

Research

Medication errors: the human factor

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∞ See related article page 42

In this issue, Parshuram and colleagues describe a study that included 118 health care professionals who prepared 464 morphine infusions under simulated conditions with direct observation.¹ The morphine concentration in each prepared infusion was measured using chromatography. They report that 34.7% of infusions deviated from the intended concentration by more than 10%. In addition, they found that 3% of drug-volume calculations had 2-fold errors and 1.2% had 10-fold errors. This study supports previous findings of high error rates in the preparation of intravenous medications.

The high error rate for intravenous narcotic preparations should come as no surprise. The immutable reality is that humans make mistakes. Patients will be safer when we accept this reality and design clinical tasks accordingly. Medication errors pervade all phases of acute care. About 20% of patients will have a potentially harmful error in their preadmission medication history that may result in an incorrect medication order at the time of admission.² During admission to hospital, the error rate for drug prescribing is at least 3%,^{3,4} and, based on direct observation, the error rate in drug administration is about 19%.⁵ There is a 2% error rate for intravenous infusions in critical care.⁶ Upon discharge, about 25% of patients will have an error in their discharge prescriptions compared with their hospital medications.⁷ Although these studies used different methods and measures and included different patient populations, their collective message is that the likelihood of having a hospital admission free of medication error is vanishingly small.

Despite the frequency of these medication errors, most cause no harm to patients. The most common error is delayed drug administration resulting from a missing dose. More serious medication errors have a greater potential for harm and can be termed “potential adverse drug events.” For example, a 10-fold error in morphine concentration is obviously more serious than a 10% error. Medication errors that actually cause harm are termed “preventable adverse drug events.” For every 100 medication errors, there are between 4 and 10 potential adverse drug events and 1 preventable adverse drug event.⁸ Depending on methods and definitions, about 1%–2% of patients will experience a preventable adverse drug event while in hospital.⁹

There are 2 potential approaches to reducing medication error. The “person-centred approach” focuses on the individual who makes the error. This individual may receive education, training or possibly discipline if the error was serious (e.g., a 10-fold morphine overdose). The person-centred approach is doomed to fail, however, because errors are an

Key points of the article

- Medication errors are common.
- The system-centred approach to medication error is based on 3 principles: error is unavoidable; processes can be designed to reduce the possibility of error; and processes can be designed so that errors are detected and corrected before harm occurs.
- Forcing functions, simplification and standardization are useful safety-improvement concepts.

inherent property of the people doing the work and the complexity of the work itself, as demonstrated by Parshuram and many others.¹ By contrast, the “system-centred approach” is based on 3 principles:¹⁰ error is unavoidable; processes can be designed to reduce the possibility of error; and processes can be designed so that errors are detected and corrected before harm occurs.

Many strategies can reduce the possibility of error. “Forcing functions” are safety design features that completely eliminate the possibility of a specific error. In the study by Parshuram and colleagues, the use of a concentrated morphine solution (10 mg/mL) was strongly associated with serious errors (2- and 10-fold errors).¹ One potential forcing function would be to remove 10 mg/mL morphine solutions from pediatric areas and to use 2 mg/mL solutions exclusively. This simple manoeuvre would not change the rate of error, but it would change the rate of serious error. The Institute for Safe Medication Practice recommends the removal of 10 mg/mL morphine solutions from pediatric care areas.¹¹ Despite this recommendation, a 2004/05 survey found that up to 25% of pediatric care centres in Ontario continue to stock the concentrated solution.¹¹

Simplification is another valuable safety improvement method. Calculators strategically placed in preparation areas for intravenous narcotics will simplify the task and eliminate the potential for error that results from mental arithmetic. Standardization can also reduce the potential for error.¹² For example, hospitals can limit the number of intravenous morphine solutions and require these solutions to be prepared centrally in the pharmacy, rather than ward staff preparing numerous infusion concentrations.

Safety improvements can entail additional costs and complexities.¹³ In general, forcing-function strategies that involve

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hazard removal (e.g., elimination of concentrated narcotics) are cheaper and less complex than major system changes (e.g., computerized physician order entry). However, unintended downsides can occur with all safety improvements. For example, the removal of concentrated potassium chloride solutions without appropriate replacement solutions could lead to inappropriate hoarding of the concentrated solution by staff,¹⁴ and poor design and implementation of systems for computerized physician order entry can increase error.¹⁵

Medication errors are unavoidable, but attention to safety improvement principles can reduce harm. The study by Parshuram and colleagues provides further empirical data that should spur us to action. We must continue to focus our attention on systematically applying and evaluating safety improvements, rather than demanding perfection from individual health care professionals.

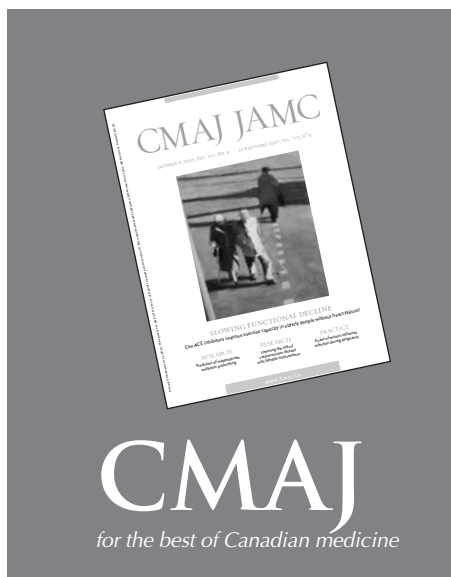
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