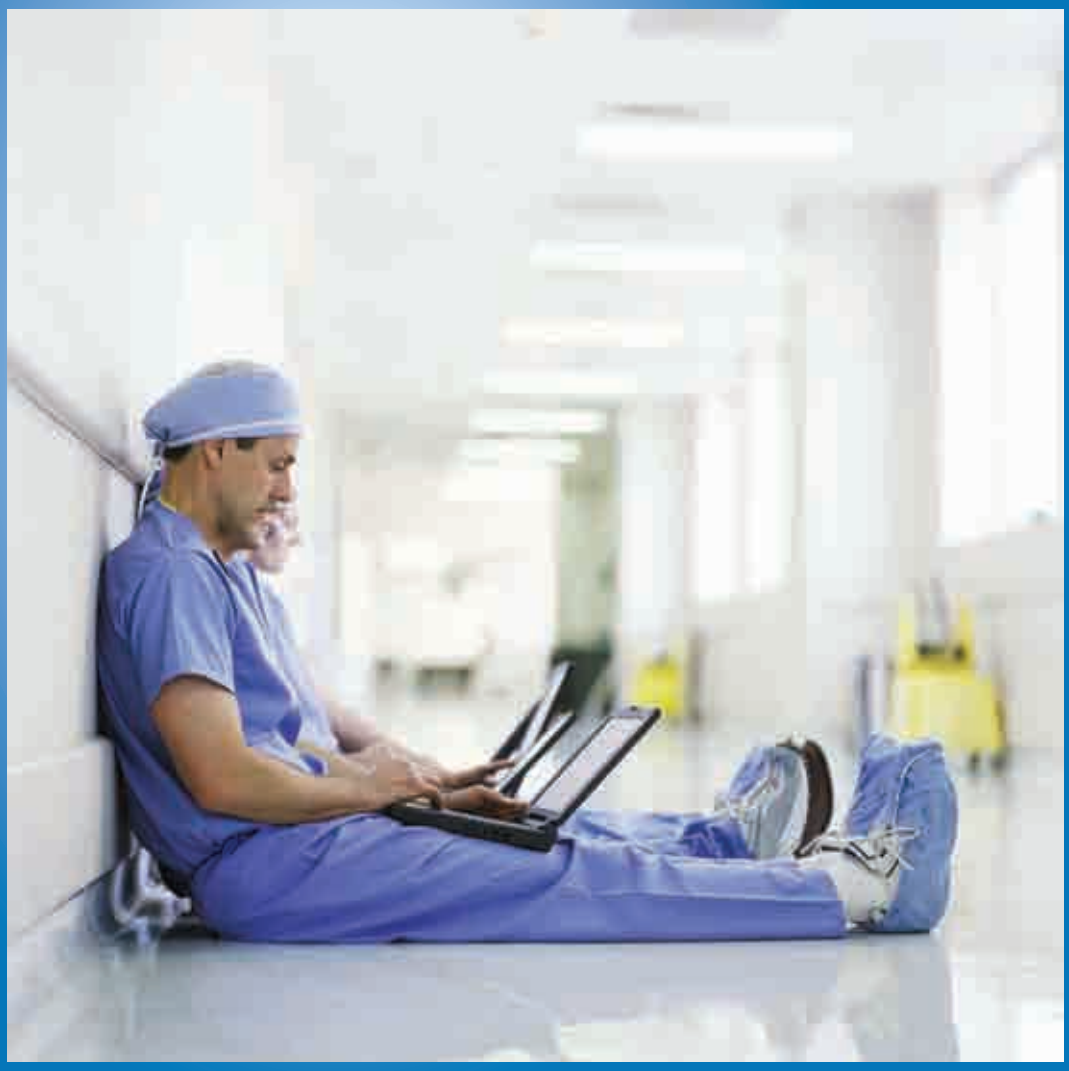
Saving Lives, Reducing Costs

Computerized Physician Order Entry Lessons Learned in Community Hospitals



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Kaitlyn Laramee, Winchester Hospital
Arthur Little, MD, Winchester Hospital
Daniel MacNeil, South Shore Hospital
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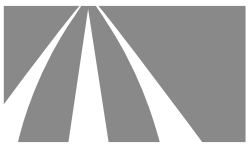

