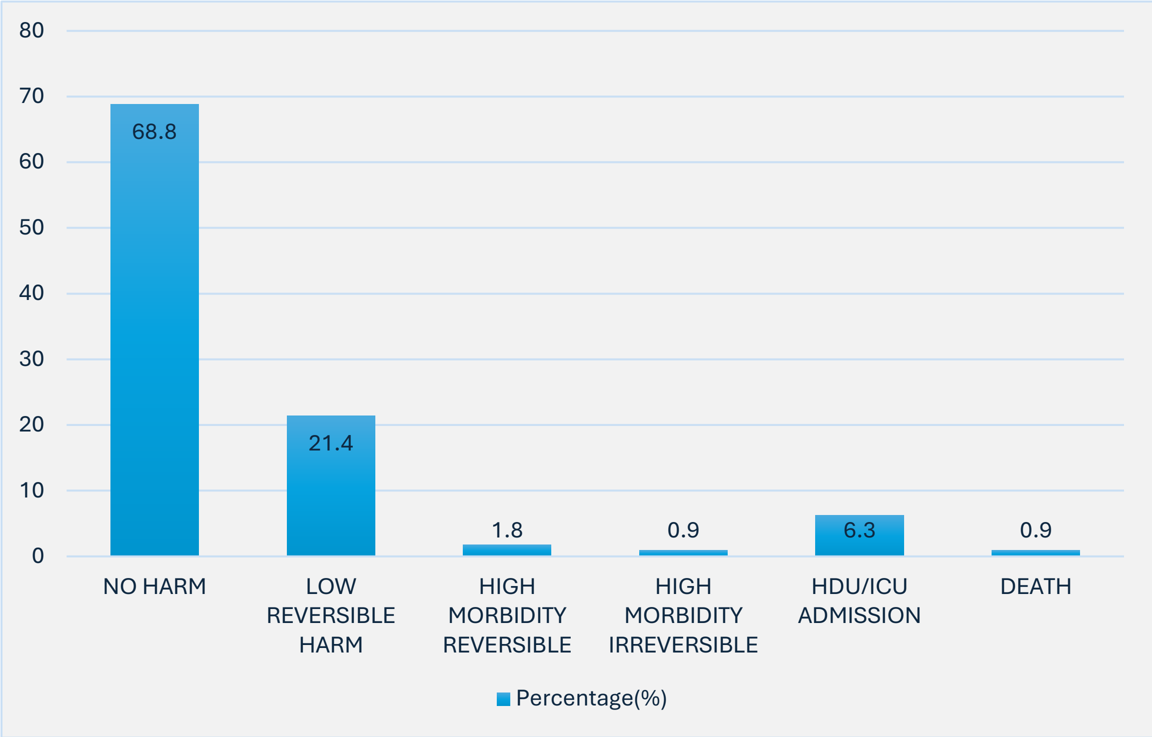
Table 8: Contributory factors for the occurrence of medication administration errors among respondents

Contributory factors	Frequency	Percentage
Distraction/Fatigue	75	67.0
Undue Pressure	8	7.1
Misreading Label	9	8.0
Poor Knowledge/Exp With Drug	3	2.7
Poor Storage Of Drug	1	.9
Pump Wrong Programming	1	.9
Poor Communication Between Practitioners	5	4.5
Others Unspecified	10	8.9
Total	112	100.0

4.4 The adverse effects following medication administration error

According to 77 (69%) respondents, there was no harm to the patient following a medication administration error, followed by 21% participants who stated that the harm was low but reversible. There were 7 (6%) HDU/ICU admission and only 1 (0.9%) death (Figure 6).

Figure 6: The adverse effects following medication administration error



CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Introduction

In this chapter, the findings of this study will be interpreted and followed by a critique based on previous studies. The chapter will also draw conclusions in the context of the significance and objectives of the study. From these conclusions, recommendations are formulated, and the limitations of the study would be highlighted.

5.1 Demographics

In this nationwide survey of the anaesthesia service providers, an impressive 92% response rate was obtained from practitioners in private and government hospitals. Similar surveys in India, Ethiopia and Saudi Arabia, reported much lower rates of 9%, 42% and 80% respectively.[1,2,5] The spread and sample size make the survey results more representative of the burden and characteristics of the MAEs in Namibia.

The survey results revealed the youthfulness of the anaesthesia service providers in Namibia, most of the participants (38%) were of the age-group 25-35 years. This finding is like Firde's study results, who reported a mean age of 29 years. Moreover, most (58%) of the respondents in this survey were females, a higher proportion (83%) of respondents were males in Firde's Ethiopian study.[1]

The data showed that most anaesthesia service providers (56%) surveyed were medical officers, and the specialists were only 23%, this is unlike the Indian survey where most respondents were specialist (94%). Of the respondents in Aldossary et al's study in Saudi Arabia, 49% were specialists, about twice the number of this index survey. [2,5]

In this survey and the Ethiopian study already alluded to, much higher percentages (71% and 88% respectively) worked for the government which is at variance with an Indian study where 34% worked for the government and 64% were engaged at private hospitals or as free lancers. In this study, most respondents (71%) had 5 years working experience in keeping with the young age profile. This is different from Aldossary et al's results which showed much less respondents (45%) under 5 years of experience, and 13% more than 20 years.[5] With respect to working hours, over 8 hours was the norm amongst the respondents.

