PERCEPTIONS OF NURSES ON THE MEDICATION ERRORS IN PRIMARY HEALTH CARE CLINICS IN GREATER TZANEEN MUNICIPALITY OF LIMPOPO PROVINCE, SOUTH AFRICA

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DEDICATION

“In memory of my late father Mr Joel Maritz Mushwana and my mother Mrs Tinyiko Lady Mushwana who laid down a firm foundation for me to have courage in spite of all adversity”

DECLARATION

I declare that **PERCEPTIONS OF NURSES ON THE MEDICATION ERRORS IN PRIMARY HEALTH CARE CLINICS IN GREATER TZANEEN MUNICIPALITY OF LIMPOPO PROVINCE, SOUTH AFRICA** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted before for any other degree at any institution.

…… ……..

Othello Kid Mushwana **Date**

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ABSTRACT

Background

Previous studies have shown that medication errors are the most frequent cause of preventable morbidity in health care facilities. Although medication errors are inevitable, the determination of medication errors and their predisposing factors may pave a way of establishing mechanisms of reducing these errors to a minimum. In researching the relationship between possible contributing factors and medication errors, the safety of patients can be greatly enhanced and costs of healthcare reduced. Determining error types is the first step in preventing errors. The goal of the study was to fill the information gap that is there regarding medication errors in Primary Health Care. The objective was to determine the perceptions of nurses on the types of medication errors, the predisposing factors and the prevalence of medication errors at these PHC clinics.

Methods

A mixed method approach was used in this study, combining a quantitative descriptive research method together with a qualitative approach. The study was carried- out at PHC clinics in the Greater Tzaneen Municipality which has a total number of 40 clinics. The Greater Tzaneen Municipality health care professionals in these facilities were the subjects and questionnaires and field notes were used to collect the relevant data. All the health care professionals that participated in the study were from the nursing profession. The sample volume consisted of 63 health care professionals from nine randomly selected PHC facilities.

Results

The study identified different types of medication errors as per PHC staff perceptions. Some of the identified errors were as follows: no medication (49%), changing of medication (40%), wrong dose and incorrect documentation both at (27%) and dispensing omission (24%).It was found in the study that the more the experience and the higher the level of education the less likely was the chances of error commitment by the participants.

Predisposing factors in these institutions were found to be of personal and systematic nature. Some of these were identified as follows :Heavy workload(78%),lack of equipment(70%),insufficient training(63%) and poor medication supply system (52%).In terms of the frequency of occurrence of the medication errors, the findings for some of the most frequent errors were: No medication(22%),incorrect documentation(13%),changing of medication(8%),wrong duration of treatment(8%) and wrong time (8%).The findings for some of the moderate frequent medication errors were: Changing of medication(19%),frequency of medication(19%),no medication(14%),wrong duration of treatment(13%) and wrong medication (11%).Some of the least frequent errors were identified as :Changing of medication(32%),incorrect medication(24%),wrong dose (22%) and dispensing omission(21%).

Conclusion

Generally, medication errors and unsafe acts at PHC should be worrisome. Medication errors and their related predisposing factors or latent conditions, if not addressed may impair the attainment of primary health care goals of providing effective, efficient and accessible health care to communities if proper care is not taken to reduce medication errors to a minimum.

Key words

Medication error; Patient safety; Primary health care

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DEFINITION OF TERMS

The following terms will be used in this study as defined below:

• Adverse event- An unwanted injury caused by medical management of a medical condition rather than by disease process (Michel et al, 2004.)

• Adverse reaction-A response to a drug which is noxious and unintended, and which occurs at doses normally used in man for the prophylaxis, diagnosis, or therapy of disease, or for the modifications of physiological function (WHO 1972)

• Dispensing errors- Any inconsistencies or deviations from the prescription order (Rama et al 2010)

• Medication error- 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(NCC-MERP 2005;Smith 2016)

• Medication reconciliation- Process of systematically identifying the medication a patient is taking at home and comparing them with newly ordered medication at the health care facility. (Cater et al 2015)

• Patient safety - Freedom from accidental injury because of medical care or medical errors (Institute of Medicine 1999)

• Primary health care- The provision of integrated, accessible health care services by health care professionals who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community (Donaldson,Yordy, & Vanselow 1994)

• Pharmacovigilance-The science of adverse drug reactions (ADR) and drug related problems: their detection, assessment, management and prevention (Mehta et al 2014).

• Primary Health Care - Essential health care made accessible at a cost a country and community can afford, with methods that are practical, scientifically sound and socially acceptable (WHO, 1978)

ACRONYMS

ADE-Adverse drug event

ADR-Adverse drug reaction

FDA- Food and drug Administration

IOM- Institute of Medication

MAE- Medication administration error

PHC- Primary Health Care

TREC- Turf loop Research Ethics Committee

CHAPTER 1

1. INTRODUCTION

Medication treatment is a fundamental element in patient health care, it is a multi-disciplined practice which requires synchronized efforts and participation of health care professionals to carefully distribute medication to patients without any harm (Zyoud & Abdullah 2016).In carrying out their professional duties, these professionals should always bear in mind that patient safety, not only is it a concern to the particular patient, but is a global health care concern (WHO 2014). According to Parry et al (2015), registered nurses play an integral role in keeping patients safe due to their direct provision of care. Primary Health Care (PHC) facilities in many countries are the first contact a patient has with the health care system. In addition to other activities at the PHC facility, registered nurses are responsible for drug administration which is achieved through four stages, namely prescription, transcription, dispensing and administration (Al-Shara 2011), Drug administration in this regard, is thus a high risk activity and may provide an ideal environment for medication errors to thrive as these may happen at any of the stages. According to Zyoud and Abdullah (2016), it has been found by one study conducted in 2008 that nurses experience more than six errors throughout their professional career. Parry et al (2015), allude to the fact that medication error is the most frequent cause of preventable morbidity in hospitals and has therefore been identified as a priority safety issue and a central concern for the nursing profession. Zhu et al (2014) confirms that the management of patient medication is a high risk nursing activity and the probability of medication errors is likely to increase along with the increase in the number of drugs available for treatments. Preventing medical errors and promoting patient safety and quality is a focus of many organizations, including the Institute of Medicine in the United States Of America (USA) (Kohn et al 1999). In 2008, researchers estimated that potentially preventable adverse drug events kill 7,000 Americans annually and that medication errors that result in harm are the number-one cause of in-patient fatalities. There is evidence that the death rate from medication errors is increasing. According to Karanjekar and Shrotriya (2015), the number of deaths from medication errors and adverse reactions in the USA between 1983 and 1993 rose from 2876 to 7391.

While error rates vary widely among facilities, experts believe at least one medication error occurs per hospital patient every day and that medication errors pose the greatest risks and consequences in critical care settings, where patients are sicker and lack the resilience to respond adequately to an adverse event and receive almost twice as many medications as patients on general floors (Kohn et al 1999). Anderson and Townsend (2010) report that approximately 20% of critical care medication errors are potentially life-threatening and 42% of these errors necessitate additional life-sustaining treatments. According to Rama et al (2010), medication errors are a leading cause of mortality in the United States.

With increased access to new essential medicines, such as antiretroviral (ARV) therapy in Africa, there is a greater need to monitor and promote safety and effectiveness of medicines. The burden of adverse events from poor product quality, adverse drug reactions and medication errors may affect achievement of the full benefits of these new medicines and pose great challenges to health care systems in Africa. Besides the impact of medication errors on morbidity and mortality and the direct cost of managing the events, medication errors also have other associated costs in terms of the loss of confidence in the health system, economic loss to the pharmaceutical industry, non-adherence to treatment, and development of drug resistance. Although it is challenging to measure these costs, it is apparent that they may constitute a profound impact on the resources of the health systems in Africa (SPS program. 2010).

According to Naledi et al (2011), South Africa is one of the economic powerhouses of Africa and spends about 8.6% of its gross domestic product (GDP) on health. Unfortunately, it appears not to have the health outcomes that would be expected from such investment. Some of the countries that spend less on GDP have better health outcomes. This may be attributed to the fact that health care provision in South Africa has become more competitive and the current level of patient awareness about their health needs, rights and responsibilities has increased drastically. This global patient awareness leads to litigation processes when health professionals err in their provision of health services. Mapumulo (2015) reports that the Health Minister Aaron Motsoeledi is considering setting up a litigation authority to deal with malpractice claims, this comes after he revealed that the health

department was facing law suits totalling R25 billion. According to Raborife (2017) the Gauteng department of health annual 2016/2017 report had set aside R13.5bn for potential medico-legal liability claims of which medication errors are included, a figure that could be better spent making sure that health facilities provided quality care.Magagula (2015) reports that in the past two years, nearly R3 billion worth of medical negligence claims have been lodged against the Mpumalanga health department and more than R44 million has been paid already. These claims include medication errors. According to a study conducted at George Mukhari Hospital, the incidence of medication errors in the neonatal intensive care unit(NICU) and paediatric wards at that teaching hospital was higher than values reported elsewhere in the world (Truter et al 2017).The National Coordinating Council for Medication Errors Reporting and Prevention (NCC MERP) in the USA, takes the stance that there is no acceptable incidence rate for medication errors, and that the goal should be to continually improve health care systems so that medication errors are prevented (NCC MERP 2002). The type of medication errors, predisposing factors and their prevalence have not been thoroughly investigated in the PHC facilities in South Africa. Interventions are therefore needed to decrease medication errors and improve patient safety through safe medication administration.

1.1. The research problem

According to Lehmann (2008), primary care in South Africa is overwhelmingly nurse-based. The majority of clinics are staffed by professional, enrolled and auxiliary nurses who are supported by some clerical, general and community health workers. This means that nurses perform certain tasks that would traditionally be performed by other specialized health professionals in other health institutions like hospitals. Although there is a new concept of PHC re-engineering which is aimed at taking the health care service to the communities by emphasizing prevention and health promotion and by strengthening the district health system ,this intervention is yet to be rolled out in most of the health care clinics. The quality of care need to be improved through better supervision and clinical governance and paying attention to the basics, amongst systemic interventions in the PHC.(Soul City institute 2013).In light of the increased burden of disease and the growing population, these health care institutions are prone to medication errors.

According to Karanjekar and Shrotriya (2015), medication errors can be classified into the following types:

- Contextual - which refers to time , place, person and other factors in a given situation
- Modal - which refers to the mode of occurrence, whether it is omission or commission
- Psychological - explains the error with respect to human error and not system failure.

The psychological class is further classified into the following sub-classes:

- Knowledge based errors - which occur because of lack of knowledge or failure to acquire the required information.
- Rule based errors - which occur due to failure to follow established rules or due to wrong rules set.
- Action based errors - which result from faulty actions mainly due to lapses in attention e.g. wrong dose, wrong route etc.

There seems to be very little information as to what are the predisposing factors, the types and magnitude of medication errors at Primary Health Care clinics in South Africa since the introduction of the essential drugs, a component of the Primary Health Care (PHC) concept. Medication administration to patients is part of clinical nursing practice with high risk of error occurrence just like in any clinical setting where medications are administered by other healthcare providers. The quality of the Primary Health Care delivery system can be improved if we can quantify medication errors and take necessary steps to limit medication errors by prevention, early detection and mitigation.

The current high costs of health care definitely demand a more effective and safe health care system that is accessible, reliable and cost effective. No health system is designed to cause harm, but since it is a human institution, it is susceptible to errors in the provision of patient health care.

1.2 Research questions

- What are the nurses' perceptions on the different types of errors that occur in primary health care practice?
- What are the nurses' perceptions on the predisposing factors to medication errors?
- What are the nurses' perceptions on the prevalence of medication error in PHC?

1.3 Aim of the study

The aim of the study was to identify the types, predisposing factors and the prevalence of medication errors in Primary Health Care (PHC) facilities in the Greater Tzaneen Municipality.

1.4. Objectives of the study

The objectives of the study were:

- To determine the perceptions of nurses on the types of medication errors that occurs at the PHC clinics.
- To describe the perceptions of nurses on the predisposing factors to medication errors at the PHC clinics.
- To determine the perceptions of nurses on the prevalence of medication errors at the PHC clinics.

CHAPTER 2

2. Literature Review

This chapter presents a comprehensive literature outline related to the study. It outlines literature on effective health care and patient safety, medication errors, the concept of medication errors, predisposing factors of medication errors, types of medication errors, prevalence of medication errors and the health care system in South Africa.

2.1 Prevalence of medication errors

According to Guerrero-Aznar et al (2014), the number of errors that occur in the daily delivery of health care is much higher than we would think, this may be due to the punitive nature of most medication error reporting systems and that reports estimate that between 50-96% of errors go unreported. Al-shara (2011) estimates that medication errors that occur during the prescription and administration stages account for 65-87% of all medication errors. There is a wide range of medication kept in the PHC facilities according to the essential drug list (EDL) that are dispensed and administered by the nurses. This puts registered nurses in a vulnerable position to commit medication errors. According to Aronson (2009), medication errors can occur among other situations in:

- Choosing a medicine-irrationally, inappropriately, ineffective prescribing, overprescribing and overprescribing
- Writing the prescription illegibility
- During dispensing –wrong drug ,wrong formulation and wrong label
- During administering the medication -wrong dose, wrong route, wrong frequency and wrong duration
- During the monitoring therapy-failing to alter therapy when required, erroneous alteration

2.2 Medication administration

As mentioned earlier, in many health systems in the world nurses are the group of health care providers who are closest to the patients. They have a major responsibility in administration of medication for patients, particularly in the wards and rural health facilities. Elliot and Liu (2010) state that, medication administration arguably carries the greatest risk. In spite of training received by the nurses, there is no guarantee that medication errors will not occur. The issue of medication administration error (MAE) within the acute-care setting has long been the focus of research. A patient-centred nursing process approach requires that the nurse is familiar with drug action (Pharmaceutics, Pharmacokinetic and Pharmacodynamics Phases), medication administration and calculations to name but a few things. Since nurses are intimately involved in the delivery of medications and the final person to occupy the link on medication administration, they are accountable for the responsibilities in the avoidance of any medication error that may occur (Elliot & Liu 2010). According to Ya-Hui et al (2014), in a paediatric setting, medication error occurring at the administration stage constitute the most common type of preventable event accounting for 59% of all the errors and it was reported that nurses were responsible for most of the errors, in particular omission errors. In another study by Salmasi et al (2015) most administration errors reported ranged from 15.2% to 88.6%. Wrong dosage schedule, i.e. wrong time, was the most frequently cited type of administration error in that study. According to Smith (2016), medication administration errors are not always due to the nurses' mistake but can happen when patients are charged with administering their own medication and the nurse can prevent such errors by providing adequate information about the performance of such tasks e.g. smoking causes vasoconstriction that will impede sublingual absorption when sublingual medication is administered ,thus patients should be advised to refrain from smoking for an hour before the use of such medication. Unfortunately most errors in PHC goes unreported due to poor reporting systems and or the punitive nature of such systems as alluded by Guerrero-Aznar et al (2014).

