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Effects of Computerized Order Entry and Clinical Decision Support Systems on Medication Safety

A recent report in the Archives of Internal Medicine by Kaushal and others, (June 2003) examines the effects of computerized physician order entry (CPOE) and clinical decision support systems (CDSSs) on improving medication safety.

In their report, the authors conclude that the use of CPOE and isolated CDSSs can substantially reduce medication error rates. "However, the effect on ADE rates has not been adequately tested because studies with sufficient power have not been performed." The studies that have no detected differences in adverse drug events involved evaluation of a small number of "homegrown" systems.

Dr. Kaushal states that it is estimated that 770,000 of hospitalized patients suffer some degree of harm resulting from drug use. Comparatively, incidence rates of adverse drug events (ADEs) for this population range from 2 to 7 per 100 admissions. Dr. Kaushal points out that a true national incidence rate of ADEs in this population is difficult to ascertain due to varying definitions that currently exist for adverse drug events.

Studies conducted thus far reveal that approximately 28% of ADEs are associated with a medication error, and are subsequently deemed to be preventable. Of those preventable ADEs, 56% have been found to occur during the drug-ordering phase. Primarily, these identified mediation errors include missing doses, incorrect doses, frequencies, or routes. In observational studies that evaluate the execution of medication orders, high rates of administration errors have been found.

Analysis of medication errors suggests that prevention strategies aimed at systems rather than individuals have been most effective in reducing errors. CPOE and CDSSs are showing promising results in targeting the ordering phase of the medication delivery process where most medication errors and ADEs occur.

CPOE consists of a variety of computer-based systems that share the common feature of automating the medication ordering process and ensure

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standardized, legible, and complete orders. CDSSs are currently built into most CPOE systems in varying degrees. Basic clinical decision support systems provide computerized advice regarding drug doses, routes and frequencies. More sophisticated CDSSs incorporate the ability of performing drug allergy checks, drug laboratory value checks, and drug-drug interactions checks. These systems can also provide reminders about corollary orders such as prompting the clinician to order glucose checks after ordering insulin. Drug guidelines are also incorporated into some of these systems. (Kaushal, et al, 2003)

In their review of these systems, Dr. Kaushal and her research team studied trials evaluating the effects of CPOE and CDSSs on medication safety. A search of MEDLINE and the Cochrane Library and manual searches of bibliographies of retrieved articles was conducted. Criteria for inclusion in this systematic evaluation were randomized control trials, non-randomized control trials, and observational studies with controls where the measured outcomes were clinical (e.g. adverse drug events) or surrogate (e.g. medication errors) markers. Based on these criteria, 5 trials assessing CPOE and 7 trials assessing isolated CDSSs were examined. The findings were as follows: of the CPOE studies, 2 trials demonstrated a marked decrease in serious medication error rate, 1 an improvement in corollary orders, 1 an improvement in 5 prescribing behaviors and 1 an improvement in nephrotoxic drug dose and frequency. Of the 7 studies evaluating isolated CDSSs, 3 demonstrated statistically significant improvements in antibiotic – associated medication errors or adverse drug events and 1 an improvement in theophylline –associated medication errors. The remaining 3 studies had nonsignficant results.

The authors note that although further studies targeted at a few critical questions are desirable, these should not be a requirement before widespread adoption of CPOE. Further research is needed to evaluate commercial systems, to compare the various applications and to identify key components of applications, and to identify factors related to successful implementation of these systems.

Many public and private groups are increasingly endorsing CPOE and other information technologies as a means of improving patient safety. This article states that the Leapfrog Group has identified CPOE as 1 of 3 changes that would most improve patient safety in the United States.

The cost of incorporating CPOE with decision clinical support systems may appear daunting to many administrators, particularly in economically difficult times. Financial challenges remain for institutions desiring to incorporate this technology into their hospital systems. Ongoing discussion and legislative efforts aimed at producing financial incentives and providing grant support continue. A Medicare Payment Advisory Commission report suggested instituting financial incentives for CPOE implementation. United States senators Bob Graham (D- Fla) and Olympia Snowe (R- Maine) have introduced a bill titled the “Medication Errors Reduction Act of 2001” to establish an informatics system grant program for hospitals and skilled nursing facilities. Kaushal et al, report that at the state level, California recently enacted legislation stipulating that acute care hospitals implement information technology such as CPOE to reduce medication related errors.

Dr. Kaushal recently spoke at the Quality Colloquium held at Harvard University and addressed some of the known barriers to implementing a CPOE program. During the follow-up discussion on the

cost of incorporating this technology, one audience member turned to another and stated, "The question is not can we afford to implement CPOE, the question is, can we afford NOT to implement CPOE?"

