

**ORIGINAL ARTICLE**

# Audit of medication errors by anesthetists in North Western Nigeria

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## Abstract

**Background:** Safety issues are an important aspect of anesthesia practice. The relevance of medication and drug administration errors in our everyday practice is an important aspect of medical audit. Although there have been few case reports of drug administration errors by anesthetists, there is paucity of information regarding medication errors in anesthetic practice in Nigeria. We set out to study the incidence of medication errors among anesthesia practitioners in Kaduna State, North Western Nigeria and to suggest ways to minimize such errors.

**Materials and Methods:** A questionnaire-based study was conducted among physician anesthetists and nurse anesthetists working in the major secondary and tertiary hospitals in Kaduna State, North Western Nigeria. The data obtained was analyzed using SPSS Version 17.0 and the data presented in relevant charts and tables.

**Results:** A total of 43 persons responded to the questionnaire with a high response rate of 86% and a male/female ratio of 2.3:1. Most of the anesthetists (38 or 88%) work in tertiary government hospitals. Twenty-four (56%) of them admitted to ever having a medication error, and 34 (79%) of them attributed the medication error to problems with drug labeling from manufactures using similar labels for different drugs. Untoward sequelae resulted in 44% of the patients that were affected by these medication errors and these ranged from cardiac arrest to delayed recovery from anesthesia. Majority of the respondents recommended vigilance, double checking of drug labels, and color coding of syringes as ways to minimize medication errors.

**Conclusion:** Medication errors do occur in the everyday practice of anesthetists in Nigeria as in other countries and can lead to morbidity and mortality in our patients. Routine audit and reporting of critical incidents including errors in drug administration should be encouraged. Reduction of medication errors is an important aspect of patient safety, and vigilance remains the watchword.

**Key words:** Anesthetic practice, medication errors, safety

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## Introduction

Drug errors during anesthesia remain a serious cause of iatrogenic harm.<sup>[1,2]</sup> The National Coordinating Council for Medication Errors Reporting and Prevention defines a medication error as any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the health-care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing;

order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.<sup>[3]</sup>

There is a dearth of information in the West African sub-region about drug administration errors among anesthetists. Mato and Fyनेface-Ogan working in the South-South region of Nigeria reported 3 cases of drug administration errors in a Teaching hospital.<sup>[4]</sup> These

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cases were mostly attributed to human error. The reported incidence of medication errors range from 1:131 to 1:5475 anesthetics.<sup>[5-9]</sup>

Despite the wide range of reported incidence and perceived lack of consensus regarding the magnitude of the problem, it is unacceptable that any patient suffers harm, no matter how minor, while undergoing anesthesia.<sup>[10]</sup> The relevance of medication and drug administration errors in our everyday practice cannot be understated.

We set out to study the incidence of self-reported medication errors among anesthesia practitioners working in health institutions in Kaduna State, Nigeria and to suggest ways to minimize such errors.

## Materials and Methods

This multi-center cross-sectional survey was conducted among physician anesthetists and nurse anesthetists working in the major secondary and tertiary hospitals in Kaduna State, North Western Nigeria. Fifty structured questionnaires were administered to anesthesia care-givers at 6 hospitals that were selected based on convenience. The total number of eligible respondents was 56, and the 50 respondents that were included in the study were selected on the basis of convenience and availability. Forty-three questionnaires were returned, and the data obtained was analyzed using SPSS Version 17.0 and the data presented in relevant charts. Fisher's exact *t*-test was applied where applicable, and a  $P < 0.05$  was considered as statistically significant.

## Results

A total of 43 persons responded to the questionnaire (86% response rate) with 30 being males and 13 females, giving a male/female ratio of 2.3:1. There were 23 physician anesthetists (including consultants and trainees) and 20 nurse anesthetists [Figure 1]. Most of the respondents (39 or 88%) work in tertiary government hospitals [Figure 2]. Majority of the anesthetists 24 (56%) admitted to ever having a medication error [Figure 3]. More Physicians than nurse anesthetists reported drug errors, and this was statistically significant ( $P = 0.037$ ; Figure 4).

The years of practice also show a significant relationship with medication errors ( $P = 0.040$ ), but it is observed that most of the respondents were in the category of 5-10 years' experience while other groups had fewer numbers [Figure 5]. Government secondary tertiary health institutions seem to have more medication errors, but the Chi-square *P* value indicates that it is random and the relationship of type/place of practice is by chance.

