Effectiveness of interventions to prevent medication errors: an umbrella systematic review protocol

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Review question: What is the effectiveness of interventions designed to prevent medication error on medication administration errors, medication-related harms and medication-related death in acute care patients?

Keywords adverse drug events; hospitalization; medication errors


Introduction

Medication safety is essential in any setting where medications are prescribed, dispensed and/or administered. The safe administration of any medication requires that the correct medication is prescribed, then correctly dispensed, in the correct form and strength, prepared correctly and given at the correct times and in the correct dose to the correct person via the correct route.1 The sheer complexity of the process, and the number of people potentially involved, means that many opportunities for error exist.

In Australia, medication safety’s importance is highlighted by its inclusion in the National Safety and Quality Health Service (NSQHS) Standards, where it is listed as Standard 4, which provides detailed guidance for the safe use of medicines.2 Similarly, in the USA the Federal Drug Administration (FDA), which includes the Division of Medication Error Prevention and Analysis (DMEPA), provides guidelines to reduce the risk of harms associated with medications.3

Medication errors, defined as medications administered at the incorrect time, frequency, strength, dose, by the incorrect route, or to the incorrect individual, have long been a source of harms to patients and increased costs to health systems worldwide.4 Medication errors may lead to adverse drug events, which may increase length of hospital stay, treatment burden and costs, including legal action by the individuals harmed or their families.5,6 These errors may occur at the prescription, dispensing or administration stage of the medication process.2 In hospitals, errors may be made by medical staff, pharmacists and other pharmacy staff, nurses and midwives, in all clinical settings and with all types of patients.

In hospitals, medication-related error is the most frequent source of patient harm,7,8 representing 20% of all incidents.2 Not all medication errors lead to serious harm to patients; it is estimated that only around 1% of medication errors lead to serious adverse events for the patient.10 The prescription and administration phases of the medication process are the most common points where errors occur,11 with prescription or ordering error accounting for approximately 16% of all medication errors and 50% occurring at the administration phase, according to figures from the United Kingdom.12 The overall prevalence of medication administration error has been variously estimated in empirical studies as being between 1.7% and 59.1% of total opportunities for error,13 a broad range which is difficult to interpret. A systematic review of 91 studies using direct observation, however, calculated a median error rate of 19.6% (8.6–28.3%) of all types of error, including timing error, and 8.0% (5.1–10.9%) when timing errors were excluded.14

Medication error rates vary between different clinical settings and geographical areas. For example, in Middle Eastern countries, the rates of error

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vary between as low as 7% to as high as 90% in some countries. Similarly, the overall incidence of medication error in Southeast Asian countries also varies greatly (15–88%). Medication error represents 28% of all medical errors, and medical error is estimated to be the third highest cause of death in the United States. In Australia the rate is estimated at approximately 9% of all medication administrations.

The causes of medication errors can be broadly categorized as either human factors such as distraction, failing to account for the patient’s condition, lack of knowledge, and/or fatigue, or system factors such as lookalike/sound-alike medications, workload, staffing, medication supply and storage problems. For nurses, deliberate violation of guidelines is the most common cause of error, particularly when administering some classes of medication, however across all professions involved in the medication process, attention slips are the most common single cause of medication error.

Workplace culture has been identified as a significant contributor to medication error. Nurses violate administration policies and guidelines often in workplaces where non-complying practice is a cultural norm. Similarly, workplace cultural norms about error and incident reporting affect the quality of the data as well as the safety of patients and some authors estimate that up to 95% of medication errors are not reported. Staff involved in medication errors sometimes fear consequences such as job loss, reputation damage, and the reactions of coworkers resulting if errors are reported.

A systematic review on the causes of medication errors highlights the relatively weak evidence available on this question, with a large number of studies relying on subjective self-report measures to quantify error rates. Self-report is a poor measure of the actual rate of medication error as studies have shown significant numbers of medication errors are never reported. Issues with the state of the evidence have also been reported in regards to the effect of study methodology on medication error rates, with the majority of studies being of less rigorous design, leading to increased risk of bias and decreased reliability.

A wide variety of different interventions have been trialed to address the problem of medication errors in hospitals. Interventions are usually targeted at specific sources of error, such as drug identification, distraction, dispensing of incorrect drugs, or incorrect prescribing. Information technology-based interventions, such as Computerized Decision Support Systems (CDSS) and Computerized Physician Order Entry (CPOE), have been used to improve dispensing and prescription practices, as well as to improve drug titration and patient monitoring to prevent under- or over-dosage. A systematic review of this class of intervention has reported that few studies show statistically significant evidence of effectiveness with smaller improvements in practice seen in more methodologically rigorous studies and so their actual effectiveness remains unclear.

Other interventions, such as signage and designated “quiet zones” have been implemented to reduce the effect of distractions and interruptions on staff administering medications. Distractions and interruptions are common during medication administration and are considered to be associated with medication errors due to their negative impacts on memory and concentration. A 2013 systematic review of these interventions highlighted the methodological weakness of the existing evidence on these types of interventions, with many studies at high risk of bias. Other interventions, including education, electronic bar-coding, systems changes and ward redesign have also been used with varying degrees of effect.

Despite the extensive prior work to improve medication safety, medication errors still persist. Multiple interventions have been implemented to address this problem and improve medication safety, many papers have been published, and multiple systematic reviews of those interventions have been conducted, on specific interventions, in specific geographic regions and more broadly. Despite the extent of this work, wide searches have found that no umbrella review has yet been published to bring together the findings of all good quality systematic reviews and meta-analyses on this topic. It is essential that the most effective interventions are recognized so they can be implemented into practice to prevent medication error and promote medication safety.

