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INVESTIGATING THE ADMINISTRATION OF MEDICATION IN A PRIVATE HEALTHCARE FACILITY: IDENTIFYING THE MOST COMMON MEDICATION ADMINISTRATION ERROR

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NIRVANA SELAGAN

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A dissertation submitted to the Discipline of Pharmacy in partial fulfilment for the degree of Masters of Pharmacy (Pharmacy Practice) in the School of Health Sciences, University of KwaZulu-Natal, Westville.

Supervised by: Prof Fatima Suleman

Dr Elizabeth B. Ojewole

Date of submission: 09 December 2015

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Declaration 2 - Ethics

Ethics approval was obtained from Bio-Medical Research Ethics Committee (BREC) Reference: BE060/14. A permission letter was also obtained from the facility in which the study was conducted before the study began.

Declaration 3 – Manuscript

A detailed contribution prepared in a manuscript format for submission to a publication with the data generated in this study is presented in this dissertation. The manuscript is titled: "Investigating the administration of medication in a South African private healthcare facility by direct observation and nurses' questionnaire". The manuscript was written by Selagan N., Suleman F., and Ojewole EB for submission to the International Journal of Clinical Pharmacy.

LIST OF MANUSCRIPT FOR PUBLICATION

1. Manuscript prepared for publication:

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LIST OF FIGURES, TABLES AND ABBREVIATIONS

COMPLETE TERM	ABBREVIATION
Medication Administration Errors	MAEs
Institute for Safe Medication Practices	ISMP
Intravenous	IV
American Society of Hospital Pharmacists	ASHP
Statistical Package for the Social Sciences	SPSS
Microsoft Excel	EXCEL
Biomedical Research Ethics Committee	BREC
Nil per mouth	NPO
Staff nurses	ENs
Registered Nurses	RNs
United Kingdom	UK
United States of America	USA

ABSTRACT

Background

Medication errors are an ongoing global problem for which there is limited South African data. Most medication errors have been shown to occur during the prescribing and administration of medication, with medication administration errors being the type of medication error least likely to be caught before reaching the patient. A study was conducted in one ward in a South African private healthcare facility to investigate the administration of medication in order to identify the most common medication administration error. The potentially serious effects of medication administration errors for the patient, as well as limited South African data on the topic show the significance of this study.

Aim

Identification of the most common medication administration error in the selected ward.

Method

Medication administration was observed over 16 consecutive days in one ward in a private healthcare facility in KwaZulu-Natal, South Africa. Allowing medication errors to occur for observation was considered unethical. Observer intervened in cases of potential errors before the error reached the patient. These potential errors were counted as near-misses. Nurses who administered medication in the ward also filled out a questionnaire to obtain their views on medication administration errors. Sampling was by convenience for both elements of the study.

Results

A near-miss rate of 10.65% (n=56) including wrong time near-misses. The most common type of near-miss was wrong dose (33.93%, n=20).

Discussion/Conclusion

The most common type of near-miss was wrong dose mainly due to ineffective communication between members of the healthcare team, which provides direction for educational efforts to improve system safety and thereby reduce near-miss rate.

Recommendations

A bigger study involving more sites is required. Improved communication is required especially between pharmacists and nurses administering medication by communicating changes on prescriptions to nurses and providing medication information.

Keywords

Medication administration error, near-misses, patient safety, improved communication

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CHAPTER 1 - INTRODUCTION

1.1 INTRODUCTION

This dissertation follows a manuscript format. The background to the study presented in this dissertation is described in this chapter. Included in this chapter are also the rationale for the study, as well as the main aims and objectives. The significance of the study regarding improving patient care and safe medication use are presented. This chapter concludes with an overview of the dissertation.

1.2 BACKGROUND AND CONTEXT

Medication errors, including medication administration errors (MAEs), pose a potentially serious threat to patient safety (Kohn et al. 1999; McLeod et al. 2014). The problem of medication errors is not new. In the 1960s, studies on medication errors were already being reported (Ridge et al. 1995). Medication errors also include other categories of errors such as prescribing errors and dispensing errors (Barker et al. 2002; Berdot et al. 2012; Moyen et al. 2008; Policy Plus 2010; Wright 2013).

MAEs occur in most parts of the world and in all sectors of healthcare (Ridge et al. 1995; Saghafi & Zargarzadeh 2014). However, South African statistics on the problem of medication errors and MAEs appear to be limited (Keers et al. 2013; Welzel 2012) at both public and private healthcare facilities. In a systematic review (Keers et al. 2013); only 4 of the 55 studies reviewed were from South Africa. Most South African studies were about anaesthetics. Anaesthetists are not the staff members who usually administer medication to patients. Thus the need for this study, which focuses on the traditional hospital setting in which nurses administer medication to patients.

The challenges faced in the administration of medication were highlighted in this study. Factors that contribute to medication errors were also investigated and examined by reviewing available literature. Nurses' views on medication administration errors were obtained by questionnaires filled out by nurses themselves. This study is expected to identify errors and their effect on patient safety, as well as to help reduce future errors. This study is further expected to increase awareness of medication errors and their occurrence. Aspects regarding consequences of reporting an error are also explored.

1.3 MEDICATION ERRORS

Medication errors may occur at any point in the medication process (Barker et al. 2002; Berdot et al. 2012; Moyen et al. 2008; Policy Plus 2010; Wright 2013). The medication process consists of the prescribing, dispensing and administration of medication (Barker et al. 2002; Berdot et al. 2012; Moyen et al. 2008; Policy Plus 2010; Wright 2013). All types of medication errors are important. Prescribing errors are errors that occur during the process of prescribing medication and usually involve doctors. Dispensing errors refer to errors that occur during the dispensing of mediation and

usually involve pharmacy staff. Medication administration errors refer to errors that occur during the administration of medication and usually involve nurses.

1.4 MEDICATION ADMINISTRATION ERRORS

Medication administration involves giving the patient a dose of medication. MAEs pose a potentially serious threat to patient safety (Kohn et al. 1999; McLeod et al. 2014). A study in Iran (Saghafi & Zargarzadeh 2014) reported that an average of one third of medication was administered in error. This shows the significance of the topic. South African data on this topic is limited (Keers et al. 2013; Welzel 2012) and is a gap this study addresses. This study also provides a baseline to direct initiatives to reduce MAEs (Keers et al. 2013; Welzel 2012; Wright 2013) and increase safety in the medication process (Barker et al. 2002; Berdot et al. 2012; Moyen et al. 2008; Policy Plus 2010; Wright 2013). This will also have the effect of improving patient safety and quality of care.

Prescribing errors and administration errors have been reported as the most common types of medication errors (McLeod et al 2014; Saghafi & Zargarzadeh 2014). MAEs pass through fewer "check points" than prescribing errors (Keers et al. 2013). Prescribing errors also go through pharmacy and nurses as checking points (Anderson & Townsend 2010; Keers et al.2013). MAEs are therefore less likely to be detected before reaching the patient (McLeod et al. 2014) than other types of medication errors and were chosen as the focus of this study. Nurses are often blamed for MAEs (Keers et al. 2013; Wright 2013) as they are the individuals who usually administer medication to patients (Anderson & Townsend 2010). Nurses' views on MAEs were therefore sought in this study.

- ***MAEs and potential harm***

MAEs are a problem for all healthcare professionals (Kohn et al. 1999). MAEs can have far-reaching costs in terms of bodily harm, loss of lives or prolonged hospitalisation for patients (Kohn et al. 1999). There may also be possible psychological factors for both the patient and healthcare professionals involved (Anderson & Townsend 2010; Kohn et al. 1999; Wright 2013). These potential effects on patient safety, as well as effects for healthcare professionals involved further highlight the significance of the topic and support the need for this study on MAEs as a way to increase patient safety and improve safe medication use.

1.5 DEFINITIONS

a) MAEs

For the purpose of this study MAEs were defined as medication administered in a way that was different to the prescription direction (Keers et al. 2013; McLeod et al. 2014; Wright 2013). It is unethical to allow MAEs to occur for observation, so medication administration near-misses were looked at. This study aimed to identify common MAEs before they

occurred as near misses. Thus the term "near-miss" is used to describe results of the study while the term "MAE" is used when referring to literature or errors that have already occurred.

b) Near-misses

Near-misses were defined as potential errors that could have occurred but were caught before reaching the patient. This corresponds with the popular definition of the term "near-miss" according to a survey by the Institute for Safe Medication Practices (ISMP 2009). Observer intervened discretely in the case of a potential error before the actual error occurred. MAEs were all counted as near-misses, as the observer intervened before the occurrence of the error.

The definition of medication administration error used in this study was therefore adopted and adapted from other studies (Barker et al. 2002; Keers et al. 2015; McLeod et al. 2014; Saghafi & Zargarzadeh 2014; Wright 2013) in order to make results more comparable with other studies.

1.6 DESCRIPTION OF CORE RESEARCH PROBLEM AND SIGNIFICANCE

South African statistics on MAEs are limited (Keers et al. 2013; Welzel 2012). To date, no studies on MAEs in a private healthcare facility have been reported from South Africa which is a gap this study addresses. This study focused on general medications administered by nurses to patients in a hospital ward. This study is therefore the first to report on MAEs in a private healthcare facility in South Africa, and particularly in KwaZulu-Natal. Limited South African statistics on MAEs (Keers et al. 2013; Welzel 2012) suggests that data may not be published by healthcare facilities which further emphasises the need for this study to provide South African data on this serious topic.

1.7 AIMS AND OBJECTIVES

The study aimed to investigate the administration of medication in a private healthcare facility ward in KwaZulu-Natal Province to identify the most common near-miss.

