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A systematic review of the literature on look-alike, sound-alike (LASA) medication errors

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Review question(s)

Medication errors that occur when medications have similar-looking or similar-sounding names or similar product packaging and labelling are called look-alike, sound-alike (LASA) errors. The objective of this review is to systematically identify and evaluate the evidence on interventions delivered in any healthcare setting that aim to reduce the rate of LASA errors.

Secondary objectives are to identify markers used to measure interventions, such as similarity measures or readability, and to describe the benefits and shortfalls of these interventions.

Searches

We will search for full-length peer-reviewed articles the following electronic databases: MEDLINE (via Ebsco), EMBASE, Scopus, and Web of Science (Core collection). The search strategy for MEDLINE is given in the accompanying PDF document (link below), and this was adapted for the other databases. We will also handsearch reference lists of selected studies for relevant items not identified by the electronic searches.

A quick MEDLINE search for [lasa AND (drug OR name OR error)] reveals that the acronym LASA was first used in a PubMed source in 2011 by Kovacic and Chambers; a few articles before this used sound-alike or look-alike, such as Teplitsky (1973). LASA is thus a recently coined term, and much more of the literature pertaining to LASA errors uses alternative terms, such as ‘name confusion’, ‘similar drug names’, or ‘drug name confusion’. Search strategies will thus need to account for inconsistencies in the use of terms in this field of study and it is hoped that in this way a greater number of relevant publications can be examined.

Link to search strategy

http://www.crd.york.ac.uk/PROSPEROFILES/48198_STRATEGY_20160822.pdf

Types of study to be included

We will include in this review any randomised or quasi-randomised controlled trials (RCTs) that examine the potential of interventions to reduce the rate or the risk of LASA errors. No limits will be applied to dates of publication. Limits will be applied to languages of publication: English, Italian, Russian, Spanish. We will exclude cohort studies, questionnaires, surveys, opinion pieces, and case reports.

Condition or domain being studied

Medication incidents are the second most commonly reported patient safety events (i.e. harms) in the UK, accounting for 11% of incidents; such incidents resulted in 50 deaths between October 2011 and September 2012 alone (NPSA 2013, Jordan & Kyriacos 2014). Medication error is defined as “an unintended failure in the drug treatment process that leads to, or has the potential to lead to, harm to the patient” (EMA 2016).

Medication errors may occur when medications share certain properties, such as similar-looking or similar-sounding names, or features of product packaging and labelling. These ‘wrong drug’ errors are so-called look-alike, sound-alike (LASA) errors (Bryan et al. 2015). LASA errors make up a high proportion of all medication errors, with estimates ranging from 6% to 50% and represent a significant threat to patient safety (Emmerton & Rizk, 2012). They may

occur during prescribing, dispensing, or administration and may result in wrong dosing, overdosing, or underdosing (Aronson 2009a). LASA errors may be due to similarities in product packaging, in dosage form or strength, or therapeutic indication. They can also occur through selection of the wrong medication from a shelf, or from an electronic list (Emmerton & Rizk, 2012; Ciociano & Bagnasco 2014).

This review is primarily concerned with errors that are caused by look-alike or sound-alike names. These errors occur because of shared properties between two names, in either written or spoken form, and entail the incorrect substitution of one medication for another, which may or may not result in administration of the medication to the patient. The cause of the error lies in the orthography (written form) or phonology (spoken form) of the LASA pair, and a number of similarity measures have been tested (Kovacic & Chambers, 2011; Lambert et al., 1999). Studies of United States Adopted Names (USANs), many of which take the form of International Nonproprietary Names (INNs), have shown that the prescribing frequency of certain medications and the number of medications with similar therapeutic indications may prime the risk of LASA errors (Lambert et al., 2003). We are interested in linguistic LASA errors – errors caused by orthographic or phonetic similarity between generic names for medications. We are not interested in errors that are caused solely by similar packaging or labelling, or similarities in the written form of units for medication (formulation, strength, or concentration).