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Prepared by First Consulting Group

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Table of Contents

CPOE Lessons Learned in Community Hospitals

Introduction

The Massachusetts Hospital CPOE Initiative is a collaborative effort led by the Massachusetts Technology Collaborative (MTC) and the New England Healthcare Institute (NEHI) with a goal of achieving adoption of Computerized Physician Order Entry (CPOE) in all Massachusetts Hospitals within four years. The initiative has completed an assessment of the hospitals' readiness for CPOE, is conducting a pre-CPOE Baseline study and is now proceeding to help hospitals successfully implement CPOE.

A group of Chief Information Officers (CIOs) and CPOE project managers from Massachusetts hospitals that are implementing CPOE or are planning to implement CPOE in the near future gathered to identify support needs. This group identified three areas as its top concerns where managers could most benefit from assistance:

- Physician incentives
- Process redesign – focus areas, approaches/tools
- Metrics – baseline and post-implementation

The next highest priority areas were:

- Physician training
- Organization/governance of clinical decision support
- Leadership commitment

MTC and NEHI engaged First Consulting Group (FCG) to identify community hospitals around the country that had successfully implemented CPOE and to discuss approaches to addressing these six high-priority areas. The purpose of the project was to assemble information about successful approaches for use by teams in the Massachusetts hospitals who are responsible for CPOE implementation. The focus was on U.S. hospitals with a large number of community physicians using CPOE, rather than hospitals with a large number of staff physicians, hospitalists, or residents. Although a few of the hospitals did have residents and employed physicians as well.

The approach for gathering CPOE lessons learned included a literature search and telephone interviews of project leaders at hospitals that have successfully implemented CPOE. The literature search provided several publications that contained useful information about approaches and tools related to CPOE implementation. An annotated bibliography in Appendix A briefly describes the practical content in a number of useful publications.

Interviews were conducted with the project manager or physician lead of five community hospitals that have implemented CPOE. The hospitals were selected based on the following criteria:

- CPOE is used in more than 80 percent of the hospital units.
- At least 75 percent of orders are entered by physicians using CPOE.
- More than 50 percent of admissions are managed by independent community physicians.

Information regarding the extent of use of CPOE was obtained from project leaders at each hospital. Profiles of the hospitals that participated can be found in Appendix B. Topics covered during the interviews dealt with physician incentives, process redesign, metrics, physician training, organization/governance of clinical decision support, and leadership commitment.

All of the project leaders interviewed provided practical information of interest to any community hospital undertaking the challenging task of implementing CPOE. The following report details the results of those interviews, supplemented by information from a prior FCG study of CPOE in community hospitals and information obtained during the literature search.

Physician Incentives

Key points:

- All five hospitals started out with the intention that all physicians would use CPOE, but only two had a formal policy to that effect.
- In every hospital, much effort was expended to convince physicians that CPOE was a necessary investment in patient safety and quality, to make CPOE easy to learn and use, to support physicians during the transition, and to encourage them to adopt it.
- Although none of the study hospitals offered financial incentives for training or use, they did invest in dedicated time of physicians to lead the effort.

One of the decisions that frames the entire CPOE effort is the expectation concerning physician adoption. Executives and project leaders must decide whether electronic order writing will be voluntary, encouraged, or required. Hospitals interviewed had all achieved significant physician adoption, with CPOE utilization ranging from 78 percent to 100 percent. However, they had defined expectations and related policies somewhat differently.

Several hospitals had residents and employed physicians such as intensivists or hospitalists. In every case, these physicians were expected to use CPOE for all of their orders, and they did so, following training and with support at go-live.

