



Drug administration errors by South African anaesthetists – a survey

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Objectives. To investigate the incidence, nature of and factors contributing towards wrong drug administrations by South African anaesthetists.

Design. A confidential, self-reporting survey was sent out to the 720 anaesthetists on the database of the South African Society of Anaesthesiologists.

Results. A total of 133 questionnaires were returned for analysis (18.5% response rate). Of the respondents, 125 (94%) admitted to having inadvertently administered a wrong drug. Thirty respondents (22.6%) said they had made errors on at least four occasions. A total of 303 specific wrong drug administrations were described. Nearly 50% involved muscle relaxants. A further 43 incidents (14%) involved the erroneous administration of vasoactive drugs. Five deaths and 3 non-fatal cardiac arrests were reported. In 9.9% of incidents the anaesthetic time was prolonged by more than 30 minutes.

Contributory causes identified included syringe swaps (40%), misidentification of drugs (27.1%), fatigue (14.1%), distractions (4.7%), and mislabelling of syringes (4.7%). Only 19% of respondents regularly use colour-coded syringe labels complying with the national standard.

Conclusions. Most anaesthetists experienced at least one drug error. The incidence of wrong drug administrations by South African anaesthetists appears to be similar to that in Australasia and Canada. The commonest error was a 'syringe swap' involving muscle relaxants. Most drug errors are inconsequential. An important minority of incidents result in severe morbidity or death. The study supports efforts to improve ampoule labelling, to encourage the use of syringe labels based on the international colour code and to develop a national reporting system for such incidents.

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Medication errors are an important problem in health care, causing harm to patients and increasing costs. In 1993 they were estimated to account for 7 000 deaths in the USA.¹ The problem is particularly troublesome in anaesthesia. Studies from New Zealand, Australia and Canada suggest that the majority of anaesthetists will administer the wrong drug at some stage during their career.²⁻⁴ Although the majority of wrong drug administrations do not result in harm to patients, a significant minority of incidents result in morbidity or death.³ Apart from an audit of drug administration errors performed at the University of Cape Town (UCT) in 2004,⁵ the incidence in South Africa is unknown. This study set out to investigate the incidence, nature and possible causes of wrong drug administration among members of the South African Society of Anaesthesiologists (SASA).

Methods

After obtaining ethics committee approval from the UCT Ethics Committee, a confidential self-reporting survey was posted and sent electronically to all 720 anaesthetists registered with the SASA in 2004. The questionnaire was accompanied by an explanatory letter and the anonymity of respondents was

assured. Information was sought as to the incidence, nature of and factors contributing to wrong drug administrations.

Results

A total of 133 completed surveys were returned for analysis (18.5% response rate). Three-quarters of respondents were in full-time private practice and 18.8% in academic practice. One hundred and twenty-five respondents (94%) admitted to having administered a wrong drug or the right drug into the wrong site at some stage during their anaesthetic career. Thirty of these (22.6%) had done so on at least four occasions.

A total of 303 specific wrong drug administrations were made. The syringe swap of suxamethonium chloride for fentanyl was the single commonest error (37/303 incidents, 12.2%). This error frequently occurred before induction of anaesthesia and in 13 cases the patient was aware of being paralysed before onset of anaesthesia. In 43 incidents (14%) the error involved the wrong administration of a potentially dangerous vasoactive drug. Thirty-eight of 133 respondents (28.6%) had either been personally responsible for, or had been aware of a nurse under their direction, injecting a drug into a wrong site. The groups of drugs most commonly administered erroneously are shown in Fig. 1.