The study had the following objectives

1: To determine the most common near-miss in the selected ward by direct observation of medication administration

2: To establish main reasons for MAEs through a questionnaire for nurses administering medication

3: To identify the class of medication most often associated with near-misses by recording medication administered during data collection

4: To identify the route of administration most often associated with near-misses

5: To establish the extent of the near-misses by calculating the near-miss rate

1.8 OUTCOMES OF THE STUDY

Main types and numbers of near-misses were determined which helps provide direction for interventions to reduce MAEs (Keers et al. 2013; Wright 2013). Nurses' perceptions on causes of MAEs were determined. Determining causes of the problem has been suggested as the first step to finding solutions (Keers et al. 2013; Wright 2013). Class of medication most often associated with near-misses helps identify class of medication to pay particular attention to when administering. This study helps improve patient safety by aiming to reduce MAEs. The safe and efficient use of medication is promoted. Nurses were educated on medication during the study promoting the safe and efficient use of medication. Medication errors can be an intimidating topic to healthcare professionals and this study helps to address the topic in a sensitive manner that promotes learning.

1.9 OVERVIEW OF DISSERTATION

The dissertation is divided into the following 4 chapters.

CHAPTER 1 – INTRODUCTION

This chapter describes the introduction and background to the study. It outlines medication errors, MAEs and definitions thereof. It also presents the aim and objectives of the study.

CHAPTER 2 – LITERATURE REVIEW

This chapter presents the literature review for the study. A concise summary of literature on the subject of medical errors and medication errors, with a focus on MAEs is presented in this chapter. Main findings of previous studies are described, as well as causes of errors and factors contributing to errors. Common methods used to detect MAEs were described together with their advantages and disadvantages. Recommendations regarding information to consider when conducting studies on medication errors are presented, as well as factors that influence comparing results from different studies. Intravenous (IV) medication errors are also explored in more detail as IV medications have been the focus of some studies. System-related factors are also explored in this chapter.

CHAPTER 3 - MANUSCRIPT

This chapter reports the work prepared for submission to the International Journal of Clinical Pharmacy for publication. The article is titled "Investigating the administration of medication in a South African private healthcare facility by direct observation and nurses' questionnaire" by Nirvana Selagan, Fatima Suleman and Elizabeth Ojewole. The manuscript describes the numbers and types of near-misses observed, together with nurses' views on MAEs including causes of MAEs, and

suggested actions to prevent future MAEs. The manuscript is presented in this chapter in the format required by the journal according to their author guidelines for submission.

CHAPTER 4 – CONCLUSION

This chapter describes the conclusions drawn from the study findings, and presents recommendations for future studies on MAEs. Limitations to this study are also described as well as recommendations for decreasing the occurrence of MAEs.

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CHAPTER 2 – LITERATURE REVIEW

2.1 INTRODUCTION

The topic of medication errors is well-known and there is international literature available. Medication errors are occurring in many countries across the world but South African literature on the topic is limited (Keers et al., 2013), highlighting the need for South African studies such as this. Reviewing medication error rates from various countries enabled comparisons of results. Limited South African data on the topic was one gap identified in the literature. The National Core Standards for Health Establishments in South Africa identifies the importance of patient safety in the South African Healthcare system as a priority area (National Department of Health, 2011). This highlights the relevance of the study topic to the South African context.

2.2 MEDICAL ERRORS AND MEDICATION ERRORS

MAEs have been reported since the 1960's (Ridge et al. 1995), which shows that this is an ongoing problem and highlights the significance of the topic.

a) Medical Errors

The Institute of Medicine's "To Err Is Human" report's (Kohn et al. 1999) quoted figures of 44 000 - 98 000 deaths annually due to medical errors (Kohn et al. 1999) were cause for serious concern. Medical errors include events such as falls and bed sores, as well as medication errors (Kohn et al. 1999). 44 000 deaths were more than deaths due to motor vehicle accidents, breast cancer and AIDS (Kohn et al. 1999). This shows the potentially serious effects of medical errors including medication errors on patient safety and highlights the importance of this topic.

b) Medication Errors

Medication errors include errors during the prescribing, dispensing and administration of medication (Barker et al. 2002; Berdot et al. 2012; Moyen et al. 2008; Policy Plus 2010; Wright 2013). Literature on medication errors showed that errors during prescribing and administration were most common (Keers et al. 2013; Keers et al. 2015; McLeod et al. 2014; Saghafi & Zargarzadeh 2014). Prescribing or dispensing errors may also be uncovered during medication administration (Anderson & Townsend 2010; Keers et al. 2015). This shows how nurses administering medication are a further checking system in the medication process and highlights the importance of the medication administration stage. Errors in prescribing or dispensing may therefore increase MAE rates if they are not detected before administering medication. This further emphasises the need for correct medication administration since this is the final step in the medication use process (Keers et al. 2013) and

involves giving the patient a dose of medication. These facts reinforce the need for this study on MAEs and the choice of topic.

c) Medication Administration Errors

MAEs were reported as being the type of medication error least likely to be caught before reaching the patient (McLeod et al. 2014). This emphasises the need for studies on MAEs because the potential effect on patient safety is evident. In general, South African data on medication errors is not abundant (Keers et al. 2013; Welzel 2012) even though this is an international concern. Thus the need for South African studies on MAEs like this one is shown, further emphasising the significance of this study.

2.3 TYPES OF MEDICATION ADMINISTRATION ERRORS

MAEs are classified into different types. The types of MAEs investigated differed among various studies reviewed. Types of MAEs detected in this study were adapted from other studies (Barker et al. 2002; Berdot et al. 2012; Ridge et al. 1995; Saghafi & Zargarzadeh 2014). These were generally the most common types of medication errors reported in studies reviewed and therefore examined in this study. The definition of wrong time errors as "doses administered more than 60 minutes out of scheduled time of administration" (Barker et al. 2002; Saghafi & Zargarzadeh 2014) was utilised in this study.

Doses not administered due to specific reasons were not included as omission errors (Barker et al. 2002) and recorded separately. This strategy was adopted in this study as it gives a more accurate measurement of MAE rate.

2.4 METHODS TO DETECT MAEs

Different methods have been used to detect MAEs in studies reviewed. Direct observation is generally regarded as the gold standard method (Barker et al. 2002) for detecting MAEs and was one of the methods chosen in this study. Other methods which have been used to detect MAEs include retrospective chart review, covert observation and reviewing incident reports. Interviews and questionnaires administered to nurses and other healthcare workers have also been used to determine causes of MAEs, and were used in this study too. Some studies also used a combination of methods as in this study. The following comparison of common methods used to detect MAEs show reasons for using chosen methods.

a. Incident Reports

These refer to self-reporting of incidents usually by the person who was involved in the error or who witnessed the error (Keers et al. 2013; Westbrook et al. 2015). Reporting of incidents are usually

required in facilities as part of a safety measure to keep track of errors that have occurred (Keers et al. 2013; Westbrook et al. 2015).

Advantages of Incident Reports

This method of data collection is not labour intensive for the investigator as the reporting and categorising of errors has already been done by the persons reporting the error.

Disadvantages to Incident Reports

This form of MAE detection is retrospective as it focuses on errors that have already occurred and does not allow for intervention to prevent the error from reaching the patient. Only a small proportion (25%) of medication errors are actually reported according to a study by Mayo (Mayo & Duncan 2004). Therefore incident reports do not accurately represent the occurrence and types of medication errors (McLeod et al. 2014; Westbrook et al. 2011; Westbrook et al. 2015). Incident reports depend on many factors (McLeod et al. 2014). The error must first be identified. This depends on whether the incident is recognised as an error. The error must then be reported which may involve filling in a form which may take time (Gray 2008; Westbrook et al. 2015). Being afraid of punishment or embarrassment, as well as being sensitive to the reactions of others (Westbrook et al. 2015) or implications of the error (Westbrook et al. 2011) may reduce the reporting of errors.

b. Direct Observation

Subjects are aware they are being observed in this method of MAE detection. This is a prospective study design. Direct observation was one of the methods chosen for this study.

Advantages of Direct Observation

This method was found to be the best method for determining MAEs (Keers et al. 2013). Direct observation is generally regarded as the gold standard method for detecting MAEs (Barker et al. 2002; McLeod et al. 2014). This method allows for more aspects of medication errors to be detected (Keers et al. 2013; McLeod et al. 2014) than review of patient files. Direct observation allows the detection of potential errors (Keers et al. 2013) which file review does not allow. Direct observation also allows for intervention by observer to prevent an error from reaching the patient. Direct observation also provides the opportunity for nurses to ask questions about medication that they may not get the chance to in usual work practice. Direct observation thus allows for education of nurses on the correct use of medication. Direct observation also shows where other issues such as the availability of medication may contribute to errors (Ridge et al. 1995). This further highlights the merits of this method to detect MAEs.

Disadvantages to Direct Observation

Disadvantages to this method are that it is time-consuming and labour intensive (Berdot et al. 2012; McLeod et al. 2014). Change in behaviour may occur for subjects being observed. This change in behaviour is referred to as the "Hawthorne effect" (Keers et al. 2013). However, such behaviour change was "minimal" according to other studies (Westbrook et al. 2011). The "Hawthorne effect" was not seen as a serious problem when observing persons doing a routine task (Barker et al. 2002). Medication administration can be considered a routine task to a nurse. This suggests that the Hawthorne effect is not seen as a barrier to using direct observation to detect MAEs. This further highlights the use of this method to detect MAEs. Nurses being more careful when administering medication as they knew they were being observed could result in a lower observed error or near-miss rate (Ridge et al. 1995). These disadvantages were not considered major obstacles to the use of this method.

c. Covert Observation

This method is also referred to as disguised observation. Subjects are not aware they are being observed in this prospective method of data collection.

Advantages of Covert Observation

Subjects unaware they are being observed should remove the Hawthorne effect.