2.3 Error reporting

Mayo and Duncan (2004) have cited fear as one of the major reasons why errors are not reported, particularly by nurses. They found that some medication errors were not reported because nurses were afraid of the reaction they would receive from the nurse manager. Hence, the real incidence and prevalence of medication errors are not reported. The participants of a study conducted in Primary Care clinics in Malaysia confirmed that medication errors were underreported despite the availability of a reporting system (Samsiah et al 2016). It would be reasonable to assume that it is possible that medication errors which could be more serious could be more prevalent than it is portrayed by literature.

According to Athanakisakis (2012) there is growing evidence that nursing administrators play a central role in the management of medication errors, with the head nurses having a strong influence in clinical nurses' conduct to keep a positive attitude towards the reporting of medication errors. A survey conducted by Jones and Treiber (2010) found that among nurses, 94% either strongly agreed or agreed that medication errors should be reported even when no harm resulted to the patient. The study suggested that most nurses were reluctant to report medication errors and as such most medication errors were not reported. Based on these findings, it is obvious that there is some inconsistency between actual occurrence and reporting. These findings also suggest that there may be barriers to reporting.

Barriers to reporting can be broken down into four major groups according to studies by Koohestani and Baghcheghi (2009), and Covell and Ritchie (2009). The major groups of barriers to reporting are: inadequate definition of what a medication error is, fear, reporting process, and administrative process. These studies seem to suggest that fear ranked as the highest barrier to reporting since participants indicated that they were most fearful of adverse consequences from reporting medication errors. These studies also indicated that among nursing students, the fear of decreasing evaluation score and introducing educational problems along with instructor's reprimand ranked as the highest barriers. Both studies revealed that, the process of reporting, time to fill out proper forms and time to contact physician was not regarded as a significant barrier to reporting. Weant et al (2014) describe medication error reporting as an essential aspect of reducing medication error and

that no punitive action should be taken against any individual who reports such errors as it is for the benefit of all stakeholders including the patient.

2.4 Patient identity

Findings from a study by Scott et al (2014) revealed that a prevalence of 41.2% of medication errors in the emergency department was due to a failure to apply patient identification bands. In a hospital setting, failure to pay attention to the wristband has been reported to be one of the factors that contribute to medication error in some health facilities (Ulanimo 2007). Although wrist bands are not used in most PHC facilities, positive identification is imperative to ensure that the right medication is received by the right patient. Verbal verification of the right patient is therefore one method of correct identification. Where wrist bands are used both name and medical record number should be verified against the patient's wrist band and medication chart (Elliott & Liu 2010). If this verification process is not done, medication errors are likely to arise.

2.5 Dispensing errors

According to Salmasi et al (2015), dispensing errors happen when the medication dispensed is not compatible with the prescription ordered e.g. wrong medication, frequency, dosage, instructions etc. According to Kavanagh (2017), the key contributing factor to medication incidents is the quality of the prescription. Illegible and, or ambiguous prescriptions, non-standard abbreviations, acronyms, decimals and call- in prescriptions are frequently associated with medication errors (Rama et al 2010). Spelling errors and the similarities in appearance of different medication can cause confusion to healthcare professionals. Scores of patients were recently at the mercy of pharmacist who raised an alarm after discovering that a container of Mylan Oxybutynin 5mg 100's tablets(used to treat urinary incontinence and urgency) was actually containing Mylan Indapamide 2.5mg 30's which is used to treat hypertension. The unfortunate event had a potential to course discomfort and suffering and the consequences could have been far more severe especially in patients with low blood pressure already (Power 2016).

Unfamiliarity with medication such as new drug name or medication with similar drug packing can cause medication error due to lack of pharmacological knowledge

of the health professional and confusion between similar packages respectively (Fu et al 2007). Cloete (2015) suggests that nurses must not administer medication from illegible prescriptions. Proper communication is therefore essential for the verification of prescriptions when uncertainty arises. In addition, nurses' knowledge of medication and their ability to perform precise drug calculation is one of the most important factors to ensure their competence in performing medication treatment to patient in a correct and safe manner (Ehteshami et al 2013)

2.6 Working environment and conditions.

The Swiss cheese model likens the occurrence of medication errors to a stack of Swiss cheese slices where the holes represent a minor error and the holes may allow a problem to pass through for as long as they are aligned so each layer is a potential defence against a medication error being realized(Edwards & Axe 2015).Gomez et al (2016), explains that in the Swiss cheese model, the main factors responsible for medication errors are the deficiencies in the health care system, the organisation and the functioning of such organization over and above the professional or the product alone. Although the health care professionals in the PHC may have the necessary competencies, work environment may to some extent be a contributing factor to the prevalence of medication errors. According to Cloete (2015), system factors that contribute to medication errors among others include: the safety culture of an organisation, management and leadership, workplace communication and policies and procedures as well as lack of accessible step by step guidelines and protocols for the operation of equipment. Yoost and Crawford (2016) suggests that equipment used in health care facilities such as blood pressure monitoring equipment and weighing balances should be readily available and checked for proper functioning before the start of every examination. Pape et al (2005) mentioned in their study that conversations with other staff members and visitors or multi-tasking that occurs during medication preparation and administration can result in errors. Yoost and Crawford (2016) also point out that distractions and interruptions during medication administration contribute to medication errors. Athanasakis (2012) suggests that the simplification of medication procedures and the placing of "Do not disturb" labels in the compounding area to discourage interruptions by visitors and to remind the nurses of the importance of concentration during medication preparation may help provide a safe working environment.

Interruptions in the working environment may prevent the execution of the normal procedures for checking the six rights (right dose, right route, right time, right drug, right patient and right records) .Reducing unnecessary conversation and other distractions is therefore an important aspect in administering medication safely to patients.

Other factors that contribute to the medication errors include understaffing or heavy workload at health facilities (Gorgich et al 2015, Kavanagh, 2017, Svitlica 2017). Inexperience on the part of some healthcare providers at the facilities, and inadequate equipment while administering the medication may lead to medication errors (Carlton & Bleggen 2006). According to Cloete (2015), the number of hours that nurses work the length of their shift and heavy workloads may result in fatigue which may subsequently result in medication errors. Environmental characteristics such as, poor lighting, high noise levels, lack of or confined working areas and a lack of privacy may also contribute to medication errors.

2.7 Personal factors

Various studies have identified personal factors that contribute to medication errors as physical and mental wellbeing, skills, decision-making ability and the knowledge of the health care professional. Other contributory factors are time pressures, fatigue or exhaustion, i.e. burning out on the part of healthcare practitioner (Mayo & Duncan 2004; Ulanimo et al 2007; Cloete 2015). A lot of studies also highlighted other factors associated with a particular individual such as medication calculations ability, contribute to medication errors. Thus nurses with poor mathematical skills will likely increase the risk of error in calculating dosages due to the complexity of drug calculation and the need to stick with precise medication dosage (Zyoud & Abdullah 2016). The level of knowledge and proficiency in medication treatment process, the neglect of medication protocol of their institution as a result of heavy workload, insufficient work experience and unsuitable work environment are also contributing factors to medication error occurrence (Alsulami et al 2013). Anasathakis (2012) suggests the delivery of premixed medication such as prefilled syringes to the nursing staff without any more need for preparation by the nursing staff, especially in medication that require precision in dosage calculation as a measure to circumvent dosage calculation errors. The wellbeing of the health care workers therefore plays

an important role in determining whether a medication error will happen or not. It is therefore imperative to establish whether there is sufficient training that takes place to assist with coping mechanisms in health care practice.

2.8 Expertise and training

According to Ya-Hui et al (2014), several studies have identified that insufficient pharmacology knowledge is one of the most significant factors contributing to drug administration errors on the part of the nurses. This means that the sources of medication errors can also be linked to the training institutions and the quality of training the health professionals receive. Wasserman et al (2017), cite inappropriate antibiotic prescribing as a result of inadequate training at undergraduate level thus adequate training of prescribers may be a valuable tool in reducing antibiotic resistance. In their observation, they also allude to the fact that the antibiotic stewardship in South Africa is inclined towards post graduate clinicians mainly found in hospitals and have not reached community settings like primary health care institutions. Moreover these programmes are mostly run by infectious diseases physicians who are not so many in South Africa.

In paediatrics, for example Ya et al (2014), point out that children are particularly vulnerable to medication errors because of their immature and unique state of physiological development, which can result in high sensitivity to drugs and low tolerance to errors. This is mainly due to the need for weight based drug dosing involving multiple calculations, dilution of stock solutions and limited communicating skills when experiencing side effects. The nurses therefore need to be properly trained to perform such complex tasks .

Jordan (1997) explains that, incorporating learning theories into nursing curricula promotes critical thinking and create an opportunity for students to reflect on experiences for example by case studies, promotes the acquisition of knowledge from experience. The six rights ,namely: the right medication, the right dose, the right patient, the right route, the right time and the right documentation are taught to all nurses at some point in their education as the basic technique to help reduce the occurrence of medication errors. Unfortunately, many nurses fail to honour these rights consistently (Jones & Treiber 2010). A survey conducted in the United States of America (USA) by mailing to a random sample of registered nurses provided a

different perspective in contributing to the body of knowledge about the nurses' perceptions of how and why medication errors occur. In this survey 78% of the nurses admitted to making medication errors and provided a detailed account of these errors citing insufficient training as one of the causes of medication errors. It is imperative therefore that health care givers in PHC should learn from medication errors and focus on the prevention of these medication errors in the future (Jones & Treiber 2010).Technology is one of the instruments that can be used to reduce medication errors.

2.9 Appropriate technology

Information technology (IT) systems provide clear and compelling mechanisms for reducing medication errors and improving safety, with a growing body of evidence supporting the role (Agrawal 2009). Such systems include, computerized physician order entry, automated dispensing, barcode medication administration, electronic medication reconciliation, and electronic health records (Agrawal 2009).These technological interventions will off course be effective provided the health care professionals especially in PHC are equipped with the necessary competencies. There is also scepticism about their widespread clinical use mainly because most of the current evidence is based either on single-site evaluations and incorporation on a large scale is not evaluated (Agrawal, A 2009). According to Ehteshami (2013), the biggest challenge in today's world is providing the integrated healthcare services and access to patient information by healthcare team members in a timely and reliable manner. Electronic health records (EHR) seems to be a major breakthrough as instant information retrieval is available for different health professionals. The introduction, implementation and training of the nurses in the PHC about the appropriate health technologies will with no doubt go a long way in reducing medication errors.

The Institute of Medication (IOM) in the USA demanded health care improvement and the era of the electronic medical records was introduced to try and reduce paper error manual charting that compromised patient safety while health care costs increased. This seemingly breakthrough in health safety improvement presented its own flaws in that, increased time for medication errors were observed due to confusing software and slow internet connection (Schwartzberg et al 2015).The

delay may lead to delayed administration of medication and missed doses. In another study cited by (Agrawal 2009), there was a threefold increase in mortality in children after implementation of computerized physician order entry (CPOE), and there was a 36% reduction in standardized mortality using exactly the same software but with a different implementation strategy. This indicates that, caution needs to be exercised when new technology is introduced and implemented in PHC as it may present negative consequences for medication reconciliation and documentation and ultimately patient safety.

2.10 Medication -reconciliation and documentation.

According to Yoost and Crawford (2016), health care documentation is any written or electronically generated information about a patient that describes the patient, the patient's health and the care and services provided including the dates of care. Paper records have several major problems such as illegible hand writing, storage and control and that the paper chart is only available to one person at a time. Electronic health record documentation enhances patient safety and communication with other health professionals (Yoost & Crawford 2016).

Medication discrepancies on hospital admission are common, occurring in up to 67% of inpatients (Cater et al 2014). Such discrepancies include the interruption of regularly used medication, inconsistent dosing or frequency of home medications, and provision of incorrect medications that differ from those normally prescribed. The collection of a complete verified medication history is essential to the process of medication reconciliation. According to Cater et al (2014) the biggest challenge is when the patient cannot talk and more problems are compounded when the patients are moved from one place to the other in the hospital. Medication reconciliation can thus be a source of medication errors in the emergency department (Cater et al 2014).Some emergency situations happens from time to time in the PHC facilities where patients have to be stabilized before they can be transported to hospitals. This type of arrangement can present medication reconciliation glitches during the movement of patients from one facility to the other. Salmasi et al (2015), reports that 36.5% of reconciliation errors was reported by a study in Singapore. Medication reconciliation at PHC is part of the nursing practice and as such possibilities of

reconciliation errors happening cannot be excluded especially in the emergency department where most procedures are done against time.