In addition to their clinical work, 36% of the respondents were also involved in critical care services, while in Ethiopia's survey more than half of the respondents were involved in academic and teaching endeavours.[1]

5.2 Prevalence and characteristics of medication administration error among participants

5.2.1 Prevalence of medication administration error among participants

This survey results showed a high rate of occurrence (79%) of MAEs among the respondents similar to the 76% reported by Annie et al in India.[5] Researchers in Ethiopia and Saudi Arabia found high prevalences (64% and 69%) of at least one medication administration error among the anaesthesia providers surveyed.[1,2] While MAE studies carried out in Canada and New Zealand revealed higher rates of 85% and 94% respectively, Labuschagne et al in South Africa reported a much lower rate of 39%.[5,8,15] The wide variation in prevalence could be attributable to the different study designs employed. Some researchers used direct observation while others reviewed incident reporting systems. This index study being retrospective, relied on the ability of respondents to recall past experiences and therefore can be subject to recall bias, so under-reporting cannot be ruled out. Furthermore, such self-reporting requires a level of sincerity which cannot be ascertained. The data from studies that employed prospective designs have no such limitations.[14,15,17,31]

MAEs and clinical experience of anaesthesia providers

In this study, 71% of the respondents who had experienced MAEs have practiced anaesthesia for less than 5 years, which is higher than Annie et al's report of 64% with over five years of anaesthesia practice.[5] Their (Annie et al's) study population and Firde's indicated that years of experience or qualification did not deter anaesthesia providers from committing errors, given that 94% specialist anaesthesiologists and 64% Master of Science (MSc) graduates were involved.[1,5]

MAEs and working hours

The survey results revealed that most respondents (82%) with MAEs worked for over 8 hours daily. This finding was significant since high workload of health professionals cause fatigue and affect their cognitive function leading to medication administration errors.[6, 22,36,37] The need to provide a 24-hour emergency and critical care services is one of the reasons for the long work hours at the hospitals and this leads to sleep deprivation and compromised cognitive function. This long working hour situations affect the quality of critical decision making by the physician and nurses.[33]

In Europe, effective from 1998, work hour restrictions have been put into policies and legislations as stated in European Working Time Directive (EWTD).[34,35] According to this directive, a maximum 48-hour work week and a minimum of 11 consecutive hours of rest daily, are stipulated for all workers among other restrictions. The enforcement of these regulations is now for all workers across the European Union, including medical residents and their consultants.[34-36] This regulation for work hour restrictions is in contrast to the reported work experiences of the 82% of the respondent in this study, who works for than 8 hours per day with resultant fatigue and the potential for medication administration errors. It is noteworthy that the poor resource countries might find this challenging to implement largely due to inadequate human resource for health.

Researchers in Netherlands noticed that work hours between 6 pm to 7 am and 10 am to 2 pm were more fraught with medication administration errors than in the early morning hours. This may be linked to workload, the uneven distribution of tasks during the day, and / or tiredness of the staff.[23,37]

This index study similar to Feleke and colleagues found that practitioners during the night shift were more error-prone probably from the lack of circadian adaptation to night work leading to impaired alertness and performance.[38]

5.2.2 Types of medication administration error among participants

Medication administration errors could be errors of commission (process error), or errors of omission. Error of commission could be administration of wrong drug, at wrong dose, at wrong time, through a wrong route, wrong labelling or wrong equipment while omission is failure to administer the medication at the appropriate time or failure to record/monitor.[1,14,15,39]

Forty six percent (46%) of this survey's respondents stated that omission was the commonest type of medication administration error encountered in their practice and followed by wrong drug administration. The error of omission is either the medication was not administered, or the record of the medication administration was not kept (documentation error), and diverse reasons can be argued for the occurrence of this of type of MAE. Firstly, the knowledge base of the respondents concerning the appropriate use of the medication can be called into question, the institutional policy or guidelines might be either non-existent or ambiguous, poor team communication and lastly the problems with equipment (malfunctioning or lack) used to aid drug administration can also contribute to error of omission in the theatre.[40,41]

In a similar nationwide survey in India, syringe swap was the commonest type of MAEs, where wrong medications were administered inadvertently due to various reasons.[5] In the United States of America, Nanji and his colleagues reported labelling error (24%) as the commonest type of error at their centre, followed by wrong drug use (23%). Labuschagne and colleagues reported wrong drug administration as the commonest type of MAE. In Brazil the most common error reported by Oliveira et al was drug exchange (52%) which is a form of error of commission like syringe swab, and followed by omission (23%).[6,8,11]

Unlike this index study, Kim et al reported that incorrect dose was the commonest (29%) type of medication error followed by substitution (28%), incorrect route (8%), and omission (7%), as revealed in their review of the WebAIRS (an online voluntary incident reporting system for anaesthetists in Australia and New Zealand).[21] The common thread in these findings is that errors of omission and/or commission occur among anaesthesia providers, irrespective of years of experience, qualification or country of the practitioner.