References:
Kaushal , R; Shojania K; Bates, D;.. "Effects of Computerized Order Entry and Clinical Decision Support Systems on Medcation Safety; A Systematic Review" *Archives of Internal Medicine, 2003*; vol;163; p:1409-1416. .

Massachusetts Department of Public Health and Partners Healthcare to Collaborate on Analysis of Web-Based Reporting Systems

The Massachusetts Department of Public Health and Partners HealthCare will be joining efforts at assessing web-based incident reporting systems. Funded through a grant from the Agency for Healthcare Research and Quality this effort will analyze data obtained from web-based reporting system at three Partners Institutions. This collaboration will also evaluate the effectiveness of these systems on identifying medical errors thus allowing further investigation of their causes.

Jeffrey Cooper, Ph.D., Recipient of 2003 John M. Eisenberg Patient Safety Award

The National Quality Forum (NQF) and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) announced the 2003 recipients of the annual John M. Eisenberg Patient Safety Awards. Jeffrey Cooper, Ph.D. has been named this year's honoree for the category "Individual Lifetime Achievement." Dr. Cooper receives this award in recognition of his unique application of human factors research to anesthesia machine safety and his pioneer efforts in critical incident analysis.

Dr. Jeffrey B. Cooper, Ph.D., is the Director of Biomedical Engineering for the Partners HealthCare System, Inc. (PHS) and Associate Professor of Anaesthesia at Harvard Medical School in the MGH Department of Anesthesia and Critical Care.

Dr. Cooper began his career in research and development with the Anesthesia Bioengineering Unit in the MGH Department of Anesthesia in 1972, leading the team that conducted seminal studies of critical incidents and human error in anesthesia. The first publication of those studies in 1978 was one of the earliest reports of medical error and its relationship to human factors. During the same time, he was leading a team that developed one of the first microprocessor-based medical technologies, the Boston Anesthesia System, aimed at integrating functions and alarms to reduce human and system errors associated with anesthesia delivery apparatus. Both of these efforts have catalyzed changes in anesthesia safety in the ensuing years. In 1981, he became MGH Associate Director of Biomedical Engineering. After a brief hiatus back to research, he was appointed Director in 1991. Soon after the creation of PHS, Cooper assumed the role of its Director of Biomedical Engineering. More recently, he became an Associate Director in the Center for Integration of Medicine and Innovative Technology.

Dr. Cooper is also the founder and Executive Director of the Center for Medical Simulation, which is dedicated to the use of realistic simulation in healthcare for education and training, especially for crisis management and teamwork. He is a founding member of the Anesthesia Patient Safety Foundation, serving continuously on its Executive Committee since 1985 and for 13 years as Chairman of the Committee on Scientific Evaluation. Cooper also organized and chairs the Research Program of the

National Patient Safety Foundation.

This is the second year in a row that a Center affiliate has won an Eisenberg Award. Last year, Dr. Bates received it for his leadership in safety research.

National Quality Forum Publishes Consensus Report: Safe Practices for Better Healthcare

The National Quality Forum (NQF), recently published a detailed report outlining 30 healthcare practices that should be "universally utilized in applicable clinical care settings to reduce the risk of harm to patients"

The NQF report emphasizes that this set of safe practices focuses on high priority practices that include the following**:**

a. "have strong evidence that they are effective in reducing the likelihood of harming patients

b. are generalizable (can be applied in multiple clinical settings and/or multiple patient types)

c. are likely to have significant benefit to patient safety if fully implemented

d. have knowledge about them that is usable by consumers, purchasers and researchers."

The safe practices identified were developed from many resources including a report by the Agency for Healthcare Research and Quality's University of California San Francisco - Stanford University Evidence – Based Practice Center; the Leapfrog Group's three safety " leaps"; the NQF project Steering Committee; NQF Members and health professional specialty societies and other organizations responding to NQF's query for suggested safe practices.

The NQF list of 30 endorsed set of Safe Practices are structured into the following five categories:

- creating a culture of safety;
- matching healthcare needs with service delivery and capability;
- facilitating information transfer and clear communication ;
- adopting safe practices in specific clinical care settings or specific processes of care; and
- increasing safe medication use.

The NQF Consensus Report states that " For any given healthcare provider, the choice of practices that will have top priority will depend on the individual provider's circumstances, including what practices already have been implemented availability of resources, environmental constraints, and patient mix."

The consensus report also lists 27 practices that the NQF feels should receive high priority for additional research. Lastly, the report recommends that specific actions be undertaken in the following areas: dissemination and implementation of the practices, measuring their implementation; and updating and improving the set of practices.