2.11 Emergency department (room)

The critical nature of a vast number of emergency departments presents a ripe opportunity for medication errors to strive. This is mainly because patients in the emergency department tend to be unknown to the practitioners and less is known about their medical history. In most cases medication is dispensed and administered without the pharmacist to perform critical professional safety checks (Weant et al 2014) .Often times as mentioned earlier, the PHC is the first line of contact with emergency cases where patients need to be stabilized and transferred to hospitals depending on the seriousness of the condition. It is at this stage that medication errors can occur. According to Scott et al (2014), the most compelling reason why medication error is ripe in the emergency department is the time critical nature of medication administration i.e. most medication are administered in an act of urgency and findings from previous studies show that medication errors contribute between 35% and 60% of all errors in the emergency department with 2.3% of the medication errors being prescription errors and 2.1%-36% being administration errors. Weant et al (2014), also highlight that the most prevalent medication error in the paediatric emergency department is overdose, mainly because of the low doses involved and the narrow margin of error compared to adults. Lack of knowledge about a drug and the patient the medication is intended for, result mostly in medication errors due to misinterpretation or misunderstanding of verbal instructions between the health care professionals (Weant et al 2014). While the health care professionals may have the necessary competencies, work environment may to some extent be a contributing factor to the prevalence of medication errors. There is therefore a need for pharmacovigilance even in emergency departments.

2.12 Pharmacovigilance

Pharmacovigilance involves a multi-disciplinary approach from manufacturers, regulators, public health programmes, clinical institutions, researchers, health care workers as well as patients. As medicines are used in healthcare facilities by healthcare providers, there is no guarantee that the safety profile of the drug will remain the same into the future and across the whole spectrum of different ethnic

groups (Suleman 2010) .Within this uncontrolled setting a continuous monitoring of adverse drug reactions is vital to ensure early recognition and management of risks. The role of the pharmacist has since evolved from traditionally dispensing medicines to acting as a consultant on pharmacotherapy, both for physicians and for patients (Suleman, 2010).The expertise of this profession should therefore not be under-utilized, especially in primary health care where they are needed most. There is therefore evidence that pharmacists need to be given an important role in the further development of pharmacovigilance as they are experts in medication in order to enhance patient safety. Mehta et al (2014), reaffirms that pharmacovigilance is a fundamental component of monitoring and evaluation of medical institutions and or public health programmes. It is therefore of outmost importance for the government to invest in a well constituted, multi-disciplinary and well integrated pharmacovigilance system that will enhance collaboration within different programmes and help reduce wasteful expenditure by reducing medication errors and address medication shortages and stock-outs.

2.13 Medication shortages and stock-outs.

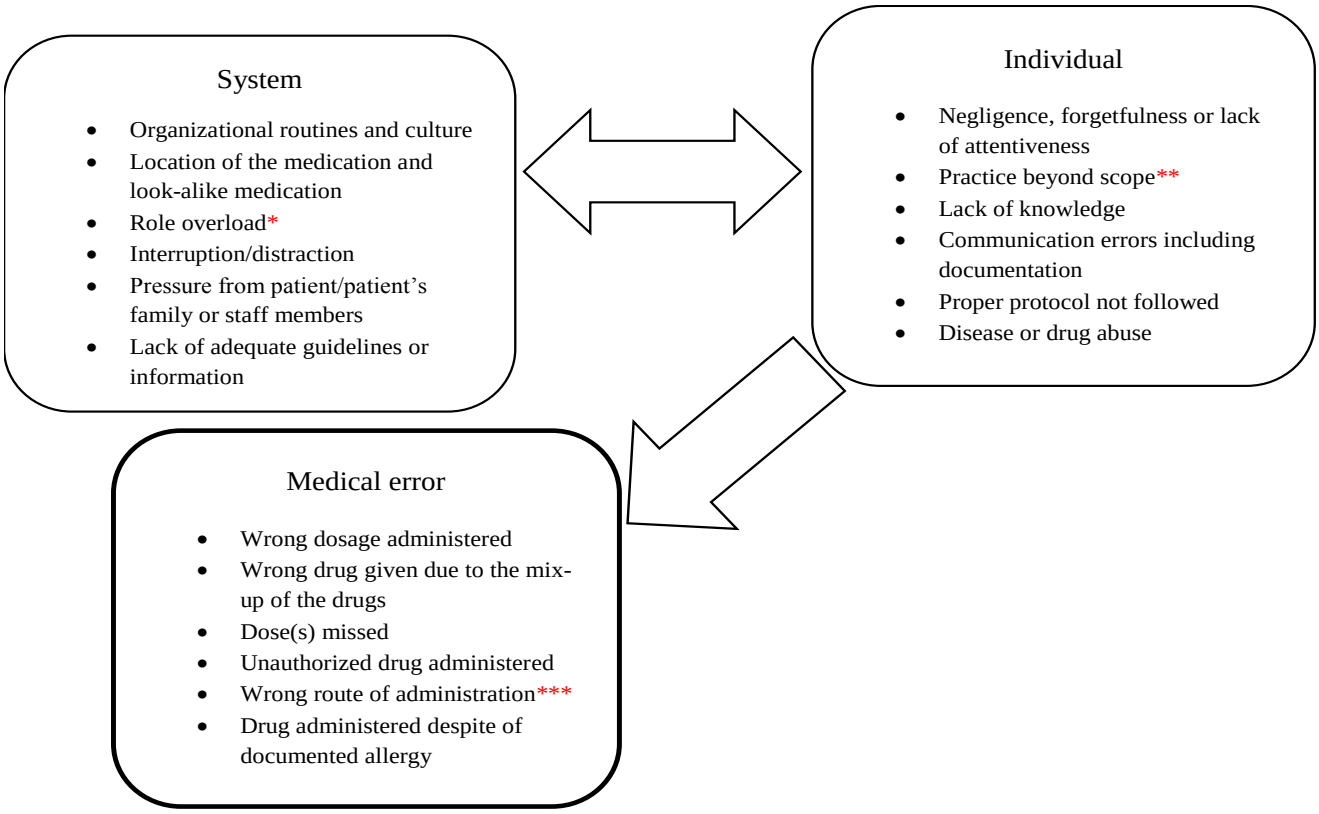
Procurement of medicines in South Africa is centralized and managed by the National Department of Health with some minor variations in the procurement of certain medications like HIV medication. With this arrangement contracted suppliers deliver directly to depots and in some cases directly to the Central distribution unit and health facilities (Magadzire et al 2017). This centralization of procurement services is therefore bound to fail the patients in terms of access to medication when there are glitches in the system due to unnecessary bureaucracy, red tape and other problems. Drug shortages mostly happen in a minority of cases that are due to pharmaceutical companies being unable to provide enough drugs worldwide. Drug stock-outs on the other hand mean that health facilities are unable to dispense the complete amount of one or more medications to patients, mostly due to logistical and management problems. Whatever the cause maybe, patients are the ones paying the price for a dysfunctional system. Drug shortages can result in safety consequences with increased potential for medication errors due to increased prescribing of unfamiliar agents during this period. Drug shortages or stock-outs may also impact other areas of medical care such as medical procedure delays and

treatment protocol delays. An example will be a situation where operations cannot be performed due to a shortage of anaesthetics in a health facility.

Perceived causes of procurement inefficiencies that were identified by Magadzire et al (2017) in their study done in the Western Cape were attributed to: delay in award of pharmaceutical tenders, removing national contracts for certain medicines on provincial code lists and supplier failure to meet contract obligations. Gray (2014) also alludes to the fact that there is usually one contracted supplier of each medicine which limits the options of alternative suppliers during shortages and also due to the large volumes required to meet the needs of the public sector. Ramothwala (2017) reports that the minister of health Dr Aron Motsoeledi conceives that communication problems between the supply chain and the depot as well as the shortage of pharmacists whereby nurses assume the work that is normally done by a pharmacist e.g. the ordering of medication, is a major cause of medication stock-outs especially in PHC. It is therefore imperative to address causes of medication stock-outs starting at the national level going down to the PHC facilities, an important contribution that can be made by drugs and therapeutic committees in the public sector to ensure that patient care is not adversely affected. The predisposing factors of medication errors should thus be investigated in order to obviate medication errors.

2.14 Predisposing factors

According to Smith (2016), factors that contribute to medication errors can be divided into, errors that are caused by the system (flaws in the institution's system and procedures, the provider's equipment, procedures, operators, supplies or environment) and individual healthcare professionals (fatigue, stress, multitasking and interruptions). Yoost and Crawford (2016) identify human factors that affect medication errors to include knowledge or performance deficits e.g. administering a drug intravenously rather than intramuscularly, miscalculation of dosages, stress and lack of sleep. A study by Berggvist et al (2012) revealed that medication errors occur in a complex interaction between human and system factors. Sanghera et al (2007) has classified error producing conditions as systematic and individuslistic as shown in figure 2.1 below.



*A condition in which there is insufficient time to carry out all of the expected role functions due to lack of adequate staff, overcrowded ward, rapid patient turnover, having responsibility for many unstable patients, or emergency situations.

**A nurse administers a drug(s) or a dose(s) not ordered or authorised by a physician or other health-care professional with authorisation for prescribing drugs

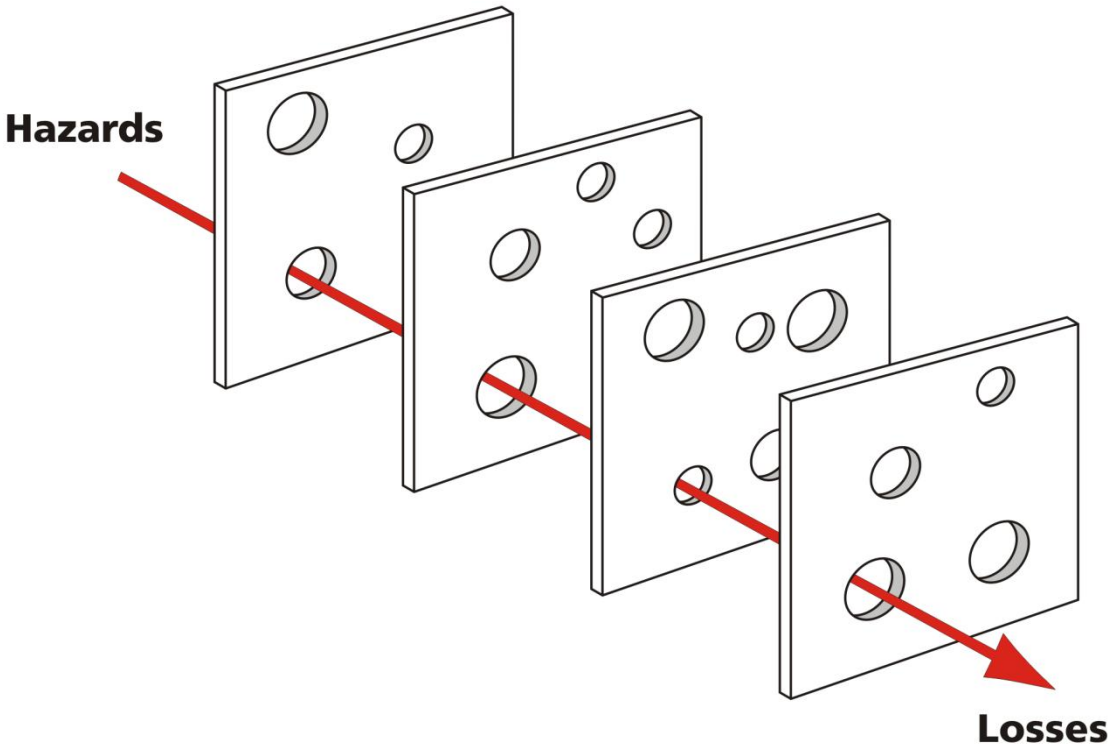
*** e.g. oral solution.

Berggvist et al (2012)

Figure 2.1 Contributing factors and medication errors

In summary, human error problem which results in medication errors can viewed in two ways: the personal approach and the system approach. Each has its model of error causation and each model gives rise to philosophies of error management (Reason 2000).

