Nurses’ Perceptions of Medication Administration Safety in Public Hospitals in the Gauteng Province: A Mixed Method Study

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Abstract

**Background:** This study was carried out to determine factors perceived to impact on medication administration errors and possible solutions to such errors in medical and surgical units of public hospitals in Gauteng Province, South Africa. More data on this challenge to patient health are needed from low- and middle-income countries like South Africa.

**Methods:** A mixed-methods research design with a sequential approach was used. Data were gathered among 683 (n=280) medication administrators using self-report surveys, and 16 (n=15) nursing unit managers using semi-structured individual interviews.

**Results:** Causes of medication error related to communication, human, environmental and medication-related factors were considered to have a moderate risk. Workload (M=3.39; SD 0.91), stock problems (M=3.18; SD 0.96) and illegible prescriptions (M=3.05; SD 1.09) pose the greatest threats to medication administration safety. Most participants (n=184; 71.1%) agreed that medication errors never or rarely occurred in their units. The majority of respondents graded overall patient safety as excellent or very good (n=161; 61.5%). With regard to safety culture, nurses felt that they are actively attempting to improve medication safety (n=239; 90.5%), that people support one another in the unit (n=216; 80%), and that their procedures and systems are good at preventing errors (n=210; 80.2%). Participants felt that medication administration errors were rarely reported, and the most apparent reason for not reporting medication administration errors was fear and administrative response. Safety culture items were correlated with medication error incidence, grade of overall patient safety and reasons for non-reporting. Qualitative findings supported the quantitative data, adding knowledge, skill and attitude of staff as further threats to medication administration safety. Adherence to protocols, auditing, education and training, collaboration and support, communication, awareness of changes, resource management and improved pharmacological training could be seen as the foundation for improved medication administration safety.

**Conclusions:** Solutions aimed at mitigating medication errors should be based on causes identified within a specific context. In the Gauteng Province of South Africa, multidisciplinary collaboration and communication; support of nurses by the hospital administration; hospital systems, procedures and initiatives; better resource management and improved pharmacological training could be seen as the foundation for improved medication administration safety.

Introduction

Globally, the cost associated with medication errors has been estimated at well over 40 billion dollars annually.[1] This monetary loss is anything but negligible, but an even worse consequence of these errors at hospitals is that they could harm patients rather than being of benefit to them, sometimes to the degree of loss of life.[2, 3] This problem is deemed so detrimental that the World Health Organization (WHO)[1] launched a "Medication Without Harm" campaign as the third Global Patient Safety Challenge.

Identifying causes of medication error may contribute towards addressing this challenge. Numerous factors can contribute to medication errors, including communication, human, environmental and medication-related factors.[2, 3]

Attempting to provide an estimate of the problem, a systematic review of 91 studies was conducted and a median medication error incidence of 19.6% of total opportunities for error was calculated.[4] However, most studies included were from high-income countries, raising concern that fewer data are available from low- and middle-income countries, where the incidence of errors tends to be higher.[2–4]

Overall safety culture and reporting systems of a unit impact on the incidence of medication error.[5] Reporting systems mitigate the risk of repeated errors, underlining the need for safe routes for nurses to report errors and near-misses.[6]

Although evidence of an abundance of interventions aimed at mitigating medication errors exists,[7] the practice setting dictates the effectiveness of such interventions.[8] This is in line with the theoretical framework set by the WHO research cycle for patient safety, where determining causes of a patient safety concern should precede attempts to develop solutions for that concern within a given context.[9]

Methods

**Aim**

The aim of this study was to determine perceived factors impacting on medication administration errors, and possible solutions to these, according to nurses in the medical and surgical units of public hospitals in Gauteng Province of South Africa (SA).

