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# Prevalence, Characteristics, and Outcomes of Drug Administration Errors among Anesthesia Providers in Namibia - A Cross-Sectional Study

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## Abstract

**Background:** Drug administration errors are widespread in healthcare and are a major reason for malpractice claims against anesthesia service providers. The outcomes of medication errors range from no harm to grievous events such as intensive care admissions or death; nonetheless, they are preventable. In this survey, we determined the prevalence and characteristics of drug errors among anesthesia practitioners in Namibia, identified the contributing factors, and assessed their outcomes for patients. **Methods:** We used a cross-sectional design. A self-administered questionnaire was mailed to anesthesia service providers (specialist anesthesiologists, anesthesia registrars, and medical officers) across the 34 public hospitals and 18 private hospitals in Namibia over a period of one month. **Results:** Out of 122 questionnaires distributed, 112 (92%) anesthesia providers responded. A higher percentage were female (52%), and most were medical officers (56%). Among the respondents, 79% had experienced one or more medication errors during their anesthesia practice. The most common type was omission (46%), followed by the administration of a wrong drug (27%). In 69% of cases, there was no harm to the patients, while 6% had intensive care unit admissions and 1 (0.9%) died. **Conclusion:** We found a high prevalence of medication errors during anesthesia practice in Namibia, most due to fatigue or distractions. Most errors did not cause harm to the patients. It is imperative to increase awareness and training for prevention as well as to establish a nationally coordinated incident reporting system.

**Keywords**

Drug Administration Errors, Anesthesia Providers, Prevalence, Characteristics, Outcome, Namibia

## 1. Introduction

Anesthetic drug administration errors (DAEs) are very concerning, given that high-potency medications are administered parenterally within time-critical limits during surgery. The typical pressures in the operating room with high patient flow and work overload can make an anesthesia provider error-prone, coupled with the fact that no other practitioner vets the processes at his or her workstation [1] [2]. Patient safety is at the heart of medicine, hence the old doctrine, "first, do no harm." We define medication administration error according to the National Coordinating Council for Medication Error Reporting and Prevention (NCC-MERP) as "any preventable event leading to inappropriate drug use or patient harm, while under the control of a health care professional, patient, or consumer." The outcome of medication errors on patients could range from no adverse effect to death; the anesthetist involved (secondary victim) could also be traumatized psychologically. Studies have shown that this problem remains prevalent globally, with the occurrence rate ranging between 70% and 95% [3]-[5].

To the best of our knowledge, no case report or study has documented drug errors during anesthesia practice in Namibia. In this survey, we determined their prevalence and characteristics, identified the contributing factors among anesthesia providers, and assessed their outcomes on patients in Namibia.

## 2. Methods

Following approval from the Decentralized Ethical Committee of the University of Namibia (SOM20/2024), we employed a descriptive, cross-sectional study design. The total population of anesthesia providers in Namibia (122), comprising 92 anesthesia providers from public hospitals and 30 private practitioners, constituted the sampling frame. There are three categories of practitioners: specialists with postgraduate qualifications, registrars (medical officers undergoing anesthesia training), and medical officers (MOs). Each MO would have completed an 8-week anesthesia rotation during the 24-month internship period and a minimum of 12 weeks of supervised anesthesia service. A confidential, self-administered questionnaire created using Google Forms was distributed among the 122 anesthesia service providers in all public and private hospitals in Namibia via email and WhatsApp. The questionnaire, which was prepared with input from studies in Saudi Arabia and India [2] [6], was sent with an explanatory letter, and anonymity was assured. Participants were sent regular reminders during the 1-month survey period.

We excluded near misses, which are incidents with the potential to become

errors based on our NCCMERP definition of drug administration error. The questionnaire covered sociodemographic characteristics, experience with medication errors (including the nature of the error) and associated factors, as well as the outcome of the errors for the patients. The outcomes were none, minimal (reversible/short-term harm), moderate (harmful effect necessitating prolonged hospitalization or a therapeutic procedure), and severe (harmful effect that required intensive care therapy, a major procedure, or mortality). The data were recorded in Microsoft® Excel (2013) and analyzed using IBM SPSS Statistics for Windows, Version 22, Armonk, NY: IBM Corp. Descriptive statistics for nominal categorical variables are expressed as numbers, frequencies, and percentages. A logistic regression model was used to test for associations between drug errors and categorical data. The descriptive charts were generated using Microsoft Excel and SPSS.

## 3. Results

Out of a total of 122 anesthesia providers in Namibia, 112 (92%) completed the questionnaire; over half (52%) were female. According to Table 1, most participants (38%) were in the age group 25 - 35 years, and the majority (71%) worked in government hospitals. The anesthesia providers were mostly medical officers (63, 56%), and the fewest were specialists (21%). Most respondents (71%) had less than 5 years of experience. A higher proportion (80%) worked more than 8 hours per day.