Participants/ population

Included studies will look at the use of interventions by healthcare professionals (such as doctors, nurses and pharmacists) or healthcare students.

Intervention(s), exposure(s)

It is clear that the best strategy for reducing LASA errors would be pre-marketing assessment of similarity (Lambert et al., 2001; Lambert et al., 2003) between a name and other existing names. However, LASA pairs may come to light only after errors and near miss reporting, and so several strategies for reducing LASA error have been proposed. Pre-approval strategies have been recommended, such as computerised searches, expert judgement, and psycholinguistic testing. Reviews of the problem of LASA errors commonly separate interventions into ‘person’ and ‘system’ approaches (Emmerton & Rizk 2012; Ciociano & Bagnasco, 2014).

The person approach commonly apportions blame by focusing on the role of the practitioner in errors, implying negligence, carelessness, inattention, or incompetence (Ciociano & Bagnasco, 2014; Cutter & Jordan, 2013). It also takes into account the potentially chaotic circumstances in which medications are prescribed, dispensed, or administered, which may include interruptions and distractions, especially in high intensity environments such as an emergency department (Tuohy & Paparella, 2005), or an intensive care unit (McDowell et al. 2009). Since a LASA error may occur in writing or speaking a name (language production) or in reading or hearing a name (language reception), it has been recommended that clinicians say and/or spell the name out loud, to ensure correct understanding and solidify the name in working memory (Emmerton & Rizk, 2012).

The system approach assumes that ‘to err is human’ and that the root causes of error lie in non-human factors present in the system (Cutter & Jordan, 2013; Reason, 2000). The system approach thus attempts to reduce error by identifying and addressing 'latent conditions’ (Reason, 2000) in the system that prime the risk of error. It is generally accepted that system-based approaches see greater success (Reason 2000; Tuohy & Paparella 2005; Emmerton & Rizk, 2012). Elucidating external causative factors of error encourages practitioners to report errors and near misses, which may be under-reported owing to fear of reprisal, blame, and damaged reputation (Aronson, 2009b). Common system approaches to reducing LASA error are typographic adaptation (font colour, weight, kern, and use of capitalisation such as Tallman lettering), barcoding, and computerised physician order entry (CPOE) (Emmerton & Rizk, 2012). This review will explore LASA error reduction interventions reported in the literature.

Tallman lettering was first proposed by Davis et al. (Davis et al., 1992) and uses selective capitalisation of LASA name pairs to highlight their distinctive characters, for example, DOBUTamine and DOPamine, or hydrALAzine and hydrOXYzine (Emmerton et al., 2014; Filik et al., 2006). Tallman lettering has the potential to reduce LASA errors in written/typed communication, but not spoken, and it helps to differentiate look-alike packaging. Moreover, it is relatively easy to implement, both on physical packaging and electronically. Tallman lettering was recommended by the US Food and Drug Administration for use in a small list of LASA name pairs in 2001 (Filik et al. 2006), but results on the efficacy of Tallman lettering are equivocal (Or & Wang, 2014).

Computerised alerts have been introduced into dispensing software to alert the user to potential LASA medication pairs and to intercept LASA errors. For example, an alert may read: This drug is typically used for hypothyroidism. No such problem appears on the problem list of this patient. [Cancel / Ignore / Add diagnosis] (taken from Galanter et al. 2014). Computerised alerts are used in various forms to varying degrees (Emmerton & Rizk, 2012). They have been shown to be an effective error reduction strategy (Galanter et al., 2014) and can contribute to lists of problem names, jog attention, and inform on specific properties of LASA pairs, so that, for example, names that share the initial three letters are more likely to be confused.

In this review we will seek to identify studies examining the potential of any intervention to reduce the risk or the rate or LASA error. We anticipate that studies exploring the following interventions will be found:

• Reducing interruptions and distractions.

• Typographic adaptation, e.g. Tallman.

• Barcoding.

• Computerised physician order entry.

Comparator(s)/ control

Interventions will be compared against usual practice without the intervention.