A complete list of the NQF-Endorsed Set of Practices can be found by visiting the National Quality Forum website at www.qualityforum.org

1 Retrieved from the worldwide web September 17, 2003; www.qualityforum.org/txsafeexecsumm+order6-8-03PUBLIC.pdf

Patient Safety 2004 HMS CME Course Proposed for Spring 2004

Under the direction of Saul N. Weingart, MD, PhD, and David W. Bates, MD, MSc, a Harvard Medical School continuing education course designed to provide a comprehensive review and update of patient

safety for physicians and non-physician clinicians has been proposed for this upcoming Spring.

Patient Safety 2004 aims to discuss the problem of medical error and its emergence as a major public health problem in the past decade. The course offering will provide a human face to the problem by presenting the experience of patient and physician. Large-group lectures will address the nature of error in healthcare, drawing heavily from human factors engineering and systems theory. Faculty for this program will draw on the concentration of patient safety expertise and experience in the Harvard Medical Institutions.

Sponsoring institutions include Beth Israel Deaconess Medical Center, Brigham and Women's Hospital and the Harvard Center of Excellence for Patient Safety Research and Practice**.**

Frontline: Patient Safety Publications, Research Projects, and Presentations

Bates DW., Gawande, AA., "Improving safety with information technology**."** *New England Journal of Medicine. June 19, 2003. Vol 348(25); p:2526-34.*

Schiff GD. Klass D. Peterson J. Shah G. **Bates** DW. "Linking laboratory and pharmacy: opportunities for reducing errors and improving care." *Archives of Internal Medicine. April 28, 2003. Vol 163(8) p:893-900.*

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Chan KA. Truman A. **Gurwitz** JH. Hurley JS. Martinson B. Platt R. Everhart JE. Moseley RH. Terrault N. Ackerson L. Selby JV. "A cohort study of the incidence of serious acute liver injury in diabetic patients treated with hypoglycemic agents." *Archives of Internal Medicine. Mar 24, 2003. Vol:163(6); p:728-34.*

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Kaushal R. Shojania KG. **Bates** DW. "Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review." *Archives of Internal Medicine. June 23,2003. Vol:163(12; p:1409-16.*

Weingart, S. N, "Seeing Error Through New Lenses." Journal of General Internal Medicine. August 2003; Vol: 18(8); p: 675-676.

Research Projects

Gandhi, TK**.** (Principal Investigator); **Bates,** DW**, Rothschild,** JM., **Poon,** E. (Co- Investigators) recently received grant support from the Agency for Healthcare Research and Quality for a project titled: *"Using Barcode Technology to Improve Medication Safety."*

This study will examine what the impact of barcode and electronic medication administration record (barcode/eMAR) technology have on reducing medication errors in hospitalized patients, what the impact of barcode/eMAR technology is on nursing and pharmacy efficiency and satisfaction, if the cost of barcode/eMAR technology can/will be justified by its benefits?

Gandhi, TK**.** (Principal Investigator), has recently received grant support from the Harvard Risk Management Foundation for a study titled: *"The Effect of a Hospital Results Management System on Physician Awareness of Post-Discharge Laboratory and Radiology Results."*
This is a cross-sectional study, which will be followed by a randomized controlled trial at 2 tertiary care hospitals. The aims of this project are to determine the prevalence of post-discharge laboratory and radiology results that require clinical action, how frequently physicians are unaware of actionable post-discharge results, and the effect of HRM on result awareness and physician satisfaction.

Agus M, **Landrigan**, C. (Principal Investigators) received grant support from the Harvard Risk Management Foundation for a study titled: "*Implementation of a Pediatric Intermediate Care Unit: Effects on Patient Safety."*

This is a prospective cohort study that is measuring differences in rates of errors and adverse events for patients with target medical conditions in a pediatric hospital before and after implementation of an intermediate ICU.

Mistry KP**,** (Principal Investigator)**; Landrigan,** C.**, Bates,** DW.**, Goldmann,** D. (**Co-Investigators**) "*Communication during Post-operative Patient Hand Off in the Pediatric Intensive Care Unit."*

This is a prospective study measuring rates of post-surgical communication errors, downstream errors, and adverse events among patients in a pediatric ICU.

Rothschild, JM. (Principal Investigator) **Landrigan** C**.** (Co- Investigator) have been awarded funding from the Harvard Risk Management Foundation for a study titled: "*Intercepting Near Miss Adverse Events: The Critical Care Nursing Safety Net.*"

This is a prospective study using direct observation and chart review to measure rates of nursing intercepts in a cardiac care unit, and exploring the nature of these intercepts.

Presentations

Bates, DW. "Safety and Quality" Plenary speaker, National Health Information Infrastructure 2003, Developing a National Action Agenda for NHII, US Department of Health and Human Services, June 30, 2003. Washington, DC

Rothschild, JM. **Keohane**, C., Thompson, S., **Bates,** DW**.** "*Intelligent Intravenous Infusion Pumps to Improve Medication Administration Safety"* AMIA; November 8-12, 2003 Washington, D.C.