Disadvantages to Covert Observation

This method also involves deception and may result in nurses not trusting the observer. Deceiving fellow healthcare professionals does not build trust in working relationships which is a further disadvantage to this method. Covert observation resulted in observer feeling "discomfort" at deceiving subjects being observed (Ridge et al. 1995).The disadvantages heavily outweighed the advantage to this method and these provided reasons for not choosing this method in this study.

d. Questionnaire/Interview

This method allows for specific questions to be posed to nurses or other healthcare professionals and their responses recorded in order to gather data.

Advantages of Questionnaire

This method allows for collecting information directly from the target population group. Nurses' views on causes of MAEs were obtained since they are the target population who administer most medications to patients admitted in a facility (Anderson & Townsend 2010). Nurses are recognised as key role players in the medication process.

Disadvantages to Questionnaire

A disadvantage is that it is time consuming for the nurse to fill out in their already busy schedule. Questionnaires or interviews which target staff members involved in errors (Nichols et al. 2008) may be embarrassing or have other psychological implications for those involved. This may also lead to subjects not being entirely truthful in their responses. Therefore the questionnaire component in this study focused on medication errors in general and involved not just nurses involved in errors found in the study in order to maintain a blame-free approach and promote learning. Questionnaires/interviews may incur "subjective bias" (Keers et al. 2013) as subjects report their views. The advantages to this method outweighed the disadvantages and this method was also employed in the study.

e. Retrospective Chart Review

Retrospective chart review involves reviewing medication charts to detect errors that have already occurred. This method has been used together with other methods to detect medication errors (Westbrook et al. 2015).

Advantages of Retrospective Chart Review

This method is convenient as charts may be reviewed at any time and should not result in discomfort for the investigator. Chart review is not as labour intensive as other methods.

Disadvantages to Retrospective Chart Review

This method does not allow for detection of certain types of medication errors such as wrong time or wrong dose errors which direct observation does allow (Keers et al. 2013) and therefore allows for detection of fewer errors. This method involves the review of data that is already recorded and does not allow for intervention in the case of potential errors or the determination of whether recording has been done accurately.

Review of literature provided confirmation that best available methods namely direct observation and nurses' questionnaire were used in this study to detect MAEs as well as for providing nurses views on MAEs. Nurses administer most medications to patients in the ward and their views were important in this study.

2.5 COMPARING RESULTS FROM OTHER STUDIES

Factors which need to be taken into consideration when trying to compare medication error rates between studies include definitions, calculations and methods used.

Studies using similar or the same **methods** as in this study therefore formed the basis for comparison of results. These studies used direct observation (Barker et al. 2002) and covert observation (Berdot et

al. 2012; Ridge et al. 1995; Saghafi & Zargarzadeh 2014). Thus, we are comparing error rates from studies with similar methods.

The **setting of the study** is also reported to influence medication error rates (Keers et al. 2013). It was reported that there was a "high prevalence" of MAEs in hospitals (Keers et al. 2015). This also reinforces the significance of this study site as the potential effects on patient safety will be greater in a hospital setting making the study essential to determining safety aspects. Most studies reviewed were conducted in hospital settings to enable comparison of results. This provides reason for conducting research in hospitals and reinforces the need for this study.

Inclusion or exclusion of **timing errors** must be stated (McLeod et al. 2014), as error rates including wrong time errors would be higher than those excluding wrong time errors. It was therefore decided to report MAE rates in this study as two values; one value including wrong time near-misses and the other value excluding wrong-time near-misses (Berdot et al. 2012). This would enable the results of this study to be more easily interpreted as well as make comparisons with other studies easier. A study (Barker et al. 2002) reported a 19% medication error rate which decreased to 10% when wrong time errors were excluded. This shows the extent that wrong time errors can have on a reported medication error rate and forms the basis for including near-miss rates as two values in this study. Calculations for near-miss rates in this study were adapted from existing studies (Barker et al. 2002; Berdot et al. 2012; Lisby et al. 2005).

The number of errors possible for each medication administration must also be stated in studies on MAEs (McLeod et al. 2014). If more than one error is possible for each administration, this allows for a higher MAE rate and is therefore an important factor to consider.

The inclusion of IV medication must be stated since different error rates have been reported for IV and non-IV medications (McLeod et al. 2014) with IV medications being associated with higher error rates (Westbrook et al. 2011). This shows the need for studies on MAEs to include IV medications since the effects on patient safety have been demonstrated. Thus IV medications have been included in this study.

2.6 CLASSES OF MEDICATION

Studies on MAEs also showed classes of medication involved (Berdot et al. 2012; Ridge et al. 1995). Reporting classes of medication help show whether particular classes of medication are more often associated with MAEs than other classes. A possible reason for this could be nurses needing more information on particular classes of medication. Therefore reporting classes of medication for MAEs is important.

Antibiotics (general anti-infectives for systemic use) were reported in other studies as being the medications most often involved in medication errors (Berdot et al. 2012; Gray 2008) which was anticipated in this study also.

2.7 CAUSES OF AND FACTORS CONTRIBUTING TO MAEs

A wide range of causes and factors that contribute to MAEs have been reported in the literature. It is important to understand causes of MAEs in order to develop and put into practice interventions to decrease their occurrence (Keers et al. 2015). This study is expected to help identify such causes, as well as help reduce future errors by increasing awareness of MAEs and thereby improve patient safety.

Prescriber's handwriting, distractions to nurses and nurse being tired were cited as the top 3 causes of medication errors in a study on nurses' perceptions on medication errors (Mayo & Duncan 2004). Personal factors that contributed to error included tiredness, multi-tasking, stress, distractions, heavy workload (Anderson & Townsend 2010; Keers et al. 2013; Nichols et al. 2008), as well as the health status of nursing staff (Keers et al. 2013). Interruptions, disruptions or distractions during medication administration have been reported as factors that contribute to MAEs (Deans 2005; Keers et al. 2013; Policy Plus 2010; Taxis and Barber 2003). Interruptions were also reported as being associated with a greater risk of error (Westbrook et al. 2010), as well as more severe MAEs. Telephone calls have been reported as a major source of interruptions (Policy Plus 2010) but it is not stated whether these were personal calls or nurses being interrupted from their duties to take work-related calls. The study facility does not allow nurses to have cellular phones on them when on duty in an attempt to minimise this as a source of interruption.

Errors in dispensing has also been reported as a cause of errors (Keers et al. 2013). Nurses believing their workload was high (Keers et al 2013; Keers et al 2015; Nichols et al 2008), such as during periods of short staffing or during busier periods were also noted as a cause of error (Drach-Zahavy et al. 2014; Keers et al. 2015; Welzel 2012).

Inexperience has been noted as contributing to errors (Keers et al. 2013; Keers et al., 2015; Taxis and Barber 2003; Westbrook et al. 2011). A decreased rate and severity of errors was reported as nurses' experience grew (Westbrook et al. 2011). This is to be expected and highlights the need for sufficient training to enable nurses to gain experience and learn correct practices on medication administration.

A noisy, busy working environment that was in chaos was also noted as contributing to errors (Anderson & Townsend 2010; Keers et al. 2015). Problems with equipment and other environmental factors as well as system factors have also been noted to cause or contribute to MAEs (Deans 2008; Keers et al. 2015; Kohn et al. 1999; Policy Plus 2010; Welzel 2012). System factors (Anderson &

Townsend 2010; Hahn 2007) increase the possibility of an error occurring (Kohn et al. 1999). "More commonly, errors are caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them" (Kohn et al. 1999). The need for safer systems was mentioned in the literature (Kohn et al. 1999; Welzel 2012) as contributing to errors (Brady et al. 2009).

A fundamental reason for MAEs that must be mentioned is that humans do make mistakes (Kohn et al. 1999; Welzel 2012) which relates to the human error theory being reported as a cause of medication errors (Keers et al. 2015; Welzel 2012). Human error (Keers et al. 2013; Keers et al. 2015; Ridge et al. 1995; Taxis and Barber 2003; Welzel, 2012) has also been noted as a reason for MAEs. The Institute of Medicine reported that most errors were not due to carelessness although individuals must still be careful (Kohn et al. 1999). This highlights the need for not casting all the blame on one individual (Welzel 2012; Taxis and Barber 2003).

2.8 PREVENTING MAEs

A complete systems view that includes external factors and environment factors is recommended in the literature to prevent medication errors (ASHP 1993; Chilton 2007). Safety processes should be instituted to prevent errors from occurring (ASHP 1993; Kohn et al. 1999). Recommendations specific to different members of the healthcare team have also been put forward (ASHP 1993).

2.9 HEALTHCARE PROFESSIONALS AND MAEs

Healthcare professionals are often blamed when a medication error occurs (Welzel 2012). For example, prescribing errors pose problems for prescribers; dispensing errors pose problems for pharmacists. Administration errors pose problems for nurses, and potentially pharmacists and doctors too, especially if the administration error is due to an error in prescribing or dispensing (Chilton 2007). Medication errors may cause patients to lose trust in the healthcare team (Kohn et al. 1999). Impact on health care professionals includes psychological effects such as embarrassment and loss of confidence in their ability to perform their duties (Anderson & Townsend 2010; Kohn et al. 1999; Wright 2013). Nurses may experience psychological trauma (Kohn et al. 1999; Mayo & Duncan 2004) as well as physical effects (Kohn et al. 1999).

Nurses were named as the healthcare professionals responsible for most reported errors (Gray 2008). This could be due to the fact that nurses report more errors than other healthcare professionals and not just simply that they are involved in more errors. Nurses are usually blamed for error (Keers et al. 2013) being the ones who usually administer medication. This study adopted a blame-free approach (Kohn et al. 1999; Welzel 2012).

In some studies healthcare professionals were not even aware of errors they were involved in until they were interviewed (Nichols et al. 2008). This shows missed opportunities for learning. If one is

made aware of errors, they may be more likely not to make the same error again and being aware is likely to make the person more vigilant. By being aware of errors, one is better able to recognise an error in order to report any error that may occur and therefore modify actions in order to prevent the error from occurring again in the future.

