Review: Ordering medications by computer can reduce medication errors

Kaushal R, Shojania KG, Bates DW. **Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review.** Arch Intern Med. 2003;163:1409-16.

QUESTION

Are prevention strategies, such as computerized physician order entry [CPOE] and clinical decision support systems [CDSSs] that target the ordering stage of medications, effective for reducing medication errors and adverse drug effects?

DATA SOURCES

Studies were identified by searching MEDLINE, the Cochrane Library, and reviewing bibliographies of relevant articles.

STUDY SELECTION AND ASSESSMENT

Studies were selected if they were randomized controlled trials (RCTs), nonrandomized controlled trials, or observational studies with controls that evaluated CPOE or CDSSs for reducing medication errors, and measured clinical (any measure of morbidity or mortality including adverse drug events) or surrogate (observed errors and intermediate outcome such as laboratory test results with a well-established connection to the clinical outcomes of interest [usually adverse effects]) outcomes.

OUTCOMES

Included adverse drug events (injuries resulting from drug use) or potential adverse drug events (medication errors in the process of ordering, transcribing, dispensing, administering, or monitoring with substantial potential to harm a patient that may or may not actually reach a patient).

MAIN RESULTS

2 RCTs (9671 patients) that assessed CPOE combined with CDSSs and 6 RCTs (655 patients) that assessed isolated CDSSs met the selection criteria. CPOE: Improvement in ordering of corollary medications was 25% greater in patients cared for by faculty and residents assisted by CPOE than in those allocated to the control group (1 RCT, $n = 2181$) ($P < 0.001$). The rates of appropriate prescriptions by dose and frequency were greater by 13% and 24%, respectively, in the intervention period than in the control period for nephrotoxic drugs in patients with renal insufficiency (1 RCT, $n = 7490$) (P values < 0.001). CDSSs: Pathogen susceptibility (percentage of culture results in which all isolated pathogens were shown to be susceptible) to a computer-suggested antibiotic drug regimen was 17% greater than that suggested by a physician (1 RCT, $n = 451$) ($P < 0.001$). Fewer patients in the intervention group than in the control group had toxic levels of antibiotics (1 RCT, $n = 48$) (18.9% vs 37.8%, $P = 0.04$). In 4 other RCTs, the groups did not differ for any of the outcomes measured.

CONCLUSION

Prevention strategies that target the ordering stage of medications such as computerized physician order entry and clinical decision support systems are effective for reducing medication errors.

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COMMENTARY

As defined by Kaushal and colleagues, CPOE refers to a variety of computer-based systems that share common features of automating the medication ordering process, which work to ensure standardized, legible, and complete orders. Similarly, a CDSS is a software program that matches patient data with a computerized knowledge base to generate patient-specific assessments or recommendations that are then presented to health care providers for consideration. CDSSs have been tested for their use in improving diagnosis, drug prescribing, and preventive and active care (1). As highlighted in this review, such systems can improve "processes of care," for example by alerting the user when the route of medication administration was not specified or that a dose of medication was not appropriately reduced for renal impairment.

The results of this review are most useful for physicians, information technologists, and administrators who are responsible for making decisions about purchasing and developing such systems for their local hospital environments (all the primary studies in this review pertained to inpatient management). Unfortunately, when adopted as standard practice, the upfront costs of such computer systems are notoriously expensive. A primary question to be asked is whether implementing such systems will result in meaningful improvements in patient outcomes.

The conclusions by Kaushal and colleagues are consistent with the findings in a previous review (1) that the efficacy of these systems for improving clinically important patient outcomes remains to be clarified. Additional considerations when adopting a CPOE or CDSS are transportability to local environments, successful integration with existing practitioner workflow and electronic or paper medical records, need for training and extra support staff, and user satisfaction with the system. Practitioner resistance to accepting such systems may be especially fierce if workflow demands and requirements for data entry are greater and more time-consuming than with traditional paper processes.

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Reference

1. **Hunt DL, Haynes RB, Hanna SE, Smith K.** Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. JAMA. 1998;280:1339-46.