

## REVIEW ARTICLE

### MEDICATION ERRORS IN ANESTHESIA AND CRITICAL CARE

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**ABSTRACT:** Medication errors are common throughout healthcare system and result in significant morbidity and mortality. Medication related incidents are a common form of reported medical errors. In theory they should never occur. These mistakes are also called "Never events". Some of these are avoidable and preventable events. 50% of these mistakes are preventable. "India records 5.2 million medical injuries a year".<sup>1</sup>The UN body quantified the number of surgeries taking place every year globally-234 million. It said surgeries had become common, with one in every 25 people undergoing it at any given time. China conducted the highest number of surgeries followed by Russia and India. In developing countries, the death rate was nearly 10% for a major surgery.<sup>1</sup>All surgeries need one or other form of anaesthesia. Anaesthetic practice is unique because anaesthetists are personally responsible for all the steps from drug preparation to drug administration. Therefore, they need to have heightened awareness of the risk factors which create conditions for drug errors to occur.<sup>2</sup>Anaesthesia is unusual in requiring the administration of several potent, dangerous, rapidly acting drugs in a relatively brief timeframe. These drugs would be harmful if given without considerable care and attention to dose, timing and order of administration. These drugs are almost exclusively administered by Anaesthetists and the drugs are rarely checked by anyone other than the anaesthetist before administration. Drug error in relation to anaesthesia may therefore be of particular interest both to the specialty and the wider population.<sup>3</sup>

**KEYWORDS:** Medication Errors, Anaesthesia, critical care, Preventable Errors, Mortality, Morbidity, Risk Factors, Safety Measures, Check Lists.

**INTRODUCTION:** "The error of one moment becomes the sorrow of whole life" - A Chinese proverb. Medication errors, including those occurring in anaesthesia and intensive care, continue to be among the top 10 causes of overall mortality worldwide.<sup>4,5</sup> Most anaesthetists would admit to having made at least one drug error in their working practice.<sup>5</sup>The estimated rate of drug errors is reported to be around one error in every 133 anaesthetics.<sup>5</sup> In intensive care practice, the incidence of adverse drug events is reported to be ~130 errors per 1000 patient days.<sup>6</sup>

The World Health Organization (WHO) said on that "millions of people die each year from medical errors and infections linked to health care. It said that if the checklist is effectively used worldwide, about 500,000 deaths could be prevented each year".<sup>7</sup> It is worth noting that these figures are likely to be an underestimate of the true picture; this is because of a well-recognized culture of under-reporting in almost all health-care systems.<sup>8</sup>

With regard to the timing of the critical incidents, adverse drug events are known to occur more frequently during the maintenance phase of anaesthesia (42%), compared with either during induction (28%) or at the beginning of the surgery (17%).<sup>9</sup> In the intensive care, the administration of a single dose of medication may require many individual steps. Errors related to the administration of drugs are more frequent (53%), when compared with those related to either prescription (17%), preparation (14%), or transcription (11%).<sup>10</sup> Among the drugs used during

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anaesthesia, intravenous drugs like induction agents, neuromuscular blocking agents, opioids, sedatives, anticholinergic drugs, and local anaesthetics have all been reported to be involved in either wrong dose, wrong route, or wrong order errors. In the intensive care, the commonly involved drugs in the reported errors include heparin, insulin, inotropes, sedatives, potassium chloride, magnesium sulphate, and antibiotics.

### WHAT WAS REPORTED?:<sup>11,12</sup>

- 3,188 anaesthesia related incidents were reported, 69% of these were as 'near miss'.
- 65 incidents were reported using the anaesthetic eForm, 7.5% of these were reported at severe harm or death e-form. Medication errors have been estimated to occur in around 1:133 anaesthetics.<sup>10</sup>

**DISCUSSION:** The importance of drug error has been emphasized in the Harvard Medical Practice Study,<sup>13</sup> the Quality in Australian Healthcare Study,<sup>14</sup> and a report from the U.S. Institute of Medicine.<sup>15</sup> In the Australian study, drug errors were the fourth commonest category of adverse events (accounting for 10.8%), resulting in permanent disability in 17% and death in 8%. Drug administration error in anaesthesia is an important subset of drug error in general. Most of the errors reported in anaesthesia practice are also preventable. Serious morbidity and mortality resulted from clearly preventable events.<sup>16</sup> The reduction of iatrogenic harm has been recognized as a priority in healthcare.<sup>14</sup> It is important to understand that iatrogenic harm is not a homogeneous problem, but is contributed to by deficiencies in the system in which medical professionals work.<sup>15</sup>

