The impact of pharmacy computerised clinical decision support on prescribing, clinical and patient outcomes: a systematic review of the literature
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CRD summary
The authors concluded that safety focused computerised clinical decision support systems had greater effectiveness than those focused on quality use of medicines (QUM). Good communication between pharmacists and physicians was needed to realise the full benefits of QUM-focused systems. Uncertain quality of included studies and a risk that relevant studies were missed mean these conclusions should be interpreted with caution.

Authors' objectives
To determine the impact of computerised clinical decision support systems (CDSSs) targeting pharmacists on physician prescribing, clinical and patient outcomes.

Searching
MEDLINE, PREMEDLINE, EMBASE, CINAHL, PsycINFO, INSPEC and Cochrane Database of Systematic Reviews were searched for articles published in English from 1990 to 2009; some search terms were reported. References from identified articles were checked by hand.

Study selection
Experimental and strong quasi-experimental (non-randomised studies with comparison groups or interrupted time-series with or without comparison groups) studies that targeted pharmacists and compared a CDSS with usual pharmacy care-based and/or paper-based decision support were eligible for inclusion if they reported data on at least one outcome for prescribing, clinical, patient or pharmacist workload outcomes. Studies were required to provide information that could be applied to a specific patient and to generate information or advice to the pharmacist in an electronic format. Studies that included interventions based around hypothetical scenarios rather than clinical practice and studies that reported only cost outcomes were excluded.

Most of the included studies utilised system-initiated decision support. Other studies utilised user-initiated decision support or a mix of both system and user-initiated support. In three studies the method of invoking CDSS was unclear. The interventions in eight studies consisted of CDSS only. The other studies were multifaceted. Pharmacists received additional training, lectures, guidelines and/or support materials in addition to the decision support itself. Most interventions focused on pharmacists exclusively. Other studies included pharmacists and physicians and/or other healthcare professionals (such as nurses and nurse practitioners). Study settings included ambulatory care and institutional care (hospital in-patients). Prescribing outcomes were reported in most of the included studies. Clinical and patient outcomes were also reported. The most common clinical focus was cardiovascular disease management. Other clinical areas included anticoagulant therapy, antibiotic prescribing and respiratory conditions.

Two reviewers independently identified potentially relevant articles from titles and abstracts. It was unclear how many reviewers were involved in the selection of studies from full papers.

Assessment of study quality
Two reviewers assessed study quality using criteria of study design, unit of randomisation, differences in baseline characteristics, objectivity of outcome measures, completeness of follow-up, whether statistical analyses were adjusted for clustering and whether the authors mentioned possible contamination of the study groups.

Data extraction
The frequency and nature of interactions between pharmacists and physicians and/or patients and the impact of CDSS on pharmacist workload and work patterns were extracted. Studies were classified as having either a safety or a quality use of medicines (QUM) focus.
Two reviewers independently extracted data from the primary studies. Any disagreements were resolved by consensus.

**Methods of synthesis**
Fisher's exact test was used to determine differences in the proportion of studies that showed significant improvements on the main outcomes of interest (namely differences between safety studies and QUM studies, between ambulatory and institutional care and between system and user-initiated studies).

**Results of the review**
Twenty-one studies were included: 16 randomised controlled trials (RCTs), of which seven were randomised by cluster (ward, team, unit, pharmacy); four non-randomised studies with concurrent or historical control groups; and one interrupted time series design. Eleven studies addressed safety and 10 addressed QUM issues. All studies except one were conducted in North America.

All 21 studies reported at least one positive outcome from prescribing, clinical and patient. Two of three studies had statistically significant results in favour of CDSS on most outcomes. Ninety-one per cent of CDSS studies compared with 40% of QUM studies that addressed safety issues reported a significant change in the desired direction for most outcomes (p=0.01).

Most studies that showed a benefit of CDSS were conducted in institutional (88%) rather than ambulatory care (54%) settings, were user-initiated (100%) rather than system initiated (88%) and involved CDSS alone (75%) rather than being multifaceted (62%); none of the differences in these proportions was statistically significant.

**Authors' conclusions**
Greater effectiveness was found for safety-focused compared with QUM-focused CDSSs. The full benefits of QUM-focused CDSSs may not be realised without good communication between pharmacists and physicians.

**CRD commentary**
The review question was supported by clearly defined inclusion criteria. Several electronic databases were searched. The restriction to studies published in English may have meant that relevant studies were missed. No specific attempts were made to locate unpublished studies, which raised the possibility of publication bias. Appropriate steps were taken to minimise the likelihood of bias and error in data extraction and study quality assessment; it was unclear whether similar steps were used in all stages of study selection. Study validity was assessed using relevant criteria, but no results were reported and this made it difficult to fully interpret the reliability of the review findings. Differences between studies made a narrative synthesis appropriate.

The authors' conclusion should be interpreted with some caution due to the uncertain quality of the included studies and the possibility that relevant studies were missed.

**Implications of the review for practice and research**
**Practice**: The authors did not state any implications for practice.

**Research**: The authors stated that developments in pharmacy-based CDSSs needed to consider interprofessional relationships as well as computer system enhancements. Pharmacists outside of institutional settings may require additional support to promote contact with physicians about appropriate medicines management strategies.

**Funding**
National Prescribing Service (NPS) Ltd as part of a research partnership with the Universities of Newcastle and New South Wales.

**Bibliographic details**

PubMedID
20441116

DOI
10.1211/ijpp/18.02.0002

Original Paper URL

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Clinical Pharmacy Information Systems /organization & administration; Decision Support Systems, Clinical /organization & administration; Evidence-Based Medicine; Humans; Outcome Assessment (Health Care); Pharmaceutical Services /organization & administration; Pharmacists /organization & administration; Practice Guidelines as Topic; Practice Patterns, Physicians' /standards; Quality of Health Care

AccessionNumber
12010004198

Date bibliographic record published
20/10/2010

Date abstract record published
08/06/2011

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.