Table 1. Sociodemographic characteristics of the study participants (n = 112).

| VARIABLE | Frequency (percent) |
|---|---|
| **Gender n (%)** | |
| Male | 54 (48.2) |
| Female | 58 (51.8) |
| **Age group, n (%)** | |
| 21 - 34 | 43 (38.4) |
| 35 - 44 | 36 (32.1) |
| 45 - 54 | 18 (16.1) |
| 55 - 64 | 14 (12.5) |
| 65 and above | 1 (0.9) |
| **Professional status, n (%)** | |
| Medical officer | 63 (56.3) |
| Registrar | 26 (23.2) |
| Specialist | 23 (20.5) |

Continued

| | |
|---|---|
| **Years of experience, n (%)** | |
| <5 | 80 (71.4) |
| 5 - 9 | 15 (13.4) |
| 10 - 14 | 17 (15.2) |
| **Workplace n (%)** | |
| Government hospital | 80 (71.4) |
| Private practice | 15 (13.4) |
| Government & private | 17 (15.2) |
| **Daily work hours, n (%)** | |
| >8 hours | 89 (79.5) |
| <8 hours | 23 (20.5) |

### 3.1. Prevalence and Characteristics of Medication Administration Errors among Participants

Among the respondents, 88 (79%) admitted to having experienced one or more DAEs during their anesthesia practice (Table 2). Of these, 30 (27%) experienced at least one medication error every 3 months in one year. For most participants (55%), although the DAEs were not related to any shift duty, they occurred more at night (38%) than during the day (7%). In 51 incidents (46%), the error was failure to administer an intended medication when due (omission), followed by the injection of a wrong drug (27%) (Figure 1).

Table 2. Prevalence, types, contributing factors, and sequelae of medication administration errors among participants (n = 112).

| Variable | Frequency (percent) |
|---|---|
| **Have you experienced a medication administration error during your anesthesia practice?** | |
| Yes | 88 (78.6) |
| No | 24 (21.4) |
| **How frequently did the errors occur?** | |
| Only once to date | 37 (33.0) |
| Once a year | 31 (27.7) |
| Once a month | 13 (11.6) |
| Once every three months | 14 (26.8) |
| Few per month | 1 (0.9) |

**Continued**

| | |
|---|---|
| **Professional status, n (%)** | |
| Medical officer | 63 (56.3) |
| Registrar | 26 (23.2) |
| Specialist | 23 (20.5) |
| **Years of experience n (%)** | |
| <5 | 80 (71.4) |
| 5 - 9 | 15 (13.4) |
| 10 - 14 | 17 (15.2) |
| **Workplace n (%)** | |
| Government hospital | 80 (71.4) |
| Private practice | 15 (13.4) |
| Government & private | 17 (15.2) |
| **Daily work hours, n (%)** | |
| >8 hours | 89 (79.5) |
| <8 hours | 23 (20.5) |

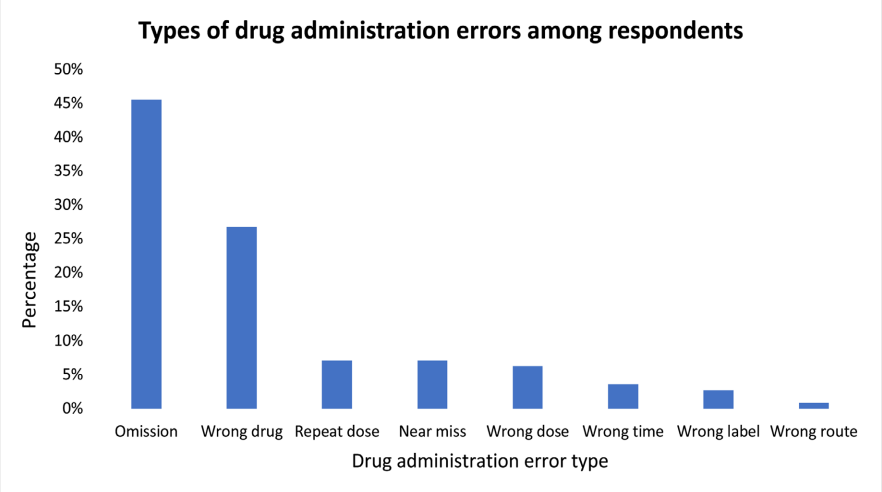


**Figure 1.** Types of drug administration errors among respondents.

The induction phase recorded the highest error rate (52%), followed by the maintenance phase (38%). The top two routes were intravenous and intrathecal. Most respondents (64%) drew the medications themselves; a higher proportion of practitioners (83%) labeled the syringe after drawing up the medication. Error detection was immediate in 80% of cases.

