Medication error in anaesthesia and critical care: A cause for concern

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INTRODUCTION

“The error of one moment becomes the sorrow of whole life” - A Chinese proverb

The management of anaesthesia and critical patients has become safe with the advent of newer safe anaesthesia drugs, good quality equipments and high standards of monitoring, but the practice of poly-pharmacy, complex working conditions and involvement of multilevel medical and paramedical staff expose these areas to potentially life threatening medication error at some point of the treatment process.

Although majority of these errors are without any serious adverse outcome but some of them are associated with increased morbidity and mortality leading to prolonged hospital stay, high cost of treatment and potential for litigation. The Institute of Medicine (IOM) report highlights that 44000 - 98000 patients die each year as a result of medical errors, a large portion of these being medication related.

INCIDENCE

Medication errors are common in health care system and reported to be the seventh most common cause of death overall. A total of 2266 members of the Canadian Society of Anaesthesiologists were approached to find out the incidence of medication errors. Surprisingly 30% of them admitted to experience at least more than one error in their lifetime. Japanese Society of Anaesthesiologists (JSA) investigated 27454 anaesthesia procedures over a period of 8 years (1999 – 2007). Out of total 233 incidences of medication error, 6.2% were clerical errors, hence they were not included in the study. Rest were either over-dose (25%), substitution error (23%) or omission error (21%). A total of 89% of respondents in a survey of anaesthesiologists in New Zealand have admitted to made a drug administration error at some stage of their carrier. In a retrospective review of 2000 anaesthetic procedures in Australia, 144 were found to be involved in wrong drug administration. In another study of 55426 cases in Norway, 63 (0.11%) cases of a drug error were found, out of which 3 cases were classified as serious.

Among critically ill patients, the rate of medical error ranges from 1.2 to 947 errors per 1000 ICU days with a median of 106 errors per 1000 ICU days. In intensive care although majority (40%) were of wrong infusion rate, in another study, the incidence of adverse drug event (ADE) was found to be similar in medical ICU and coronary care unit of a tertiary care hospital (127.8 and 131.5 errors per 1000 patient days, respectively).

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All these reports are the tip of the iceberg as many cases are not reported due to various reasons like different population variation, clinical practice variation, lack of uniformity in definition, method of reporting and collection of data, fear of blaming and defamation among colleagues etc.[14]

**TYPES OF MEDICATION ERRORS**

A medication error is any error in the medication process, whether there are adverse consequences or not [Table 1]. Errors can be divided into two groups according to the working system:[15] active failure and latent conditions. **Active failure** are unsafe acts committed by people who are in direct contact with the patient, slip and lapse are skill behaviour errors whereas mistakes are knowledge-based errors due to perception, judgement, inference or interpretation. **Latent conditions** are due to the reasons within the system and occurs when individuals make decisions that have unintended consequences in the future.[15,16]

Alternatively, errors can be classified as error of omission or error of commission. **Errors of omission** are defined as failure to perform an appropriate action whereas **errors of commission** are defined as performing an inappropriate action.[17]

The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) realised the need for a standardised categorisation of error. On 16 July 1996, this council adopted a medication error index that classified the error according to the severity of the outcome.[18] [Figure 1]. This is required for categorising medication errors. The ISMP has already implemented this index for use in the database.

**TIME OF THE MEDICATION ERROR**

Critical incidents occurred most commonly during middle of the anaesthesia (42%), frequently during induction (28%) and at the beginning of the procedure (17%).[19] Against the popular belief that most of the medication errors occur in late night shifts, Fasting et al[9] found that out of 63 drug errors only 1 occurred at night, whereas 56 incidences occurred in day shifts.