In three hospitals, from the outset it was made clear that all physicians, including all community physicians, would be required to use CPOE. The hospital president in one directed that physicians would use CPOE. At a second hospital, the expectation was formalized into a medical staff policy, following a decision by the chairs of the medicine, surgery, and obstetrics departments. The policy was implemented as CPOE went live in each unit, with re-enforcement by the chair of the CPOE/IT Steering Committee and, with referral to department chairs as necessary. Contributing factors in both cases were insurer incentives and patient safety initiatives within the wider health system.

The third hospital had a formal policy mandating CPOE use but relied upon factors other than enforcement to accomplish the transition. The policy was adopted by a physician advisory group including both clinical department chairs and natural physician leaders within the medical staff. The Chief Medical Information Officer (CMIO) relied upon peer pressure and one-on-one counseling, as well as a large investment in coaching, to bring about adoption. The CMIO pointed to a long history of collaborative work on quality and the general culture of active physician involvement in the hospital as factors that contributed to physician participation.

In the other two hospitals where project leaders were interviewed, the approach to the transition can be characterized as “voluntary with significant encouragement.” In these organizations there was no explicit direction requiring the use of CPOE, but physicians were expected to do so and strongly encouraged through various mechanisms. At one organization, CPOE was presented to the medical staff as part of a larger strategic initiative to eliminate the paper medical chart. When the entire medical staff voted to move ahead with the strategy, they were not only buying

into CPOE, but also agreeing to transition to dictation or direct entry of all notes and electronic signing of documents. Once CPOE was implemented, paper order sheets were no longer available on the units except in the case of downtime.

Four of the study hospitals did not use financial incentives of any kind, either for community physicians to participate in training or to encourage them to use CPOE, although several mentioned providing food at key events to induce more physicians and residents to attend. One hospital offered Relative Value Unit (RVU) credits to compensate any physicians who had a loss of productivity during go-live that cost them personally. According to the CIO, they didn't have to use credits often.

However, every hospital, regardless of how they framed physician adoption, portrayed CPOE as a necessary change and made an enormous investment to make the system easy to learn and easy to use.

- CPOE was a very high-profile project in every hospital, consistently linked with the need to improve patient safety and quality.
- Physicians led decision-making groups and participated in system build, and CMIOs and/or other physician champions worked hard to effect the transition.
- Considerable time was spent seeking feedback from physicians to address their concerns, making sure the system met physician workflow requirements and was easy to use, and providing personalized support and training.

Basically this represented the hospital's commitment to the medical staff to ease the transition. (See Training and Workflow sections below for more information about the approaches in the areas.)

Tactics for Inducing/Encouraging Physician Adoption	
1	Provide one-on-one training anywhere and anytime
2	Provide 24-hour support coverage during go-live
3	Make it easy to establish remote access from office and home
4	Assign high priority to enhancements that benefit ease of task completion – one hospital is implementing new functionality that will allow physicians to convert medications to scripts at discharge.
5	Invest in order sets and help physicians build Favorites Lists
6	Build a track record of highly responsive support and system changes to meet physician needs
7	Empower nurses to serve as super users and encourage physician direct entry (some hospitals establish a policy that nurses only enter verbal orders under specified circumstances)
8	Remove all paper order sheets from the floor

Although hospitals did not provide financial incentives to physicians for training or to use CPOE, each hospital did make a significant investment in dedicated physician time of one or more physicians in the role of the CMIO or physician champion. Three of the study hospitals had an official CMIO position:

- One hospital was affiliated with a larger health system with a full-time CMIO who led the CPOE implementation in every hospital.
- In the other two hospitals, the CMIO's time was split with other duties – in one hospital also performing as the CIO and in the other hospital also practicing as a hospitalist.

Another hospital had a position similar to a CMIO, splitting time between clinical and administrative work (0.3 FTE administrative time was not supposed to be dedicated to clinical information systems but was consuming at least this amount of time). In the hospitals where the CMIO role was part-time, both interviewees reported spending 70-75 percent of their time and many long days during rollout but considerably less time in other phases of the project. One small study hospital hired two physician champions as an alternative to having a CMIO – one employed physician and one community physician. Each physician received stipends of about $20,000 per year for their time.