Inclusion criteria

Participants

The review will consider systematic reviews that include any healthcare worker involved in prescribing, dispensing or administering medications to patients in acute care. These healthcare workers may be registered nurses, enrolled or
licensed vocational nurses, midwives, pharmacists or medical doctors.

**Interventions**

This review will consider systematic reviews that evaluate the effectiveness of interventions and strategies designed to prevent medication error in acute care settings. There will be no exclusions based on the type of interventions of interest. Medication error is defined as “a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient.”

**Outcomes**

This review will consider systematic reviews that include the following outcomes: medication errors of any etiology, medication error-related harms and medication error-related death. These outcomes will be measured by error rates, numbers of adverse events, and numbers of deaths. Medication error-related harm will be defined as: harm to a patient caused by inappropriate use of a drug.

**Systematic review types**

This umbrella review will consider any systematic reviews and meta-analyses of effectiveness data, including the quantitative component of comprehensive reviews. This will include systematic reviews and meta-analyses embedded in evidence-based guidelines and Health Technology Assessments. Included reviews will have provided a clearly articulated and comprehensive search strategy, and evidence of critical appraisal of the included studies using a standardized tool.

Systematic reviews published in English will be included. Only systematic reviews published since 2007 will be included as this is more likely to reflect current medication standards, practices and safety interventions.

**Methods**

**Search strategy**

The search strategy will aim to find both published and unpublished systematic reviews. An initial limited search of MEDLINE and CINAHL has been undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe the articles. This informed the development of a search strategy which will be tailored for each information source. A full search strategy for MEDLINE is detailed in Appendix I. The reference list of all systematic reviews selected for critical appraisal will be screened for additional reviews.

**Information sources**

The databases to be searched include: MEDLINE, CINAHL, Web of Science, Embase, the Cochrane Library, the JBI Database of Systematic Reviews and Implementation Reports.

The search for unpublished studies will include: ProQuest Dissertations and Theses and MedNar.

Keywords: medication, drug, medicine, pharmaceutical, error, adverse drug event, patient harm, safety, prescribing, dispensing, transcribing, preparation, administration, monitoring, hospital, inpatient, patient, ward, unit, systematic review, meta-analysis.

**Study selection**

Following the search, all identified citations will be collated and uploaded into Endnote (Clarivate Analytics, PA, USA) and duplicates removed. Titles and abstracts will then be screened by two independent reviewers for assessment against the inclusion criteria for the review. Reviews or meta-analyses that meet the inclusion criteria will be retrieved in full and their details imported into Joanna Briggs Institute System for the Unified Management, Assessment and Review of Information (JBI SUMARI). The full text of selected papers will be retrieved and assessed in detail against the inclusion criteria. Full text papers that do not meet the inclusion criteria will be excluded and reasons for exclusion will be provided in an appendix in the final systematic review report. Included papers will undergo a process of critical appraisal. The results of the search will be reported in full in the final report and presented in a PRISMA flow diagram. Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

**Assessment of methodological quality**

Selected systematic reviews will be critically appraised by two independent reviewers for methodological quality in the review using the standardized critical appraisal instruments from the Joanna Briggs Institute for systematic reviews. Any
disagreements that arise will be resolved through discussion, or with a third reviewer.

Following critical appraisal, reviews that do not meet a certain quality threshold will be excluded. The decision to exclude will be based on systematic review methodology not described or poorly conducted, critical appraisal of included studies not done, or literature review papers described as a systematic review but not including any features of accepted systematic review methodology.

**Data extraction**

Data will be extracted from papers included in the review by two independent reviewers using the standardized data extraction tool available in JBI SUMARI. The data extracted will include specific details about the interventions, populations, review methods and outcomes of significance to the review question and specific objectives. Any disagreements that arise between the reviewers will be resolved through adjudication by a third reviewer. Authors of papers will be contacted to request missing or additional data where required.

**Data synthesis**

Extracted findings will be presented in tabular format for each pair of interventions and outcomes. Based on the strength of the evidence for the effectiveness of the intervention using the three colors of the traffic light: an effective intervention (green), no effect or difference compared to a control intervention (amber), and a detrimental intervention or one that is less effective than a control (red).  

**Assessing certainty in the findings**

A Summary of Findings table will be created using GRADEPro GDT software. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach for grading the quality of evidence will be followed. The Summary of Findings table will present the following information where appropriate: absolute risks for treatment and control, estimates of relative risk, and a ranking of the quality of the evidence based on study limitations (risk of bias), indirectness, inconsistency, imprecision and publication bias.

The following outcomes will be included in the Summary of Findings table: medication errors of any etiology, medication error-related harms and medication error-related death.

**References**

18. Makary MA, Daniel M. Medical error—the third leading cause of death in the US. BMJ: (Online) 2016;353:i2139.
 Appendix I: Search strategy for MEDLINE (Ovid)

1. exp Hospitalization/ or exp Inpatients/ or exp Hospitals/ or exp Critical Care/ or Intensive Care Units.mp. or hospital”.mp. or inpatient”.mp. or in patient.mp. or ward.mp. or unit”.mp.
2. exp Medication Errors/ or (medication adj5 error”).ti,ab. or medication safety.ti,ab. or (medication adj3 incident”).ti,ab. or (inappropriate adj5 prescription”).ti,ab. or (inappropriate adj3 medication”).ti,ab. or (preventable adj5 adverse drug event”).ti,ab. or (preventable adj3 adverse drug reaction”).ti,ab. or (prescribing adj3 error”).ti,ab. or (prescription adj3 error”).ti,ab. or (dispensing adj3 error”).ti,ab. or near miss”.ti,ab. or (medication administration error”.ti,ab.)
3. intervention.mp or strategy.mp or system.mp.
4. 1 and 2 and 3
5. (systematic review.mp.) or (meta-analysis.mp.)
6. 4 and 6