Understanding these differences has important practical implications for coping with ever present risk of mishaps in clinical practice no matter what level in the health system. Defences, barriers and safeguards in the health system occupy a key position. In ideal world each defensive layer would be intact. In reality, however, they are more like slices of Swiss cheese, having many holes, unlike in the cheese, these holes are continually opening, shutting and shifting their location. Once these holes are aligned the defences in the system are compromised and losses occur, in this case medication errors occur as illustrated below.



https://upload.wikimedia.org/wikipedia/commons/e/e8/Swiss_cheese_model_of_accident_causation.png

Figure 2.2 Swiss cheese model

CHAPTER 3

3. METHODS AND MATERIALS

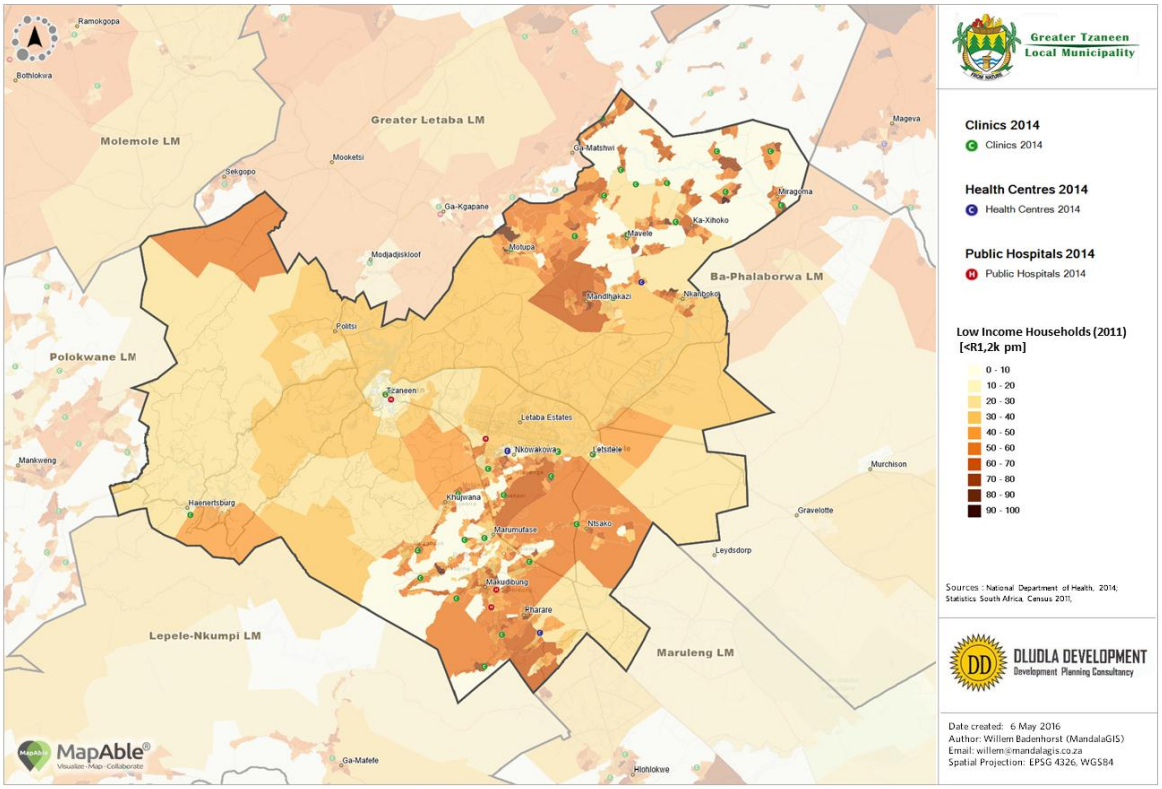
This chapter describes the method and techniques used in the collection and analysis of data. These include the study site, population, study design, sampling procedure, data collection procedure and data analysis procedure.

3.1 Study Site

The study was conducted in the public health care clinics at the Greater Tzaneen Municipality of the Limpopo Province in South Africa. The PHC facilities are spread throughout the towns, townships and villages to allow for easy access by the communities. The Greater Tzaneen Municipality consist of 34 wards with at least one clinic per ward with some of the bigger wards having two clinics. The total number of PHC clinics in the Greater Tzaneen Municipality is 40, each with an average of eight nurses of different categories. The population of the Greater Tzaneen Municipality from census 2011 was found to be 390 095 with 108 926 households. The population estimate for March 2016 was found to be 416 488 with a density of 128.4 per square kilometre which translates to 1.5% increase per year from 2011 to 2016 (http://www.citypopulation.de/php/southafrica-admin.php?adm2id=LIM333). The map for the depiction of the position of the clinics is provided in the figure below.

MAP 4a

Greater Tzaneen SDF : **Health Facilities in relation to Low Income Households**



(http://www.greatertzaneen.gov.za)

Figure 2.2 Area map of research site

3.2 Study population and sampling procedure

3.2.1 Population

The population of this study comprised of the health professionals, mainly nurses working in shifts at PHC clinics in the greater Tzaneen municipality of Limpopo province. Each clinic was headed by the clinic operations manager who was assisted by the primary health care nurse in the overall management of the clinic. The professional (registered) nurses, enrolled nurses and auxiliary nurses were mostly involved with the professional practice of the nursing profession. Registered (professional) Nurses either had an associate's degree in nursing, a bachelor's degree in nursing or a diploma from a special hospital-based program. Although enrolled nurses and auxiliary nurses didn't have degrees in nursing, they had to undergo training and received certification to perform their duties. Beyond the PHC facility, the hierarchy of reporting goes in ascending order as follows: local area manager, sub-district manager, director Primary Health Care and the district executive manager. The organogram in the PHC is represented as follows:

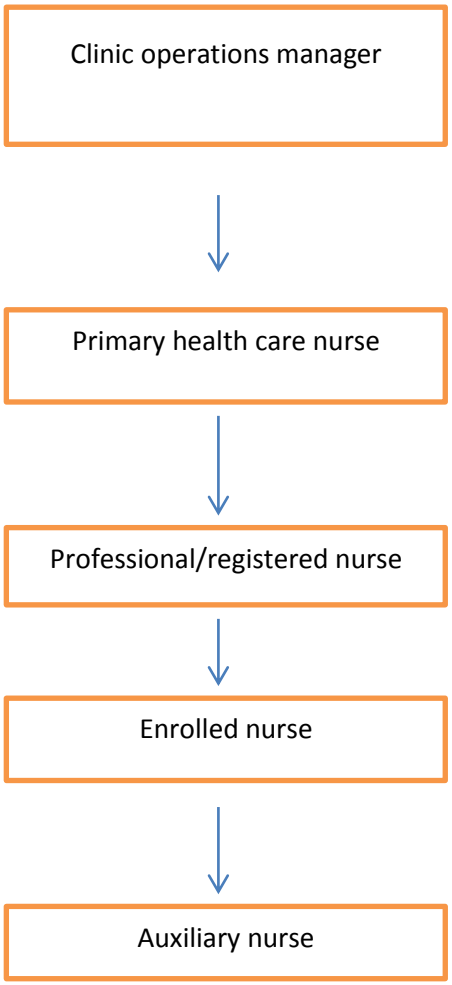


Figure 3.2 : Organogram for nursing staff at a PHC clinic.

3.2.2 Sampling approach

A systematic sampling was used to identify the clinics from the 40 clinics that would be selected to take part, with the first clinic being randomly selected and every 5th clinic selected from the list of clinics in the Greater Tzaneen municipality. The list was not arranged in any specific order, it was used as it was received from the provincial department of health without alteration. As such bias was reduced as described by Babbie (2016), who confirms that bias is reduced if the list is not arranged in any specific order. A total of 63 participants out of nine randomly selected clinics were then conveniently and purposively selected in terms of their willingness to participate in the study. These participants came from a total of 90 nurses that were approached and 27 nurses declined to participate. According to Kumar (2014), convenience sampling is guided by the convenience to the researcher. In this study the researcher was guided by the approval of the nurses to participate in the study. The reason for this type of sampling was that the researcher wanted to get as much participation to the study as possible. It would have been pointless to try and select a handful of people randomly from a population and try and turn them into willing participants due to the sensitivity of the study. According to Blaikie (2010) in such cases to insist on a random sampling method would render the research impossible.

3.3 Study design

A mixture of a retrospective qualitative and quantitative approach was employed in this study. This methodological triangulation was used in order to off-set the weakness of one method with the strength of the other thus improving the validity and reliability of the research. The capacity of both methods was then enhanced and the quality of the findings enriched as stated by Sarantakos (2013).

3.4 Data collection instruments

Field conversations (notes) and focus group conversations were conducted during the introduction of the project to the subjects to obtain as much relevant information as possible before the questionnaires were distributed.

A questionnaire was developed after an in- depth literature review was conducted to serve as the basis for the development of the data collection instrument in order to

derive objectivity in the conceptualization of the problem. The content validity in the questionnaire was derived from the literature review and having considered the objectives of the study and the research questions. The questionnaire was then piloted.

3.5. Pilot study

The questionnaire was pre-tested on respondents that had the same characteristics as those used in the study i.e. nurses belonging to the clinics that were not selected for the study. The pre-testing was done to help ascertain the validity of the data, to develop a procedure for data collection, identify and to rectify any ambiguity and flaws in the data collection tool. The pre-testing was also done to ascertain the reliability and feasibility of the items in the questionnaire in addressing the research questions. The problem encountered in the pre-testing phase was that most respondents were not keen on participating as they were of the view that the study might undermine their professional integrity. It is imperative to note that care was taken to make sure that the facilities selected for the pilot study were not included in the study sample. The questionnaires were distributed to the participants and later discussed with the participants in order to pin point any ambiguity and misunderstanding.

3.6 Data collection

Data was collected using structured, pretested self-administered questionnaires after the purpose of the study was explained and consent was obtained. The questionnaires were distributed to the respondents and collected on the same day. The questionnaire asked questions related to: demographics, ordinal scale and multiple choice questions. Focus group interviews were conducted during the morning gatherings (shift handover meetings) as this time was convenient for the participants and it was the only time the participants assembled. These focus group discussions were conducted by the researcher with each group of the nurses at the different clinics during the collection of questionnaires. The interviews were unstructured and allowed participants to raise any issues they saw relevant. The information obtained was recorded directly on a coding sheet and was then utilized during data analysis. The participation revealed that most participants were comfortable talking in a group. This method was used because it was convenient as

individual interviews were not viable due to the hectic schedule in the PHC clinics. Field notes and quotes were recorded during the field conversations and the information obtained was coded as the interview progressed using an onsite paper and pencil technique. The descriptions of the people, quotations and descriptive phrases served as general reminders in order to link comments made in response to specific questions on the questionnaire. This method was chosen because it preserved ideas and memories from interviews and is the most economical qualitative method in terms of time and cost (Tessier 2012).The focus group interviews and the field notes were used over and above the questionnaires in order to ensure that contextual information was collected as an essential component of the research project. The overall mixed method of data collection was employed to provide a narrative that builds on the strengths of each method while reducing the weaknesses of each individual method.

3.7 Data analysis

The researcher used the Statistical package for social sciences (SPSS) to organise and analyse the data. Frequency tables were used to summarise the data. The results of the analysis were then interpreted with respect to the research questions. Bar charts were also used to enhance clarity during data interpretation.

3.8 Reliability, validity and objectivity

The pilot exercise conducted was for the purposes of developing and testing adequacy of the research instrument and assessing the feasibility of the study.

External validity in this study was increased by the fact that the characteristics of the pilot sample closely mirrored the population that was studied.

3.9. Bias

In this study bias was minimised by conservatively interpreting the results and taking care not to divert from the chosen sampling procedure. Data was collected during the day where participation was likely to be higher and the site of data collection was at the natural habitat i.e. the PHC facility. According to Pape et al (2002) systematic bias often occurs when the response rate in a study is low or when the study method or sampling criteria create an artificial difference between the exposure and the

outcome. Professional knowledge of the data collector, a healthcare provider in his own right, did not influence the conduct of the study. The data collection forms were easy to fill so as to increase the number of properly filled questionnaires and minimise the potential for data recording error which could increase bias.

3.10. Ethical considerations

The study was approved by the Turf loop Research Ethics Committee (TREC), the Provincial Department of Health, and the District Department of Health. Permission was also requested from the clinic managers for the study to be conducted in the respective clinics without interfering with health service provision.

To guarantee that the information provided by the subjects remained anonymous and confidential, no names were written on the questionnaires and participants were only identified by numbers to facilitate data capturing. Comprehensive and clear information about the research project was provided to all participants and a consent form made available for the subjects to sign before the questionnaires were completed. The respondents were not unduly influenced to participate or coerced. It was clearly emphasized and explained to the subjects that participation was purely voluntary and that refusal to participate was not going to prejudice them in any way. A ballot box was used to collect all completed questionnaires as an added effort to guarantee anonymity.

CHAPTER 4

4. RESULTS

This chapter presents the results of the data gathered from the participants and the analysis that was conducted to answer the research questions and therefore meet the research objectives. The chapter presents the demographic findings and then goes to the descriptive statistical analysis results mainly in the form of frequencies. It also discusses the reliability and normality tests conducted to validate the data and finally presenting inferential statistical test results for the various correlational tests done on the data.

4.1 Demographics

4.1.1 Gender

A sample of 63 persons was chosen based on their willingness to participate. The average number of health professionals per clinic was 12 and 9 clinics were selected which translates to 108 of the number of health professionals in the clinics that were chosen.84% of the respondents were female, 3% male and 13% chose not to disclose their gender but still participated in the study.

4.1.2 Age

By age, 18.% of the respondents chose not to specify their age, 6% were below 25 years of age, 24% between 26 and 35 years, 22% between 36 and 45 years and another 22% between 46 and 55 years and the remaining 8% over 56 years of age. The age range was between 22 and 60 years.

4.1.3 Race

Classifying the sample by race 86% of the sample was classified as black African and the remaining 14% of the respondents chose not to indicate their race. It should be noted that, race was not a variable expected to influence the outcome but was included for statistics purposes.

4.1.4 Participation

Only 63 of the 90 nurses that were approached agreed to participate in the study making it 70% of the nurses approached that agreed to take part. This supports the notion that a fear of victimization is a reality in PHC clinics as described in the literature review.

4.1.5 Profession

The majority of the respondents were registered / professional nurses who made up 60% of the sample followed by enrolled nurses (26%) and those who did not specify their professions due to a fear of victimization constituted (14%).A summary of the demographic information is presented in the following table:

Table 4.1: DEMOGRAPHIC DATA OF THE RESPONDENTS.