In a survey conducted in New Zealand problems with drug labels were contributing factors with 9% of error reports.<sup>17</sup> In a study of 55,426 anaesthetics in Norway, drug error was reported in 63 or 0.11% of cases over 36 months.<sup>18</sup> In a study of 896 drug errors reported in Australia, 187 (20.8%) involved selecting the wrong ampoule or making an error in drug labelling.<sup>19</sup>

The National Patient Safety Agency in England and Wales has produced its first report based on findings of the National Reporting and Learning System from November 2003 to June 2006. It shows a rate of 5 adverse incidents reported per 100 admissions in acute hospitals and about 3 in every 1,000 reported incidents resulted in death. Medication errors constituting 8.3%.<sup>20</sup>

**STUDIES INVOLVING ANAESTHETIC ADVERSE DRUG EVENTS:**<sup>21</sup> The high rate of omission of drugs on admission to hospital could have significance for patients in the perioperative period.

These incidents came from the National Reporting and Learning System (NRLS) which was set up by the National Patient Safety Agency (NPSA) for prospective collection and analysis of critical incident reports from health-care staff, patients, or the general public. Medication errors from November 2003 to June 2006 accounted for 65026 cases 8.2%, only 10317 (1.3%) resulted in severe harm or death. These findings support those of other groups that although these errors are quite common, severe errors are uncommon. Many of the errors also appear to be preventable.

**Table 1:** Degree of harm to patients.

**Source:** reports to the NRLS database from November 2003 up to the end of June 2006.

**Note:** more than one patient may be affected by an incident, so the number of patients are greater than the number of incidents.

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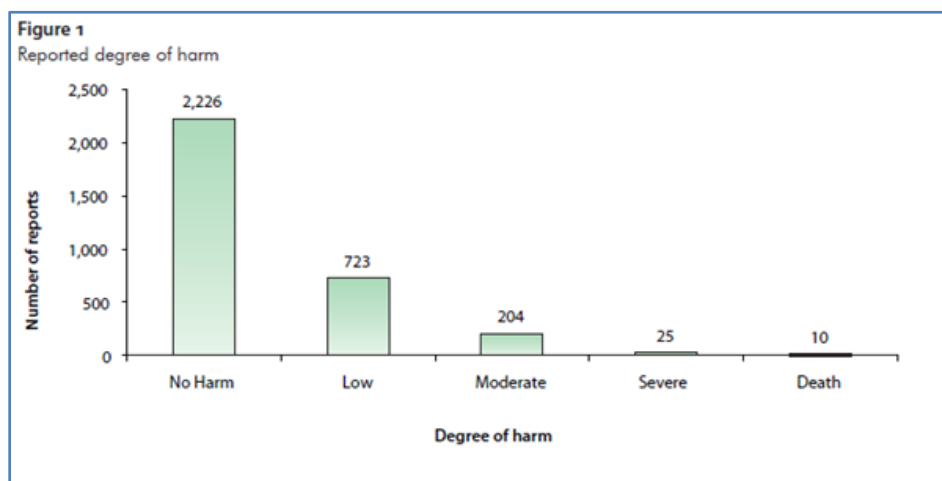
to the end of March 2006			April 2006 to June Up 2006			Total
Degree of harm	No.	Per cent	No.	Per cent	No.	Per cent
No harm	419,528	68.5	119,591	67.6	539,119	68.3
Low	151,659	24.8	45,117	25.5	196,776	24.9
Moderate	33,155	5.4	9,798	5.5	42,953	5.4
Severe	5,204	0.9	1,943	1.1	7,147	0.9
Death	2,577	0.4	593	0.3	3,170	0.4
<b>Total</b>	<b>612,123</b>	<b>100.0</b>	<b>177,042</b>	<b>100.0</b>	<b>789,165</b>	<b>100.0</b>
<b>Medication errors</b>	<b>50,516</b>	<b>8.3</b>	<b>14,510</b>	<b>8.2</b>	<b>65,026</b>	<b>8.3</b>

Table 1

**Table 2:** A comparison of results from two prospective studies on medication error in anaesthesia carried out in New Zealand South Africa.