2.10 GAP IN LITERATURE

In general, South African data on medication errors is sparse (Keers et al. 2013; Welzel 2012) even though this is an international concern. This reinforces the need for this study. Most available South African literature on MAEs was on anaesthetics (Keers et al., 2013). This shows a need for studies on MAEs in a more traditional setting, involving other healthcare professionals, namely nurses as in this study which further emphasises the need for this study. Further South African literature on medication errors is needed and this study provides South African data on MAEs.

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CHAPTER 3 – MANUSCRIPT

This chapter presents a manuscript prepared for submission to the International Journal of Clinical Pharmacy.

Investigating the administration of medication in a South African private healthcare facility by direct observation and nurses' questionnaire

Selagan Nirvana, Postgraduate student, Discipline of Pharmaceutical Sciences, Westville campus, University of KwaZulu-Natal, Durban, South Africa

Email: nirvanaselagan@gmail.com

Suleman Fatima, Discipline of Pharmaceutical Sciences, Westville campus, University of KwaZulu-Natal, Durban, South Africa

Email: sulemanf@ukzn.ac.za

Ojewole Elizabeth B, Discipline of Pharmaceutical Sciences, Westville campus, University of KwaZulu-Natal, Durban, South Africa

Email: ojewolee@ukzn.ac.za – corresponding author

Abstract

Background

Medication administration forms part of the medication process and involves giving the patient a dose of medication. Errors can occur during the prescribing, dispensing and administration of medication. Medication administration errors are one of the most common types of medication errors. An Iranian study reported that on average, one third of medications were administered in error. Very little research is available on the types and rates of medication administration errors in South Africa. Investigating current practices would identify areas of improvement in terms of safe medication use and delivery of better quality of care to all patients.

Objective

This study sought to detect whether medication administration errors were occurring, as well as to explore nurses' views on medication administration errors.

Setting

One ward in a South African private, urban healthcare facility.

Method

For the purpose of this study, medication administration errors were defined as medication administered in a way that was different from prescription direction and potential errors that could have occurred were counted as near misses. Direct observation was undertaken of medication administration during nursing medication rounds over 16 consecutive days allowing for the observation of 526 medication administrations and 56 near-misses. Nurses who administer medication in the ward were recruited to fill out a questionnaire on medication administration errors with a total of 12 nurses completing the questionnaires. Data was analysed using SPSS and EXCEL.

Main outcome measure

The rate and type of near-misses were determined.

Results

Near-miss rate was 10.65% (n=56 near-misses and N=526 medication administrations observed) including wrong time near-misses. Most common type of near-miss observed was wrong dose (35.71%, n=20). Medicines affecting the alimentary tract and metabolism (28.57%, n=16) accounted for most near-misses. Not checking with Registered Nurse before administering medication (83.3%,

n=10) and illegible doctor's writing on prescriptions (50%, n=6) were suggested as main causes of medication administration errors (n=12 questionnaires completed).

Conclusion

Medication administration errors seem to be occurring in South African healthcare facilities. A bigger study involving more sites is required. Better communication between healthcare professionals and among nurses is required.

Keywords: medication administration errors (MAEs), near-misses, direct observation, improved patient safety, effective communication

Practice Statements

- The findings of this study provide preliminary insight into medication administration errors in wards in South Africa
- The study has demonstrated that direct observation can be used in detection of medication administration errors
- The study points to a need for better communication between pharmacists and nurses in terms of brand and generic names of medicines

Introduction

Medication administration errors (MAEs) are a type of medication error. Medication errors may occur during prescribing, dispensing and administration of medicines. All types of medication errors are important. Prescribing and dispensing processes pass through doctors and pharmacists before reaching the patient [1-2]. Prescribing errors and administration errors have been reported as being the most common types of medication errors [1,3-5]. MAEs are the type of medication error least likely to be caught before reaching the patient [2,5]. MAEs were therefore chosen for investigation in this study. MAEs pose a potentially serious threat to patients, as well as healthcare professionals [3]. MAEs are also largely preventable [4].

MAEs occur throughout the world and in all sectors of healthcare. A study in Iran reported an average of one third of medications being administered in error [4]. An Australian study reported an MAE rate of 27.4% [6]. South African statistics on MAEs are limited. A systematic review of 55 studies on MAEs in hospitals contained only 4 studies from South Africa [5,7]. The few available South African studies include errors in administration of anaesthetic medications by anaesthetists who are not the persons who administer the majority of medications in hospitals [4]. Most medications administered to patients in a hospital setting are administered by nurses [2]. Limited South African literature on the topic may lead us to overlook an issue of serious concern or not present the complete nature and extent of the problem [5]. Patient safety has been categorised by the South African National Department of Health as one of the "six critical areas" [8] with room for improvement. Compliance in these areas is needed in as little time as possible highlighting them as "fast-track areas" [8]. This shows the recognition of the importance of patient safety in South African healthcare which includes the public health sector.

Direct observation is generally regarded as the gold-standard method for detecting MAEs, as it allows for the detection of potential errors which other methods such as retrospective chart review may not [7,9-10]. Incident reports depend on subjective data and rely on many factors including the actual reporting of the error [5,6]. It is therefore not recommended to use these as the sole method of detecting errors. Reducing medication errors helps improve patient safety which is the goal of all members of the healthcare team [11]. However, medication errors can be an intimidating topic to healthcare professionals [12].

An Australian study showed zero error reports for 10 955 MAEs observed [6]. Filling out incident reports within specified timeframes, fear of being disciplined, as well as not identifying errors correctly influence reporting of errors [6,12].

For the purpose of this study, MAEs were defined as medication administered in a way that was different from the prescription and potential errors that could have occurred were defined as near misses [1,3-4,10-12].

Aim of the study

The aim of this study was to investigate medication administration by direct observation in order to determine whether MAEs occurred, the nature and extent of MAEs, nurses' views on causes of MAEs and class of medication most often associated with MAEs in the selected ward.

Ethics approval

Ethics approval was obtained from the research department of the healthcare facility, as well as the Biomedical Research Ethics Committee (BREC) of the University of KwaZulu-Natal (Reference: BE060/14) before the study began.

Method

This was a mixed methods study that included direct observation of medication administered during nurses' medication administration rounds, and then a questionnaire distributed to the nurses. Sampling was by convenience for both elements of the study. The study site was a 34 bed adult, general ward in a private healthcare facility in KwaZulu-Natal, South Africa. This ward sees a variety of patients in terms of age and disease states.

For the direct observation portion of the study, the observer used the normal structural organisation of the ward on that day for the purpose of observation. The ward was generally split into 2 to 3 sections for medication administration, depending on the number of patients admitted in the ward. Observation was prospective, and by a pharmacist. If a nurse declined to be observed, the observer proceeded to the following section or next nurse who agreed to be observed. Medication administration was observed over 16 days. Observations occurred on all days of the week, including weekends and public holidays. Medication administration was observed at different times of the day to account for confounding factors. Medication administered was checked against the prescription to determine whether administration was according to the specifications of the prescription and to detect potential MAEs. It is unethical to allow MAEs to occur for the purpose of observation in terms of both professional and facility standards. Observer intervened in cases of potential MAEs before the error reached the patient and the event was recorded after intervention. Intervention was recorded on data collection sheets. These potential errors were counted as near-misses. No more than 1 near-miss was recorded for any one medication administration observation [1]. Class of medication was according to the body/organ systems they exert their action on [7,13,15].

The 8am medication administration round is generally regarded as the main medication administration round of the day and medication scheduled for administration at this time was observed most often. Medication administration was observed during 8am, 11am, 2pm and 8pm medication administration rounds. Intravenous (IV) medications were included in this study [9]. Administration of blood and plain IV fluids were excluded as these were not regarded as medications.

The aspects used to determine near-misses were: wrong patient, wrong drug, wrong dose, wrong time, wrong route (whether the 5 Rights of Medication were observed), as well as omitted dose and unauthorised dose [11,13]. Omission of dose refers to dose scheduled for administration not given until intervention by observer [11,13]. Unauthorised dose refers to extra doses almost given, such as cases where the medication was stopped or where the patient had already received the total number of doses specified on the prescription [13]. The near miss rate was calculated by dividing the total number of near misses by the total number of medications administered and converted to a percentage [14]. Near-miss rates are reported both including and excluding wrong time near-misses as this is generally the most common type of near-miss observed [3,10,14]. Nurses' names were not recorded for medication rounds or near-misses observed.

For the questionnaire aspect of the study, participants were nurses who administered medication in the selected ward and consented to participate. Participants included nurses who were observed during medication administration, as well as other nurses who are able to administer medication. Participants were recruited by convenience sampling. Questionnaires were handed out by the investigator to nurses individually. Investigator waited while nurses filled out questionnaires and collected completed questionnaires. This also ensured that the target population filled out the questionnaire. Non-identifying demographic information (age, nursing rank and years of nursing experience) was collected. Nurses' opinions on causes of MAEs were recorded via open-ended questions. Information on the reporting of medication errors in general was documented in terms of whether errors were reported, as well as to whom these were reported. The class of medication thought to be most often involved in MAEs was also questioned. The questionnaire was adapted from previous studies [2,12,15]. Findings from this questionnaire provided nurses' opinions which formed important data in this study.

Statistical analysis of data was reported mainly using descriptive statistics, such as frequencies, percentages and means using EXCEL and SPSS (Statistical Package for the Social Sciences) version 23.

Results

Observation of medication administration rounds

526 medication administrations were observed during 20 medication administration rounds (mean=26.3, SD=16.7, SE=3.7). A total of 56 near-misses were observed (mean=2.8, SD=2.4, SE=0.5).