Expectations about physician use of CPOE were tempered by reality in a number of different ways. All study hospitals have policies that indicate when verbal and telephone orders are appropriate. Typically, verbal orders are allowed during codes and other emergencies. (The FCG report for the California Health Care Foundation (CHCF) contains a sample policy from a community hospital that incorporates this type of exception.) All hospitals also offer physicians remote access to the CPOE system and have attempted to limit telephone/verbal orders from outside of the hospital to those circumstances where electronic order entry was not realistic (e.g., physician is calling in during the night and does not have computer on). One hospital specified that verbal orders were also acceptable during deliveries and surgeries as these care processes did not lend themselves to electronic order entry. Another hospital stipulated that total parenteral nutrition (TPN) and chemotherapy orders continue to remain on paper as the complexity of these orders cannot be safely managed by their CPOE system yet.

Workflow

Key points:

- Hospitals invested a great deal of effort in redesigning workflow to ensure a smooth rollout and to take advantage of CPOE in process improvements, some of which were focused on standardization.
- In addition to processes on nursing units, attention must be paid to pharmacy, radiology, and any other department that is involved with orders.
- Redesigned processes were vetted with staff and tested in one or more pilots.
- A team including physicians also worked on system set-up to ensure that the system is easy to use for physicians.

One big undertaking when implementing a Clinical Information System/CPOE system is figuring out how best to integrate CPOE into workflow. This is not only a necessary investment in change management (which pays off in a smooth rollout), but also the opportunity to reexamine and tighten up processes to improve safety and quality by leveraging what CPOE can contribute. The order management process is an incredibly complicated one, touching many disciplines and departments and involving many policies and procedures. Consequently, sorting out how to change workflow necessitates involving a lot of people and uncovers many thorny issues that can take a long time to resolve. (One CMIO interviewed reported a lot of debate and a long time devoted to just one issue: the hospital policy for order renewal and to what extent CPOE should enforce it.)

> "Policies and procedures – all of the issues around workflow – were the hardest part. CPOE is only 10 percent technology."
> *CMIO, community hospital*

For this reason, the study hospitals invested considerable effort in workflow analysis/redesign and began months before the go-live date for pre CPOE. (Project leaders in one that did not, reported a five-month delay between the pilot and resumption of rollout and considered this a major lesson learned.)

For CPOE, there are three main areas of focus: order management workflows on every inpatient unit; system set-up for physicians to be intuitive, easy to use, and a good fit with how they do their work; and order management workflows in pharmacy and other ancillary departments.

At a high level, the process for tackling order management workflows involves three steps:

- Designing new workflows (typically after examining existing ones).
- Reviewing new workflows with each unit/department to ensure they fit.
- Aligning policies and procedures with the new workflow.

To tackle workflow, most of the study hospitals interviewed created interdisciplinary teams in advance, including nursing directors, nursing staff, the lead physician, clinical analyst(s) from Information Services (IS), and representatives from pharmacy and other ancillary departments. The team met frequently before CPOE go-live, often interacting with a physician advisory group and other groups such as the Pharmacy and Therapeutics (P&T) Committee for guidance and

to resolve thorny issues that would arise. Major decisions and policy changes were referred to the Medical Executive Committee or other appropriate group or executive. (The same general approach and investment of effort were reported by the 10 community hospitals in the California Health Care Foundation study. [See Appendix A])

The CMIO at one hospital reported a slightly different approach. The nurse informaticist and physician champion built a core team to address workflow (radiology, pharmacy, physicians, nurses, etc.), loaded the model system from the vendor, and then over 4-5 months modified it to conform to their view of an ideal workflow on each nursing unit. In preparation, each member of the team served as unit secretary on one unit for one day. At go-live in the pilot, two nurse analysts and the CMIO were on the unit to resolve issues and make the necessary adjustments. During a second pilot on a medical intensive care unit, they repeated the process, although many fewer adjustments were needed. Following the two pilots, the team reviewed the workflow and software with the staff on each unit before go-live, finding fewer and fewer issues to address as implementation progressed.