The administration of a single dose of any drug to the patient in critical care requires at least 80 - 200 individual steps at different stages namely prescription, transcription, preparation, dispersion, and administration.[20] Most errors occurs during the administration stage (53%), followed by prescription (17%), preparation (14%), and transcription (11%).[21]

**RISK FACTORS**

Previous reviewers had concentrated primarily on quantitating the overall anaesthesia risk using mortality as the measure of negative outcomes. Human errors were believed to be a factor ranging from 65-87% for deaths during anaesthesia in several studies.[22-25]

Attempts to identify the risk factors have been limited to variables related to either surgical procedures or

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**Table 1: Definition of medication errors**[16]

| Medical error          | Definition                                                                 |
|------------------------|---------------------------------------------------------------------------|
| Medication error       | Any error in the medication process, whether there are any adverse consequences or not |
| Adverse drug event     | Any injury related to the use of a drug. Not all adverse drug events are caused by medical error or vice versa |
| Preventable ADE        | Harm that could have been avoided through reasonable planning or proper execution of an action |
| Near miss              | The occurrence of an error that did not result in harm                    |
| Slip                   | A failure to execute an action due to routine behaviour being misdirected |
| Lapse                  | A failure to execute an action due to lapse in memory and a routine behaviour being omitted |
patients. Factors associated with anaesthesia and/or factors that may have predisposed to an anaesthesia error were not analysed. Furthermore, no study has focused on the process of error, devices, etc., regardless of the outcome. Cooper and colleagues\(^{26}\) have identified several risk factors in a critical incident analysis to study preventable mistakes. Maximum errors were due to either inadequate experience (16\%) or due to inadequate familiarity to equipment or device (9.3\%) whereas haste and inattention or carelessness each amounted to 5.6\% errors during anaesthesia [Table 2].

Various other factors exist in operating rooms giving rise to a high incidence of medication errors during the conduction of anaesthesia. Lack of staff, overtime and odd working hours, inattention, poor communication, carelessness, haste and fatigue are the common factors related to medical and paramedical personnel.\(^{8,10,27-29}\) Look-alike, sound-alike drugs,\(^{30,31}\) confusing, inaccurate or incomplete drug labels and packaging,\(^{31}\) swapping of syringe labels,\(^{32}\) swapping of syringes and ampoules,\(^{33}\) unlabelled syringe,\(^{34}\) and failure of drug dose calculation,\(^{5}\) have been reported in the literature from time to time.

In critical care, apart from those mentioned above, some other factors also exist which complicate the matter further. Severity of illness,\(^{35}\) lack of usual medication list,\(^{36}\) need of sedation and artificial ventilation,\(^{37}\) calculation and programming of infusion pumps,\(^{38}\) inexperience, lack of drug knowledge, sleep deprivation of provider,\(^{39,40}\) high stress and fast pace of medication\(^{10}\) and frequent changes in drugs and doses\(^{41}\) have been listed by different authors.

**DRUGS INVOLVED IN MEDICATION ERRORS**

Various group of drugs involved in medication errors during practice of anaesthesia have been reported by different authors. Induction agents like pentothal sodium, ketamine, depolarizing and non-depolarizing muscle relaxants, narcotic and sedatives, anticholinergics, and local anaesthetics have been given wrongly either due to misidentification, wrong labelling, syringe swap, or exchange with another drugs because of inattention or haste. However, in majority of the cases these errors did not result in any serious harm to the patients.\(^{5,9,42}\)

In critical care units, the involvement of inotropes, narcotics, sedatives, analgesics, potassium chloride, magnesium sulphate, and anticoagulants like heparin or anti-infective agents have been identified in different studies.\(^{12,13,43,44}\)

**CONSEQUENCES OF MEDICATION ERRORS**

There is an increasing recognition that medication errors are causing a substantial global problem as many results in harm to patients and increased cost to health care providers, and anaesthesia and critical care are no exception to this.\(^{45}\)

Medical errors are the leading cause of death in USA. A total of 44000 - 98000 Americans die every year. IOM has estimated that each year medical errors injured at least 1.5 million Americans and cost the health system more than 3.5 billion U.S. dollars. In another study approximately 7000 deaths in USA have cost more than 2 billion dollars.\(^{3}\)