The reported clinical effects of drug errors are shown in Table I. The majority of adverse events were of no clinical significance. However, immediate intervention was required in 121 recorded outcomes (41.3%). There were 5 deaths in this series. One death was considered to be surgical and unrelated to the wrong drug administration. A second death was due

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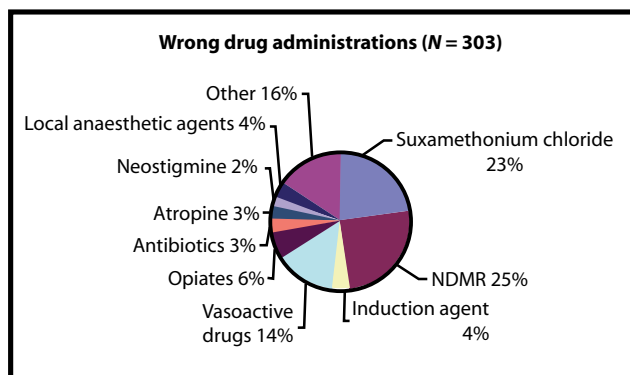


Fig. 1. Categories of drugs administered in error during anaesthesia (N = 303) (NDMR = non-depolarising muscle relaxant).

Table I. Clinical effects of drug errors (N = 216)

Clinical effect	Number
Hypertension	24
Hypotension	4
Cardiac arrest	5
Tachycardia	10
Bradycardia	5
Prolonged paralysis	87
Other	61
Awareness under anaesthesia	20

to an unintended overdose of lignocaine where a highly concentrated preparation intended for intravenous infusion only was used in error for regional anaesthesia. The third death involved the erroneous use of propranolol in place of adrenaline during cardiac resuscitation; the patient died 48 hours after the incident and whether or not the patient would have survived without this error is unclear. One death involved the use of the wrong concentration of esmolol, resulting in the administration of 50 times the intended dose. The final death was the result of a nursing error when a muscle relaxant was administered instead of a local anaesthetic resulting in paralysis and hypoxia. Three non-fatal cardiac arrests were reported. Two of these involved the administration of adrenaline instead of a neuromuscular reversal agent and both were resuscitated successfully. In the third case, suxamethonium was given when a non-depolarising relaxant had been intended and this led to a brief, easily managed cardiac arrest.

Errors led to a prolongation of the anaesthetic time in 81/303 incidents (26.7%). In 31/303 incidents anaesthetic time was prolonged by more than 30 minutes but less than 2 hours.

The major contributory factors identified were syringe swap (injecting from the incorrect syringe) (40.2%), misidentification of drug (27.1%), fatigue (14.1%), distraction (4.7%), and mislabelling of syringes (3.6%) (Table II). Sixty per cent of respondents always read the labels on ampoules before drawing up drugs whereas 39% read the labels 'most of the time'. Although 62% of respondents were aware of the

Table II. Factors contributing to wrong drug administrations (N = 361)

Contributing factor	Primary	Secondary	Total	% of total
Syringe swap	144	1	145	40.2
Misidentification	98	0	98	27.1
Fatigue	14	37	51	14.1
Distraction	8	9	17	4.7
Mislabelling	11	2	13	3.6
Other	15	5	20	5.5
No factor given	8	9	17	4.7

existence of a South African standard for the colour coding of syringe labels in theatre and three-quarters felt strongly that colour-coded syringe labels in theatre would decrease the incidence of drug errors, only 19% regularly use such colour-coded labels. In comparison, only 13% of respondents felt strongly that having all syringes labelled with black-on-white labels would reduce the incidence. Three-quarters of respondents felt strongly that a standardised colour-coding system of labelling drug ampoules would decrease the incidence of drug errors.

Errors were reported at the time by only 28/125 anaesthetists who reported making an error (22.4%). Nearly 60% of respondents (79/133) would have reported the incident to a central agency if one existed. The preferred central reporting agency for drug administration errors by respondents was SASA (79%), followed by the Medicines Control Council (14.2%), the hospital concerned (8%), and the Department of Health (6.8%).

Discussion

This survey suggests that the incidence of drug administration errors by South African anaesthetists is similar to that in other First-World countries.^{2,3} Although the probability of an anaesthetist making a drug error at some stage of his or her career is high, the overall likelihood of a drug error when anaesthetising an individual patient remains very low. The majority of errors did not result in patient harm but the incidence of potentially dangerous errors, particularly those involving vasoactive drugs, is of concern. Wrong drug administrations have economic consequences. Apart from patient morbidity and even death, our study showed that in over one-quarter of incidents, anaesthesia was prolonged by over 30 minutes.