Standardizing process was a goal during workflow redesign. Project leaders from each hospital cited uncovering many practices that varied from unit to unit, sometimes in ways outside of the boundaries of hospital policy and standard procedures ("work-arounds"). The extent to which the hospital has already achieved standardization of practices such as medication administration times contributes to the amount of effort required. In one small study hospital, each of the nursing units was represented on the workflow team so that standardization was built into the original workflow design and had been "vetted" for applicability. (A case study of how one community hospital built a foundation for CPOE with a series of projects focused on standardizing care is referenced in Appendix A.)

The workflow redesign needs to extend to all departments "touched" by CPOE. Project leaders from several hospitals emphasized that CPOE affects processes of any department that receives orders. The changes for Pharmacy are probably the most significant, but every department has some. One team mentioned a thorny issue arising with radiology around whether they would still receive a call to schedule a CT scan (the unit secretary had previously called after transcribing the order).

All hospitals interviewed conducted a pilot and then rolled out CPOE unit by unit/or by physician specialty. This permitted further refinement at each stage and the ability to focus on the unique workflows of each unit or clinical department along the way. As more units were live on CPOE, the go-live process for other units became easier and easier. One team demonstrated the system prior to go-live to staff on the unit to obtain buy-in and provide an opportunity to request changes.

Generally the study hospitals developed new workflows with and without physician order entry. This not only addressed the likely situation at go-live and during phase-in (which was longer in hospitals with "voluntary" adoption), but also was needed for downtime. All agreed that a dual process environment is difficult and confusing for physicians and complicated for nurses. (One project team mentioned the necessity to add a new section in patient charts so it was clear which were handwritten and which were physician-entered orders.) In some cases, this reality aided in convincing reluctant physicians to make the transition to electronic order writing.

A second major focus of workflow redesign was on system set-up for physicians. This was typically accomplished by the implementation team working iteratively with individual and groups of physicians.

Focus Areas in System Set-up for Physicians
• Sign-on (number of steps and recovery of tasks in progress) • Terminology (order master file, generic/brand name medications, names of order sets, and ease of locating item of interest) • Labels on buttons and navigation options • Screen content and layout • Screen flow (especially during an order session and moving from task to task and patient to patient) • Defaults and required fields • Access to patient information during ordering (number of steps and automatic display of relevant information such as latest creatinine) • Order sets • Quick access to frequent orders ("Favorites" or preference list) • Medication checking and other rule-based prompting during ordering • Patient lists • Patient information displays (patient at a glance, rounding, department-specific)

One study hospital convened a Physician Order Management (POM) group that met frequently with the implementation team during system design and setup. The POM group was charged with making decisions on system features and functionality. Any physician could join the effort at any time, with special outreach to physicians with specific concerns or complaints to encourage their participation.

Every hospital put a lot of effort into developing order sets and strived to have many in place before go-live. The hospitals handled order set development decisions in a variety of ways. (For more information about the approach, see the Clinical Decision Support section below.)

Metrics

Key points:

- Study hospitals did not have the resources to do much pre-CPOE measurement requiring manual data collection so they tended to rely upon metrics already collected for other purposes.
- System reports concerning the incidence and responses to clinical decision support (e.g., drug-allergy checking) and the use of institutional order sets not only demonstrate value but also aid in efforts to improve the effectiveness of clinical decision support.
- All hospitals were able to obtain system reports on physician use of CPOE and used these to target physicians for additional support or encouragement.

The Advisory Board, The Alliance, and other reports on CPOE in the Annotated Bibliography (Appendix A) recommend having formal objectives for improvements in quality and safety, defining metrics for a number of objectives, and comparing performance before and after CPOE implementation. Metrics of pre-CPOE performance documenting gaps is convincing evidence to back up communications about the importance of CPOE. Demonstrating the improvements achieved can justify the investment to the board and wider hospital community and can be used to encourage late adopter physicians.