Variable		Frequency	Percent (%)
Gender	Not specified	8	13
	Male	2	3
	Female	53	84
	Total	63	100
Age	Not specified	10	18
	25 and below	4	6
	26-35 years	15	24
	36-45 years	14	22
	46-55 years	14	22
	56+	5	8
	Total	63	100
Race	Not specified	9	14
	Black African	54	86.
	Total	63	100
Occupation	Not specified	9	14
	Professional/Registered Nurse	38	60
	Enrolled Nurse	16	26
	Total	63	100
Years of Experience	Not specified	14	21
	5 years and below	14	23
	6-10 years	17	27
	11-15 years	6	10
	16-20 years	12	19
	Total	63	100

A skewness test was peformed on the demographic information and the data revealed that the sample was not normally-distributed as Kurtosis scores were below or far above 3 which is a benchmark that indicates a perfect symmetry (absence of a skew). The Skewness scores fall outside the 0.5 to -0.5 range required for normality. Therefore according to Bai and NG (2005) the data had to be analysed using non-parametric tests as explained in the methodology. The test results are indicated below:

Table 4.2: KURTOSIS AND SKEWNESS TESTS PERFORMED ON DEMOGRAPHIC INFORMATION

	Gender	Age	Race	Occupation	Highest Level of Education	Years of Experience
Valid	63	63	63	63	63	63
Missing	0	0	0	0	0	0
Skewness	-2.26	-0.20	-2.27	0.90	0.60	0.60
Std. Error of Skewness	0.30	0.30	0.30	0.30	0.30	0.30
Kurtosis	3.41	-0.65	3.25	2.51	-0.44	-0.63
Std. Error of Kurtosis	0.60	0.60	0.60	0.60	0.60	0.60

4.1.6 Experience of working at a Primary Health Care facility?

Reviewing the sample by years of experience at the Primary Health Care facility. 27 % had between 6 and 10 years' experience, 23% below 5 years' experience, 21% of no specified experience, 19% between 16 and 20 years' experience and 10% between 11 and 15 years work experience. The number of the years of experience considering the fact that some participants did not disclose ranged between zero and twenty years.

4.2 The types of errors identified were as follows:

- Wrong patient – This was, for example, when medication was given to the wrong patient as a result of documentation mix-ups.

- Wrong dose –when the incorrect strength of medication was dispensed or administered e.g. 10mg instead of 20mg.

- Wrong day-when medication was given on a day it was not supposed to be given as prescribed e.g. methotrexate is given on weekly intervals i.e. every 7^{th} day. A situation where such drug was given on any other day except on the prescribed day fell within this category. Medication given on an unscheduled day fell in this category. This included situation where medication like enemas was not taken a day before a procedure as instructed.

- Wrong time-when medication was given at the wrong time of the day e.g. morning instead of night, e.g. simvastatin tablets which control synthesis of cholesterol in the liver. Most manufacturers recommend that they are taken at night, on the basis of physiological studies which show that most cholesterol is synthesised when dietary intake is at its lowest.

- Wrong route-when medication was administered via an incorrect route e.g.Diclofenac injection was given subcutaneously instead of intramuscularly. Frequency of the medication-when medication was ordered at a frequency indicated on the prescription form but administered at a different interval e.g. given only at bedtime when the prescription order is three times daily four times instead of three times a day

- Changing of medication-when medication was inappropriately introduced or stopped.
- No medication- when the patients were unable to receive medication due to unavailability of the medication either due to shortages or stock-outs.e.g shortages and stock-outs of Fixed dose combination(FDC) drugs and paediatric antiretroviral (ARV) dosages across the provinces.
- No information on contra-indication given –when the concurrent use of medicine or food affects the efficiency of prescribed medication e.g. failing to advice patients to avoid aspirin while taking warfarin.
- Dispensing omission-when medication was not given to a patient due to an act of omission by the health professional e.g. medication not included on the prescription.
- Incorrect documentation-when there was an omission or incorrect information on the patient treatment chart e.g. prescribed medication was not included on the treatment chart.

4.3 The perceived frequency of medication errors.

As can be seen in the following Table 4.1 the study revealed that the most frequently identified type of medication error was, no medication (49%) followed by changing of medication (40%), wrong dose and incorrect documentation both at 27% and dispensing omission (25%) etc. The results are summarized as indicated in the table below:

Table 4.3: PERCEIVED FREQUENCY OF OCCURRENCE OF EACH TYPE OF ERROR.

Type of error *(Unsafe acts)*	**Number of times mentioned**	**Percentage frequency**
No medication	31	49%
Changing of medication	25	40%
Wrong dose	17	27%
Incorrect documentation	17	27%
Dispensing omission	16	25%
Wrong duration of treatment	15	24%
Wrong medication	13	21%
Frequency of medication	13	21%
Wrong day	11	18%
Wrong time	11	18%
Contra indication	11	18%
Wrong patient	10	16%
Wrong route	9	14%
Duplication	5	8%

The results were further illustrated in the form of a bar-chart as indicated below:

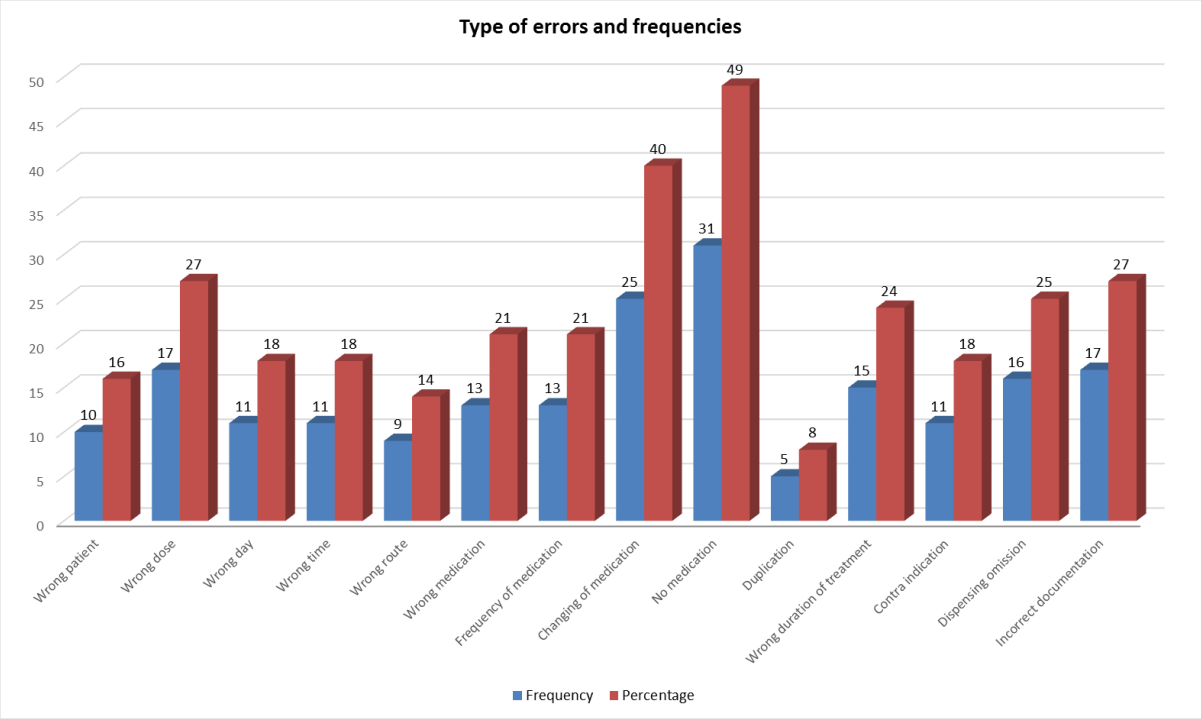


Figure 4.1 Bar chart showing the frequency distribution of the types of errors

4.4 Predisposing factors identified

The following are factors perceived to be predisposing to the occurrence of medication errors at the facilities

- Heavy workload- At each PHC clinic because of shortage of staff and the number of patients that needed attention, nurses felt overwhelmed with work, since they had to do the prescribing, transcribing, dispensing which included counselling, and in certain instances administration of medication.

- New staff- When new staff is not familiar with procedures and protocols and certain drugs used in the health care facility, this results in medication errors. A neglect of such treatment procedures mostly due to heavy workload, insufficient work experience resulted in medication errors. An example in the PHC was when tablets for the treatment of bilharzia were given without weighing the patient and making the relevant dosage calculations according to the patient's weight.

- Unfamiliar medication-when medication was new to the health professional and the health professional could not understand how it works. A combination drug (artemether / lumefantrine) used to treat malaria is an example of a drug that sparked a lot of problems when it was introduced to the clinics. A 3-day treatment schedule with a total of 6 doses is recommended for adult patients with a bodyweight of 35 kg and above as follows: Four tablets as a single initial dose, 4 tablets again after 8 hours and then 4 tablets twice-daily (morning and evening) for the following 2 days (total course of 24 tablets). Some nurses used it over a period of 12 days and some 24 days.

- Unfamiliar patient condition-When the health professional is not familiar with the diagnosis and does not have enough information about the disease condition. During down referrals the diagnosis is made at a hospital level and patients are sent to clinics for further treatment as the clinics are closer to home e.g. people suffering from diabetes mellitus

- Crowded work area-when there is insufficient space to adequately perform duties by health professionals. The layout in most clinics did not allow for

separate designated areas for compounding, receiving and administration of medication

- Lack of equipment –faulty or in availability of equipment may lead to misdiagnosis .Equipment to measure blood pressure and weighing scales are mostly used in these facilities

- Illegible handwriting-Transcription errors could occur when there is a miscommunication between the person prescribing the medication and the one who is dispensing or administering the medication, this could be a consequence of illegible handwriting.

- Hostile environment-working environment that is not conducive to employees may cause medication errors. This include workplace violence such as aggression, harassment, bullying, intimidation and assault perpetrated against nurses from patients, relatives, other nurses, managers and other professional groups.

- Poor medication supply system-Inadequate procurement and distribution of medication may cause medication errors due to unavailability of medication to be dispensed or administered at the PHC clinics e.g. when ordered medication does not arrive in time from the depot e.g. several incidences where patients on antiretroviral therapy (ART) were turned back and told to try the following day because the facility did not have antiretroviral drugs.

- Interruptions-an environment that is prone for disturbances is a breeding ground for medication errors. Examples of such interruptions were a ringing telephone, questions from staff and patients. A nurse was reported to have diluted a powder for suspension twice due to interruption by patient thus rendering the strength of the antibiotic weaker. The antibiotic was supposed to be diluted with 9ml of water but was diluted with 18ml instead

- Physical health-the physical health of the health professional may be a predisposing factor to medication errors e.g. the concentration of a health professional who was ill was not the same as on the days when she or he did not have health problems.

The results of the predisposing factors in the PHC facilities yielded heavy workload (78%), lack of equipment (70%), insufficient training (63%) , poor medication supply system (52%) crowded work area(48%), lack of motivation(41%) and complicated prescription or orders(29%) as some of the identified predisposing factors. The summary is indicated as per table below:

Table 4.4: FREQUENCY DISTRIBUTION OF PREDISPOSING FACTORS.

Factor *(Latent condition)*	Number of times mentioned	Percentage frequency
Heavy workload e.g. high nurse to patient ratio	49	78%
Lack of equipment e.g. faulty weighing scales in the clinic	39	70%
Insufficient training e.g. no updates given on drugs.	40	63%
Poor medication supply system	33	52%
Crowded work area	30	48%
Lack of motivation	26	41%
Complicated prescription or orders	18	29%
Illegible hand writing	14	22%
Unfamiliar medication	13	21%
Hostile environment	13	21%
Personal neglect	12	19%
Unfamiliar patient condition	12	19%
Interruptions	12	19%
Labeling	11	18%
New staff	10	16%
Physical health	8	13%

The results on the table above were further illustrated in the form of a bar-chart as indicated below:

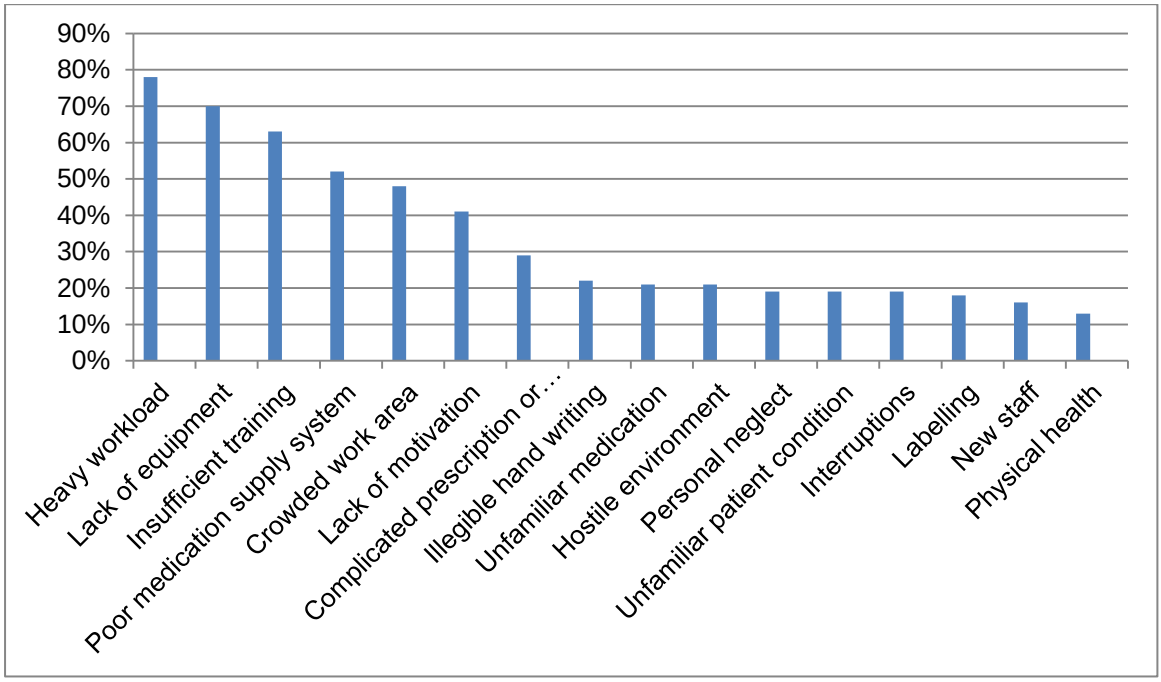


Figure 4.2 Predisposing factors of medication errors

4.5 Perceived prevalence of medication errors

The results for the perceived prevalence of medication error according to the rating scale indicated the least frequent medication errors (0-33%), moderately frequent (34%-66%) and most frequent (67%-100%).The description of the individual medication errors is already given in the description about the types of medication errors. The following table present a summary of the results in terms of how frequent they were said to occur by the participants. It is important to note that the earlier Table 4.1 described how often the errors were mentioned which is not the same as how often each error occur according to the participants' perceptions, Table 4.6 reveal the list of medication errors identified as the ones that are very unlikely(least frequent) to happen. The results show, changing of medication (32%), incorrect documentation (24%), wrong dose (22%), dispensing omission (21%) etc as indicated in the table below as the least frequent medication errors in the PHC clinics.