**Design**

A mixed-methods sequential explanatory design was employed. The quantitative phase applied a cross-sectional survey design conducted according to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines,[10] while the qualitative phase used a qualitative descriptive inquiry with individual semi-structured interviews according to Consolidated Criteria for Reporting Qualitative Studies (COREQ) guidelines.[11]

**Participants and setting**

Multi-level sampling was applied. Gauteng Province was purposively selected, as it represents the largest proportion of SA’s population and has the highest concentration of hospitals. SA has a public and a private healthcare sector, the public healthcare sector serves 84% of the SA population and was selected for this study. The public healthcare sector consists of three levels of care, namely tertiary, provincial and district hospitals, and proportionate sampling of these hospital levels was conducted. From 27 public hospitals in Gauteng Province two tertiary hospitals, three provincial hospitals and three district hospitals were included (n = 8). An all-inclusive sample of medication administrators (professional, enrolled [two-year diploma] and student nurses) in medical and/or
surgical units, working on all shifts within a two-week period at these hospitals, was selected to complete surveys (N = 683). A sample size of 247 was determined to be adequate with a 5% error margin and 5% level of significance. Nursing unit managers from two randomly selected medical and/or surgical units of each hospital were also interviewed (N = 16).

**Data collection**

The Causes of Medication Administration Errors Survey[3] has four subscales, namely: communication (10 items); human factor (11 items); environment (14 items); and medication-related (10 items) causes of medication error. These were measured on a four-point Likert scale from 'No risk' (1) to 'Significant risk' (4).

Two questions were derived from the Registered Nurse Forecast (RN4CAST) survey. One seven-point Likert scale item, ranging from 'Never' (1) to 'Every day' (7), determined perceptions of medication error incidence in the unit. Another five-point Likert scale item, ranging from 'Excellent' (1) to 'Failing' (5), determined respondents’ grade for overall patient safety in the unit.[12]

The following section of the survey originated from the Agency of Healthcare Research and Quality (AHRQ) Hospital Survey on Patient Safety Culture. Seventeen five-point Likert scale items, ranging from 'Strongly disagree' (1) to 'Strongly agree' (5), represented five patient safety culture composites in the unit, comprising non-punitive response to errors (three items); organisational learning (two items); overall perceptions of patient safety (four items); staffing (four items); and teamwork (four items). Also drawn from the AHRQ survey, incidence of reporting in the unit consisted of three five-point Likert scale items, ranging from 'Never' (1) to 'Always' (5).[13] A fourth item was added to this subscale by the researcher to determine the perception of incidence of reporting errors which caused harm to a patient.

Lastly, from the Medication Administration Error Reporting Survey,[14] 16 six-point Likert scale items, ranging from 'Strongly disagree' (1) to 'Strongly agree' (6), representing four different subscales of reasons for non-reporting of medication errors were included. Subscales comprised disagree with definition of medication error (four items); reporting effort (two items); fear (five items); and administrative response (four items).

Exploratory and confirmatory factor analysis was used to test instrument validity. The Kaiser-Meyer-Olkin measure of sampling adequacy and goodness-of-fit measures for all subscales were deemed acceptable. Cronbach's alpha was calculated to determine the reliability of subscales and compared to those obtained in previous studies (Table 1).

In the context of SA only two subscales ('Teamwork', and 'Non-punitive response to error') of the AHRQ composite concerning safety culture reflected acceptable reliability. All other subscales of this composite were therefore reported as individual items.

The four fundamental epistemological standards listed by Lincoln and Guba (1985) were applied to ensure the trustworthiness of this study.[15] Strategies applied included triangulation of method and source, prolonged engagement, peer debriefing, member checking, saturation of data and use of a co-coder.

The top three causes of errors in medication administration were identified from the results of the survey, and these were followed-up with probing questions. The semi-structured individual interview schedule comprised the following questions:

1. In your opinion, what are the main causes of medication errors in your unit?
2. How can this risk be limited?
3. High workload, stock distribution problems and illegible prescriptions were identified as the main causes of medication errors. What can be done to lessen the staff’s workload?
4. What can be done to limit stock distribution problems?
5. What can be done about illegible prescriptions?
6. Is there anything else you would like to add with regard to improving medication administration safety?