5.2.3 Perioperative period and route of administration that the medication administration occurred

The process of medication administration starts before, during surgery after theatre in the ward the anaesthesia service provider takes the strategic lead in all these processes starting from drug selection to drug administration and documentation.[12,38,42,] In this index study, more than one third of respondents (44%) said that the induction phase of anaesthesia recorded the highest number of MAEs followed by maintenance phase. This finding is not unexpected because it is during these two phases of anaesthesia that the bulk of the perioperative medication administration occur.[23,27,43-45] Many researchers agree that MAEs frequently occurred during induction and maintenance phases of anaesthesia for the same reason that multiple drugs are administered.[30,44,46,47] Moreover, in the context of the multitasking nature of anaesthesia practise, it is possible for clinicians to omit, swap, or misidentify a medication while attending to other tasks.[20,21,23,46]

The route of medication administration when most of the MAEs occurred was intravenous route as reported by 87% of the respondents, followed by the intrathecal route (7%). The preponderance of these two routes in the development of MAEs are similar to the findings of other researchers.[5,31,37,39,47] The low frequency through intrathecal (7%) and perineural (1%) routes imply that medication administration errors are commoner with general anaesthesia than regional techniques. This finding agrees with researchers in Nigeria.[46,48,49] Apart from the fact that some anaesthetic medications are high risk drugs with narrow therapeutic indexes, the greater number of medications being used during general anaesthesia might be responsible for these differences.[31,39,50]

5.2.4 Process of survey participants' medication administration errors.

Anaesthesia service providers across board are routinely required to perform concurrent tasks of clinical management of the current, last and next patients on the surgical list for the day, while also teaching, and at same time maintaining the team dynamics with the other theatre staff.[36] Importantly, the anaesthesiologists still have to administer and manage large number of medications perioperatively which raises the concern about who draws out, label and administer medications in the theatre without compromising patient safety.

During the provision of anaesthesia services, the 64% of the respondents in this index study said they drew out their medications themselves and another 30% of the respondents stated that the specialist anaesthesiologist does this. In the Ethiopian study, 41% of respondents admitted to using anaesthetic medications that were prepared by students under supervision.[1] Aldossary et al's reported that in Saudi Arabia 56% of respondents said it was the anaesthesiologists the that draw up the drugs because the country's policy allows only the anaesthesiologists to provide anaesthesia services.[2] Firde posited that participants who prepared their medications and at same time administer the medication were less likely to experience MAEs because this reduces the risk of miscommunication between anaesthesia staff which is a contributory factor to the occurrence of MAEs perioperatively.[11,16]

In this index study, most respondents (87%) did not use colour-coded syringes similar to Johnson and colleagues' finding in Nigeria and this contrasts with Aldossary et al's finding where most (85%) respondents used colour-coded syringes in their daily practice in Saudi Arabia.[2,8] Many studies have revealed that colour coding of syringes minimize medication errors because it aids quick recognition of a potential MAEs.[1,2,8,48] The usage of simple techniques like labelling with white adhesive tape or paper seems insufficient to help in differentiating medications especially during critical times in the theatre. Two of the foremost internationally recognised institutions, American Society for Testing and Materials (ASTM) and Institute for Safe Medication Practices (ISMP) have advised the use of a standard syringe colour coding system to reduce the rates of MAEs caused by swapping of syringe and ampoules.[51,52] In similar studies done by both Moreira et al among nurses and physicians, and Stevens and his colleagues among paramedics they reported that using color-coded and prefilled syringes improved medication administration time and decreased the occurrences of MAEs among paramedics, nurses and physicians.[53,54] Though inconsistent application of colour schemes can cause confusion and has contributed to medication misadventures.[54]

Most of the respondents (83%) in this survey drew out the medications in the syringe before labelling while Aldossary et al reported that 56% respondents in their study practised this.[1] However, in Ethiopia, 51% of the participants labelled the syringes first before withdrawing the drug when preparing the medication.[2]

The association between the frequency of MAEs and the medication labelling procedure of medications was observed by Aldossary and his colleagues, and they opined that labelling the syringe before withdrawing the medication had led to MAEs more frequently than withdrawing the medication then labelling the syringe. Data from several studies is still very diverse on this, some researchers promotes labelling the syringe before withdrawing medication, while some suggest that medications should be drawn up in the syringe before labelling.[2] Nevertheless, the recommendation form the National Patient Safety Agency is that service providers should draw out the medication first, and then follow it by labelling and this should be the process for a single medication per time.[2,4,37,59] The tradition of labelling an empty syringe is being discouraged, and the culture of labelling the syringe after withdrawing the medication should be promoted.[2]