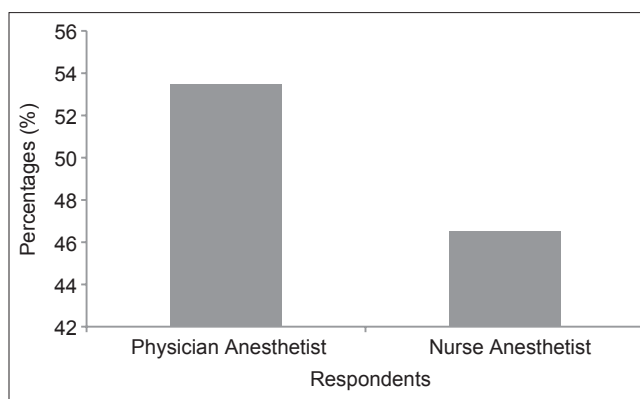


Figure 1: Distribution of Respondents

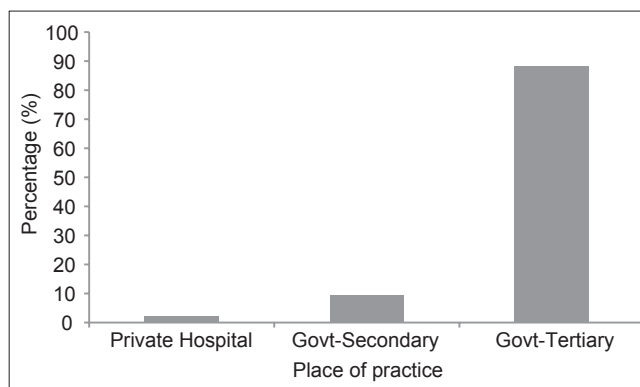


Figure 2: Distribution according to place of practice

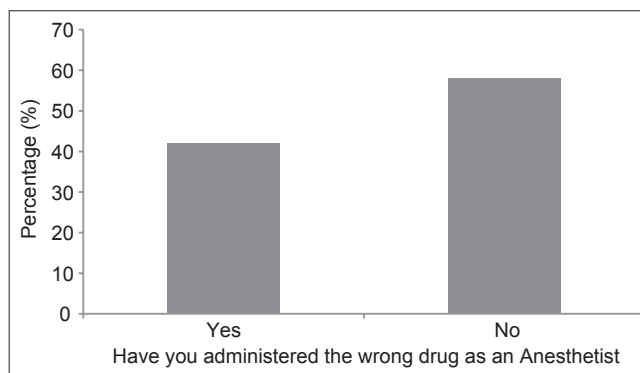


Figure 3: Distribution according to medication error

The drugs most commonly administered erroneously are pancuronium instead of suxamethonium, atropine instead of ergometrine or adrenaline instead of oxytocin and vice versa, and the syringe swap or vial swap of suxamethonium chloride for pancuronium was a common mistake often made by the respondents.

Some of the errors were classified as dangerous with the potential to cause serious hemodynamic or neurological damage, for example, administering adrenaline instead of oxytocin. One patient suffered a cardiac arrest after receiving adrenaline in error. Seventy-nine percent (40) of the anesthetists attributed the medication error to

problems of the drugs with similar labeling by the drug manufacturers [Plates 1 and 2]. Fatigue and syringe labeling errors were contributory factors to medication errors according to 23.5% and 28.4% of the anesthetists, respectively. Of the patients in whom there was a medication error, 81% suffered from a brief apnea. Other untoward sequelae ranged from sedation, tachycardia, and cardiac arrest to delayed recovery from anesthesia in 19% of the

patients [Figure 6]. Majority of the respondents recommend vigilance (9), appropriate and double checking of drug labels (18), and color coding of syringes (7) as ways to minimize medication errors. Other recommendations by the respondents include selection of appropriate drugs by the anesthetists (3), provision of adequate manpower (anesthetists) (2), and training and retraining of those already on staff (4) [Figure 7].