Near-miss rate

The near-miss rate including wrong time near-misses was 0.1065 (10.65%, n=56). The near-miss rate excluding wrong time near-misses was 0.0837 (8.37%, n=44).

Types of near-misses

Wrong dose (35.71%, n=20) was the most common type of near-miss observed as indicated in Figure 1. There were zero wrong patient near-misses (0%, n=0). During this study, nurses usually greeted patients by name and interacted with them before administering medication. The "other" category (8.93%, n=5) refers to those near-misses that did not fall into any of the specified categories. Doses not administered for specified reasons (n=105) were not classified as near-misses and recorded separately [9]. The most common reason for these doses not being administered according to the prescription was the patient refusing the dose (47.62%, n=50), followed by patient being nil per mouth (NPO) (19%, n=20), medication not available (17.14%, n=18), patient away from ward (7.6%, n=8), IV line out (4.8%, n=5) and other reasons (3.8%, n=4).

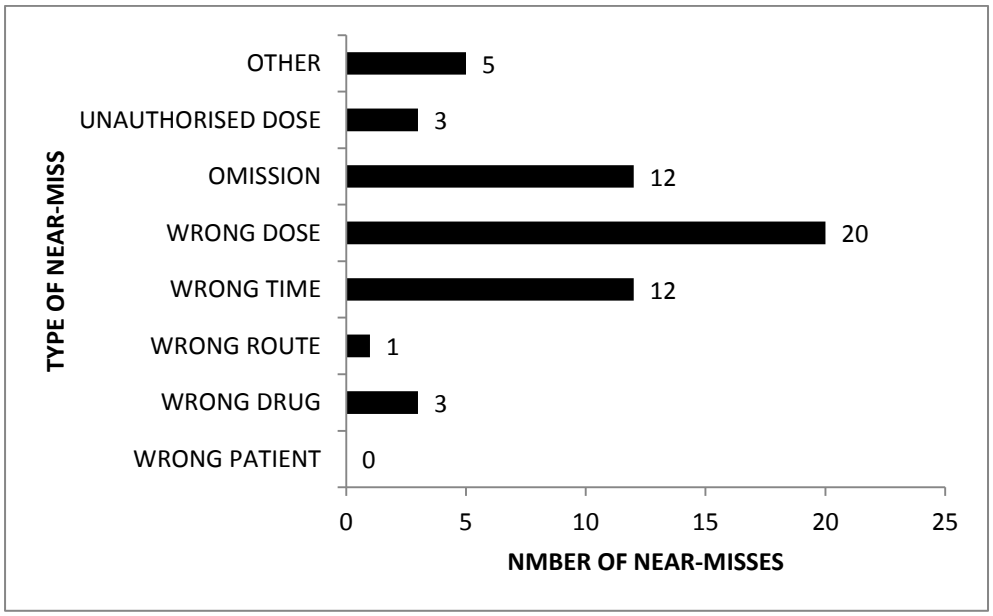

Figure 1 – Types and numbers of near-misses (n=56)

Classes of medication administered

The main class of medication administered were those acting on the alimentary tract and metabolism (27.2%, n=143). Class of medication was adapted from studies on MAEs and South African Medicines Formulary 8th Edition [7,12]. Classes of medication administered together with classes of medication for near-misses observed are presented in Table 1.

Table 1 - Classes of medication administered and near-misses observed.

Class Of Medication	**Medication Administered n (%)**	**Near-Misses Observed n (%)**
Musculo-Skeletal System	94 (17.87)	3 (5.36)
Alimentary Tract & Metabolism	143 (27.19)	16 (28.57)
Respiratory System	87 (16.54)	8 (14.29)
Central Nervous System	36 (6.84)	4 (7.14)
General Anti-Infectives for Systemic Use	80 (15.21)	14 (25)
Blood & Blood Forming System	20 (3.80)	2 (3.57)
Cardiovascular System	44 (8.37)	5 (8.93)
Systemic Hormonal Preparations	16 (3.04)	4 (7.14)
Dermatological	6 (1.14)	0
TOTALS	526 (100%)	56 (100%)

Classes of medication for near-misses

Class of medication most often associated with near-misses were alimentary tract and metabolism medications (28.57%, n=16), and general anti-infectives for systemic use (including antibiotics) (25%, n=14).

Route of administration for near-misses

The route of administration of medication for near-misses observed was categorised according to oral, intravenous, inhaled, or sub-cutaneous routes. The oral route was the medication administration route most often involved in near-misses (58.93%, n=33) followed by the IV route (26.79%, n=15), sub-cutaneous (5.36%, n=3) and inhaled routes (8.93% n=5).

Nurses who declined to participate

One nurse declined to participate in the study stating that she had participated in the pilot phase. Another nurse stated personal reasons for not participating during a particular medication round but agreed to participate during another medication round. Two nurses stated being too busy to participate during particular medication rounds but agreed to participate during other medication rounds.

Quantitative Study Arm Results:

Nurses' characteristics

Twelve questionnaires were completed out of a total of 20 nurses who are able to administer medication in the ward. Sample of nurses who agreed to participate was by convenience sampling of available nurses in the ward at the time of questionnaire administration. All of the 20 possible candidates were not approached to complete the questionnaire. 60% of nurses per shift who administer medication are staff nurses (ENs). Results from questionnaires showed staff nurses as the majority of participants (66.7%, n=8) while Registered Nurses (RNs) accounted for 25% (n=3) and bridging students (in the process of obtaining qualification for registered nurse) 8.3% (n=1) of total participants. Years of experience ranged from 1-15 years with a mean of 5.17 years (SD= 3.8, SE=1.1). Ages of nurses ranged from 22 years to 38 years old. Some nurses declined to note their age on the questionnaire. The mean age of nurses was 27.9 years (SD=5.2, SE=1.7). All nurses who completed the questionnaire were permanent staff (100%) and not sessional staff.

Reported Causes for MAEs

Nurses were requested to each list 3 causes of MAEs. Main reported causes for MAEs or near-misses as seen in Figure 2, were not checking with RN if unsure (83.3%, n=10) and doctor's writing (50%, n=6). It was observed that nurses administering medication also have other tasks to perform and are often interrupted even when in the middle of a medication round. However, interruptions were not reported as a cause of MAEs on questionnaires.

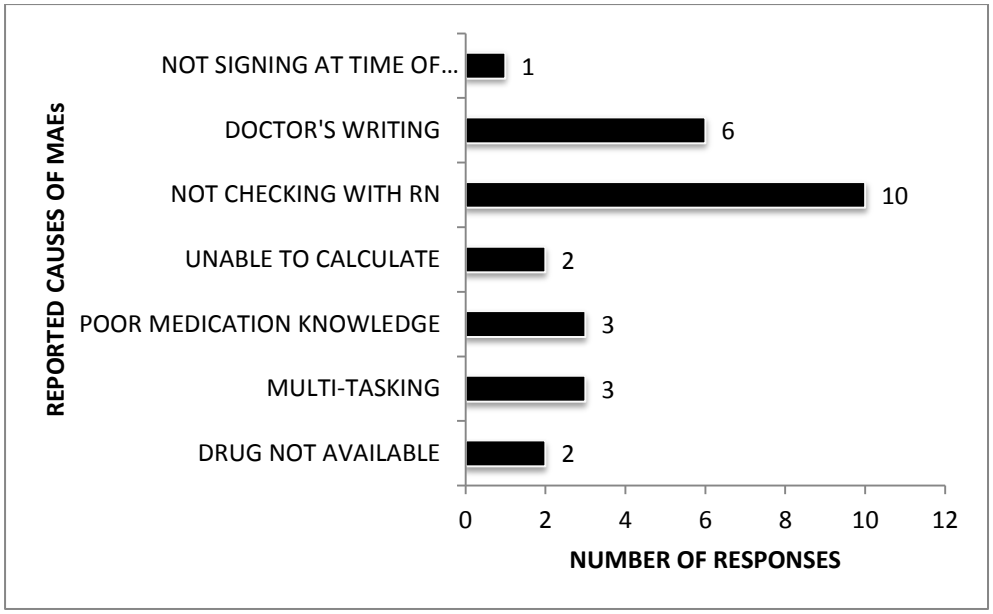

Figure 2 – Reported Causes of MAEs from the Nurses' Questionnaire (n=12)

Reporting of MAEs

All (100%, n=12) of the nurses stated that they report an error they may make. Multiple responses were provided to the question as to whom these errors were reported to. A quarter (25%, n=3) said they report these to the nursing shift leader, 50% (n=6) to sister in charge, 33.3% (n=4) to RN, 16.7% (n=2) to Unit Manager and 8.3% (n=1) to superior. Some nurses provided more than one answer to this question. Actions taken to prevent an error from occurring again included further teaching or training (91.7%, n=11), in-service from pharmacists (16.7%, n=2), checking with nursing sister before administering medication (16.7%, n=2) as well as disciplining of the individual involved in the error (16.7%, n=2).

Class of medication thought to be most often involved in MAEs

The majority of participants (83.3%, n=10) thought general anti-infectives for systemic use (antibiotics) was the class of medication most often involved in error, 16.7% (n=2) musculoskeletal system medication (analgesics), 8.3% (n=1) systemic hormonal preparations (cortisone), 8.3% (n=1) cardiovascular system medication (digoxin), 8.3% (n=1) alimentary tract and metabolism medication (insulin) and 16.7% (n=2) IV therapy.

Discussion

It is difficult to compare medication error rates among countries as different methods, different definitions of what constitutes an error, and different ways of calculating error rates are used [5,9,11,13-14,16-17]. Error rates are believed to differ depending on these factors. Recommendations from the literature were thus followed in this study regarding calculating error rates with and without

wrong time errors [13], and stating the inclusion of IV doses in order to make the results of this study more comparable with studies on MAEs conducted elsewhere [9].