Table 4.5: DISTRIBUTION OF THE LEAST FREQUENT MEDICATION ERRORS.

Type of error	**Least frequent**
	Frequency/percentage
Changing of medication	20 | 32%
Incorrect documentation	15 | 24%
Wrong dose	14 | 22%
Dispensing omission	13 | 21%
Wrong patient	13 | 21%
Wrong medication	10 | 16%
No medication	9 | 14%
Contra indication	9 | 14%
Frequency of medication	8 | 13%
Wrong duration of treatment	8 | 13%
Duplication	8 | 13%
Wrong time	7 | 11%
Wrong day	5 | 8%
Wrong route	4 | 6%

The table below indicate the moderate frequent medication errors as identified by the participants. The list in descending order consists of changing of medication and frequency of medication both at (19%),no medication (14%), wrong duration of treatment (13%), (incorrect documentation, dispensing omission, Contraindication, wrong medication) all at 7% and the list goes on as indicated below:

Table 4.6: DISTRIBUTION OF MODERATE FREQUENT MEDICATION ERRORS

Type of error	**Moderate frequent**
	Frequency/percentage
Changing of medication	12 | 19%
Frequency of medication	12 | 19%
No medication	9 | 14%
Wrong duration of treatment	8 | 13%
Incorrect documentation	7 | 11%
Dispensing omission	7 | 11%
Contra indication	7 | 11%
Wrong medication	7 | 11%
Wrong day	6 | 10%
Wrong dose	5 | 8%
Wrong route	5 | 8%
Wrong patient	5 | 8%
Wrong time	4 | 6%
Duplication	4 | 6%

The results in the most frequent category yielded, no medication (22%), incorrect documentation (13%), (changing of medication, frequency of medication, wrong duration of treatment, and wrong time at (8%).The rest of the list is shown in descending order in the table below:

Table 4.7: DISTRIBUTION OF THE MOST FREQUENT MEDICATION ERRORS

Type of error	**most frequent**
	Frequency/percentage
No medication	14 | 22%
Incorrect documentation	8 | 13%
Changing of medication	5 | 8%
Frequency of medication	5 | 8%
Wrong duration of treatment	5 | 8%
Wrong time	5 | 8%
Wrong day	4 | 6%
Dispensing omission	3 | 5%
Wrong dose	3 | 5%
Wrong route	3 | 5%
Duplication	3 | 5%
Contra indication	2 | 3%
Wrong patient	2 | 3%
Wrong medication	1 | 2%

The results from the tables above were further illustrated in a bar-chart as indicated below:

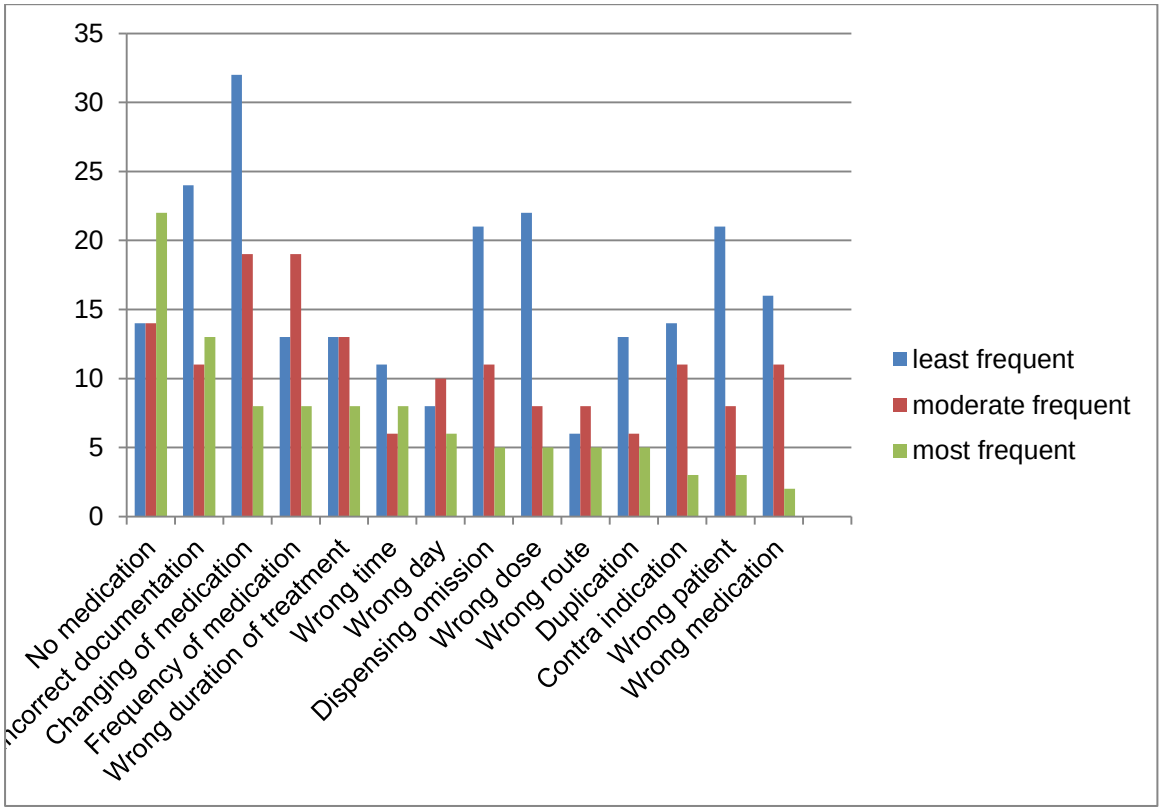


Figure 4.3 prevalence of medication error

4.6 Correlation tests

The results of the correlation tests that were performed to determine the link between the demographic factors, types of errors, the prevalence of medication errors and the predisposing factors were indicated as follows:

Table 4.8 CORRELETION BETWEEN DEMOGRAPHIC FACTORS, TYPES AND PREVALENCE OF MEDIDATION ERRORS.

	Age		Occupation		Highest Level of Education		Years of Experience	
	Tb	Sig. 2 (Tailed)	Tb	Sig. 2 (Tailed)	Tb	Sig. 2 (Tailed)	Tb	Sig. 2 (Tailed)
Wrong Patient	-0.037	0.736	0.077	0.51	-0.029	0.795	-0.102	0.353
Wrong Dose	0.071	0.515	0.026	0.825	0.152	0.172	0.016	0.883
Wrong Day	0.087	0.428	-0.017	0.887	-0.225	0.045	0.044	0.685
Wrong Time	-0.046	0.674	-0.13	0.267	0.156	0.168	0.132	0.229
Wrong Route	-0.033	0.766	-0.04	0.732	0.104	0.359	-0.118	0.286
Wrong Medication	0.021	0.843	-0.087	0.452	0.2	0.073	0.124	0.253
Frequency of Medication	-0.003	0.977	0.011	0.923	0.141	0.204	-0.226	0.036
Changing of Medication	0	0.995	0.118	0.298	-0.033	0.766	-0.023	0.827
No Medication	0.046	0.665	0.007	0.952	0.195	0.076	0.155	0.147
Duplication	-0.01	0.929	-0.035	0.765	0.139	0.216	0.005	0.961
Wrong Duration of Treatment	-0.055	0.61	-0.042	0.716	0.07	0.529	-0.022	0.841
Contra-Indicators	-0.032	0.773	0.079	0.503	0.031	0.786	0.133	0.226
Dispensing Ommission	-0.073	0.506	0.003	0.98	0.07	0.535	0.124	0.257
Incorrect Documentation	0.045	0.676	-0.064	0.581	-0.012	0.915	-0.004	0.972

Using a significance level of 0.05 ($p<0.05$) as a benchmark, the above table shows that independent variables age, occupation, highest education level and experience have insignificant relationships with errors , i.e. ($p>0.05$).

Years of experience one had served and the frequency of medication error however had a significant but weak relationship ($r=-0.225$, $p<0.05$), meaning as the one's education levels went up; their frequency of experiencing this type of error went down slightly. A significant but weak relationship was also noted between highest level of education as an independent variable and the wrong day error ($r=-0.225$, $p<0.05$).As one's education level went up, the frequency with which administering medication on a wrong day as an error also goes down.

In this study, as shown in the table above, unfamiliar medication has got positive significant correlations with four of the dependant variables or errors as indicated below:

Contra-indicators (Tb=0.415, p<0.05)

Duplication (Tb=0.419, p<0.05)

Wrong patient (Tb=0.435, p<0.05)

Wrong time (Tb=0.393, p<0.05) Hostile environment has shown to have positive, moderate relationships with duplication, wrong dose and wrong route as mediation errors.

Duplication (Tb=0.409, p<0.05)

Wrong day (Tb=0.426, p<0.05)

Wrong route (Tb=0.432, p<0.05)

Hostile environment has further shown a positive correlation of 0.428, (Tb=0.428, p<0.05) with wrong route.

The general expectation of the study was that the results were going to show strong, positive correlations between medication errors and the predisposing factors of these errors. However, the strongest correlations were in the moderate strength range

(0.39 to 0.44). In addition this consisted of a few variables which included the following predisposing factors:

- unfamiliar medication
- hostile environment
- unfamiliar patient
- complicated prescription
- insufficient training and new staff

All the other causes outside these five had weak relationships (below 0.39) with the dependent variable – medication errors.

CHAPTER 5

5. DISCUSSION

This chapter presents the discussion and the interpretation of the results in the present study. The conclusion, the significance of the study and the recommendations are also outlined.

5.1 No medication and the predisposing factor

The results from the present study, in particular correlation analysis of demographics and medication errors, showed that as education and experience increased, the prevalence of medication errors was reduced. This was to be expected as experience coupled with continuing professional education is always associated with efficient risk management. Some studies, nonetheless, have shown that no single or combination of nurse demographic characteristics were strongly associated with nurse perceptions of medication errors (Mayo and Duncan 2004) However, in the study by Bailey et al (2003), where they had nurses of different levels of training, it was found that there was direct relationship between education and medication errors, rather than inverse relationship, wherein as education increases the number of errors decreased. Their study showed that Licenced Practical Nurses, who are, to some extent in South Africa, equivalent to State Enrolled Nurses, made least number of medication errors followed by nurses with associate degrees. Those with Bachelor of Science in nursing degrees had the highest incidence of medication errors. In addition Bailey et al (2003) found that medication error incidence increased with the number of years of experience. According to them, most medication errors were made in the first five years or after twenty years of experience. They did not however, explain the dip in the unsafe acts that occurred as one acquired more experience. It would be difficult to ascribe, aberrant mental processes such as forgetfulness, inattention, poor motivation, carelessness, negligence and recklessness to the medication errors in their study. In the present study the view of human error problem as a person approach did not seem to play a major significant role as an error provoking condition. Nonetheless, if the following quote from some clinic staff is anything to go by, caution has to be exercised when interpreting the results.

"*We are mostly overworked, it's only the prayers that we do every morning that keep us going and most of the time we don't have medication and the patients insult us".*

This certainly could cause variability in human behaviour which may not be easy to manage and to develop countermeasures for. This is not to suggest that there should not be countermeasures at the PHC facilities to reduce unwanted variability in human behaviour. It can be reasonable to assume that, heavy workload, probably due to shortage of staff, identified as one of the error provoking conditions can easily lead to unsafe acts, namely medication errors and procedural violations. These are possible due to human behaviour variations and personal attributes. This cannot be the case in the present study where medicine shortage was perceived as the major medication safety concern which was then understood as an error. However, unavailability of medicine or "no medication" can be analysed from both person and systems approaches. The two approaches are not mutually exclusive. Various factors and circumstances have the potential to increase the risk and prevalence of harmful medication incidents during a period of medicine unavailability.

As mentioned above, the present study found that the unavailability of medication or shortage of medication was perceived by the clinic staff to be the major medication error. This type of medication error may be linked to poor medication supply from distribution centres and poor governance. Poor medication supply system was indeed a significant predisposing factor or latent condition, in particular medicine stock-outs, to many types of medication errors as perceived by 52% of the participants. Studies by Magadzire et al (2017) and by Smith (2016) similarly recognize poor procurement system as a significant predisposing factor to medication errors. Gonzalez (2015) concurs with this notion and further explains that stock-outs are indicative of a bigger problem related to the management and accountability in the health system and that an interruption of certain medications like ARV drugs,TB medication and antibiotics might lead to relapses and drug resistance respectively. The following quote from the results obtained during field conversations with some of the staff illustrate how medication stock-outs and shortages were a problem at the PHC facilities during the study period.

"It takes us two weeks to receive an order from the Department of Health. Sometimes some of the medication in the invoices is not supplied. I feel sad when

we have to turn patients back because of shortages. We have been struggling to get iron tablets for pregnant women now for quite some time and its always sad to turn them back because most of them can't afford a private pharmacy".