Plate 1: Ampoules of Suxamethonium and Pancuronium



Plate 2: Thiopentone 500 mg and 1 gm vials by Rotex Medica® GMBH

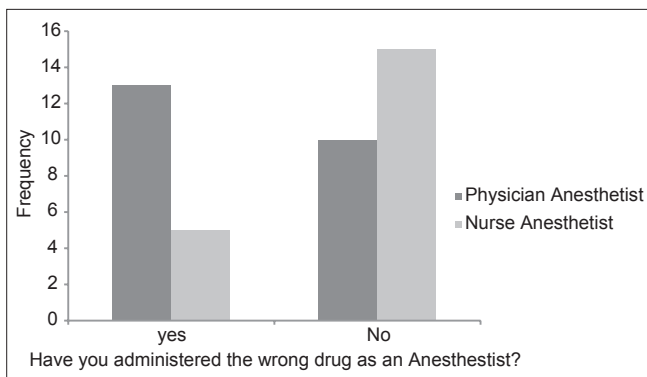


Figure 4: Distribution of medication errors according to basic qualification

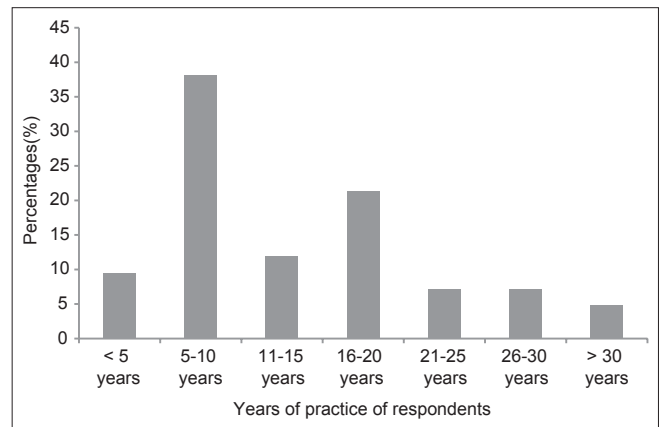


Figure 5: Years of practice of respondents

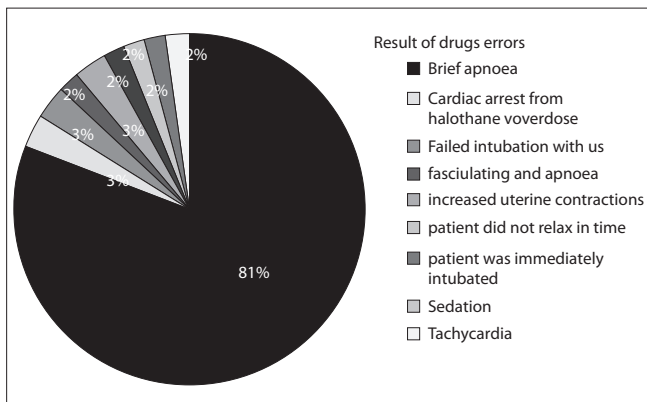


Figure 6: Reported result of drugs errors on patients

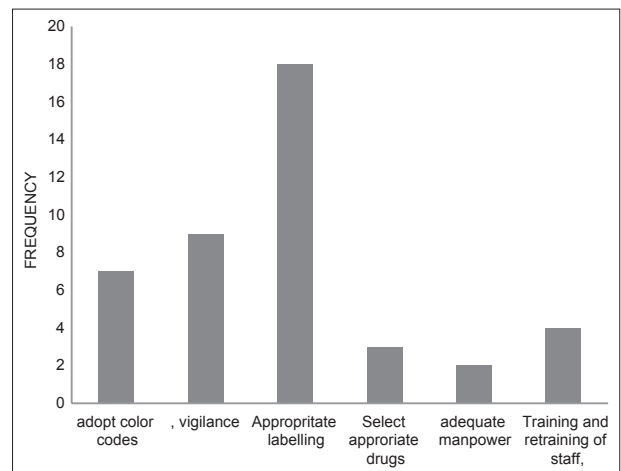


Figure 7: Recommendations by respondents

## Discussion

Medication errors in anesthesia are mainly those of drug administration and not prescription because in the operating theaters, the anesthetists select, prepare, label, and administer all the drugs needed for the procedure. As a result, commonly known strategies for reduction of prescription errors such as computerized physician order systems and support systems are of little use in anesthesia.

Webster, *et al.*,<sup>[6]</sup> classified the drug errors into the following categories:

- Omission – drug not given
- Repetition – extra dose of an intended drug.
- Substitution – incorrect drug instead of the desired drug; a swap
- Insertion – a drug that was not intended to be given at a particular time or at any time
- Incorrect dose – wrong dose of an intended drug
- Incorrect route – wrong route of an intended drug
- Other – usually a more complex event not fitting the categories above.

The high response rate (86%) in this survey is noteworthy. It is usually assumed that the higher the response rate, the more likely the results are representative of the population, provided the sampling is appropriate. This survey suggests that the incidence of self-reported drug administration errors by anesthetists in Kaduna State, North Western Nigeria is similar to that in other countries.<sup>[11,12]</sup> In an earlier survey by Merry and Peck,<sup>[11]</sup> a questionnaire was posted to a random sample of 75 New Zealand anesthetists. Drug administrations per anesthetic were counted on a random sample of anesthetic records at Green Lane Hospital. Ten anesthetists were asked the number of anesthetics administered per year. Eighty-nine percent of 66 respondents reported at least one error of drug administration, and 12.5% had actually harmed patients. There was no relationship between any preventative strategy and frequency of error.<sup>[11]</sup> This is somewhat similar to the findings in our survey where Majority of the anesthetists 24 (56%) admitted to ever having a medication error [Figure 3].