A pilot interview was conducted (not included for analysis) with a professional nurse to assess the clarity of the questions and the time-frame needed for interviews. No changes to the interview schedule were deemed necessary. Interviews took an average of 20 minutes to complete. Two participants agreed to be interviewed, but did not give consent for audio recording thereof, so detailed notes were made on these interviews. Recordings of the other interviews were transcribed verbatim.

**Data analysis**

Data were analysed using the computer software program SPSS Version 23 (SPSS Inc., 2016). Demographics and the results of scales were presented using descriptive statistics (means, frequencies, percentages and standard deviations). The reliability of the instruments was established by Cronbach's alpha, and validity through confirmatory factor analysis. In addition, the relationships between the main study variables were tested using Spearman's rank-order correlations, while associations between the personal and situational demographics and the main study variables were tested using Spearman's rank-order correlations, t-tests, analysis of variances (ANOVAs) and effect sizes.

For the qualitative findings, thematic content analysis was used.

**Ethical considerations**

Ethical clearance was granted by North-West University (NWU-00182-14-A1) and the Gauteng Department of Health. Goodwill consent was provided by each of the participating hospitals. The researchers sought to comply with sound ethical principles, including respect, scientific merit and integrity, distributive justice, and beneficence in all aspects of the study.[16]
Results

Two hundred and eighty (280) completed surveys were returned, a 41% response rate. In terms of the interviews, although data saturation was reached after ten interviews, five more were conducted (n=15).

Demographics

Most participants were female (n=220; 89.8%), professional nurses (n=120; 51.3%) with a 4-year diploma in nursing (n=113; 48.3%) and permanently employed (n=236; 94.4%). The largest proportion of respondents were aged 35-45 years (n=98; 43.2%) and had 5-9 years of working experience in the current hospital (n=124; 59.6%).

Descriptive statistics

Table 2 presents responses for individual items and subscales.

Causes of medication error related to communication, human, environmental and medication-related factors were considered to have a moderate risk, with the following causes being the most common: high patient-to-nurse-ratio (M=3.44; SD 0.87), work overload (M=3.39; SD 0.89), inadequate staffing (M=3.36; SD 0.89), stock distribution problems (M=3.18; SD 0.96), high acuity level of patients (M=3.09; SD 1.0) and illegible prescriptions (M=3.05; SD 1.09). The three main causes of medication error were thus summarised as workload (including high patient-to-nurse ratio, work overload, inadequate staffing and patient acuity), stock distribution problems, and illegible prescriptions.

Most participants perceived medication errors as never occurring (n=60; 23.2%), or occurring a few times a year or less in their units (n=124; 47.9%). Only four respondents (1.5%) perceived that medication errors could occur in their units every day.

The majority of respondents perceived the overall grade of patient safety as excellent or very good (n=161; 61.5%).

Three safety culture items related to staffing shortages triggered concern: 83% (n=230) of respondents disagreed that there are enough staff to handle the workload, 72.3% (n=190) agreed that they work in “crisis mode”, doing too much, too quickly, and 70.5% (n=186) agreed that staff work longer hours than is best for patient care. However, on the positive side, nurses felt that they are actively attempting to improve medication safety (n=239; 90.5%), that people support one another in the unit (n=216; 80%), and that their procedures and systems are good at preventing errors (n=210; 80.2%).

Most degrees of error severity were only reported sometimes, although the errors that could cause harm to the patient were reported more often, albeit not always. A quarter of participants (n=60; 26%) perceived that medication errors that cause harm to patients were never or rarely reported, while 32.9% (n=77) perceived that errors that could potentially harm the patient were never or rarely reported.

The main reasons for not reporting medication errors were fear and administrative response, where the following items were rated highest: nurses are blamed if something happens to patients (M = 4.47; SD 1.84), individuals rather than systems are implicated for errors (M= 4.10; SD = 1.93), and the patient or family may develop a negative attitude toward the nurse (M=4.05; SD 2.02).