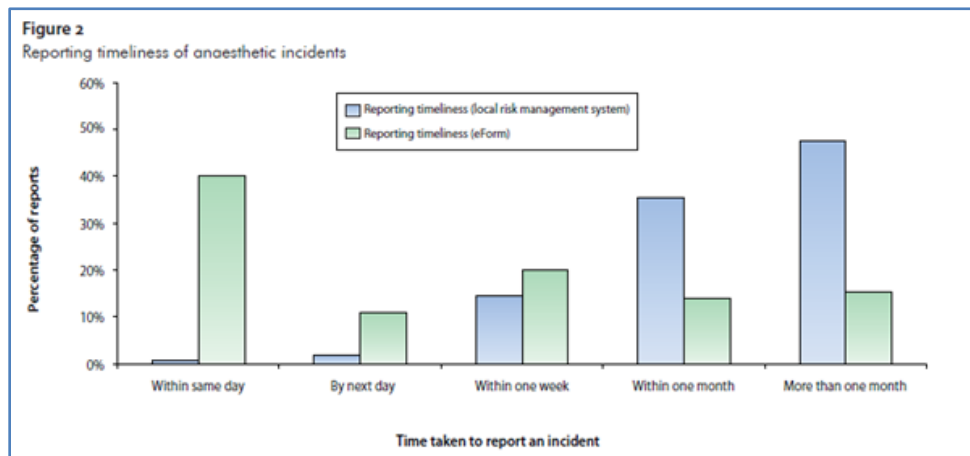
<b>Number of anaesthetics</b>	<b>10 806</b>	<b>30 412</b>
Response rate (%)	72	53
Incidence of error or near miss (%)	0.75	0.36
Adverse outcomes (actual numbers)	3	5

Table 2



**Figure 1:** Shows the degree of harm incurred by patients within the anaesthetic specialty during the period 1 January to 31 March 2012. Ten deaths were reported though LRMS and none via the anaesthetic e-Form.

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**Figure 2:** Shows the time taken to report incidents via the anaesthetic eForm (directly received into the NRLS) and via LRMS (uploaded to the NRLS periodically via local systems) during the period 1 January to 31 March 2012.

### Action recommended by survey group, and action type:

**Table 3:** Action recommended action strength.

1. The label on any drug or ampoule or syringe should be carefully read before a drug is drawn up or injected -	Strongly recommended
2. Legibility and contents of labels on ampoules and syringes should be optimized according to agreed standards	Strongly recommended
3. Syringes should be labelled (always or almost always)	Strongly recommended
4. Formal organization of drug drawers and workspace should be used	Strongly recommended
5. Labels should be checked specifically with a second person or device before a drug is drawn up or administered	Recommended
6. Errors in i.v. drug administration during anaesthesia should be reported and reviewed	Recommended
7. Management of the drug inventory should focus on minimizing the risk of drug error	Recommended
8. Similar packaging and presentation of drugs should be avoided where possible	Recommended
9. Drugs should be presented in prefilled syringes rather than ampoules	Possibly recommended
10. Drugs should be drawn up and labelled by the anaesthetist who will administer them	Possibly recommended
11. Colour coding by class of drug according to an agreed national or international standard should be used	Possibly recommended
12. Coding by syringe position or by the needle on the syringe should be used	Unclear

Table 3

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The NPSA published a guide entitled seven steps to patient safety. These steps are as follows.

- Step 1: Build a safety culture.
- Step 2: Lead and support your staff.
- Step 3: Integrate your risk management activity.
- Step 4: Promote reporting.
- Step 5: Involve and communicate with patients and the public.
- Step 6: Learn and share safety lessons.
- Step 7: Implement solutions to prevent harm.

**ERROR REPORTING:** This is related to speaking up. If the system confers a degree of anonymity upon the person reporting the error, then some of the psychological safety issues can be bypassed but people will only continue to report errors if certain conditions hold. Doctors are less likely to report errors if they feel that they get little for the investment. If the process takes time, if there is no feedback, or if the feedback is not helpful, then reporting is less likely to take place.

According to an analysis of over 73,000 intravenous drug errors reported to the US Pharmacopoeia Med Marx database between 2000 and 2004, more than 50% of errors were in the process of actually administering medications, and 60% of these errors occurred in the intravenous administration of 1 of 20 “high alert” medications. Between 3% and 5% of these reported errors led to patient harm.<sup>22</sup>

Figure-3<sup>23</sup> However, 5% occurred in the operating room or in the pre- or post-anaesthesia care units, where anaesthesiologists and nurse anaesthetists routinely practice. In the operating room, it has been estimated that 1 drug administration error occurs for every 133 anaesthetics. Approximately 1% of these errors actually cause patient harm. Therefore, elimination of medication errors represents a tremendous opportunity to save lives and improve patient care in the OR as well as in the remainder of the hospital.<sup>23</sup>

Medication	% of Harmful Errors
Morphine Sulphate	8.5
Heparin	8.3
Hydromorphone	6.1
Insulin	4.9
Vancomycin	3.9
Fentanyl	3.8
Furosemide	2.3
Potassium Chloride	2.2
Meperidine	2.1
Methylprednisolone	1.8
Lorazepam	1.7
Cefazolin	1.7
Loversol	1.7
Midazolam	1.7
Dopamine	1.6
Diltiazem	1.5
Total Parenteral Nutrition	1.4
Phenytoin	1.4
Piperacillin/Tazobactam	1.4