5.3 Contributory factors for the occurrence of medication administration errors

Most of the respondents (67%) reported that distraction and fatigue was the reason for the medication administration errors that they experienced in their practice. The fact that 80% surveyed worked for over 8 hours daily and the demanding/multi-tasking nature of anaesthesia services in the operating theatres can be implicated. These findings are similar to haste/hurry, excessive dependency on junior colleagues and heavy workload reported in the Indian and Saudi Arabian studies previously mentioned.[2,5]

Although 41% of respondents could not say if the time of the day of their work shift duty was linked to the MAEs, 36% said that it occurred more at night. This becomes significant in the context of distraction and fatigue for the occurrence of MAEs. This was corroborated by Firde's report that a notable number of MAEs occurred in the night in their setting.[1] Contrary to our finding, Cooper et al. found that maximum errors were due to inadequate experience (16%) or inadequate familiarity to equipment (9.3%) as opposed to haste and inattention.[27]

5.4 The adverse effects following medication administration error

This survey results showed that 69% of respondents said that there was no harm to the patient following a medication administration error, and this was followed by 21% participants who stated that the harm was low and reversible. This was lower than the 87% of respondents who also stated that there was no harm to the patients when MAEs occurred as reported by Annie et al in India. A similar rate of adverse event (33%) was reported by Nanji et al even though theirs was a prospective directly observed study.[11]

According to Aldossary et al's results, 85% of the respondents stated that the MAEs did not cause patient harm.[2] It is noteworthy that though most MAEs have been inconsequential, some have led to major morbidity/mortality in patients.[1,5,14] According to Firde, the more frequent complication of medication administration error observed by participants was prolonged hospital stay following surgery and anaesthesia (25%).[1]

In Nigeria, Johnson et al reported a different scenario where majority of the respondents (79%) said that the MAEs resulted in harm to the patient ranging from mild to severe.[46] Drug administration errors are important causes of morbidity and mortality, and has been reported to be responsible for about 7000 deaths yearly in the United States, causing direct health costs and possibly preventable human hardship.[18,46,55]

It is noteworthy that the focus of this index survey was the adverse effects of medication error on the patients and not the respondents. It is well known that MAEs affect anaesthesia service providers and their capacity to function at work even when no harm was done to the patient.[14,35] In an online survey, McCawley et al assessed the impact of MAEs on anaesthesiologists working in Australia and New Zealand, and reported guilt, embarrassment, and disrupted sleep patterns in 14% of respondents.[30]

CONCLUSION

The survey found a high rate of anaesthetic medication administration errors, mostly due to errors of omission and/or commission with distraction and fatigue featuring prominently. Experienced clinicians made fewer errors than less experienced practitioners. The respondents reported most errors were not associated with patient harm. The findings contribute to the small but growing body of literature about anaesthetic medication safety in Namibia.

RECOMMENDATIONS

The findings of this survey have some implications for anaesthesia practice. Understanding the causes of medication errors can help anaesthesia service providers and policymakers to establish and build capacity for incident reporting system, formulate safety guidelines for anaesthetic medication management, including preventive, corrective, reporting strategies and others that are listed as recommendations below.

1. A centrally coordinated or lead system approach to the prevention of MAEs and its harmful effects should be set up for an incidence reporting systems across the hospitals in Namibia as part the national health policy.
2. There is need to encourage future research on MAEs in Namibia especially to fill in the information gaps that this study did not cover. Direct observational study design is suggested. Such investigations could cover the common anaesthetic drugs associated with errors, preventive strategies, and investigate what makes a nonjudgemental working culture in the operating theatre to encourage anaesthesia service providers to disclose errors frequently and truthfully.
3. To create awareness and implement with training programs on patient safety, MAEs identification and documentation. This will focus on preventive strategies such as refilled syringes, 2-person checking, drug labelling, colour coding, and accurate dose calculations, etc.

LIMITATIONS

As a retrospective survey study, the main limitation is that it relies on “self-report” – a known limitation of retrospective survey questionnaires with recall bias and reliance on participant sincerity, which might have underestimated or overestimated the occurrence of medication errors. In addition, another challenge with MAEs research remain with the varying types of terms, different definitions of terminologies, and the type of methodologies used.

REFERENCES

1. Firde M. Incidence and root causes of medication errors by anaesthetists: a multicentre web-based survey from 8 teaching hospitals in Ethiopia. Patient Saf Surg. 2023;17(1):1-7.

2. Aldossary DN, Almandeel HK, Alzahrani JH, Alrashidi HO. Assessment of medication errors among Anaesthesia Clinicians in Saudi Arabia: cross-sectional survey study. Global J Qual Saf Healthc. 2021;5(1):1-9.