In a similar but larger survey in Canada, Orser and colleagues<sup>[12]</sup> set out to determine if anesthetists in Canada had experienced a medication error and to identify causal factors. The perceived value of a Canadian reporting agency for medication errors and improved standards for labels on drug ampoules was also investigated. They conducted a self-reporting survey mailed to members of the Canadian Anesthesiologists' Society ( $n = 2,266$ ). Respondents provided free-text descriptions of medication errors and answered fixed response questions. Surveys from 687 anesthesiologists (30% response rate) revealed that 85% of the participants had experienced at least one drug error or "near miss." Although most errors (1,038) were of

minor consequence (98%), four deaths were reported. The commonest error involved the administration of muscle relaxants instead of a reversal agent. "Syringe swaps" (70.4%) and the misidentification of the label (46.8%) were common contributing factors. The Canadian anesthetists (97.9%) reported that they read the ampoule label "most of the time" although the label color was an important secondary cue. Approximately half of the participants in that study said they would report the error if a reporting program existed, and 84% agreed that improved standards for drug labels would reduce the incidence of error. Orser and colleagues concluded that most anesthetists in their survey experienced at least one drug error. The commonest error was a "syringe swap" that involved a muscle relaxant. Most errors were of minor consequence; however, serious morbidity and mortality resulted from clearly preventable events. Their results supported the development of improved standards for drug labels and the establishment of a Canadian reporting program for medication errors.<sup>[12]</sup>

No anesthetist will complete his or her career without making a drug error at some stage.<sup>[13]</sup> The overall likelihood of a drug error when anaesthetizing an individual patient may be very low 0.01-0.75%.<sup>[13]</sup> In our survey, more physician anesthetists seem to have reported that they have administered drugs in error than nurse anesthetists. This is evidenced by the higher numbers [Figure 4] and the higher  $P$  value (0.037). However, this data obtained is 'self-reported' by the respondents, and it is possible that some of the reports may be biased.

In this report, the years of practice also show a significant relationship with medication errors ( $P = 0.040$ ), but it is observed that most of the respondents were in the category of 5-10 years' of experience while other groups had fewer numbers [Figure 5]. It may be difficult to conclude from the results because it doesn't really have a pattern, and the groups are not well represented even though the results have been expressed in percentages. The interpretation of the findings of this survey is that the higher the year of practice from 5 years upwards, the higher the risk of medication errors. This may be due to exposure to higher numbers of cases as the years go by. Government secondary tertiary health institutions seem to have more medication errors, but the Chi-square  $P$  value indicates that it is random and the relationship of type/place of practice is by chance.

In our survey, the majority of errors did not result in patient harm (56%), but the incidence of potentially dangerous errors, particularly those involving vasoactive drugs such as adrenaline is of concern. One patient suffered a cardiac arrest due to wrongful administration of adrenaline instead of oxytocin during a cesarean section; however, she was successfully resuscitated [Figure 6]. Apart from patient morbidity and even death, wrong drug administrations have

economic consequences as they may lead to prolongation of the duration of hospital stay.

Poor labeling of ampoules and vials was identified as another important cause of drug errors. Strategies described to prevent such errors include improved labeling with clear fonts that emphasize the generic name rather than the proprietary name,<sup>[14]</sup> using a two-person check when drawing up drugs, and the introduction of bar-coded ampoules with a computer that speaks the name of the drug after it has been scanned before being drawn up.<sup>[15]</sup>

A hospital-based, bar-code-enabled point-of-care system can work as follows:<sup>[16]</sup>

- Each patient receives a bar-coded identification bracelet. The bar code on the bracelet links the patient with his or her electronic health record, which is maintained by the hospital and which contains information about drug therapy and other medical information
- Each unit dose of medication (for both prescription and non-prescription drugs) is labeled with a bar code
- At the time the medication is dispensed for a patient, pharmacy staff use a scanner to read the medication's bar code. The computerized database matches this code with the information in the patient's health record, to confirm that the correct medication is being dispensed
- Before the medication is administered to the patient, the nurse or other health care provider uses a bedside or portable scanner or reader to scan both the bar code on the patient's identification bracelet and the bar code on the label of the unit-dose package of the medication to be administered
- The computer compares information in the patient's health record with information linked to the medication's bar code. If there is a match, a confirmation is issued, and the medication, dosage, and time of administration are entered automatically into the patient's electronic health record. If the information does not match (e.g. an error in patient identification, medication, dose, dosage form, or administration time), the nurse is alerted by an error message, and a possible adverse event is avoided. This process allows such "near misses" to be captured for analysis, so that the institution can address causes in a systematic way.<sup>[17]</sup>