Lacking the research focus and resources of academic medical centers, community hospitals have fewer resources and expertise to apply to new studies, especially those that require manual data collection. Although data for some CPOE-relevant metrics can be extracted from the system, pre-studies usually require extensive chart reviews and often also tracking of activities and activity completion not otherwise documented. As a result, measurement in the community hospitals interviewed was typically relevant metrics already collected for another purpose (compliance with requirements of the Joint Commission on Accreditation of Healthcare Organizations, Core Measures, patient safety). Most supplemented this information with manual studies that could be conducted fairly easily (e.g., from pharmacy logs). One project manager stated “we do know lots of processes have improved with CPOE but have nothing before to compare with the post-implementation data to demonstrate this.”

Impact Metrics and Sources of Information	
Lag time from order to administration of STAT med	Manual study (order time available from CPOE for the "after study;" admin time from e-MAR—electronic Medication Administration Record--if in place before CPOE)
Lag time from order to administration of antibiotic	Manual study (order time available from CPOE for the "after study;" admin time from e-MAR if in place before CPOE)
Lag time from medication order to administration (overall)	Manual study (order time available from CPOE for the "after study;" admin time from e-MAR if in place before CPOE)
Laboratory test turnaround time	Manual study in pre; data extraction from system in post
Errors resulting from order transcription	Manual study
Length of stay	Analysis of Admission/Discharge/Transfer data
Medication-related errors and adverse drug events	Generally tracked based on incident reporting and surveillance
Pharmacist telephone calls to clarify medical orders	Manual logging
Order changes following pharmacist review/verification	Manual logging
Pharmacist time devoted to medication order verification	Manual study aided by extraction of some system data
Lag time for pharmacist verification of medication orders	Manual study aided by extraction of some system data
Verbal orders not signed within required time	Manual study; may be routinely tracked
Physician response to CPOE order reminders/alerts (order is changed) • Medication alerts • Medication substitution • Switch to oral from IV • Lab duplicate checking • Radiology duplicate checking	Post only; only if system can track and report on incidence of, and response to, alerts
Inappropriate medication or route	Manual study in pre; extraction of data from system in post study
Compliance with JCAHO standard for orders for restraints	Manual study in pre; extraction of data from system in post study
Compliance with care recommendations in Core Measures	Manual study in pre; extraction of data from system in post study (data typically already collected for reporting)

(Source: Study hospitals and references in Annotated Bibliography.)

Two hospitals are regularly using powerful evidence of the effectiveness of clinical decision support in helping physicians make better ordering decisions: system reports showing how often alerts, such as drug-drug interaction or lab test duplication, are fired and how often physicians change or cancel an order in response. The information not only documents the value of CPOE, but is also important input to managing decision support.

Utilization Metrics and Sources of Information	
Physician use of order entry	System reports detailing percent of orders entered directly and entered by others; physician-specific
Physician use of order sets	Post only; from system reports when available; otherwise requires inserting "order" in order set that can flag use of order set in analysis

During implementation all hospitals did take advantage of system reports measuring physician use of the CPOE system. These reports provided a view of progress with the transition overall and permitted targeting late adopters for additional training and/or counseling. One hospital used an additional report to identify physicians who could benefit from follow-up training: one showing which users frequently canceled orders or were canceling the same order several times in one "ordering session" (and were obviously struggling to enter their orders). Users identified in this manner were contacted and offered personalized coaching.

To permit tracking use of order sets, two study hospitals using Meditech include a dummy order in the order set (e.g., "CHCF order set) that serves as a flag for purposes of analysis and reporting.

Another important area of utilization tracking is the use of order sets. (These measures could also be counted as process measures for quality because order sets facilitate compliance with hospital guidelines and protocols.) Information about use of order sets is valuable information to spur efforts to increase adoption, to identify order sets that might need attention to improve relevance or address other issues, and, even, to target physicians for additional coaching/counseling.