3. Leahy IC, Lavoie M, Zurakowski D, Baier AW, Brustowicz RM. Medication errors in a paediatric anaesthesia setting: Incidence, aetiologies, and error reduction strategies. J Clin Anesth. 2018; 49:107-11.

4. World Health Organization. Medication Without Harm WHO Global Patient Safety Challenge [Internet]. 2017 [cited 2023 October 19]. Available from: http://apps.who.int/bookorders.

5. Annie SJ, Thirilogasundary MR, Hemanth Kumar VR. Drug administration errors among anaesthesiologists: The burden in India - A questionnaire-based survey. J Anaesthesiol Clin Pharmacol. 2019;35(2):220-6.

6. Oliveira Junior JMD, Santos Neto LFD, Duarte TB, Carmona BM, da Costa LVP, Tramontin DF, et al. Factors associated with medical errors in perioperative anaesthetic practice: cross-sectional study. Braz J Anaesthesiol. 2023;73(1):117-9.

7. Charuluxananan S, Sriraj W, Lapisatepun W, Kusumaphanyo C, Ittichaikulthol W, Suratsunya T. Drug errors from the Thai anaesthesia incidents monitoring study: Analysis of 1,996 incident reports. Asian Biomedicine. 2017;6(4):541-7.

8. Labuschagne M, Robbetze W, Rozmiarek J, Strydom M, Wentzel M, Diedericks BJ, et al. Errors in drug administration by anaesthetists in public hospitals in the Free State. South African Medical Journal. 2011;101(5):324-7.

9. Ogunleye OO, Oreagba IA, Falade C, Isah A, Enwere O, Olayemi S, et al. Medication errors among health professionals in Nigeria: a national survey Int J risk SAF Med. 2016;28(2):77-91.

10. Negash G, Kebede Y, Hawaze S. Medication errors in the adult emergency unit of a tertiary care teaching hospital in Addis Ababa. Arch Pharma Pract 2013; 4:147-53

11. Nanji KC, Patel A, Shaikh S, Seger DL, Bates DW. Evaluation of perioperative medication errors and adverse drug events. Anaesthesiology. 2016;124(1):25-34.

12. Zhang Y, Dong YJ, Webster CS, Ding XD, Liu XY, Chen WM, et al. The frequency and nature of drug administration error during anaesthesia in a Chinese hospital. Acta Anaesthesiol Scand. 2013;57(2):158-64.

13. National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP). Definition and types of medication errors. http://www.nccmerp.org/about-medication-errors. Accessed 20 October 2023.

14. Bratch R, Pandit JJ. An integrative review of method types used in the study of medication error during anaesthesia: implications for estimating incidence Br J Anaesth. 2021;127(3):458-69.

15. Webster CS. The evolution of methods to estimate the rate of medication error in anaesthesia. Br J Anaesth. 2021;127(3):346-9.

16. Abbasi S, Rashid S, Khan FA. A retrospective analysis of peri-operative medication errors from a low-middle income country. Scientific reports. 2022;12(1):12404.

17. Acheampong F, Tetteh AR, Anto BP. Medication administration errors in an adult emergency department of a tertiary health care facility in Ghana. J Patient Saf. 2016;12(4):223-8.

18. Mulac A, Taxis K, Hagesaether E, Granas AG. Severe and fatal medication errors in hospitals: findings from the Norwegian Incident Reporting System. European Journal of Hospital Pharmacy. 2021;28(e1): e56-61.

19. Härkänen M, Vehviläinen-Julkunen K, Murrells T, Rafferty AM, Franklin BD. Medication administration errors and mortality: incidents reported in England and Wales between 2007–2016. Research in Social and Administrative Pharmacy. 2019;15(7):858-63.

20. Koyama AK, Maddox CS, Li L, Bucknall T, Westbrook JI. Effectiveness of double checking to reduce medication administration errors: a systematic review. BMJ Qual Saf. 2020;29(7):595-603.

21. Kim JY, Moore MR, Culwick MD, Hannam JA, Webster CS, Merry AF. Analysis of medication errors during anaesthesia in the first 4000 incidents reported to webAIRS. Anaesth Intensive Care. 2022;50(3):204-19.

22. Cavell GF, Mandaliya D. Magnitude of error: a review of wrong dose medication incidents reported to a UK hospital voluntary incident reporting system. Eur J Hosp Pharm. 2021;28(5):260-5.