### 3.2. Contributory Factors and Outcomes of Medication Errors in Patients

Majority of respondents (67%) blamed fatigue and distraction for the occurrence of medication administration errors in their anesthesia practices (Figure 2). According to 77 (69%) respondents, there was no harm to the patients, 7 (6%) patients required ICU management, and only 1 (0.9%) mortality was recorded.

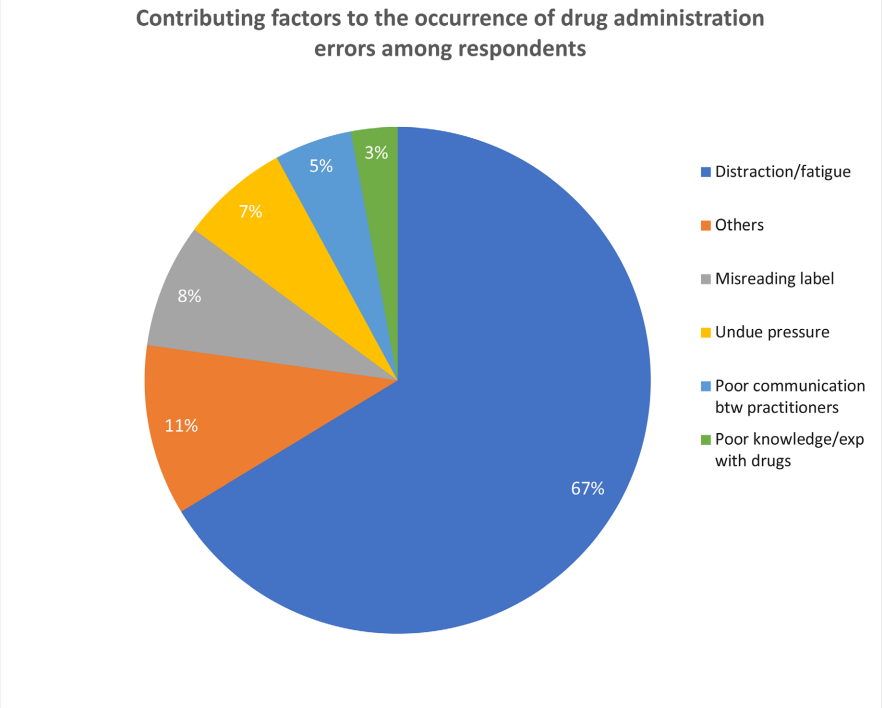


Figure 2. Contributing factors to the occurrence of drug administration errors among respondents.

## 4. Discussion

In our study of medication administration errors in Namibia, 92% of anesthesia practitioners responded, in contrast to similar studies in India, Ethiopia, and Saudi Arabia, which reported much lower rates of 9%, 42%, and 68%, respectively [2] [4] [7]. Our finding of a high occurrence rate (79%) of DAEs falls within the 70% - 95% range of several surveys [6]-[9]. While many international studies revealed high error rates, Labuschagne *et al.* in South Africa reported a much lower rate of 39% [6] [10]. Drug administration errors are a global phenomenon affecting both high- and low-income countries. The wide variation in prevalence could be attributable to the different study designs employed. Some researchers used direct observation, while others reviewed incident reporting systems. Furthermore, self-reporting requires a level of sincerity that cannot be ascertained. However, the guarantee of anonymity sought to address this limitation in our study (Figure 3).

In this study, 71% of the respondents who had experienced DAEs were mostly medical officers with less than 5 years of practice. However, results from similar

studies abroad indicated that years of experience and qualifications did not deter anesthesia providers from drug errors, given that a high percentage of their cohorts were specialists with much longer years of clinical experience [3] [4] [6].