Study hospitals that were able to obtain pre-post metrics demonstrated significant improvements in order management. For example, one hospital had radiology and laboratory turnaround time for orders collapse from 1 hour to 10-15 minutes. This hospital also experienced a 50 percent reduction in pharmacist calls to physicians for order clarification. In another hospital, calls to physicians from pharmacy dropped 77 percent and the turnaround time for radiology orders by 50 percent. Similarly, the average time lag from medication order to administration was reduced from 90 minutes to 11 minutes.

All hospitals reported that they have embedded quality interventions, such as those outlined by JCAHO and CMS, into their order sets and were collecting information on utilization. One hospital was able to report on how the occurrence of quality interventions improved as a result. For example, post CPOE go-live all cardiac patients now receive an aspirin before being discharged to home; prior to CPOE only 60 percent of patients were receiving this treatment.

Physician Training

Key points:

- Study hospitals relied totally or mostly on one-on-one training for community physicians.
- "Training" was designed to be short and to focus on the basics, with extensive follow-up coaching (in the style of "at the elbow") to increase skills and proficiency at go-live and thereafter.

Organizations implementing CPOE face a number of decisions about how to approach and organize physician training. The study hospitals reiterated similar advice to that of other sources in the bibliography: *do not rely on classroom training for community physicians*. They all emphasized individualized one-on-one training as the rule, although small group training was successful in some cases for a small portion of the medical staff. (Classroom training was the standard practice for residents, employed physicians, and nurses.) In many respects the study hospitals followed similar practices to the 10 community hospitals in the CHCF study.

General Advice on Training from 10 Community Hospitals

- Expect classroom training to work better with nurses than physicians
- Always train using system setup physician will be using
- Worst time to schedule training is when physicians are rounding on their patients
- Make it as easy as possible to obtain training (drop-in, any time, anywhere, go to them, if necessary)
- Train physicians in what they need to know at that time and do not expect more than 20 minutes of attention– training is an ongoing program, not a one-time event
- Provide many forms of just-in-time training or coaching

Three of the study hospitals offered only one-on-one training for physicians. The other two organizations provided a combination of classroom, small group, and one-on-one training although project leaders indicated that most community physicians ended up using one-on-one training. Each hospital made a concerted effort to keep training time to a minimum (as low as 20 minutes in one hospital where physicians were already using the system routinely for results viewing and other tasks). To accomplish this, they focused on the basics because this could be accomplished in a realistic amount of time and retention of knowledge about more advanced functions would be limited.

Approaches of Study Hospitals to Training Community Physicians
One-on-one training only Three 30-minute sessions. • Procedure Order Entry, a unit clerk instructed this session • Medication Order Entry, a pharmacy technician instructed this session • Results Viewing, an IT project team manager instructed this session
One-on-one training only Two 90-minute sessions • Procedure Order Entry – nurse super user instructed this session • Medication Order Entry – pharmacist instructed this session
One-on-one training only Medical students from local medical schools to conduct training • 20 minutes to cover the CPOE basics, longer when physician had time
Combination of classroom, small group, but mostly one-on-one Mix of classroom, small group, but mostly one-on-one training Trainers were CMIO and physician champions • Planned for 1 hour "but expected 45 minutes"
Combination of classroom, small group, but mostly one-on-one Six physicians trained as super users and CMIO provided all training. • 1.5-hour training session • CMIO did many of the one-on-one sessions

In all hospitals, physician training was provided in a flexible manner ("at the time and in the style the physician preferred"). Physicians were offered pre-scheduled classroom, small group, or individual training, including at their office. In addition, trainers were available on an *ad hoc* basis on the floors and in the physician lounge when physicians were rounding. One CMIO reported corralling physicians as they came in the door of the hospital.

There was no magic formula about who provided training. In fact, the study hospitals had success with a range of different staff types. One had great success with medical students; the CMIO in another believed strongly that physicians learn best from other physicians. Others used unit secretaries, pharmacy technicians, and Information Systems staff. In the CHCF 10 community hospital study most hospitals used the same clinical analysts who had worked with the physicians on system setup. Most of them were nurses.