23. Jessurun JG, Hunfeld NG, de Roo M, van Onzenoort HA, van Rosmalen J, van Dijk M, et al. Prevalence and determinants of medication administration errors in clinical wards: a two-centre prospective observational study. J Clinical Nurs. 2023;32(1-2):208-20.
24. Lee E. Reporting of medication administration errors by nurses in South Korean hospitals. Int J Qual Health Care. 2017;29(5):728-34.
25. Wondmieneh A, Alemu W, Tadele N, Demis A. Medication administration errors and contributing factors among nurses: a cross-sectional study in tertiary hospitals, Addis Ababa, Ethiopia. BMC Nurs 2020; 19:1-9.
26. Ojerinde AC, Adejumo PO. Factors associated with medication errors among health workers in University College Hospital, Nigeria. J Nurs Health Sci. 2014;3(3):22-3.
27. Alrabadi N, Haddad R, Haddad R, Shawagfeh S, Mukatash T, Al-rabadi D, et al. Medication errors among registered nurses in Jordan. J Pharm Health Serv Res. 2020;11(3):237-43.
28. Ruiz ME, Sunol MM, Miguélez JR, Ortiz ES, Urroz MI, de Lamo Camino M, et al. Medication errors in a neonatal unit: One of the main adverse events. An Pediatr (Barc). 2016;84(4):211-7.
29. Fathi A, Hajizadeh M, Moradi K, Zandian H, Dezhkameh M, Kazemzadeh S, et al. Medication errors among nurses in teaching hospitals in the west of Iran: what we need to know about prevalence, types, and barriers to reporting. Epidemiol Health. 2017;39:e2017022.

30. McCawley D, Cyna AM, Prineas S, Tan SG. A survey of the sequelae of memorable anaesthetic drug errors from the anaesthetist's perspective. Anaesth Intensive Care. 2017;45(5):624-30.
31. Kuitunen S, Saksa M, Tuomisto J, Holmström AR. Medication errors related to high-alert medications in a paediatric university hospital–a cross-sectional study analysing error reporting system data. BMC Pediatr 2023;23(1):548.
32. Workie MM, Chekol WB, Fentie DY, Bizuneh YB, Ahmed SA. Drug safety management in the operation room of referral hospital: cross-sectional study. Int J Surg Open. 2020; 26:97-100.
33. Ganesan S, Magee M, Stone JE, Mulhall MD, Collins A, Howard ME, et al. The impact of shift work on sleep, alertness and performance in healthcare workers. Sci Rep. 2019;9(1):4635.
34. Temple J. Resident duty hours around the globe: where are we now? BMC Med Educ 2014;14(Suppl 1): S8.
35. Sanchez DA, Carrasco JP, Estrella P, Ruiz R, Aginagalde AH, Garcia E, et al. Resident physician duty hours, resting times and European Working Time Directive compliance in Spain: a cross-sectional study. Hum Resour Health. 2023;21(1):70.
36. Barnard C, Deakin S, Hobbs R. Opting out of the 48-Hour week: employer necessity or individual choice? An empirical study of the operation of Article 18 (1)(b) of the Working Time Directive in the UK. Industrial Law Journal. 2003;32(4):223-52.
37. Feleke SA, Mulatu MA, Yesmaw YS. Medication administration error: magnitude and associated factors among nurses in Ethiopia. BMC Nurs. 2015; 14:53.

38. Gui JL, Nemergut EC, Forkin KT. Distraction in the operating room: a narrative review of environmental and self-initiated distractions and their effect on anaesthesia providers. J Clin Anesth 2021; 68:110110.
39. Mohanty M, Lawal OD, Skeer M, Lanier R, Erpelding N, Katz N. Medication errors involving intravenous patient-controlled analgesia: results from the 2005–2015 MEDMARX database. Ther Adv Drug Saf. 2018;9(8):389-404.
40. Al-Kaabba AF, Hussein GM, Kasule O, Alhaqwi A. Disclosing medical errors in tertiary hospitals in Saudi Arabia: cross-sectional questionnaire study. Int J Appl Math Comput Sci. 2016; 3:75-83.
41. Asefa KK, Dagne D, Mekonnen WN. Medication Administration Error Reporting and Associated Factors among Nurses Working in Public Hospitals, Ethiopia: A Cross-Sectional Study. Nurs Res Pract. 2021; 2021:1384168.
42. Abu Farha R, Abu Hammour K, Al-Jamei S, AlQudah R, Zawiah M. The prevalence and clinical seriousness of medication discrepancies identified upon hospital admission
43. Goyal N, Nemani S, Sharma A, Vyas V, Kothari N, Goyal S. Medication errors in the practice of paediatric anaesthesia - a narrative review. Anaesthesiol Intensive Ther. 2023;55(3):229-36.
44. Gariel C, Cogniat B, Desgranges FP, Chassard D, Bouvet L. Incidence, characteristics, and predictive factors for medication errors in paediatric anaesthesia: a prospective incident monitoring study. Br J Anaesth 2018;120(3):563-70.
45. Erdmann TR, Garcia JH, Loureiro ML, Monteiro MP, Brunharo GM. Profile of drug administration errors in anaesthesia among anaesthesiologists from Santa Catarina. Braz J Anaesthesiol. 2016 ;66(1):105-10.