Correlations between individual items and subscales

Table 3 presents the correlations between the different individual items and subscales. In these analyses, only findings that are statistically significant (at the 0.05 and 0.01 levels) and have a medium or large correlation are reported on. According to Cohen (1988) the following guidelines can be used for the interpretation of correlations: (a) small r=0.1, (b) medium r=0.3, and (c) large r=0.5.[17]

These results show that ‘Communication-related causes of medication error’ is related to ‘Administrative response’.

Furthermore, the AHRQ safety culture subscales and individual items point to the fact that the items ‘We are actively doing things to improve medication safety’, ‘Our procedures and systems are good at preventing errors’, and ‘Teamwork’ had the most impact on ‘Medication error incidence’ and ‘Grade of overall patient safety’.

Finally, ‘Our procedures and systems are good at preventing errors’ and ‘Non-punitive response’ had the most impact on reasons for non-reporting, and ‘Disagree with definition of medication error’ had the most impact on ‘Medication error incidence’ and ‘Grade of overall patient safety’.

There were no correlations with the demographic data (age, years of experience).

Associations between demographic and hospital data

Regarding demographic data, there was a significant association between female participants and increased reporting of ‘Medication error incidence’ (d=0.60; p=0.05). Also, provincial hospitals had higher scores of the item ‘We use more agency/temporary staff than is best for patient care’ (d=0.66; p<0.001).

Qualitative results

Three themes emerged during thematic content analysis, each with its own sub-themes, which are depicted in Table 4. Three main causes of medication administration errors were identified from the quantitative data, namely high workload, stock distribution problems, and illegible prescriptions. In the qualitative phase these were further explored and identified as theme one, while other causes of medication administration errors were identified as theme two, and recommendations to reduce medication administration errors were identified as theme three.
Several overlaps were recognised between the results from the quantitative phase and the qualitative phase. Figure 1 presents these overlaps, together with recommendations flowing from the integrated findings.

**Discussion**

Causes of medication error related to the communication, human, environmental and medication-related factors were considered to have a moderate risk. Workload, stock distribution problems and illegible prescriptions pose the greatest threats to medication administration safety. Participants felt that medication administration errors were rarely reported, although errors that could cause harm to patients were reported more often. The main reasons for not reporting errors were fear and administrative response. Overall medication safety was graded as excellent or very good, and active measures towards improvement of medication safety were reported. Qualitative findings supported the quantitative data, adding knowledge, skill and attitudes of staff as further contributors to medication administration errors. Solutions identified to improve medication safety included: adherence to protocols, auditing, education and training, collaboration and support, communication, awareness of changes, resource management and time management.

Communication was implicated as a moderate risk in causing medication administration errors, which is confirmed by the literature.[6] Better nurse-doctor communication was proposed as vital in improving medication administration safety, although communication with other role-players should not be neglected. For example, pharmacists' accurate communication regarding medication stock changes would also mitigate errors.[18]

Regarding written communication, several studies agreed that illegible prescriptions contributed to medication errors.[19–21] Survey participants identified this as the third most common cause of errors, and nursing unit managers discussed the attitudes of all role-players as key in addressing this problem successfully.

Human factor-related causes of medication error were considered to be of moderate risk to medication safety, and this was raised by most nurse managers in this study. Shams[22] mentions that human factors, such as deficits of knowledge, skills, attitudes, protocol adherence and audits, are some of the most common reasons for medication administration errors.[4,23,24] Managers thus highlighted education and training as a crucial intervention to address medication safety issues.[25] This training should include high-quality pharmacological training, and in the clinical setting should preferably be conducted by clinical accompanists, so that there is no further increase in nurses’ workload.

In fact, workload should not be exacerbated in any way, as high-, middle- and low-income countries alike identify heavy workload as the most important determinant of medication error.[26] However, as reported by participants, attempting to lighten the workload by means of temporary staff employment could intensify patient safety issues in general.[27] Literature-supported solutions to high workload may include the use of pharmacist assistants to replenish ward stock,[24] and self-administration of medication by competent patients,[25] although nursing unit managers also reiterated nurses’ responsibility for time management.