MAE rates of 19-27% have been reported in studies using direct observation [3]. A MAE rate of 3.5% (excluding wrong time errors) was noted in a UK study [11] . Error rates of 3.5% for Spain and 6.5% for France were also reported [11]. An Iranian study showed an average MAE rate of 33.3% [4]. A study in Denmark showed a 41% MAE rate [14], while one from Paris, France reported a MAE rate of 27.6% [13]. The results of this study (near-miss rates of 10.65% including wrong time near-misses and 8.37% excluding wrong time near-misses) fall within this very broad range of error rates.

Wrong dose near-misses made up the majority of near-misses observed (35.7%). A French study reported wrong dose errors of 1.9% [12] while a USA study reported wrong dose errors as 17% of all MAEs [10]. A UK study reported a 15% wrong dose error rate [11]. This suggests that the wrong dose near-miss rate in this study (35.7%, n=20) is high.

Wrong time near-misses together with omission of dose, were the second most common type of near-miss observed (21.43%, n=12 each). Wrong time errors are generally the most common type of MAE and it is therefore advised to report error rates with and without wrong time errors [1,4,13]. This enables one to note the effect of wrong time errors on total error rates. Interruptions have been noted as playing a significant role in MAEs [18]. These factors may contribute to medications not being given on time. Wrong time errors accounted for the most common type of MAE observed at 72.6% of total MAEs in a French study [13]. An Iranian study reported a 15.6% wrong-time error rate (being the most common type of MAE) while a USA study reported a 43% wrong time error rate as a percentage of all MAEs (again the most common type of MAE) [4,10]. Wrong time near-misses in this study were within this wide range but still need to be addressed.

A common reason for **omission of doses** was the unavailability of the medication in the ward at the time of nursing medication administration rounds [11]. A similar scenario was reported in a UK study where omissions accounted for 68% of MAEs [11]. Additionally, omission errors were the second most common type of MAE (14%) reported in a French study, as well as in a USA study (30%) [10,13]. Near-misses due to omission in this study were again within this range.

There were zero **wrong patient near-misses** observed (n=0) while an Australian study showed that errors relating to patient identity factors accounted for 49% and 38% of error types [14]. A Danish study showed 36% of doses administered without patient identity being verbally confirmed [14]. This shows a positive finding towards patient safety practices in this study.

Further analysis of "other" near-misses showed duplicate therapy as the most common type of **"other" near-miss** observed (8.93%, n=5), which hints at a need for improved medication

information for nurses so they are aware of indications of medication. Generic name not known and wrong indication were other reasons highlighting the need for medication information.

Unauthorised dose accounted for 5.36% (n=3) of total near-misses observed which is higher than those of other studies reviewed where unauthorised medication accounted for 4% of all MAEs in a US study, 4.6% in an Iranian study, and 3.7% in a French study [4,10,13].

Change in behaviour may have occurred for nurses being observed (Hawthorne effect) but this is generally believed to be minimal and was not believed to have influenced the results of this study [5,9]. Learnings from near-misses may have decreased overall near-miss rate as the same error may have been prevented from occurring repeatedly due to intervention before the initial error occurred [11].

The majority of the participants who completed the questionnaires were ENs (the rank of nurses who mainly administer medication in the ward) and therefore the target population. Causes of MAEs reported in nurses' questionnaire were also reported in studies reviewed and included illegible handwriting, as well as gaps in knowledge and skills which have all been shown as factors contributing to errors [12,16,19]. Communication problems have also been reported as contributing to errors [15]. This may also refer to communication problems between nurses themselves [15]. Not checking with RN was a reported cause of MAEs (83.3%, n=10) suggesting that the same applies in this facility.

Interruptions were another factor that has been noted as contributing significantly to MAEs [18, 22]. Interestingly this was not reported as a cause of MAEs by participating nurses.

All participants for the questionnaire were permanent staff who should be aware of medication administration policies and procedures as well as procedures for reporting errors. All respondents indicated they report MAEs. This is positive because previous studies have shown nurses being afraid of reactions of fellow workers and managers as reasons for not reporting errors [12]. Approximately 95% of errors are not reported due to fear of disciplinary action and being "labelled" for the error [12].

Further training was recommended by nurses as a way to reduce future MAEs [5]. Nurses having insufficient experience or training were also reported as contributing to errors [16, 20]. Lack of knowledge, lack of experience, as well as calculation errors are also noted in the literature as contributing to error [16, 21].

All healthcare workers need to work together to reduce errors [20]. Being more careful, being sure to check and then double check before administering medication have been suggested as ways to prevent MAEs [15].

Conclusions:

This study suggests that MAEs seem to be occurring in South African healthcare facilities. A bigger study involving more sites is required. Better communication between healthcare professionals, as well as among nurses is required, especially between pharmacists and nurses administering medication by communicating changes on prescriptions to nurses and providing medication information. Identifying the most common types of near-misses in the facility provides direction for interventions to improve system safety and thereby reduce near-miss rate.

Acknowledgements:

The authors would like to acknowledge and thank all nurses who participated in this study, as well as the gatekeepers for permission to use the study site for conducting the study. The authors are also sincerely grateful to Ms N Singh for peer review and Ms C Martin for editing of this manuscript. Mr B Tlou is acknowledged for assisting with statistical analysis of results and advice on statistical methods suited to this study.

Conflicts of interests:

The authors do not have any conflicts of interests to declare.

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CHAPTER 4 – CONCLUSION

4.1 INTRODUCTION

The conclusions drawn from the findings in this study are presented in this chapter. The key findings of the study as well as recommendations for future research in this field are presented. Limitations to the study are identified and the significance of the study described in this chapter.

4.2 CONCLUSIONS FROM KEY FINDINGS IN THIS STUDY

The research aimed for in this study was completed. The main aims of the study were met, data was collected and analysed, and the results allowed for conclusions to be drawn. The main aim of this study was to identify the most common near-miss by investigating the administration of medication in a selected ward at a private healthcare facility using direct observation and questionnaire as tools. The objectives in this study were:

1: To determine the most common near-miss in the selected ward by direct observation of medication administration.

2: To establish main reasons for near-misses through a questionnaire for nurses administering medication.

3: To identify the class of medication most often associated with near-misses by recording medication administered during data collection.

4: To identify the route of administration most often associated with near-misses.

5: To establish the extent of the near-misses by calculating the near-miss rate.

The key findings in this study led to the following conclusions:

- Based on Objective 1, it was concluded that wrong dose was the most common type of near-miss (35.7%, n=20)
- Not checking with RN if unsure and illegible doctor's handwriting were concluded for Objective 2 as the main reported causes of MAEs from nurses' questionnaires.
- Based on Objective 3, it was concluded that alimentary tract and metabolism medications was the class of medication most involved in near-misses.
- The route of administration most involved in near-misses was the oral route (58.93%, n=33). This was concluded for Objective 4. Other studies have shown IV medication administrations being associated with more MAEs (Westbrook et al. 2011). This finding in this study could be due to greater precautions being taken with IV medications.

- The conclusion for Objective 5 was a near-miss rate of 10.65% including wrong time near-misses and 8.37% excluding wrong time near-misses.

4.3 STUDY LIMITATIONS

Some limitations to the study were discovered which presented challenges to the study. These are as follows:

- The relatively small sample size for respondents to the questionnaire was a limiting factor. Nurses were busy and had many other duties to perform. Nurses interviewed therefore included nurses who participated in the observation arm of the study as well as other nurses who administered medication in the ward. The participants for the questionnaire were therefore recruited by convenience sampling of those nurses who could spare the time to fill out the questionnaire. Nurses who were busy with other tasks could not complete the questionnaire, so their views could not be included in the study.
- Having only one observer in this study meant that medication administration could only be observed in one ward at one specific time. Having more observers could have enabled observation in more wards simultaneously. This could have provided a more generalizable result for the entire facility. Expanding the study to other wards would also have potentially provided a bigger sample of respondents for the nurses' questionnaire.
- Employing direct observation meant that nurses were aware they were being observed which could have resulted in behaviour change and therefore reflected a lower near-miss rate.
- Learning from near-misses which were identified at the initial stages of this study might have resulted in the same near-misses not occurring again which could have influenced the findings of the study.
- Limited South African data on the types and rates of medication errors provided a challenge in this study as specific study findings could not be compared with other South African data.

4.4 SIGNIFICANCE OF THIS STUDY

- This study provides an insight into South African data on MAEs (as near-misses) which appears to be a gap in the literature.
- This study promotes awareness of MAEs in South Africa where not much is openly discussed on the topic.
- This study is expected to contribute to the elimination of some of the negativity surrounding the topic of medication errors.
- The abundance of overseas literature on the topic suggests the occurrence of medication errors in other countries, even though it is something that obviously will not be encouraged.

- This study also provides specific data for the study facility. It provides a baseline for future studies on MAEs and points out positive aspects of medication use, such as successful patient identifying processes, since zero wrong patient near-misses were detected.
- This study further saw relationships between nurses and pharmacy strengthened by using a blame-free approach without judgement. This was ascertained by positive feedback from participants in the direct observation arm of the study.
- General anti-infectives for systemic use (antibiotics) were suggested by nurses as the class of medication most often associated with MAEs which was not consistent with the findings from the direct observation arm of this study. This may suggest the success of the antibiotic stewardship programme operational in the study facility.

4.5 RECOMMENDATIONS

a) *Team Approach for Healthcare Professionals*

Preventing MAEs involves a team approach with roles for those prescribing, dispensing and administering medication (ASHP 1993). Staff should also be sufficiently trained, communication should be adequate, allow for interaction between members of the healthcare team and checking processes should be performed by different staff members as part of the systems approach (ASHP 1993) to reduce or prevent the occurrence of medication errors.

Prescribers should ensure that prescriptions are "clear and unambiguous" (ASHP 1993). Prescribers should avoid using shortened terms that nurses and pharmacists may not be familiar with as this can lead to errors (ASHP 1993).