46. Johnson UU, Ebirim LN. Drug Errors and Protocol for Prevention among Anaesthetists in Nigeria. Anaesthesiol Res Pract. 2017; 2017:2045382.
47. Rayan AA, Hemdan SE, Shetaia AM. Root Cause Analysis of Blunders in Anaesthesia. Anesth Essays Res. 2019;13(2):193-8.
48. Nwasor EO, Sule ST, Mshelia DB. Audit of medication errors by anaesthetists in Northwestern Nigeria. Nig J Clin Pract 2014;17(2):226-31.
49. Hammoudi BM, Ismaile S, Abu Yahya O. Factors associated with medication administration errors and why nurses fail to report them. Scand J Caring Sci. 2018;32(3):1038-46.
50. Grigg EB, Martin LD, Ross FJ, Roesler A, Rampersad SE, Haberkern C, et al. Assessing the impact of the anaesthesia medication template on medication errors during anaesthesia: a prospective study. Anesth Analg. 2017;124(5):1617-25.
51. Filiatrault P, Hyland S. Does colour-coded labelling reduce the risk of medication errors? Canadian Journal of Hospital Pharmacy. 2009;62(2).
52. Kinsella SM, Boaden B, El-Ghazali S, Ferguson K, Kirkpatrick G, Meek T, et al. Handling injectable medications in anaesthesia: guidelines from the Association of Anaesthetists. Anaesthesia. 2023;78(10):1285-94.
53. Stevens AD, Hernandez C, Jones S, Moreira ME, Blumen JR, Hopkins E, et al. Color-coded prefilled medication syringes decrease time to delivery and dosing errors in simulated prehospital paediatric resuscitations: a randomized crossover trial. Resuscitation. 2015; 96:85-91.
54. Moreira, Maria E., Margaret Sande, Allen Stevens, Seth Jones, Jason Blumen, et al. "Color-Coded, Prefilled Syringes Corresponding to the Broselow Tape Decrease Medication Time to Administration and Errors Among Emergency

Physicians and Nurses in Simulated Critically Ill Pediatric Patients." (2012): A150-A150.

55. Elliott RA, Camacho E, Jankovic D, Sculpher MJ, Faria R. Economic analysis of the prevalence and clinical and economic burden of medication error in England. BMJ Qual Saf. 2021;30(2):96-105.

56. Filiatrault P, Hyland S. Does colour-coded labelling reduce the risk of medication errors? Canadian Journal of Hospital Pharmacy. 2009;62(2).

57. Wells M, Yende P. Is there evidence that length-based tapes with precalculated drug doses increase the accuracy of drug dose calculations in children? A systematic review. Clin Exp Emerg Med. 2024 Jun;11(2):145-160. doi: 10.15441/ceem.23.110. Epub 2023 Nov 29. PMID: 38018070; PMCID: PMC11237260.

58. Siebert JN, Ehrler F, Combescure C, Lacroix L, Haddad K, Sanchez O, Gervaix A, et al. A Mobile Device App to Reduce Time to Drug Delivery and Medication Errors During Simulated Pediatric Cardiopulmonary Resuscitation: A Randomized Controlled Trial. J Med Internet Res. 2017 Feb 1;19(2):e31. doi: 10.2196/jmir.7005. PMID: 28148473; PMCID: PMC5311423.

ANNEXURES

Annexure 1: DEC Ethical clearance certificate.

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: SOM20/2024 Date: 17/05/2024

This Ethical Clearance Certificate is issued by the University of Namibia Ethics Committee (REC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the ethics committee.

Title of Project: Perioperative medication errors among anaesthesia service providers in Namibia – a retrospective survey.

Student: OYINBO O.M.

Student Number: 220069204

Supervisor(s): *Prof Ambrose Rukewe*

Centre for Research Services

Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee

3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee
4. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,

ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.

Name (Chairperson Ethics Committee)

Prof. Davis Mumbengegwi (Head, Multidisciplinary Research)

<u>Annexure 2: SURVEY QUESTIONAIRE</u>

QUESTIONNAIRE

The information you provide shall be treated with utmost **confidentiality** and absolute **anonymity**. It shall only be used solely for the purpose of the research. Please note that you are selected to take part in this survey because as an anaesthesia provider, you met inclusion criteria, and your response which is freely given is taken as consent to participate in this study. You may wish to withdraw your participation at any time without any consequence.

Thank you for your participation.

N.B: Please kindly see below definition of medication error, types and adverse events in case you need more information.

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

TYPES: Omission: (drug not administered/ forgotten). **Wrong drug:** (administration of a drug other than the one intended/prescribed). **Repetition:** extra dose of an intended drug. **Incorrect route:** wrong route of an intended drug. **Wrong time:** (drug administered at wrong time). **Wrong dosage:** (wrong concentration, amount, or rate of infusion) **Incorrect side:** an injection intended for one side of a patient administered into the other side (usually for a regional block). **Incorrect label:** wrong label used to identify medication. **Near miss:** an event that had the potential to develop into a medication error but was prevented by chance.

Adverse effects following medication administration error.

Adverse medication event (AME): An event involving harm to a patient associated with the administration of a medication (or the failure to administer an indicated medication). An AME may or may not be associated with error.