Patient acuity was indicated as impacting on medication administration errors, and this is also confirmed by the literature.[28] In this study, patients not being able to swallow and being uncooperative were the specific acuity issues indicated.

There is global agreement with the finding that problems in stock availability or distribution from the pharmacy are leading medication-related causes of medication administration errors.[6,19,24] According to nursing unit managers, 24/7 availability of medications could contribute greatly to timeous medication administration.

Although participants aptly identified specific medication administration risks, perceptions related to incidence of medication administration error could be skewed, as this was perceived as occurring only a few times a year, in contradiction to the literature on the topic.[3,5] This could also be as a result of participants disagreeing with the definition of medication error, as was found in this research. Participants reported units’ overall medication administration safety as very good, and correlations showed that this was based on the fact that there were active measures in place towards improvement thereof.

It is concerning that participants held negative perceptions towards teamwork, as it is highly correlated with medication administration safety and its overall improvement. This was confirmed in the literature and reiterated in this study, in that collaboration between various team members is mentioned as a central theme for facilitating a safety climate[27] and mitigating nurse errors.[6,28]

Lastly, the greatest reasons for non-reporting of medication administration errors, namely fear and administrative response, should be addressed as a matter of urgency. Reporting of medication errors or near-misses is of the utmost importance in order to plan and initiate proactive measures to contain and prevent errors, and the only way that the incident-reporting culture can be addressed is through a non-punitive safety reporting system.[29,30] Such a system provides the foundation for effective auditing, as was proposed by nursing managers, and furthermore provides a means of supporting nurses who committed medication administration errors and often have negative psychological outcomes,[31] reiterating the need for emotional support.[6] as proposed by interviewees.

**Strengths and limitations**

The main strength of this study is that it adds data on medication safety from low- and middle-income countries. Furthermore, using the WHO research cycle for patient safety, it not only determines causes of patient safety concern, but also attempts to develop specific solutions within the given context.

Limitations of this study include the fact that the survey results were reliant on the perceptions of respondents, which could have led to medication administration errors being underreported due to fear for the reputation of hospitals and/or lack of insight. However, the similarities in responses between units and hospitals contributed to the reassurance that the results were in fact a reflection of reality. Solutions for medication safety problems were limited.
only to nurses’ inputs, excluding the views of other relevant health team members. However, nurses are the primary agents in medication administration, and their views were therefore deemed most important.

**Conclusions**

Solutions aimed at mitigating medication errors should be based on causes identified within a specific context. In the Gauteng Province of SA, multidisciplinary collaboration and communication; support of nurses by the hospital administration; hospital systems, procedures and initiatives; better resource management and improved pharmacological training could be seen as the foundation for improved medication administration safety.

**List Of Abbreviations**

AHRQ - Agency of Healthcare Research and Quality  
ANOVA - analysis of variances  
COREQ - Consolidated Criteria for Reporting Qualitative Studies  
NWU – North-West University  
RN4CAST – Registered Nurse Forecast  
SA – South Africa  
SPSS – Statistical Package for the Social Sciences  
STROBE - Strengthening the Reporting of Observational Studies in Epidemiology  
WHO – World Health Organisation

**Declarations**

**Ethics approval and consent to participate**

Ethical approval was granted by the Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU-00182-14-A1), as well as from the Gauteng Provincial Department of Health. Goodwill consent was provided by the participating hospitals, and participants in the study gave written voluntary informed consent.

**Consent for publication**

Not applicable

**Availability of data and materials**

The data underlying this article will be shared on reasonable request to the corresponding author.

**Competing Interests**

The authors declare that they have no competing interests.

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**Author contribution**

All authors meet the criteria for authorship, have approved the final article and all those entitled to authorship are listed as authors. AJB was responsible for the conception and design of the study, acquisition, analysis and interpretation of data, as well as drafting the article. SKC assisted in the conception and design of the study, analysis and interpretation of data and revising the article, while HCK added to the conception and design of the study, and critical revision of the article. SME analysed the data, assisted with the interpretation of data, and critical revision of the article.