Outcome(s)

Primary outcomes

Any measure of effect on LASA near miss or error rates, or relative measures of LASA error rate (increased, same or decreased) derived from any intervention compared with no intervention.

Secondary outcomes

Any marker used to test an intervention, such as readability, which is used to test the efficacy of Tallman lettering.

Any qualitative description of benefits or shortfalls of interventions explored.

Data extraction, (selection and coding)

Selection of studies:

Selection will be a two-tiered process. The first author (RB) will screen all titles and exclude those that are clearly irrelevant to the review. RB will then screen all the abstracts of the remaining results, and SJ and AW will independently screen 50% each. All authors at this stage will be unblinded to author and journal information. RB, SJ, and AW will select potentially eligible results based on eligibility criteria in the protocol, and the full manuscripts of these will be obtained for further reading. If the total number of papers selected at this stage exceeds 30, RB, SJ, and AW will hold a meeting to discuss differences of opinion. If not, each paper will be brought forward for data extraction. For all manuscripts that are ultimately excluded, the reason for exclusion will be recorded in the Characteristics of excluded studies table. Those manuscripts remaining will be examined in this review, and recorded in the Characteristics of included studies table. RB and SJ will carry out the data extraction in duplicate; if necessary they will discuss differences of opinion, and consult AW as a third party.

Data extraction and management

The first author (RB) will extract information from the included articles, unblinded to author and journal information. A randomly selected 20% sample will be extracted by the second author (SJ). Discrepancies between extracted data will be resolved through discussion, and if necessary by consulting a third party. The nature of discrepancies will be discussed, and the consensus view applied to all extracted data. We will design a form for recording extracted data. At a minimum, we will extract:

1. Date of publication

2. Publication type

3. Author and journal details

4. Study design, RCT or qRCT

5. Retrospective or prospective error reduction

6. Type of intervention

7. Primary quantitative outcome measures

8. Secondary qualitative outcome measures

Measures of treatment effect

For the primary outcomes pertaining to error rate, or relative measure of error rate (increased, same, or decreased), we will attempt meta-analysis of the data extracted. Data will be categorised into binary outcomes, as reported by the authors (for example: effect or no effect; positive or negative effect on error rate), and for these we will calculate the summary risk ratio and 95% confidence intervals. For continuous data, we will use the mean difference. Both secondary outcomes are qualitative and will be described narratively.

Assessment of heterogeneity

We will use the I-squared statistic to assess heterogeneity in both observational and experimental studies.

Risk of bias (quality) assessment

The risk of bias in each included study will be independently assessed using RevMan and recorded by the authors in a Risk of bias table, with each article deemed to be ‘low risk’, ‘high risk’, or ‘unclear risk’. If the authors cannot resolve discrepancies through discussion, a third party will be consulted.

Strategy for data synthesis

Given the variety of settings, and stages of treatment, in which LASA errors may occur we anticipate that a meta-analysis will not be possible for the primary outcome. However, where studies with sufficient homogeneity (I-squared < 25%) exist, we will attempt a meta-analysis using a random-effects model. At the very least, we will describe and synthesise the findings narratively.

A Summary of Findings table will be used to present key findings, including:

1. a list of all primary and secondary outcomes of the review

2. a measure of magnitude of intervention effect for the primary outcomes

3. the number of studies addressing each outcome (both primary and secondary) and the degree of overlap

4. a grade for the quality of the evidence

5. a comments section

The quality of the evidence will be independently assessed by two authors using the GRADE approach, with any differences resolved by consulting a third party.

Analysis of subgroups or subsets

If there is a sufficient number in the subgroup, we will look at participant subgroups (e.g. doctors, nurses, students) and intervention subgroups (e.g. TallMan lettering, barcoding). Where possible we will also distinguish between studies conducted in clinical vs laboratory settings.

Dissemination plans
Findings will be presented in a paper, to be submitted to a peer reviewed journal. They will also be presented at a relevant conference during 2017.

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Stage of review

Ongoing

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Stage of review at time of this submission	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	Yes	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No