Annotated Bibliography for CPOE

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The search criteria included keywords: CPOE, success, implementation, case studies and medication errors. The search was limited to the English language between the years 1998-2003. The search engines and databases queried were: Google, OVID, Lexis-Nexis, MEDLINE, and Business Source Elite
E-Journals.

Thirty-five articles were reviewed, and the best 20 were selected for this annotated bibliography. These 20 articles were classified as research articles, journal articles, or coming from trade journals. The 20 articles were further critiqued and earned either good (7), very good (1), or excellent (12) ratings and placed into one of three sub-categories: implementation considerations (7), change management strategies (7), and implementation case studies (6).

One area that seemed to be lacking in the current literature was return on investment (ROI). With any type of information technology, this tangible benefit is difficult to ascertain within a short period of time. Because the start up costs are expensive and is seen as a major barrier, more literature is needed that will assist with the translation of the positive gains into tangible and monetary benefits for those considering CPOE.

Many clinical providers, as well as those in administration health care, play an important role in the advocacy of CPOE implementation. Understanding the key issues involved will assist healthcare IT workers with relationships and overall communication with senior executives, physicians, nurses, clinicians, and various health care providers, and most importantly, our patients. CPOE is one avenue that will assist with safer patient care delivery, however other methods need to be adopted by organizations in conjunction with technology to ensure better patient care. Technology is designed to assist us with performing our duties, however our professional decision-making should still remain a top priority.

This bibliography is a result of a practicum project of students from Loyola University's Master's Program in Health Systems Management.

Implementation Considerations

Reference	Key Points	Type of Article	Usability of Information	Comments
Cascardo, D.C. (2003) Are electronic medical records right for your practice? *Medscape.*	* Potential immediate and long-range uses of CPOE must be considered when purchasing a system. * Electronic medical records, as well as CPOEs, can lower costs, increase revenues and improve efficiencies. * Thoroughly examine vendor track records before making any purchasing decisions.	Trade Article	Excellent	Examines key short- and long-term features of a CPOE system.
Marshalek, G. & Casey, S. (2003) Pain Free CPOE. *Health Management Technology*, 24(2), 3.	* All critical systems must be linked by CPOE throughout the organization. * A CPOE system must be user-friendly, seamless and provide easy retrieval of clinical results. * Simply access to all systems yet concentrate on authentication.	Trade Article	Excellent	Article examines strategies such as user authentication, portal design and high-performing responses.
Scalise, D. (2002) CPOE: Is it worth it? *Hospitals & Health Networks, 76*(1).	* Less than 5% of all hospitals use CPOEs to their full extent. * Cost is the major obstacle to full implementation. * Unintuitive systems complicate physician practices and decrease compliance with implementation.	Trade Article	Good	Article comparing costs and benefits of CPOE.
Overhage, J.M., Middleton, B., Miller, R.A., Zielstorff, R.D. & Hersh, W.R. (2002). Does national regulatory mandate of provider order entry portend greater benefit than risk for health care delivery? The 2001 ACMI debate. The American College of Medical Informatics. *Journal of the American Medical Informatics Association, 9(3),199-208.*	* The two proponents for the CPOE mandate are: B. Middleton (Partners Healthcare) and R. Zielsterff (Health Vision).... Regrettably, the US healthcare system cares more about time and money than about quality and safety. US can avoid mistakes if providers are required to use a CPOE. * The two in opposition are: R. Miller (Vanderbilt) and M. Overhage (Indiana University)... Many CPOE systems were designed for clerks, not for doctors and nurses... vendor's systems are not ready, CIOS will hurry to implement something the organization is not ready for, will only cause "chaos and mayhem" in entire workflow change (p. 202).	Journal Article	Excellent	Lists annual debate from the closing session of the AMIA Annual Symposium. This year's debate looked at CPOE, an important, current, national issue. The article leaves the messages in the spirit of the debate form, for example, the statement in support/opposition of the proposition of a mandated CPOE with several rebuttals. Clear points given for and against without bias, persuading the reader.