Our study confirms that 'syringe swaps' are a frequent cause of drug error. In the study by Currie *et al.*,⁴ 63% of syringe swap errors occurred with correctly labelled syringes. The use of colour-coded syringe labels to identify drug class should be regarded as important secondary cues to identify syringes correctly but can never replace careful reading of the label. Anaesthetists need to be aware of the tendency of the human brain to identify words by pattern recognition rather than reading the letters. Hence the importance of teaching



students to read the print consciously on every label before drawing drug up into the syringe. Failure to read ampoule labels correctly and poor labelling are probably responsible for misidentification of drugs being the second most common cause of drug administration error. Fatigue featured as an important contributing factor. Causes of fatigue included sleep deprivation, boredom, work overload, physical exhaustion and alterations in circadian rhythm. The relationship between fatigue and pharmacological errors and the increased risk of such errors between midnight and 06h00 has been well documented, supporting the need for fatigue alleviation strategies and the need to limit surgery to emergency cases only after midnight.⁶

This study highlights the failure of most South African hospitals to provide internationally accepted colour-coded syringe labels for use in theatres. In 1985, Foster from Tygerberg Hospital, under the auspices of SASA and the South African Bureau of Standards (SABS), pioneered the development of a national and international standard for colour coding of syringe labels.⁷⁻⁹ This colour-coding system has been modified and adopted by authorities in the USA, Australasia, Canada and the UK.¹⁰ The SABS is currently revising the standard to comply with the international standard. Many South African anaesthetists work in multiple hospitals. Standardisation of labelling is therefore important and hospital administrators should be encouraged to provide such labels in all theatres.

Strategies described to prevent drug administration errors include improved labelling with clear fonts that emphasise the generic name rather than the proprietary name,¹⁰ 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.¹¹ At present there is no colour code to identify ampoules according to drug class. The adoption of the international code for colour coding of syringe labels for labelling ampoules by drug manufacturers would readily identify the class of drug. It would not eliminate the risk of incorrectly administering drugs of similar class such as phenylephrine for ephedrine. To avoid such errors, hospital administrators should consider purchasing prefilled syringes of drugs such as ephedrine.

The storage and presentation of drugs in theatres probably influences the likelihood of drug errors. Drug drawers are frequently haphazardly packed, with drugs with radically different actions next to each other. Webster *et al.*¹² have suggested that compartments in the drug trolley be colour coded for class of drugs.

Our findings support those of Jensen *et al.*¹³ who undertook a systematic review of the literature and made the following evidence-based recommendations for preventing drug administration errors during anaesthesia: systematic countermeasures should be used to decrease the number of drug administration errors in anaesthesia; 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 optimised according to agreed standards; syringes should (almost) always be labelled; there should be formal organisation of drug drawers and workspaces; and labels should be checked with a second person or a device before a drug is drawn up or administered.

Self-reporting surveys have limitations as tools for investigating medication errors.³ Participants are self-selected and may only report errors they judge to be consequential. Details of errors that occurred many years ago may have been forgotten. Importantly, the incidence of errors cannot be determined because the number of anaesthetics administered is not known. A prospective, multicentre study is currently underway in South Africa to attempt to ascertain the true incidence.

Conclusions

Most anaesthetists will administer a wrong drug at some time. An important minority of such incidents may cause significant patient morbidity or death. Anaesthetists and administrators need to be aware of the problem. Mechanisms for reporting such incidents should be in place to identify possible causes and measures implemented to prevent further incidents. Prospective, randomised studies investigating strategies to decrease the incidence of wrong drug administration are needed. Bodies such as the SABS, SASA and the Medicines Control Council should be involved with the pharmaceutical industry to improve and standardise ampoule labels.

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