Bar code-enabled medication dispensing and administration can be expected to reduce the incidence of the following medication errors:

- Administering the wrong medication or dosage form to a patient
- Administering a medication to a patient who is known to be allergic to that particular drug
- Administering a medication to the wrong patient
- Administering a medication at the wrong time
- Duplicating doses.

At present, there is no bar code or color code to identify ampoules according to drug class in our practice. Color code is an internationally accepted safety measure for drugs, and this is used by drug manufacturing companies. Standardization of this safety measure by practicing anesthetists will help prevent drug errors.

Majority of the respondents in our study recommend that correct labeling of drugs vials and ampoules and also syringe labeling will reduce the cases of medication errors [Figure 7]. Anesthetists are responsible for labeling the syringes they use, and this should be done with utmost care and vigilance.

The administration of drugs to patients is a complex process, which at its simplest involves prescription, preparation, and finally administering the drug itself. According to Bates *et al.*<sup>[18]</sup> medications errors occur during the processes of prescribing (39%), transcribing (12%), dispensing (11%), and administering 38%. In the operating room, anesthetists are unique in that a single practitioner is usually responsible for all parts of the process often without any formal checking maneuvers required. In other areas of medical practice, several individuals may be involved, and checking mechanisms are usually more robust. It is, therefore, important that as anesthetists, we demonstrate that we are practicing safely.

From this study, the drugs most commonly administered erroneously are pancuronium instead of suxamethonium, atropine instead of ergometrine, or adrenaline instead of oxytocin and vice versa. The syringe swap or vial swap of suxamethonium chloride for pancuronium was a common mistake often made by the respondents. This is similar to the findings by Bowdle,<sup>[19]</sup> in which a wide variety of drugs were involved in errors such as inhalational agents, opioids, muscle relaxants, and vasoactive agents. Two drugs in particular were most commonly involved. Succinylcholine was involved in 35 cases (17 percent), and epinephrine was involved in 17 cases (8 percent). In that study, drugs that were interchanged with epinephrine were ephedrine (two cases), pitocin (three cases), and hydralazine (one case).<sup>[19]</sup>

Jensen *et al.*<sup>[20]</sup> developed evidence-based recommendations for the minimization of errors in intravenous drug administration in anesthesia from a systematic review of the literature that identified 98 relevant references (14 with experimental designs or incident reports and 19 with reports of cases or case series). They validated the recommendations using reports of drug errors collected in a previous study. One general and five specific strong recommendations were generated: Systematic counter measures should be used to decrease the number of drug administration errors in anesthesia; the label on any drug ampoule or syringe should be read carefully before a drug is drawn up or injected; the legibility and contents of labels on ampoules and syringes should be optimized according to agreed standards; syringes should (almost) always be labeled; formal organization of

drug drawers and workspaces should be used; labels should be checked with a second person or a device before a drug is drawn up or administered.<sup>[20]</sup>

Other recommendations by the respondents in our survey include: Selection of appropriate drugs by the anesthetists, provision of adequate manpower (anesthetists), and training and retraining of those already on staff [Figure 7]. These aspects of minimizing errors drug administration are necessary in order to maintain a high level of safety.

### Limitations of the study

The number of respondents (43), even though representative of Kaduna State might be too small to represent the population of physician and nurse anesthetists in Nigeria and, so, may be difficult to extrapolate and make far reaching conclusions for Nigeria. Also, the data obtained is 'self-reported' by the respondents, and it is possible that some of the reports may be biased. It may, therefore, be difficult to conclude from these results because some aspects do not really have a pattern and the groups are not well represented.

### Conclusion

This study has shown that anesthetists in our survey make errors in much the same way as those who have been studied elsewhere. Majority of anesthetists will administer a wrong drug at some time or another in their career. An important minority of such incidents may cause significant patient morbidity or mortality. Mechanisms for reporting such incidents should be put in place to identify possible causes and implement measures to prevent further incidents. Prospective, randomized studies investigating the incidence of medication errors and strategies to decrease the incidences of wrong drug administration are needed. Reduction in the incidence of medication errors is an important aspect of patient safety, and vigilance remains the watchword in the safe conduct of anesthesia.

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