**Table 3.** Factors associated with the occurrence of medication administration errors among respondents.

| | Medication error | | | |
|---|---|---|---|---|
| **Variables** | **Yes** | **No** | **P-value** | **Adjusted OR (95% CI)** |
| **Gender** | | | | |
| Female | 48 (82.8) | 10 (17.2) | 0.168 | 2.2 (0.72 - 6.54) |
| *Male | 40 (74.1) | 14 (25.9) | | 1 |
| **Age in years** | | | | |
| *25 - 34 | 32 (74.4) | 11 (25.6) | | 1 |
| 35 - 44 | 28 (77.8) | 8 (22.2) | 0.393 | 1.82 (0.46 - 7.13) |
| ≥45 | 28 (84.8) | 5 (15.2) | 0.073 | 4.45 (0.87 - 2.77) |
| **Years of Experience** | | | | |
| <10 | 75 (78.9) | 20 (21.1) | 0.698 | 1.33 (0.32 - 5.48) |
| *≥10 | 13 (76.5) | 4 (23.5) | | 1 |
| **Professional status** | | | | |
| REG | 24 (92.3) | 2 (7.7) | 0.506 | 1.58 (0.41- 6.00) |
| MO | 47 (74.6) | 16 (25.4) | 0.076 | 5.75 (0.83-39.77) |
| *Specialist | 17 (73.9) | 6 (26.1) | | 1 |
| **Hours of daily work** | | | | |
| >8 | 72 (80.9) | 17 (19.1) | 0.372 | 1.69 (0.54- 5.33) |
| *<8 | 16 (69.6) | 7 (30.4) | | 1 |
| **Use of colour-coded syringes** | | | | |
| Yes | 13 (86.7) | 2 (13.3) | 0.392 | 2.2 (0.37 - 13.08) |
| *No | 75 (77.3) | 22 (22.7) | | 1 |
| **How an anaesthetic drug is drawn into syringes** | | | | |
| Draw then label | 74 (79.6) | 19 (20.4) | 0.618 | 1.4 (0.37 - 5.46) |
| *Label then draw | 14 (73.7) | 5 (26.3) | | 1 |
| **The hospital has a critical reporting system** | | | | |
| No | 38 (79.2) | 10 (20.8) | 0.951 | 1.03 (0.38 - 2.81) |
| *Yes | 50 (78.1) | 14 (21.9) | | 1 |

* = Ref.

We reported that 82% of our practitioners who experienced MAEs worked over 8 h per day. Many researchers agree that excessive working hours by doctors is a health and patient safety issue [3] [11]-[13]. In the context of anesthesia practice, one long case without a break can cause fatigue, and sleep deprivation from frequent call duties can affect one's mental alertness. It is therefore not surprising that in many surveys, anesthetic drug errors were not related to daytime or nighttime working hours [3] [6] [8]. The European Working Time Directive (EWTD), which caps a maximum 48-hour work week and requires a minimum of 11 consecutive hours of rest per 24 h duty, might be difficult to implement in low- and middle-income countries due to inadequate human resources for health [12] [13].

In our cohort, omission (failure to administer the intended medication at the appropriate time) was the most common type of error, similar to the findings of the Chinese and South African studies previously mentioned [3] [7]. Some studies reported mostly errors of commission, such as wrong drug administration from syringe swabs or mislabeling, incorrect dosing, and wrong routes of administration. The common thread in these findings is that errors of commission and/or omission occur among anesthesia providers, irrespective of years of experience, qualification, or country of the practitioner [8] [10] [14] [15].

Most of our respondents (67%) blamed their medication errors on fatigue and distractions vis-à-vis work overload and the multi-tasking nature of anesthesia services in the operating theatres covered by a single attending anesthetist. Our findings are consistent with other studies which implicated human factors like haste, inattention, undue pressure to complete surgical lists, and inadequate familiarity with drugs or equipment [3] [4] [6].

As per the outcome of DAEs, 90% of respondents reported minimal or no harm to their patients, similar to many publications that showed many drug errors were inconsequential to patients. While it is true that the occurrence of serious incidents following drug administration errors is generally low, reversible/irreversible harm, prolonged hospitalizations, intensive care admissions, or deaths have been reported. Some researchers have reported the emotional toll on practitioners; given that drug errors are largely preventable, they contribute to increased hospital costs and are important reasons for malpractice claims against anesthetists [2] [6] [10] [16] - [18]. One study estimated that over 400,000 lives are lost yearly in the US due to medication errors, ranking third to cardiac conditions and cancer [19].

The strength of our survey lies in the high response rate among anesthesia practitioners in Namibia and the high error rate we reported, which contributes to the growing body of literature about anesthetic medication safety.

## 5. Conclusion

We found a high drug error rate akin to other studies, mostly due to errors of omission with fatigue/distractions as the root cause. Experienced clinicians made fewer errors than their less experienced colleagues, albeit not statistically significant. Most errors were associated with minimal or no harm to patients. We believe

that our results can help anesthesia practitioners and policymakers to set up an incident reporting system and formulate safety guidelines in Namibia as part of the National Health Policy.

## Limitation

We acknowledge the inherent weakness of the self-reporting methodology employed, as recall bias and reliance on participants' sincerity could have impacted our overall data.

## Ethical Approval

Ethical approval was obtained from the Decentralised Ethical Committee (DEC) of the University of Namibia, reference number SOM20/2024.

## Authors' Contributions

This study was conceived and designed by Oyinbo OM and Rukewe A. All authors participated in material preparation and analysis. The first draft was jointly written by Oyinbo OM and Rukewe A, and comments were received from the others. All authors read and approved the final manuscript.

## Data Availability

The dataset used and/or analyzed during this study is available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare no conflicts of interest.

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