*(Based on 3,184 reports submitted to Med Marx involving the parenteral routes [epidural, intrathecal, intravascular and intravenous] during the years 2000 to 2004.)*

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The vast majority of drugs used in health care continue to be administered by traditional error-prone means, and drug error remains a hazard to patients everywhere. The problem is of particular concern in anaesthesia, where large numbers of potent drugs are given, often in rapid sequence. Historically, system redesign in anaesthesia has been successful in eliminating error, for example in the elimination of problems with the delivery of oxygen to patients.<sup>24</sup>

Medication error is a major cause of morbidity and mortality in medical profession, and anaesthesia and critical care are no exception to it. Man, medicine, machine and modus operandi are the main contributory factors to it. 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 patient's die each year as a result of medical errors, a large portion of these being medication related.<sup>26</sup>

The most common drugs involved in ampoule labeling errors were similar to those involved with syringe swaps. The most common drug substitutions (drug intended / drug actually given) were atropine / neostigmine, Midazolam / rocuronium, fentanyl / succinylcholine, pancuronium/ succinylcholine, succinylcholine / pancuronium and metaraminol/ naloxone. In the syringe or drug preparation error for other or unknown reasons category, the most common error was when a neuromuscular blocking drug was given instead of neostigmine. There were incidents where mannitol was used instead of saline for heparin-containing arterial line flushes.<sup>27</sup>

Simple manoeuvres like proper drug labeling, handling and storage simply can reduce the risk and improves quality of anaesthetic care. The other standards used within the department are in compliance with Joint Commission International Accreditation (JCIA) standards.<sup>27</sup> My 24 years of experience in anaesthesia practice some of the drug errors I have come across, came to my notice are as follows:

**Table 4:** i.v. drugs

Drug used	drug supposed to be used	Remarks
1.inj. scoline	inj. Midazolam	Respiratory arrest
2.inj. mephentine	inj. ketamine	severe hypertension
3.inj.vecuronium	inj. overran	Respiratory arrest
4.inj. vecuronium	inj. neostigmine	delayed recovery
inj. flaxidil	inj. flexon	respiratory paralysis
inj. adrenaline	inj. pethadine 50mg	severe hypertension
inj. adrenaline	inj. atropine	severe hypertension

Table 4

**Table 5:** Spinal drugs

inj. pethadine	inj. xylocaine heavy	respiratory depression
inj.tranaximic acid	inj.sensorcaine heavy	cardio vascular crisis, muscle rigidity
inj. neostigmine	inj. sensorcaine heavy	severe hypotension

Table 5

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**WHAT CAN THE INDIVIDUAL ANAESTHETIST DO?<sup>27</sup>**: The first and most important step is to develop an awareness of the ubiquity of medical error and the potential capacity to inflict severe harm or death on patients.

Secondly, consultant anaesthetists have great capacity to influence what goes on in the operating theatres in which they work. A safety climate with psychological safety is more likely to take place when those in a position of responsibility and leadership make explicit what they are doing and lead by example. The actions of individuals in turn influence the climate of an anaesthetic department.

Thirdly, by reporting errors and by encouraging the local feedback of the analysis of such errors or near misses, the more likely other members of the team are to do so. Evidence has shown that as more incidents are reported, the number of serious adverse events decreases.

Furthermore, the act of reporting can help the reporter reflect upon the nature of the error and the factors that may have contributed.

We should not underestimate our power to influence such processes by our actions as individuals.

The major minimizing factors were prior experience, training, pre-op checkups, re-checking the equipment, monitors, detecting the problem, supervision and skilled assistance. In the majority of cases no factors were found that could be thought to have minimized the incident. Methods suggested by the reporting anaesthetists to prevent these errors occurring included development of specific protocols, additional training, improved equipment maintenance and checking routines, more manpower, quality assurance activities, improved routines for alleviating fatigue, improved communication and supervision.<sup>28</sup>

**CONCLUSION:** We will not reduce drug error until we change the way we give drugs. We have to be vigilant in reading label, loading drugs, and labeling loaded drugs and while injecting them also. This will include knowing technological solution; it will also mean complying with these solutions. It is unlikely that forcing functions will ever make drug error in anaesthesia impossible. It is certain that redesigning the system can make errors much less probable—provided anaesthesiologists actually make the effort to take proper advantage of the innovations.

Healthcare will always involve risks, but that these risks can be reduced by analyzing and tackling the root causes of patient safety incidents. We have to promote an open and fair culture, and to encourage staff to inform their superiors when things have gone wrong and discuss preventive measures. In this way, we can build a better picture of the patient safety issues that need to be addressed.

To sum up, patient safety deals with safe practices in anaesthesia where the health providers analyze the quality and safety indicators to prevent future adverse events.

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