The risks and the rewards. (2003). *Health Data Management*, February, www.lexisnexis.com	* K. Fath, MD: "If you're not using CPOE, you're not practicing medicine as safely as possible." * Physicians are hesitant. They want to know what is in the CPOE system for them, something tangible. * A CPOE system helps ensure the best practices, forcing clinicians to think more carefully about what they order and whether it complies with best practices.	Trade Article	Good	A short article discussing efforts and lesson learned at a small hospital in N.C. This community hospital put forth a Herculean effort, especially regarding *process change*.
Murff, H.J. & Kannry, J. (2001). Physician satisfaction with two order entry systems. *Journal of the American Medical Informatics Association,* 8(5) 499-509.	* Overall satisfaction of user interface is strongly related to the efficiency with performing tasks. * An intuitive and straightforward interface ensures usability. * An excess of non-essential information overwhelms the user.	Research Article	Excellent	A comparative study examining physician satisfaction of two nationally used CPOE systems.
Bates, D.W., Teicii, J.M., Lee, J., Seger, D., Kuperman, G.J., Ma'Luf, N., Boyle, D., & Leape, L. (1999). The impact of computerized physician order entry on medication error prevention. *Journal of the American Medical Informatics Association, 6*(4), 313-321.	* The rate of intercepted potential adverse drug events throughout the study demonstrates the importance of involving nurses in the development of screens. * Suggested paths and parameters that involve safeguards and guidelines for drugs need to be defined and revised continuously as new research unfold. * Many non-technological, extraneous variables may have caused An increase in missed dose errors. * Continually evaluating and refining systems will lead to improvements that can be tested in future studies.	Research Article	Excellent	A prospective time series analysis of the impact of CPOE on the medication error rate.

Change Management Strategies

Chiff, G.D. & Rucker, T.D. (1998) Computerized prescribing: Building the electronic infrastructure for better medication usage. *The Journal of the American Medical Association,* 279(13), 1024-1029.	* CPOE restructures the way health professionals work but should not change their decision-making processes. * The development of CPOE systems must be accomplished by a consortium of health professionals in order to ensure patient confidentiality, professional autonomy and accountability. * CPOE must encompass all stages of drug delivery.	Research Article	Excellent	Article highlights the need for a guiding clinical vision to prevent losing sight of patient outcomes to automation.
Shane, R. (2002) Computerized physician order entry: Challenges and opportunities. *American Journal of Health-System Pharmacy*, 59(3), 286-288.	* CPOE is only a beginning to eliminating medication errors. * CPOE may create provider complacency and may decrease the number of safety checks performed. * Pharmacists' roles have to be redefined with the introduction of a CPOE system.	Journal Article	Excellent	Presents key planning issues to analyze before moving forward with CPOE implementation.
Taylor, R, Manzo, J. & Sinnett, M. (2002) Quantifying value for physician order-entry systems: A balance of cost and quality. *Healthcare Financial Management, (7),* 44-48.	* A balanced analysis of both cost and quality must be performed when looking to implement CPOE systems. * Factors for successful CPOE implementation include: leadership, buy-in throughout the clinical team, phased roll-out and baseline data.	Scholarly Article	Excellent	Article discussing strategies to evaluate CPOE ROI, including key performance indicators.
Briggs, B. (2003). CPOE order from chaos. *Health Data Management, 11*(2), 44-48.	* Gives examples: Alamance Regional Medical Center: Time for an order on the floor to reach pharmacy without a CPOE: 96 minutes. Time after with a CPOE: 4 minutes! * Other successful CPOE implementation: Queens, NY Health Network (winner of the HIMSS 2002 Davies Award) mentioned.	Trade Journal	Good	Nice overview of expanding with IT, physicians aboard, point of care technology and CPOE. Also, a consultant from First Consulting Group (FCG) discussed the limitations hospitals face with costs and integration issues.

Karow, H.S. (2002). Creating a culture of medication administration safety: Laying the foundation for computerized provider order entry. *Journal on Quality Improvement, 28*(7), 396-402.	* Used the radip-cycle improvement process for implementation. Each change was considered an individual Plan-Do-Check-Act cycle, and then measured for successful implementation. * *Actions were taken in terms of:* 1) **context**: the culture and attitude, acceptance, and importance regarding the change; 2) **process**: roles, workflow, and policies relating to the change; 3) **content**: how-to, such as procedural steps and rules * Discussed the process change to increase standardization and their vendor selection process.	Journal Article	Excellent	The author is an RN who focuses only on medication administration in a small hospital, since all previous literature focused on large or academic settings. *Excellent* because it also defined the vision and goals in the organization related to this change and implementation, a realistic timeline a discussion of theoretical frameworks used to guide the work, and a clear explanation of the domains of change, as suggested by an outside consultant.
Ahmad, A., Teater, P., Bentley, T.D., Kuehn, L., Kumar, R.R., Thomas, A., & Mekhjian, H.S. (2002). Key attributes of a successful physician order entry system implementation in a multi-hospital environment. *Journal of the American Medical Informatics Association,* 9(1), 16-24.	* In addition to continuous executive support, Establishing a physician consultant team empowers physicians. * Only permitting electronic entry for the means for order processing would decrease the probability of reverting to manual ordering. * Friendly user interface will result in usability. * Ongoing support provides timely problem solving.	Scholarly Article	Excellent	Article discusses the successful implementation of CPOE in a multi-hospital setting.
Order entry rules: Healthcare enterprise achieves physician acceptance, reduced medication errors and improved patient outcomes through CIS and CPOE technology (2002). Health Management Technology. 23(7), 34,38.	* Defining and customization of rules assist with physician decision-making. * Remote access from physician homes and offices and location of workstations throughout enterprise eliminate geographic opposition. * Strong support from executive management team, especially the chief medical officer serving as champion, is crucial to the system-wide acceptance.	Journal Article	Good	Discusses methods used to gain physician acceptance and the results of CPOE implementation.
Order entry rules: Healthcare enterprise achieves physician acceptance, reduced medication errors and improved patient outcomes through CIS and CPOE technology (2002). *Health Management Technology, 23*(7), 34,38.	* Defining and customization of rules assist with physician decision-making. * Remote access from physician homes and offices and location of workstations throughout enterprise eliminate geographic opposition. * Strong support from executive management team, especially the chief medical officer serving as champion, is crucial to the system-wide acceptance.	Journal Article	Good	Discusses methods used to gain physician acceptance and the results of CPOE implementation.