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Tables

Table 1: Cronbach alphas for the subscales of the instrument

| Origin / portion                | Subscale                                      | Cronbach's alpha | Previous study | Current study |
|--------------------------------|-----------------------------------------------|-------------------|----------------|---------------|
| Demographics                   | Not applicable                                | Not applicable    |                |               |
| Causes of medication errors survey | Communication-related causes of medication error | -                 | 0.89           |               |
|                                | Human factor-related causes of medication error | -                 | 0.95           |               |
|                                | Environment-related causes of medication error | -                 | 0.80           |               |
|                                | Medication-related causes of medication error | -                 | 0.92           |               |
| RN4CAST                        | Medication error incidence                    | Not applicable – single item |               |               |
| RN4CAST                        | Grade on overall patient safety               | Not applicable – single item |               |               |
| AHRQ survey                    | Teamwork within units                         | 0.79              | 0.69           |               |
|                                | Non-punitive response to error                 | 0.78              | 0.56           |               |
|                                | Organisational learning                       | 0.71              | 0.43           |               |
|                                | Staffing                                      | 0.62              | 0.30           |               |
|                                | Overall perceptions of patient safety         | 0.74              | 0.15           |               |
| AHRQ survey                    | Incidence of reporting                        | 0.85              | 0.89           |               |
| Wakefield survey               | Disagree with definition                      | 0.77              | 0.74           |               |
|                                | Reporting effort                              | 0.87              | 0.75           |               |
|                                | Fear                                          | 0.86              | 0.83           |               |
|                                | Administrative response                       | 0.77              | 0.76           |               |

Table 2. Means and standard deviations of individual items and subscales
| Individual items and factorable subscales | Description | Mean | Standard deviation |
|------------------------------------------|-------------|------|--------------------|
| Communication-related causes of medication error | Causes subscale: Four-point scale: No risk (1) to Significant risk (4) | 2.51 | 0.786 |
| Human factor-related causes of medication error | | 2.46 | 0.988 |
| Environment-related causes of medication error | | 2.89 | 0.723 |
| Medication-related causes of medication error | | 2.52 | 0.811 |
| Medication error incidence | RN4CAST Individual Item: Seven-point scale: Never (1) to Every day (7) | 2.37 | 1.336 |
| Grade on overall patient safety | RN4CAST Individual Item: Five-point scale: Excellent (1) to Failing (5) | 2.18 | 0.890 |
| We have enough staff to handle the workload | | 1.76 | 1.026 |
| Staff work longer hours than is best for patient care | | 3.74 | 1.145 |
| We are actively attempting to improve medication safety | | 4.20 | 0.805 |
| We use more temporary staff than best for patient care | | 1.83 | 1.127 |
| Mistakes have led to positive changes here | | 3.62 | 1.071 |
| It is just by chance that more serious medication administration mistakes don't happen around here | | 3.45 | 1.234 |
| We work in "crisis mode" doing too much, too quickly | | 3.78 | 1.167 |
| Medication safety is never sacrificed to get more work done | | 3.37 | 1.259 |
| We have medication administration safety problems | | 2.44 | 1.278 |
| Our procedures and systems are good at preventing errors | | 3.96 | 1.026 |
| Teamwork within units | AHRQ Safety Culture Subscale: Five-point scale: Never/strongly disagree (1) to Always/strongly agree (5) | 3.79 | 0.858 |
| Non-punitive response to error | | 3.16 | 0.967 |
| Incidence of reporting | | 3.27 | 1.271 |
| Disagree with definition | Reasons on non-report Subscale: Six-point scale: Strongly disagree (1) to Strongly agree (6) | 2.28 | 1.153 |
| Reporting effort | | 2.46 | 1.510 |
| Fear | | 3.47 | 1.487 |
| Administrative response | | 3.42 | 1.370 |

Due to technical limitations, table 3,4 is only available as a download in the Supplemental Files section.