The above quote demonstrates how shortage of medication which can occur without advance warning for clinic clients, like pregnant women, can have dire consequences to maternal and possibly infant mortality in the community. This further demonstrates that the medication supply system in the primary health care is flawed and patients suffer due to medication shortages and stock-outs. A well-functioning supply chain is therefore crucial in responding to the health needs of the population including pregnant women and ensuring effective implementation of different programmes such as the PHC re-engineering which put emphasis on prevention and health promotion. Taking good care of pregnant women is thus important to ensure that they give birth to healthy children and avoiding birth related complications. The proposed National Health Insurance (NHI) requires an improved health system in order to work properly and drug availability is one of the baselines for improvement in the health system (Soul City Institute 2015). The following is another quote from the staff at the clinic that serves to illustrate the point about how medication shortages and stock-outs make life and work hard at PHC.

"We are mostly overworked, it's only the prayers that we do every morning that keep us going and most of the time we don't have medication and the patients insult us".

The above sentiment expressed by the staff clearly shows how to an extent unavailability or no medication and human feeling can interact to result in poor motivation especially if the staff gets insults from patients. Heavy workload combined with the above mentioned insults can lower the staff morale and thus result in medication errors like wrong dose, dispensing omission and no attention paid to contra-indication due to the health professional not following the proper procedures and protocols of their professional duties and responsibilities. The following is yet another sentiment expressed by the staff.

"*Sometimes medication stock-outs leads to acquisition of out of stock medication from the nearest hospital or sending of patients to the hospital which is in turn an inconvenience to the patient who mostly need to travel and wait on long queues at the hospital".*

To an extent, as the above quote shows, it was hardly surprising from the study to see that the staff at the clinic regarded, as far as, they were concerned, unavailability (no medication) as a medication error. The present study calls attention to the need to clarify with the clinic staff what constitutes a medication error. The fact that patients needed to travel to other institutions during a period of medicine unavailability in their nearby facility, a system error defeats the purpose of bringing health care closer to the communities. Primary Health Care should be free or at most affordable thus the unnecessary travelling has a socio-economic impact in most poor communities. Some studies have also found that there can be delayed and or cancelled care as result of medicine shortages or stock-outs necessitating better classification of medication errors and adverse events during such periods (McLaughlin et al 2013). This study is therefore consistent with the findings by (Pirinen 2015) where it is reported that, in a desperate effort to maintain a continuous supply of medication to patients a phenomenon of borrowing from the neighbours was developed in certain health facilities in Finland. This phenomenon was thus precipitated by medication stock-outs and shortages that occurred in these facilities. The consequence of such phenomenon is that patients will not receive medication if the facility the medication is being borrowed from also does not have stock. This would be a serious systems failure.

This result is in agreement with the observations by Magadzire et al (2017) who reported similar procurement mismanagement in the Western Cape, South Africa which resulted in the unavailability of medication to health facilities in that region. A similar scenario was identified in Pirinen et al (2015) where registered nurses in Finland experienced unavailability of medication that caused patients to go without prescribed medication and others having to change to less therapeutically suited alternatives like second and third line treatment options. Although some patients benefited from this arrangement, some did not receive their prescribed medication. When this happens in any health system there ought to be measures put in place to monitor the outcome.

Gonzales (2015) reported that one in five facilities in South Africa had experienced stock-outs. Although there have not been any further reports since then, the assumption is that some sort of stock-out still happens in health facilities around South Africa as confirmed by the results of the present study. The outcome, in other

words have an effect on patient care and can have serious consequences. For example people living with HIV and TB risk death and drug resistance in the health facilities due to on-going interruptions to the supply of life saving medicines which they expect to obtain from the PHC facilities. The occurrence of such shortages and stock-outs in the health facilities forces the changing of medication by replacing patients' regular medication by generic or therapeutic substitutes especially with chronic medication for diabetes mellitus, hypertension and HIV infection. Generic substitution may not always be possible especially if the generic substitute is also not available. In addition, at times when medication shortages occur without adequate advance warning, the clinic may not have sufficient time to develop plans, identify therapeutic alternatives and implement necessary safety measures. Safety measures at the clinic should include;

- Information from the depot or medical store about medicines that are in short supply, including their current availability and the anticipated duration of the shortage
- Guidelines or restrictions for use of products that are in short supply. This is important activity of well function Drugs and Therapeutic Committee at the hospital that the clinic refers patients to
- Information about recommended alternatives, including dosing, preparation, administration and monitoring where possible
- Potential for error with alternative agents when changing medication and any additional steps required to enhance safety e.g. if the drug can interact with other drugs or foodstuffs if taken concurrently

This would to an extent reduce medication errors related to changing of medication.

5.2 Changing of medication and the predisposing factors

Changing of medication was found to be a significant medication error in the present study in that 40% of the respondents indicated that it was one of the types of medication error that occurred in their facility. Changing of medication according to Cater et al (2014), Fu et al (2007), one could say is a combination of several actions which include, the interruption of regularly used medication, inconsistent dosing or

frequency of home medications or when a patient is not in the position to talk, and provision of incorrect medications that differ from those normally prescribed. These were generally perceived to be one of the major set of errors that occurred at the clinic which was similar to a study finding in Singapore (Salmasi et al 2015). In their study they found that 36.5% of medication errors were due to medication reconciliation errors which are linked to the changing of medication. The reconciliation of medication taken at home and that dispensed and or administered at PHC was a measure challenge in the facilities. Similarly was the reconciliation of medication from the hospital and the ones dispensed in the PHC facilities during down referrals. It can be safely assumed that the movement of patients from one facility to another increased the risk of medication error as stated by Cater et al (2014), who alluded to the fact that the involvement of a clinical pharmacist during patient movements improves the accuracies and completeness of medication histories.

The results of this study is also consistent with the report by Bateman (2013),who reported that unavailability of medicines to patients resulting in medication change has become a national crisis in South Africa. The crisis is not only related to medicine shortages but also to the consequences of these shortages. This problem has prompted a mitigation attempt by the HIV Clinicians Society of Southern Africa to draw up a drug substitution guideline. This guideline covers HIV treatment and thus does not solve the vulnerability of patients suffering from other disease conditions such as diabetes and hypertension. There would also be a need for guidelines in the treatment and management of these chronic diseases which are increasingly being managed at the PHC facilities having been initially diagnosed at the hospital. Although it is believed that such guidelines for chronic diseases exist, they were not available in the PHC facilities that were involved in the study. This type of medication error may thus be assumed to be linked to the poor medication supply system where generic and therapeutic substitution has to be made due to unavailability of medicine in the health facilities e.g. when the Fixed Dosage Combination (FDC) anti-retroviral medications were out of stock in the PHC clinics, most patients ended up not receiving medication they were supposed to get and thus stood a chance of relapses. An opportunity for error to occur may be exacerbated by insufficient training where nurses do not have enough pharmacological knowledge and

experience involved in the substitution such as possible adverse effects and contra-indications especially with younger nurses with little experience. It is not only about knowledge in pharmacology and therapeutics concerning drugs stocked at the clinic but also continuing updates and even monitoring adverse events. Unfortunately there is no Pharmacy and Therapeutics Committees (PTCs) at the PHC level that would assist with challenges and safety concerns created when therapeutic alternatives are used. Be that as it may, there is a need for effective and functioning PTCs at the main hospitals that provide the pharmaceutical services at the clinics. Mehta et al (2014), reaffirms that pharmacovigilance is a fundamental component of monitoring and evaluation of medical institutions and or public health programmes and an institution devoid of such committees will miss out on these vital roles including addressing the unavailability of medication due to poor medication supply system. In addition as mentioned earlier PTC would be expected to provide all the necessary information regarding medicine stock- outs and alternative therapies.

According to (Cater et al 2014, Fu et al 2007), situations where medication that is normally prescribed to patients has to be replaced either by generic or therapeutic equivalents requires a comprehensive understanding of the drugs and the disease conditions involved. This support the findings of this study that insufficient training and more knowledge about the pharmacology and therapeutic as mentioned by the staff may contribute to a certain extent to medication administration errors in the health facilities including wrong dose.

5.3 Wrong dose and the predisposing factors

This is mainly a dispensing error where the medication dose dispensed is not the same as the medication dose on the prescription e.g. when a 10mg tablet is dispensed instead of a 20mg as prescribed. The consequence of such cases where the strength of the medication is less than that prescribed is that the strength of the medication might not be enough to produce the required therapeutic effect, particularly when the dosing schedule is not changed and thus constitute a medication error which is an unsafe act. This type of error can also be linked to the work environment where distractions can lead to commission of such an error especially where the packaging of the different strengths of the medication are similar and there are no labelling, markings or warnings to remind the health

professionals of specific facts that need to be considered when dispensing or during administration. Although individual factors such as, negligence, forgetfulness and inattentiveness in the part of the nurses could not be ruled out, system factors such as heavy workload and insufficient training especially dosage calculations was perceived as a problem at the health facilities .This is supported by the following quote:

" Very few nurses know how to do dosage calculations especially odd suspension dosages that are not normally prescribed maybe you might as well show us,"

This was a request made during the study indicating that inability to carry out some pharmaceutical calculations was indeed a problem. This finding is in agreement with that of Weant et al (2014) who also found that the most prevalent medication error in the paediatric emergency department in the USA was overdose, mainly because of the low doses involved and the narrow margin of error compared to adults. Al-Shara (2011) and Ehsani et al (2013) also identified wrong dose as one of the most common type of medication errors. Although most studies, concerning this type of error have been performed at hospitals and not primary health care, this type of error, if the results from the sample involved in the study are anything to go by, appeared to be common at the PHC facilities. The most probable error provoking factor at such facilities would be insufficient training especially in dosage calculations, in other words pharmaceutical calculation. From the study it was pleasing to note that the staff appeared to realize their inadequacies in an environment where they felt overworked. Counter measures for such type of error could be approached from both human and system side according to Reason (2000), as mentioned earlier in the literature review Chapter. Reason (2000), suggests that the system approach of viewing human error include recurrent error traps in the workplace and thus concentrates on the conditions under which individuals work and makes suggestions about defenses to avert errors in general, or mitigate their effects. The counter measures are based on the assumptions that although it is not easy to change human condition, the workplace conditions can be changed.

5.4 Workload, understaffing and unsafe acts

One of such conditions that could be changed in a work place is understaffing that give rise to heavy work load in the PHC facilities. In this study the most dominant pre-disposing factor was heavy workload with 78% of participants having identified it as such. A study by Gorgich et al (2015) found the most common cause of medication errors in nursing was fatigue due to heavy workload at 98%. This is in agreement with other studies by (Al-shara 2011; Ehsani et al 2013; Salmasi et al 2015; Svitlica et al 2017) which found heavy workload to be the most common predisposing factor of medication errors such as wrong dose. Kavanagh (2017) explains that heavy workload causes fatigue and distraction to the health workers and subsequently leads to the failure to observe procedures and protocol. The finding in this study appears to add support to the explanation by Stockton (2017) that most of the published interventions of medication errors such as wrong dose relied heavily on clinical pharmacists. Suleman (2010) suggests that the expertise of such profession should not be under-utilized in Primary Health Care. Unfortunately such professionals are not available in the Primary health care facilities.

Many useful tools have been developed that can aid pharmacists in addressing medication errors, for example, in situations where nurses are overloaded with work. There is a clear societal expectation that pharmacists will take responsibility for the outcome that result from medication errors at the hospital and not at the clinic. The issue of safe system is poorly developed in the Good Pharmacy Practice Guidelines and non-existent for nurses. Section 2.3.3 of the guidelines requires that “Safe system of work must be established and maintained by a pharmacist to eliminate, as far as possible, errors in any component of the pharmaceutical service’. The responsible pharmacist is held accountable for the ‘establishment and maintenance of a system for reporting errors and withdrawing defective products’. In the hospital setting, this needs to be read in conjunction with General Regulation 36 to the Medicines Act, which states: ‘The responsible pharmacist or any other person licensed in terms of section 22C(l)(a) of the Act shall supervise, safety, security, purchasing, storage, and dispensing of medicines in a hospital’. The current shortage of these professionals put pressure on the nurses thus creating a heavy workload at the clinic. Heavy workload and understaffing at the PHC facilities may therefore be possible predisposing factors to significant medication errors in this

study such as wrong dose and incorrect documentation which would be reported if at all the correct systems and human resource were available.

From the study results it can also be assumed that staff at the PHC facilities would find it difficult to report any error as expected for pharmacists by GPPC section 2.3.3. In other words, pharmacists would work together with the clinic staff to make sure that any medication error was reported. Unfortunately, the staff at the clinic, during the study, was not even prepared to disclose information, such gender and years of experience they felt that giving such information during the study, would make it easy for anyone to identify them. If errors are not reported it would be difficult to obtain accurate statistics of such errors at the PHC level, despite the many benefits and the moral basis for detection. It appeared that the staff at the clinic would hesitate in reporting errors in order to protect themselves from possible administrative measures and even reactions of patients. If the staff at the clinics were insulted for shortages of medication what would happen if the patients heard of medication errors occurring at their clinic? In addition to hesitation by the staff, there were no proper archiving and reporting systems as well as a data registration system at PHC level. In any case the staff would not be competent to handle the systems, given the fact that insufficient training in pharmacology and therapeutics was mentioned as one of the error provoking conditions. Although medication errors can be made from the use of a variety of medicine, it is important to note that the pharmacological properties or excessive use of some categories of medicines increase the risk of whether an error is experienced or not. Such medication includes antibiotics that were inappropriately used in the clinics to treat flu symptoms.