Pharmacists should ensure that they are accessible to other healthcare professionals to provide medication-related services. Pharmacists should ensure medication is adequately labelled with relevant precautions (ASHP 1993). Pharmacists should make sure that medication is made available in the ward within a reasonable time to prevent doses being delayed (ASHP 1993). The presence of a pharmacist during nurses' medication rounds was welcomed especially by junior nursing staff that were not very familiar with the medications they were administering. The usefulness of a pharmacist being present was shown as this allowed for on-the-spot answers to nurses' and patient medication questions. This may be considered as a more regular process.

Nurses should check medication against the prescription before administering and always confirm with the doctor or pharmacist if doses seem excessive or minute (ASHP 1993). All errors must be prevented even though all medication errors do not result in harm to the patient (Aronson 2009; Gray 2008; Lisby et al. 2005; Wolf et al. 2006). The need to check with RN before administering doses was seen in results from questionnaires and RNs need to be mindful of this and be willing and able to

check medications before they are administered. This is an important safety aspect. Channels of communication must remain open between nurses in order to ensure this occurs and that nurses are not afraid to approach RNs to check medication before administering.

Use of medication as prescribed and as indicated promotes the safe use of medication. Increasing nurses' medication knowledge is a further way of promoting the safe use of medication. It is up to pharmacists as custodians of the nature's drug cupboard to provide such information and guidance.

Safety systems, policies and processes in place at the study facility are designed to protect us and the patient from errors and should always be abided by (Kim & Bates 2013). They should not be bypassed in order to work faster.

b) New Policies for Healthcare Facilities

Recommendations from literature which can be considered for implementation in the study facility to prevent medication errors include computerised physician order entry and bar-coded medication (Agrawal 2009; Bates 2007). The use of barcodes for patient identification as well as for medication administered has also been shown to reduce MAE rates (Poon et al. 2010; Richardson et al. 2012). Pharmacists in the facility should provide or initiate more continuing education for nurses to keep them up to date with medication information, especially for new medication.

The patient needs to always remain the focus in the medication process. The culture of safety involves implementation of safety processes that reduce the chances of an error occurring (Kohn et al. 1999; Welzel 2012).

This study investigated the administration of medication in the selected ward and provided insight into which processes were being followed well (such as patient identifying processes) and processes that require improvement (such as checking with RN before administering medication as identified from the nurses' questionnaire). These factors will help direct quality improvement interventions (Keers et al. 2013) for new policies to areas where they are needed. Fewer MAEs mean safer care for patients. Research from findings can be used for improving quality of care to patients as MAEs may be harmful to patients. Use of medication as prescribed and as indicated promotes the safe use of medication.

c) Future Studies

- A bigger study involving more sites is required. This can involve different wards in the same facility or different facilities and facilities in different provinces. This would help provide a bigger picture of the occurrence and types of MAEs and provide more generalizable results for the entire country. Management in other facilities should encourage research in this area

so that more South African data on MAEs is available to compare results with. Multiple observers would be required for multiple sites in future studies.

- This study also provides the first step towards the determination of other types of medication errors such as prescribing errors and dispensing errors. The results of studies on prescribing and dispensing errors can then be compared to MAE error rates to determine which type of medication errors predominate in this facility. From there, studies can be expanded to other facilities. This can be used to promote reporting of errors as well as discussion of these errors in a blame-free manner.
- Findings from future studies can be compared to incident reporting data to determine if reported incidents are similar to those found in this study in terms of the types of MAEs observed and the incidents reported.
- Reasons for nurses not wanting to be observed should be examined. While the presence of an observer may have made some nurses nervous, this would probably not be the case for experienced nurses.
- Multi-disciplinary observation teams which include doctors, pharmacists and nurses working together to detect MAEs should be considered.
- The effect of near-misses on patient safety can be included in future studies.
- A current trend in this area of research on medication errors is a National Medication Safety Network (Cousins et al. 2015) which was established in England to allow for discussion of issues pertaining to safety. The establishment of a similar national body in South Africa could be investigated. This may promote compulsory reporting of medication errors thereby improving patient safety. Anonymous reporting of errors (Welzel 2012) is also suggested to encourage MAE reporting as the fear factor will now be removed.

4.6 CONCLUSION

This study provided an insight into South African data on MAEs and direction for training and education initiatives. It was concluded that wrong dose was the most common type of near-miss observed. This indicated the need for improved communication between members of the healthcare team. Alimentary tract and metabolism medication was identified as the class of medication most often involved in near-misses. The oral route was the route of administration most often involved in near-misses. Not checking with RN and illegible doctor's writing were the main reported causes of MAEs from nurses questionnaires. The findings of this study contribute to the much needed South African data on MAEs. They are recommended to assist in the detection of MAEs and eventually contribute to improved patient care in the study facility as well as in other healthcare facilities in South Africa.

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APPENDIX 1 – NURSES' QUESTIONNAIRE

QUESTIONNAIRE FOR NURSES:

1. **NURSING RANK:**
2. **YEARS OF NURSING EXPERIENCE:**
3. **AGE:**
4. **PERMANENT/SESSIONAL STAFF:**
5. **WHAT DO YOU BELIEVE ARE THE THREE MOST COMMON CAUSES OF MEDICATION ADMINISTRATION ERRORS IN THIS WARD?**

4.1……

4.2……...

4.3……...

6. **DO YOU REPORT ANY MEDICATION ERROR THAT YOU MAY MAKE?**

   IF NO, WHY?

   IF YES, WHO DO YOU REPORT THE ERROR TO?

7. **WHAT ACTIONS ARE TAKEN TO PREVENT THE ERROR FROM OCCURRING AGAIN?**

8. **WHAT CLASS OF MEDICATION DO YOU THINK IS MOST OFTEN INVOLVED IN MEDICATION ADMINISTRATION ERRORS?**

APPENDIX 2 – DATA COLLECTION SHEET

EVALUATING THE ADMINISTRATION OF MEDICATION IN A PRIVATE HEALTHCARE FACILITY - IDENTIFYING NEAR-MISSES

DAY:	DATE:	TIME:	# OF NURSES ADMINISTERING MEDICATION:			NUMBER OF NURSES ON DUTY:						
OBSERVATION #	**MEDICATION**		**DOSE**		**ROUTE**		**FREQUENCY**		**MEDICATION ADMINISTERED AS PER RX**		**REASON**	**NEAR MISS NOTED**	
	DR'S RX	**ADMINISTERED**	**DR'S RX**	**ADMINISTERED**	**DR'S RX**	**ADMINISTERED**	**DR'S RX**	**ADMINISTERED**	**YES**	**NO**		**YES**	**NO**

APPENDIX 3 – BREC APPROVAL LETTER AND EXTENSION LETTER

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

14 August 2014

Ms Nirvana Selegan
P O Box 146
Hyper by the Sea
4053
Nirvana.selegan@netcare.co.za

Dear Ms Selegan

PROTOCOL: Evaluating the administration of medication in a private healthcare facility. Identifying the most common medication administration error and its effect on patient safety.
REF: BE060/14

EXPEDITED APPLICATION

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received on 03 February 2014.

The study was provisionally approved pending appropriate responses to queries raised. Your responses received on 11 August 2014 to queries raised on 11 July 2014 have been noted by a sub-committee of the Biomedical Research Ethics Committee. The conditions have now been met and the study is given full ethics approval.

This approval is valid for one year from **14 August 2014.** To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2004), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be **RATIFIED** by a full Committee at its meeting taking place on **09 September 2014.**

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

Professor D. R Wassenaar
Chair: Biomedical Research Ethics Committee

Biomedical Research Ethics Committee
Professor D R Wassenaar (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3486 Facsimile: +27 (0) 31 260 4609 Email: brec@ukzn.ac.za
Website: http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx

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RESEARCH OFFICE
Biomedical Research Ethics Administration
Westville Campus, Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 2604609
Email: BREC@ukzn.ac.za
Website http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx

04 September 2015

Ms Nirvana Selegan
P O Box 146
Hyper by the Sea
4053
Nirvana.selegan@netcare.co.za

Dear Ms Selegan

PROTOCOL: Evaluating the administration of medication in a private healthcare facility. Identifying the most common medication administration error and its effect on patient safety. REF: BE060/14

RECERTIFICATION APPLICATION APPROVAL NOTICE

Approved:	14 August 2015
Expiration of Ethical Approval:	13 August 2016

I wish to advise you that your application for Recertification received 12 August 2015 for the above protocol has been noted and approved by a sub-committee of the Biomedical Research Ethics Committee (BREC) for another approval period. The start and end dates of this period are indicated above.

If any modifications or adverse events occur in the project before your next scheduled review, you must submit them to BREC for review. Except in emergency situations, no change to the protocol may be implemented until you have received written BREC approval for the change.

This approval will be ratified by a full Committee at its next meeting taking place on 13 October 2015.

