What evidence supports the use of computerized alerts and prompts to improve clinicians' prescribing behavior?


CRD summary
The review concluded that computerised prompts and alerts were associated with positive and often substantial effects on prescribing behaviour. The authors' conclusion appeared to reflect the evidence presented, but the reliability of the results is not known given the possibility of publication bias, limited study information and varied quality of included studies.

Authors' objectives
To assess efficacy of electronic alerts and prompts on clinicians’ prescribing behaviour.

Searching
CINHAL, EMBASE, Inspec, MEDLINE, PsycINFO and reference lists of retrieved articles were searched for studies published in any language. Search dates varied across sources and spanned 1966 to May 2007. Searches were re-run in January 2009. Search terms were reported.

Study selection
Randomised controlled trials (RCTs), time-series and before-after studies of computerised alerting or reminding systems that targeted health care professionals’ prescribing and administration of drug treatment for patients of any age were eligible for inclusion. Studies had to evaluate changes in clinically relevant prescribing outcomes (such as reduction in medical errors).

Most of the studies were conducted in hospital or in-patient settings in USA. Most participants were doctors. Alerts systems evaluated included: basic drug alerts (drug allergy warnings, drug-drug interactions, duplication alerts, basic medication order guidance); advanced drug alerts (drug-laboratory alerts, drug-condition alerts, drug-formulary alerts, dosing guidelines); and a combination of basic and advanced alert systems. Included studies reported prescribing behaviour (such as prescribing-related renal impairment, adverse drug events and so on) and cost outcomes.

Four reviewers independently assessed studies for inclusion. Any disagreements were resolved by discussion.

Assessment of study quality
Quality of RCTs was assessed by considering adequacy of minimisation of selection, performance, attrition and detection biases. Quality of before-after studies was assessed based on adequacy of study duration, comparability of groups at baseline and similarity in before-after outcome assessments.

The authors did not state how validity assessment was performed.

Data extraction
Data on alert and prompt systems (number, type) and their effects on prescribing and clinical outcomes were extracted and summarised using tables and narratively.

Data were extracted by four reviewers and verified independently by two reviewers. Any disagreements were resolved by discussion.

Methods of synthesis
Alert and prompt systems were grouped into three categories (basic drug alerts, advanced drug alerts, complex alert systems).
systems) in a table. Due to clinical heterogeneity, the authors decided not to pool data and summarised studies using a narrative synthesis.

Results of the review
Twenty studies were included: four RCTs; four interrupted time-series; six time-series analyses; and six before-after designs (details on sample sizes were not reported). RCT quality varied: randomisation and blinding were inadequate in all included studies; losses to follow-up were inadequately reported in all included studies; and power calculation was reported for only one trial. Most of the other study designs were reported to have met validity criteria: minimisation of seasonal influence and similarity in groups (prescribers/patients) and assessment of outcomes in control and intervention periods.

Prescribing outcomes: Alerts and prompts were associated with statistically significant improvement in prescribing behaviour and/or reductions in medical errors in 23 of 27 alert systems reviewed.

Clinical outcomes: Alert systems were associated with a statistically positive effect that led to decreased prescribing-related renal impairment, fewer falls in elderly people and reduced length of hospital stay in four of four alert types reviewed.

Costs: Drug-formulary alerts were associated with significant reductions in costs in two studies.

Types of alerts and changes in outcomes: Two studies assessed four basic types of drug alerts, of which drug allergy warnings and basic medication guidance alerts and drug-interaction warnings demonstrated a beneficial effect on prescribing. Basic drug alerts described as drug-interactions demonstrated no effect on prescribing.

Advanced drug alert systems were associated with a statistically significant beneficial effect on prescribing behaviour in 14 studies and clinical outcomes in five studies.

The combination of basic and advanced (complex) drug-alert systems was associated with statistically significant beneficial effects in prescribing behaviour (four studies, four alert systems).

Cost information
Alert systems were associated with annual cost savings of US$36,500 and US$6,400 in two studies.

Authors' conclusions
Most of the evidence demonstrated positive and often substantial effects of computerised prompts and alerts on prescribing behaviour.

CRD commentary
The review question and inclusion criteria were clear. Relevant databases were searched without language restrictions, which minimised the possibility of language bias. No efforts were made to search for unpublished literature and so relevant studies may have been missed. Appropriate steps were taken to minimise reviewer bias and error in study selection and data extraction, but not explicitly with validity assessment. Validity assessment was conducted using appropriate criteria and the results were incorporated in the synthesis. The decision to summarise results narratively was appropriate given considerable variations in study designs, interventions (alert, prompt systems) and outcome measures. The authors’ conclusion appears to reflect the evidence presented. However, due to the possibility of publication bias, lack of detailed study information and varied quality of included studies, reliability of the results is not known.

Implications of the review for practice and research
Practice: The authors stated that reported findings provided support for continued development and use of computerised alerts and prompts for prescribing.

Research: The authors stated that additional RCTs of computerised alert and prompts systems were needed to determine the design features (such as content, display format, wording) most strongly associated with positive effects on prescribing and clinical outcomes. Future RCTs should focus on drug-drug interaction alerts, drug-disease contraindication alerts and dosing guidelines based on age. Future RCTs should use standardised outcome measures and
be large enough to assess effects of alert and prompt systems on clinical or health management outcomes.

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