No harm: Error reached the patient but did not cause harm; error reached the patient and resulted in the need for additional monitoring or tests but no harm**.**

Low reversible harm: A harmful effect that was mild, temporary and short-term; no treatment or only minor treatment was required.

High morbidity reversible harm: A harmful effect that required more than minor treatment (including procedural treatment) or required an unplanned hospital admission or prolonged hospital stay.

High morbidity irreversible harm: Symptoms required major treatment to save the patient's life or caused major permanent or long-term harm.

HDU/ICU admission: patient's clinical condition requires critical care with admission at the High dependency unit or the Intensive care unit.

(A) PROFESSIONAL DATA:

1. I am a

(a) Medical officer
(b) Anaesthesia Registrar
(c) Specialist Anaesthesiologist.
(d) I do not want to respond

2. How old are you? (years). (a) <24 (b) 25 to 34 (c) 35 to 44 (d) 45 to 54 (e) 55 to 64 (f) 65 and over. (g) I do not want to respond

3. Sex: (Male/Female/ I do not want to respond)

4. I have been in anaesthesia practice for

(a) <5 years

(b) 5–10 years

(c) 10–15 years

(d) 15–20 years

(e) >20 years
(f) I do not want to respond

5. I work in a

(a) Government hospital

(b) Private hospital

(c) Both
(d) I do not want to respond

6. Which other fields do you practice apart from anaesthesia services? (Choose as many as applicable)

(a) Only anaesthesia practice

(b) Critical care

(c) Chronic pain management

(d) Teaching and academics

(e) Administrative responsibilities.

(f) Other non-medical activities
(g) I do not want to respond

7. How many hours do you practice daily?

(a) 8 hours or more (b) less than 8 hours. (c) I do not want to respond

(B) PATIENT MEDICATION AND MEDICATION ERROR DATA:

8. Who usually draw up the anaesthetic drugs into the syringe in your hospital?

(Choose as many as applicable)

(a) Anaesthesia Nurse.

(b) Intern doctor

(c) Medical Officer

(d) Anaesthesiologist.

(e) By Self.
(f) I do not want to respond

9. Do you/your hospital have the practice of using color-coded labels for syringes.

(a) Yes

(b) No
(c) I don't know

10. How do you draw the drug into the syringe?

(a) Label the syringes first and then withdraw the appropriate drug
(b) Withdraw the drug and then label the syringes.
(c) I don't know

11. Have you ever experienced medication administration error (see definition of terms above) in your anaesthesia practice till date?

(a) Yes
(b) No
(c) I don't know

12. If yes (to 11 above)

(12.1) What is the approximate frequency of errors?

(a) Few times a month

(b) Once a month

(c) Once every 3 months

(d) Once a year

(e) Only once till date
(f) I do not want to respond

(12.2) When have you experienced more occurrences of medication errors?

(a) Daytime working hours

(b) Night duties

(c) Not related time of work
(d) I do not want to respond

(12.3) What kind of errors did you make?

(a) Omission (drug not administered/ forgotten)

(b) Drug repetition

(c) Wrong drug (administration of a drug other than the one intended/prescribed).

(d) Wrong time (drug administered at wrong time)

(e) Wrong dosage (wrong concentration, amount, or rate of infusion)
(f) I do not want to respond

(12.4) Did any of the factors below contribute to the error?

(a) Distraction or fatigue
(b) Pressure (undue) to execute the procedure

(c) Misreading of the label/vial

(d) Lack of knowledge or experience with the drug

(e) Inadequate/improper storage

(f) Wrong programming of the infusion pump

(g) Inadequate communication between anaesthesiologists

(h) Others not specified
(i) I do not want to respond

13. What was the worst outcome for your patient after your medication error?

(a) No harm (error did not result in change in anaesthetic plane or increase in recovery time)
(b) Lower morbidity with reversible harm (e.g. increased time to tracheal extubation or postanesthetic recovery)

(c) Increased morbidity with reversible harm (invasive monitoring required for error correction)

(d) Increased morbidity with irreversible harm (myocardial infarction, cardiac arrest, or permanent neurological sequelae)
(e) HDU or ICU admission

(f) Death
(h) I do not want to respond

14. At what time of the perioperative period did the error occur?

(a) During premedication

(b) At induction of anaesthesia (or early intraoperative period)

(c) During anaesthesia maintenance

(d) During tracheal extubation (or just before tracheal extubation)

(e) In the immediate postoperative period
(f) I do not want to respond

15. What route did the medication error occur?

(a) Oral
(b) Intramuscular
(c) Intravenous
(d) Intrathecal
(e) During perineural injection
(f) Inhalational
(g) I do not want to respond

16. How long did it take to detect your error?

(a) Immediate detection

(b) Late detection

(c) Suspected, unconfirmed error
(d) I do not want to respond

17. Does your hospital have a mandatory critical incident reporting system?

a. Yes

b. No
c. I don't know