

# LDI *Issue Brief*

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Ross Koppel, PhD  
*Sociology Department and School  
of Medicine*

*and colleagues at the  
Center for Excellence in Patient  
Medication Safety  
University of Pennsylvania  
(see back)*

## ***Computerized Physician Order Entry Systems: The Right Prescription?***

Editor's note: Policymakers increasingly urge the use of information technology to improve the quality and efficiency of health care. In particular, computerized physician order entry (CPOE) is emphasized for its ability to reduce prescribing errors inherent in paper-based systems. This Issue Brief summarizes research that sounds a cautionary note about the potential for computerized systems to facilitate medication errors, as well as reduce them.

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### ***Hospital CPOE holds promise for reducing medication errors***

Hospital CPOE systems are widely regarded as the technical solution to medication ordering errors, the largest source of preventable hospital errors. CPOE has garnered strong support because its promise is so great, the frequency and effects of medication errors are so profound, and the circumstances of medication errors are so preventable.

- Compared with paper-based systems, CPOE systems have obvious advantages. They eliminate errors due to poor handwriting, reach the pharmacy instantly, and can provide important clinical information to the user just in time, such as patient allergies or warnings about drug interactions.
- Early studies provide evidence that hospital CPOE can reduce medication errors by 17% to 81%; however, most of these studies are limited and focus on potential errors avoided, rather than actual ones. Few studies have considered the possibility that CPOE systems might facilitate some medication errors, even while reducing the risk of others.
- Only 5%-9% of U.S. hospitals have fully implemented CPOE systems, although surveys indicate that 16% plan to do so in the next few years. High initial costs and physician resistance have been cited as barriers to rapid adoption of CPOE systems.

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*Multimethod study in one hospital describes risk of errors facilitated by CPOE*

Koppel and colleagues studied a large academic hospital with a widely-used CPOE system in operation from 1997 to 2004. They conducted the study from 2002 to 2004.

- The investigators used a combination of methods to study CPOE-related factors that enhance the risk of medication errors. They interviewed house staff (interns and residents), pharmacists, nurses, nurse-managers, attending physicians, and information technology managers; conducted focus groups of house staff; and shadowed clinicians in the hospital to observe house staff writing orders, nurses charting medications, and pharmacists reviewing orders. The interview responses generated new focus group questions, and the focus group responses targeted issues for observation.
- The interviews and focus group responses also informed the development of questions on CPOE in a survey of house staff. The survey asked about CPOE as a possible source of error risk, and sought to quantify the frequency of those risks.
- The survey targeted house staff who typically enter more than nine medication orders per month, and asked about their experiences with CPOE in the last three months. Of 291 house staff surveyed, 261 (88%) completed the questionnaire.

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*Study reveals 22 kinds of errors facilitated by CPOE*

The qualitative and quantitative data identified 22 sources of medication-error facilitated by CPOE. The investigators grouped these errors into two broad groups: information errors generated by fragmentation of data and failure to integrate the hospital's several computer and information systems, and human-machine interface flaws reflecting machine rules that do not correspond to work organization or usual behaviors.

- Information errors occur when information the user needs does not exist in the system or cannot be found easily, or when the system fragments clinical data. For example, the risk of ordering conflicting or duplicative medication is increased because the CPOE system separates the process of ordering from the process of discontinuing existing medications. Also, the CPOE system does not display information available on other systems. For example, only the pharmacy's computer provides drug interaction and lifetime limit warnings. It provides feedback on drug allergies, but only after medications are ordered.
  - Human-machine interface flaws include hard-to-read displays, inflexible order screens, and unclear log on/log offs. Viewing one patient's medications might require scrolling through 20 screens, and the patient's name does not appear on every screen. Fonts are small, and it is easy to select the wrong patient file because the names and drugs are close together.
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***Errors can occur when CPOE system provides misleading, fragmented, or delayed information***

The survey results indicate that situations in which CPOE increased the probability of prescribing errors are common and frequently encountered. When asked about errors and risks encountered in the past three months, house staff identified a number of CPOE-related information errors.

- The CPOE system lists medication dosages based on the units stocked by the pharmacy. However, house staff often rely on the CPOE display to determine a minimally effective or usual dose for medications they prescribe infrequently. A large majority (73%-82%) had incorrectly used the CPOE information in this way at least once; 10%-14% said they did so daily.
- Because of fragmented CPOE displays and processes, 51% of house staff reported delays of several hours in canceling a patient's medication. Twenty-two per cent indicated that this happens at least a few times every week.
- To maximize appropriate antibiotic prescribing, house staff must obtain approval from a specialist, and obtain reapproval three days later. Reminder stickers are placed in the patient's paper chart on the second day, but no reminders are built into the CPOE system. Because the systems are not integrated, 83% of house staff observed at least one unintended gap in antibiotic therapy. Thirteen percent reported that this was a daily occurrence.

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***Human-machine interface flaws reveal mismatch between computer requirements and clinical work***

The survey results also revealed common errors and error risks that stem from flaws in the interface between the user and the computer.

- Because of the difficulty of viewing all medications on one screen, 72% of house staff reported being uncertain about a patient's medications; 23% reported that this was a daily problem.
- The CPOE system is shut down for periodic maintenance, and crashes are common. Eighty-four per cent of house staff reported delaying medication orders due to system crashes, which can occur 2-3 times each week.
- Because of poor or fragmented CPOE displays, 55% of house staff reported having trouble identifying the patient for whom they were ordering medication. For 10% of the respondents, this happened daily.
- Because of inflexible ordering screens, 92% of house staff reported difficulty specifying nonstandard or off-formulary medications. Nearly one-quarter said that they encountered this problem at least once every day.

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## POLICY IMPLICATIONS

These findings reveal some features of error-prone CPOE systems that require attention. As hospitals and clinicians implement these systems, they must consider the errors CPOE may cause, as well as the errors it may prevent.

- Well-designed CPOE systems hold great promise for reducing hospital medication errors. However, patient safety initiatives should focus on the organization of work, rather than on the technology. CPOE systems should be responsive to the way clinicians and hospitals actually work.
- Once a CPOE system is in place, it should be aggressively examined in use, and quickly fixed when shown to be counterproductive.
- A variety of methods can be used to examine how a CPOE system performs in practice. Shadowing house staff, careful interviews, and surveys are all valuable tools that should be repeatedly employed.
- Hospitals should plan to continuously test, evaluate, and modify their CPOE systems, recognizing that all changes generate new risks for errors.

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*This Issue Brief is based on the following article: R. Koppel, J.P. Metlay, A. Cohen, B. Abaluck, A.R. Localio, S.E. Kimmel, B.L. Strom. Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors. Journal of the American Medical Association, March 9, 2005, vol. 293, pp. 1197-1203.*

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*Janet Weiner, MPH, Associate Director for Health Policy, Editor*

*Benjamin Isquith, Health Policy Intern*

*David A. Asch, MD, MBA, Executive Director*

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*Issue Briefs synthesize the results of research by LDI's Senior Fellows, a consortium of Penn scholars studying medical, economic, and social and ethical issues that influence how health care is organized, financed, managed, and delivered in the United States and internationally. The LDI is a cooperative venture among Penn schools including Dental Medicine, Medicine, Nursing and Wharton, and the Children's Hospital of Philadelphia. For additional information on this or other Issue Briefs, contact Janet Weiner (e-mail: [weinerja@mail.med.upenn.edu](mailto:weinerja@mail.med.upenn.edu); 215-573-9374).*

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3641 Locust Walk  
Philadelphia, PA 19104-6218  
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