Medical errors erode not only a patient’s but also a family’s confidence in health care organisations, public confidence also suffers due to these errors.\(^{46}\) The memory of errors can haunt the provider for
After a systemic review, Jenson and colleagues recommended a 12-point strategy to prevent medication errors during anaesthesia and critical care:

1. The label on any drug ampoule or syringe should be read carefully before the drug is drawn up or injected.
2. Legibility and contents of labels on ampoules and syringes should be optimized according to agreed standards with respect to font, size, colour and information.
3. Syringes should always be labelled.
4. Formal organisation of drug drawers and work space should be used with attention to tidiness, position of ampoules and syringes, separation of look-alike drugs and removal of dangerous drugs from the operation room.
5. Labels should be checked specifically with the help of a second person or a device like bar code reader before administration.
6. Error during administration should be reported and reviewed.
7. Management of inventory should focus on minimising the risk of drug error.
8. Look-alike packaging and presentation of the drug should be avoided where possible.
9. Drug should be presented in prefilled syringes rather than ampoules.
10. Drug should be drawn up and labelled by the anaesthesia provider himself/herself.
11. Colour coding by class of drugs should be according to an agreed national or international standard.
12. Coding of syringe according to position or size should be done.

Several other measures to promote safe drug administration during anaesthesia and critical care have been suggested:

1. The provision of all labels in a standardised format emphasising the class and generic name of each drug incorporating the bar code and class-specific colour code as per international standard.
2. The use of a bar code reader to scan the drug at the point of administration immediately before it is given linked to an auditory prompt to facilitate checking of the drug identity.
3. Integration of scanned information into an automated anaesthesia record and reducing the cognitive load on the anaesthetist.
4. The use of devices at the point of care.
to automatically measure the dose of the administered drug.

5. A dosing nomograph on the infusion syringe label to avoid the need of look-up tables or dose calculations.

6. The automated medication dispensing system with features such as single issue drawers and bar code scanners to facilitate safer dispensing of drugs.

Camire et al\(^{[4]}\) in a review article have suggested seven strategies to prevent errors in ICU. These are as follows:

(a) Eliminating extended physician work schedules.
(b) Computerised physician order entry.
(c) Implement support system for clinical decisions.
(d) Computerised intravenous devices.
(e) Active participation of pharmacists in ICU.
(f) Medication reconciliation.

Merali et al\(^{[59]}\) made several recommendations to reduce medication errors at different stages of the system [Table 3].

Many organisations are now dedicated to patient safety, including IOM, Institute for Safe Medical Practice (ISMP), Emergency Care Research Institute (ECRI), Joint Commission for Food and Drug Administration (FDA), Centre for Medicated and Medicare Services (CMS), National Patient Safety Foundation (NPSF), United States Pharmacopeia (USP), Agency for Healthcare Research and Quality, National Quality Forum and many more.\(^{[60]}\)

**CONCLUSION**

Despite the best efforts, the increased use of technology and high standards of both invasive and non-invasive monitoring in anaesthesia and critical care, medication errors continue to occur even at the best centres worldwide. Simple vigilance, standardised protocol, and ‘think before act’ are the key factors to avoid occurrence of medication errors.

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**Table 3: Recommendations to reduce medication errors**\(^{[59]}\)

| Patient information | \(•\) Consistent documentation and complete operative medication history |
|---------------------|------------------------------------------------------------------|
| Drug information    | \(•\) Add prompts to pre admission card |
| Communication of drug orders and information | \(•\) Provide enhanced pharmacist support |
| Drug labelling, packaging and nomenclature | \(•\) Eliminate use of dangerous abbreviations and dose expressions |
| Drug standardisation, storage and distribution | \(•\) Incorporate computerised physician order entry into strategic planning |
| Environment and workflow | \(•\) Evaluate the need and then clearly identify and segregate hazardous products |
| Staff competency and education | \(•\) Minimize advance preparation of drug syringe |
| Patient education | \(•\) Investigate, evaluate and educate staff about the dangers associated with workaround practices |
| Quality processes and risk management | \(•\) Provide enhanced education material for preoperative patients |

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