5.5 Incorrect documentation and the predisposing factors

Incorrect documentation was found to be a significant type of medication error in this study with 27% of participants having identified it as a type of medication error happening in their facilities. Scott et al (2014) found that 12.2% of medication errors in the emergency department were due to failure to document the allergy status of patients by the nurses and the administration of such medication resulted in allergic reactions. This could easily happen in the PHC clinics where allergy history such as previous itching and swelling of patients was not obtained. The results from Scott et al (2014) are consistent with the results found by Alemu et al (2017) who conducted

a cross-sectional study in two public hospitals in Southern Ethiopia and found that incorrect documentation was the most frequently perpetrated medication error and that the nurses failed to document 95% of observed doses. The study findings agree with the findings by Stockton (2017), who found incorrect documentation and incomplete medication reconciliations in Canadian hospitals as a major problem. The prevalence of such errors in that study was at 47% .The results of this study found that more participants perceived incorrect patient history documentation as the least frequent error in their facilities. This, however, must be interpreted with caution given that staff had complained about workload and understaffing, factors that could easily influence their documentation at the clinic. Although this is in disagreement with what was found in literature where most studies were done at hospitals, some participants classified documentation error as moderately frequent and some as most frequent. These inconsistencies could be due to the sensitivity of the study as this type of error is an active error associated directly with the individuals as indicated in Figure 2.1,which mentions among others personal factors like,negligence,forgetfulness,lack of attentiveness and not following proper protocol as possible causes of medication errors. In most cases an element of bias towards the lowest endpoint is experienced when asking people to respond to questions that measure socially questionable acts or activities. This is mostly prevalent in work environments characterized by blame and punishment especially in health care institutions where there is no functional non-punitive error reporting system in place (Guerrero-Aznar et al 2014) as it was the situation at the clinics.

Due to the fact that studies about this type of error were mostly conducted in hospital, the rate of errors is expected to be higher compared to primary health care as they see more patients than the primary care facilities. In addition error reporting system in hospitals are expected to be efficient and therefore medication errors are picked up and reported by pharmacists .It would be reasonable to assume that in a hospital setting there are more error provoking conditions such as heavy workload.

Incorrect documentation may also lead to a dispensing omission if the prescribed medication is not documented correctly in the patient chart. This is a type of error that can occur at any level in the health system.

5.6 Dispensing omission and the predisposing factors

Dispensing omission was found to be one of the significant medication error in the present study, being identified by 25% of the participants. A study by Scott et al (2014), revealed a prevalence of 38.4 % for errors of medication dispensing omission. The frequency of medication dispensing omission in literature varies from 1.35%-60 %.(Scott et al 2014).This is in agreement with Ya-Hui et al (2014), Nguyen et al (2015) and Babatunde (2016), who reported similar findings about dispensing omission being a significant medication error in their respective studies. Heavy workload is one of the system factors that may lead to this type of error. A shortage of other health care practitioners like clinical pharmacists, as mentioned earlier in relation to other errors, may put a burden on the nurses, coupled with environmental disturbances; an opportunity for error may be created. Insufficient training of nurses on simple procedures such as the correct documentation and the double checking of prescriptions may also lead to such errors.

5.7 Facility equipment and medication errors

Equipment continually changes in the patient care environment which includes diagnosis and therapeutic interventions. Staff has a responsibility to stay abreast of these changes and be competent in the use of the equipment. This allows the staff to be more familiar with the function of the equipment and to know when it is about to breakdown. Yoost and Crawford (2016) suggests that equipment used in health care facilities such as blood pressure monitoring equipment and weighing balances should be readily available and checked for proper functioning before the start of every examination. Availability of adequate functional equipment is integral to providing quality health care service and improved patient safety. This equipment in health care is used for diagnosis and monitoring. Inadequate equipment while administering the medication may lead to medication errors (Carlton & Bleggen 2006; Smith 2016). Similarly, lack of equipment has been identified as a significant predisposing factor in this study with 70% of the participants recognizing it as such. Faulty equipment or imperfect equipment maintenance in the health facility provide a fertile ground for medication errors and may lead to a cascade of events such as wrong diagnosis which may lead to wrong prescription which may lead to dispensing and administration errors. These latent conditions are system issues that can

translate into error provoking conditions and can create holes in the organization's quest to improve patient safety. This is further supported by Svitlica et al (2017), where it was concluded that the most significant contributing factors in dispensing and administration such as wrong dose due to misdiagnosis, are system factors such as working with inadequate equipment. Reason's Swiss cheese model identifies these as latent conditions which come as a consequence of mismanagement (Reason 2000). According to his Swiss cheese model latent conditions are the inevitable 'resident pathogen" within the system. They have two kinds of adverse effect: they can translate into error provoking conditions within the local workplace, for example, inadequate equipment and they can create weakness in the defences. Ehsani et al (2013) also reported on several studies that identified shortage of suitable equipment as a significant contributing factor to medication errors. To avoid faulty equipment being regarded as an error provoking condition it is important that staff at the clinic is trained about equipment and their competencies documented. Key actions include;

- Requesting any training on equipment one is not sure
- Being able to examine the equipment and removing it when it damaged
- Using the equipment when it is recommended
- Routinely validating clinical competence to operate the facility equipment
- Reporting any defect

With a continuing drive to implement healthcare technology at all levels in the health system to improve patient safety, it is of vital importance that issues relating poor equipment, access and ease-of-use, mentioned as factors of medication errors, in the present study, are addressed in their design and implementation.

In summary, the study to an extent, even though each type of medication error could not be linked to a specific predisposing factor or factors, has demonstrated that there were multiple, interconnecting factors. Some medication errors could be grouped into unsafe acts attributed to individual responsibility and latent conditions and some to certain predisposing conditions.

5.8 Limitations of the study

The results from the present study were driven by respondents from PHC facilities; however, based on other survey results, clearly all sizes and types of health facilities are affected by medicine shortages. The study had relatively small number of participants, purposively sampled demonstrating a selection bias toward identifying medication errors and so restricting the number of participants. Be that as it may there was indeed an appreciation that there were some errors that did occur at the facilities. Most people did not want to participate because of a fear of victimization, some thought it was an investigation and that the researcher might be a forensic officer from the Department of Health. This created a methodological problem in the sense that much could have been said and a large number of respondents would have participated in the study, had it not been for the fear factor. However, in the case of those who volunteered to participate in the study, upon further explanation some participants still preferred not to append their signatures even though the signature was only evidence that they had volunteered to participate. Some preferred to make a cross on the signature part of the consent form. Some people thought it was a futile exercise since nothing changes after the completion of the studies as recommendations are not implemented. The researcher reached a compromise in order to enhance participation and the truthfulness of the responses to allow uncomfortable participants to skip the filling of some of their personal details on the questionnaires. As stated earlier the sampling for this study was not fully random hence further studies are recommended to be carried out in this topic. Data gathering method used, in particular self-reporting could have also introduced some limitation in the study. In some study interviews have been carried out with direct observation which would have been impossible because of the possibility of introducing Hawthorn effect. The study was self-funded hence a cost effective study design had to be implemented. The obtained data was compared with the studies of the countries with different health care systems and the scenarios in these facilities may not be similar or identical to the ones that were studied.

CHAPTER 6

This chapter outlines the conclusion made based on the literature review and the results of the present study.

6.1 CONCLUSSION

It appeared that the staff at the PHC facilities did not see how they could separate the issue of no medication from its consequences. As a result they perceived non-availability of medication mainly as an error rather than an error predisposing factor. The broader NCC-MERP taxonomy was used as the formal definition in the present study.

Adopting the way Keers et al (2013) used Reason's model and given that the medication errors perceived, which in some cases had possible multiple and interlinked predisposing factors, the following conclusion can be made from the study. Causes of the perceived medication errors could be attributed to the individual responsible for the error. These were broadly considered as either, slips, lapses, mistake or violation

6.1.1 Slips and lapses.

Slips and lapses such as wrong dose, incorrect documentation, wrong duration of treatment and dispensing omission due to either heavy and or distracting environment were mentioned several times

6.1.2 Knowledge based mistakes.

Knowledge-based mistakes were less frequently mentioned, with staff pointing out however that they still needed more training in pharmacology and therapeutics, especially since medicine shortage was such a big issue. However, dispensing without paying attention to contraindications could be viewed as knowledge based mistake.

6.1.3 Violations.

Violations responsible for some unsafe acts were medication frequency, wrong dosing schedule and wrong route.

6.1.4 Other unsafe acts.

Giving the wrong drug to patient or on the wrong day could be considered to be an unsafe act even though difficult to determine whether these were deliberate acts or not.

The above causes of the medication errors or un-safe acts could be attributed to error – or violation-producing conditions or predisposing factors. The results from study demonstrate that multiple conditions can lead to an unsafe act or that multiple conditions can lead to multiple un-safe acts. This can be summarized as follows:

6.1.5 Workload and skills.

Heavy staff workload was perceived as the major contributor to some of the medication errors or unsafe acts such as omissions. Workload could be linked to distractions, short staffing and general work environment which the staff felt was not conducive. Skill mix in particular some staff lacking enough experience was also mentioned as predisposing factor

6.1.6 Medicine supply.

Medicines logistics were felt to be the major latent condition responsible for poor patient and staff relationships and, some of the unsafe acts. Poor communication between the PHC clinics and medical stores or the supplying hospital, regarding medicines shortage predisposed staff at the clinics to medication errors.

6.1.7 Health and personality.

Physical feeling, that invariably lead to personal neglect and lack of motivation were mentioned as predisposing factors to error commission.

6.1.8 Training and experience.

Unfamiliarity with the medication for the patients and to certain extent poor functioning equipment was found in conversations and interviews to be predisposing factors. Inadequate training and poor professional development regarding pharmacology and therapeutics were said to be related to errors related to medicine or generic medicine substitution and pharmaceutical calculation.

6.1.9 Policies and guidelines.

The lack of policies and guidelines regarding, for example, generic substitution were said not be there at the PHC level.

6.1.10 PHC facility equipment.

Problems with equipment used to aid diagnosis, treatment and management, thereby coming up with correct pharmacologic intervention were said to contribute to medication errors

6.2 Significance of the Study

Patient safety is a fundamental part of patient health care. Having a study that investigates the type, predisposing factors and the prevalence of medication errors in Primary Health Care is important to create awareness about the medication errors and the consequences to patient safety. This study may serve as a foundation for researchers that want to carry the research further. It may help to develop preventative strategies to obviate medication errors in the public clinics and hospitals. It may also encourage change in some policies, curriculum or assumptions in the health care sector. This will collectively save the government from wasteful expenditure and litigation costs that could impact negatively on programs such as the National Health Insurance (NHI).

CHAPTER 7

RECOMMENDATIONS

This chapter presents the recommendations of the study based on the literature review, the results and the objectives.

Methods and material

A further research is recommended to be carried out at the PHC facilities with a more random sampling technique and better resources such as funding. A larger sample and more clinics will need a bigger budget and funding from other interested parties such as the Department of Health would be of great help. A creation of a non-punitive medication error reporting system at the Health facilities would improve participation by the health professionals.

Data interpretation

Correlation analysis from the results revealed some medication errors that could not be linked to any provoking factors. This could have been caused by participants being untruthful in their responses. Educating the nurses in the PHC about the benefits of research and the value of the anonymity clause will help get reliable results.

Results

Even though the results of the present study had to be interpreted with caution because of the sample size involved and the limitations explained above, the following interventions in an attempt to reduce medication errors are recommended:

- A curriculum for nursing staff with sufficient pharmacology, refresher courses and the induction of new staff to acquaint them with procedures and protocols will go a long way in reducing medication errors.
- Technology may obviate a lot of man made errors thus acquiring and implementing clinical information technology tools such as electronic prescribing may reduce most of the medication errors.

- Medication and equipment supply system need to be revisited and improved.
- Constant maintenance and calibration of equipment need to be introduced
- Medication procurement and distribution processes need to be revisited and improved
- Introduction of a multi-disciplinary team including a pharmacist may reduce medication errors.

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Appendix 1

Consent Form

Hello, my name is Othello Kid Mushwana. I am a Master of Pharmacy Student at the University of Limpopo. Today I am here to carry out a study on medication errors in public health clinics. The information you give is important and therefore kindly be sincere in your responses. I assure you that the information you give will be handled with total confidence and at no time will you be required to identify yourself by name. Kindly answer the questions as completely and as clearly as possible. You are free to choose either to participate or not to participate.

Do you agree to participate in the study? No [ ] Yes [ ]

If Yes,

Signature…….Date……

Appendix 2

Structure of the questionnaire

SECTION	**ASPECTS COVERED**
1	Socio-demographic profile of the participant
2	Types of errors that are likely to happen in the work place
3	Possible causes of the medication errors
4	Frequency of occurrence of the medication errors

Appendix 3

Questionnaire

1. Please fill in the following information on the spaces below

Gender	age	race	occupation	Highest level of education	Number of years' experience

2. Which of the following types of medication errors did you experience in your work environment? Tick the appropriate option.

Type of error	
Wrong patient	
Wrong dose	
Wrong day	
Wrong time	
Wrong route	
Wrong medication	
Frequency of medication	
Changing of medication	
No medication	
Duplication	
Wrong duration of treatment	
Contra indication	
Dispensing omission	
Incorrect documentation	

3. What are the possible causes of errors? Tick the appropriate response

Cause	
Heavy workload	
New staff	
Personal neglect	
Insufficient training	
Complicated prescription or orders	
Unfamiliar medication	
Unfamiliar patient condition	
Crowded work area	
Lack of equipment	
Lack of motivation	
Illegible hand writing	
Hostile environment	
Poor medication supply system	
Labeling	

4. State the possible prevalence of errors in terms of magnitude. Zero (0) being non-existent, one (1) being least existent, two (2) being moderate and three (3) being most existent.

Type of error	**0**	1	2	3
Wrong patient				
Wrong dose				
Wrong day				
Wrong time				
Wrong route				
Wrong medication				
Frequency of medication				
Changing of medication				
No medication				
Duplication				
Wrong duration of treatment				
Contra indication				
Dispensing omission				
Incorrect documentation				