Yours sincerely

Mrs A Marimuthu
Senior Administrator: Biomedical Research Ethics

APPENDIX 4 – FACILITY ETHICS PERMISSION LETTER

Dear Ms Seegan

RE: EVALUATING THE ADMINISTRATION OF MEDICATION IN A PRIVATE HEALTHCARE FACILITY: IDENTIFYING THE MOST COMMON MEDICATION ERROR AND ITS EFFECT ON PATIENT SAFETY

The above-mentioned research was reviewed by the Research Operational Committee's delegated members and it is with pleasure that we inform you that your application to conduct this research at Private Hospital, has been approved, subject to the following:

i) Research may now commence with this FINAL APPROVAL from the Committee.

ii) All information with regards to Company will be treated as confidential.

iii) Company's name will not be mentioned without written consent from the Committee.

iv) All legal requirements with regards to patient rights and confidentiality will be complied with.

v) Insurance will be provided and maintained for the duration of the research. This cover provided to the researcher must also protect both the staff and the hospital facility from potential liability

vi) In accordance with MCC approval, that medicine will be administered by or under direction of the authorised Trialist

vii) The research will be conducted in compliance with the GUIDELINES FOR GOOD PRACTICE IN THE CONDUCT OF CLINICAL TRIALS IN HUMAN PARTICIPANTS IN SOUTH AFRICA (2000)

viii) Company must be furnished with a STATUS REPORT on the progress of the study at least annually on 30th September irrespective of the date of approval from as well as a FINAL REPORT with

reference to intention to publish and probable journals for publication, on completion of the study.

ix) A copy of the research report will be provided to Company once it is finally approved by the tertiary institution, or once complete.

x) Company has the right to implement any Best Practice recommendations from the research.

xi) Company reserves the right to withdraw the approval for research at any time during the process, should the research prove to be detrimental to the subjects/Netcare or should the researcher not comply with the conditions of approval.

xii) APPROVAL IS VALID FOR A PERIOD OF 36 MONTHS FROM DATE OF THIS LETTER.

We wish you success in your research.

Yours faithfully

5/8/14

Prof Dion du Plessis
Full member: Research Operational Committee & Medical Practitioner evaluating research applications as per Company Policy

Shannon Nell
Chairperson: Research Operational Committee
Date: 6/8/2014

This letter has been anonymised to ensure confidentiality in the research report.
The original letter is available with author of research

APPENDIX 5 – AUTHOR GUIDELINES OF THE INTERNATIONAL JOURNAL OF CLINICAL PHARMACY

(Available from: http://www.springer.com)

International Journal of Clinical Pharmacy
Instructions for Authors

Aims & Scope

The aim of International Journal of Clinical Pharmacy is to provide a medium for the publication of articles on clinical pharmacy and related practice-oriented subjects in the pharmaceutical sciences. The scope of the journal is clinical pharmacy, its research and its application in e.g. pharmaceutical care. The editors therefore welcome contributions on the above-mentioned topics and especially on the following:

- Pharmacotherapy and outcome research
- Clinical pharmacy
- Pharmacoepidemiology
- Pharmacoeconomics
- Pharmaceutical care
- Medicines and medical devices utilisation
- Medicines and medical devices information
- Pharmacy services research
- Medication management
- Other clinical aspects of pharmacy

The journal welcomes papers in the following categories: Review articles, Research articles, Case reports, Short research reports, Commentaries, and Letters to the Editor. All submissions (including Commentaries and, if necessary, Letters) will be peer-reviewed by experts.
Until 2010 the journal was entitled Pharmacy World & Science.

Manuscript submission

International Journal of Clinical Pharmacy has a fully web-enabled manuscript submission and review system. This system offers authors the option of tracking the review process of their manuscripts in real time. The online manuscript and review system offers easy and straightforward log-in and submission procedures. It supports a wide range of submission file formats, including Word, WordPerfect, RTF, TXT and LaTeX for article text and TIFF, EPS, PS, GIF, JPEG and PPT for figures. PDF manuscripts cannot be accepted.
All Manuscripts should be submitted through: www.editorialmanager.com/IJCP
Please register as a user before submitting the first manuscript to us.

NOTE: It is NOT necessary to submit the manuscript also in print or on disk. In case you encounter any difficulties while submitting your manuscript online, please get in touch with the responsible Editorial Assistant by clicking on 'CONTACT US' from the toolbar.

Electronic figures

Electronic versions of your figures must be supplied separately. For vector graphics, EPS is the preferred format. For bitmapped graphics, TIFF is the preferred format. The following

resolutions are optimal: line figures - 600-1200 dpi; photographs - 300 dpi; screen dumps - leave as is. Colour figures can be submitted in the RGB colour system. Font-related problems can be avoided by using standard fonts such as Times Roman, Courier, or Helvetica.

Cover letter & Submission statement

Please describe the article type of your submission (see 'Article types' below) and the reason why International Journal of Clinical Pharmacy should publish your article in your cover letter.
This letter should also contain a submission statement with a sentence that the paper has not been submitted elsewhere in similar form, and should state that all authors have contributed significantly to the publication. There should also be a statement concerning the fact that all authors are aware of the submission and agree with it.
Additionally we expect all authors' details in the cover letter, as well as the number of words of the article, of the abstract, and of the references. Please do not insert author details in the manuscript itself.

Language
We appreciate any efforts that you make to ensure that the language is corrected before submission. This probably will greatly improve the legibility of your paper if English is not your first language. It will improve the chances of the manuscript being accepted by the reviewers.

What happens after submission?

You will receive an acknowledgement of receipt of the submission. The paper will be checked for adherence to the instructions and the editorial policy of the journal. Sometimes a plagiarism check will be performed and all references will be checked. If approved, the submission will be sent to reviewers. The review procedure should be finished in approx. 6 weeks, but may sometimes take up to 3 months. You will then receive information about acceptance, needed revisions or rejection of your submission. Unless otherwise stated in the cover letter, the corresponding author will be regarded as the author for correspondence and proofs. You can follow the progress of the reviewing process on line in Editorial Manager.

Once your paper is accepted for publication, you will receive an edited version electronically for proofreading. The authors are responsible for checking and correcting the proofs. The main author will receive 25 offprints free of charge of the article within 8 weeks after its publication. More offprints can be ordered, at additional costs, when returning the proofs to the publisher. Consent to publish forms should be signed by the corresponding author and returned to Springer prior to publication. The copyright will be established in the name of Springer.

Manuscript presentation

The journal's language is English. British English is preferred but American English spelling and terminology may be used. Either one should be followed consistently throughout the article. Manuscripts should be prepared for A4 paper. Double spacing of abstract and main body of the article is appreciated. Lines in the manuscript should be numbered, page numbering is not necessary.

Short research reports

Short research reports give the preliminary or limited results of original research. Short research reports should not exceed 1500 words, excluding abstract and a maximum of 10 references. They may only contain 2 tables or figures, and should be structured like a research article. Please provide a structured abstract of max. 200 words with the headings: Background, Objective, Method, Results, Conclusion.

Case reports

Case reports should not exceed 1500 words excluding abstract, but including a maximum of 10 references, and may only contain 1 table or figure. Case reports should be structured as follows: Introduction, Ethical approval, Case description, Discussion, Conclusion. Please provide a structured abstract of max. 150 words with the headings: Case (description) and Conclusion.

Commentaries

Authors can use a commentary to convey thoughts, considerations, opinions or discuss issues. Commentaries should not exceed 2000 words, including a maximum of 20 references. They may only contain 2 tables or figures. An unstructured abstract of max. 150 words is required.

Letters to the Editor

Letters that comment on a published article will be considered for publication. Letters should not exceed 1000 words, including a maximum of 5 references. Letters may contain a maximum of 1 table or figure. No abstract required.

Abbreviations

Abbreviations should be explained upon first occurrence. Do not use abbreviations in the abstract.

Symbols and units

Please use the recommended SI units.

Section headings

First-, second-, third-, and fourth-order headings should be clearly distinguishable but not numbered.

Appendices

Supplementary material (like very large tables) should be collected in an Appendix and placed after the Reference section. Questionnaires should not be added to the manuscript, but made available on-line, and a reference should be inserted in the article.

Please use footnotes sparingly. Footnotes should be indicated by means of superscript marks (*, #, $) in the text and listed at the bottom of the appropriate page. Endnotes functions may be used to insert references.

Acknowledgements

Acknowledgements should be placed in a separate section after the conclusion. If external funding has been obtained for the study, then this should be mentioned under a separate header 'Funding', after the acknowledgements.

Conflict of interests

Conflicts of interest (also if there are none) should be stated in a separate section before the References.

References

In the text, a reference is identified by means of a number between square brackets, that should be placed at the end of a sentence before the punctuation. Please use cross-referencing if the same reference is used more than once.

According to the ICMJE, references to books, journal articles, articles in collections and conference or workshop proceedings, and technical reports should be listed at the end of the article in numbered order according to 'Citing Medicine: The NLM Style Guide for Authors, Editors, and Publishers. Abbreviations of journal names should be according to Index Medicus. We expect a maximum of 6 author names before 'et al.'. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., T. Moore, personal communication).

For the Vancouver format see: International Committee of Medical Journal Editors (ICMJE). Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and editing for biomedical publication [Internet]. ICMJE; 2003, updated Oct 2004. Last cited 12-2012. Available from: http://www.icmje.org/urm_main.html.
For the NLM guide, see 'Citing Medicine: The NLM Style Guide for Authors, Editors, and Publishers [Internet]. 2nd edition. Patrias K, author; Wendling D, editor. Bethesda (MD): National Library of Medicine (US); 2007-2012 . Last cited 12-2012. Available from http://www.ncbi.nlm.nih.gov/books/NBK7256/.

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All photographs, graphs and diagrams should be referred to as a 'Figure' and they should be numbered consecutively (1, 2, etc.). Multi-part figures ought to be labelled with lower case letters (a, b, etc.). Please insert keys and scale bars directly in the figures. Relatively small text

and great variation in text sizes within figures should be avoided as figures are often reduced in size. Figures may be sized to fit approximately within the column(s) of the journal. Provide a detailed legend (without abbreviations) to each figure, refer to the figure in the text and note its approximate location as 'Insert Fig... here' in the text. Please place the figures and legends in the manuscript on a new page after the references.

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Each table should be numbered consecutively (1, 2, etc.). In tables, footnotes are preferable to long explanatory material in either the heading or body of the table. Such explanatory footnotes, identified by superscript letters, should be placed immediately below the table. Please provide a caption (without abbreviations) to each table, refer to the table in the text and note its approximate location as 'Insert Table... here' in the text. Finally, please place the tables after the figures at the end of the manuscript.

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The Netherlands
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