Implementation Case Studies

Brewin, B. (2003) Hospital CIOs shy away from automating medical systems. *Computerworld,* 37(7), 12.	* Before implementing a full CPOE system, some CIOs advocate beginning with clinical data repositories or other "building blocks".	Journal Article	Good	CIOs from various institutions state their opinions concerning CPOE.
Cedars-Sinai physicians cautious; Hospital suspends system (2003). *Health Management Technology, 24*(3), 8.	* Complex systems may lead to delays, inconveniences and imprecise entries.	Journal Article	Good	States problems encountered by Cedars-Sinai in implementing a CPOE system.
H&HN: Hospitals & Health Networks. (2002) The Trailblazer. *H&HN: Hospitals & Health Networks, 76*(8), 8.	* Brigham & Women's Hospital was given a merit citation by the American Hospital Association for their CPOE implementation. * Technology, while a cornerstone, was only part of a safety initiative undertaken at the hospital. * All hospital departments are integrated through the CPOE system.	Journal Article	Good	Short article summarizing Brigham & Women's Hospital medication error reduction success.
Kuperman, G.J., Teich, J.M., Gandhi, T.K. & Bates, D.W. (2001). Patient safety and computerized medication ordering at Brigham and Women's Hospital. *Journal on Quality Improvement, 27*(10), 509-520.	* Higher technology solutions to reduce medication errors often require a larger up-front investment, "but they can more directly address many root causes of medication error" (p. 510). * Physicians enter 85% of orders, with reminder of orders entered by other clinicians. * Discusses change and need from all within system to change... but this is resisted, need to work together and how organization can help is discussed. * To date, 54 million orders have been entered; 40% of these constitute medication orders.	Journal Article	Excellent	Long article discussed in this 720-bed academic medical center in Boston. Their system implemented in 1993 is called BICS (Brigham Integrated Computering System) was internally developed and continually has been enhanced. Impact of CPOE system was measured via seven research studies, including three time-series and two randomized controlled studies.... results clearly delineated in easy-to-read table! Very *inclusive*, also includes implementation issues, enhanced workflow features, and decision support.

Safyer, S. (2003). Highly evolved; Montefiore Medical Center rolls out CPOE. *Modern Physician*, February 1, 26.	* CPOE was built into a much larger vision, with goals reaching beyond interception of medical errors to electronic integration of the entire delivery system for the purpose of managing care effectively. * Discusses vendor selection from four vendors * In 1994, the hospital's vision was developing the most advanced system in the marketplace. Their vision was geared toward an integrated delivery network requiring a seamless link across the inpatient and outpatient settings. Discusses the board, the CIO, and CEO, and the role of employees and success throughout the different roll-out phases.	Trade Journal	Excellent	Montefiore Medical Center is the university hospital for the Albert Einstein College of Medicine. As such, it has large-scale teaching programs and scientific scholarship in addition to a community-based integrated delivery system offering a full range of care for the residents of the Bronx and lower Westchester County in the New York City metropolitan area. Reduction of medical errors through the use of computerized physician order entry (CPOE) has become the Holy Grail of quality improvement in hospitals across the country.
Mekhjian, H.S., Kumar, R.R., Kuehn, L., Bentley, T.D., Teater, P., Thomas, A., Payne, B., & Ahmad, A. (2002). Immediate benefits realized following implementation of physician order entry at an academic medical center. *Journal of the American Medical Informatics Association,* 9(5) 529-539.	* Previous studies have done inter-unit comparisons of those with and without CPOE. This study took a single unit pre- and post- implementation approach therefore examining CPOE among the same patient population. * Complete elimination of nursing transcription errors resulted from implementation of an integrated MAR with CPOE. * Significant improvements in the physician countersignature for verbal and telephone orders was observed. * Reductions were seen in the times between the order and administration of medication, completion of radiology procedures, and the reporting of lab results. These can all lead to earlier physician access to information, better timeliness in care, and better patient outcomes.	Research Article	Very Good	Study discussing the benefits after CPOE implementation.