All stressed training physicians in the screens they would actually be using. Several used one-on-one training (and, in one instance, classroom training of residents) as an opportunity to have physicians learn how to add frequent orders to their Favorites List and to begin building the list.

Training began a few weeks before go-live and continued during implementation. As mentioned earlier, the study hospitals did not offer financial incentives to physicians to complete training. Training was required for residents and became incorporated into orientation training. Otherwise, the study hospitals did not mandate training. The project leaders from one hospital reported on an unsuccessful attempt to implement competency testing: they had great difficulty getting physicians to complete the test. Also, none of the hospitals had a formal policy requiring physicians to complete training (i.e., only physicians who complete training receive access to CPOE).

Although the flexibility of each study hospital's training approach afforded every physician plenty of opportunities to be trained, each hospital also had to develop processes/mechanisms to deal with late adopters. Non-compliant physicians were usually reported to the CMIO (or similar position). The CMIO would then reach out to the physician and offer training and support.

One study hospital took a somewhat unique approach to dealing with late adopters. For the 20 percent of physicians who did not avail themselves of training, the CMIO took a "wait-and-see" approach. Over time, as more of their peers used the system and they had to deal with the dual paper and electronic process, they came around. The hospital also did not push training for (or use of CPOE by) a small number of physicians who were nearing retirement or had fewer than eight admissions per year.

Each study hospital supplemented training and further eased the transition for physicians with extensive "at-the-elbow" support, both during actual rollout on each floor or unit and on an ongoing basis. (One CIO characterized this as "incremental training.") In addition to aiding physicians in becoming proficient users of CPOE, project leaders emphasized the critical importance of always listening to and quickly responding to physician issues and questions. Individuals providing onsite support included the lead physician, physician champion, members of the implementation team, clinical analysts from IS, and nurse and physician super users. The CMIO at one study hospital now regrets that he did not train and enlist unit secretaries as super users because they are very knowledgeable about order management, know all of the physicians, and are easy to find on the unit.

Models for Go-Live and Ongoing Support at Study Hospitals	
Go-Live Support	**Ongoing Support**
• Floors covered by hired medical student trainers. Medical students carrying pagers provided coverage for 16 hours a day (two shifts) for 7 days a week • RN super users on floor 24 x 7	• Still use medical students; medical students provide coverage over two shifts, one shift during the evening, the other during the day • Planning to phase out medical students
• At go-live, and for 6 months following go-live, resource room located near med/surg unit staffed full time with super users • The resource room contains computers for physician use only for order entry and documentation	• Currently staff the room with a super user during morning rounds
• On-site support 24 x 7 for the first week of go-live, then beeper support	• Former members of the CPOE implementation team carry the beeper during evenings/weekends. These resources are paid to provide coverage
• Support on unit for 24 x 7 for one week, then on unit for 16 x 7 for one week • CMIO on-site 12-16 hours x 7 for one week • Super user available on floor 24 x 7 • Technical staff were also available in physician lounge during go-live	• Super users on floor 24 x 7
• Offered on-site support 24 x 7 for 3 months	• Help desk support available

Example Training/Education Support Aides
• System User Manual available via hospital intranet • Animation PowerPoint on how to use CPOE, available via intranet • FAQ sent out on a bi-weekly basis via email and also posted to hospital intranet • Pocket cards tailored to each unit highlighting CPOE functionality • Test patients available in system for physicians to use for "practice" • Training video available on CD

All of the study hospitals also provided several other methods and materials to support training, such as computer-based training and quick reference tip sheets. Except for pocket guides, some of the project leaders interviewed felt these materials were rarely utilized by staff. Nonetheless they felt it was important to be able to offer them to physicians.

Ongoing training of new residents is incorporated in the orientation process. Typically IS staff, designated super users, or physician champions provide one-on-one training to new physicians. One hospital has assigned this role to a physician liaison. When major new system enhancements or upgrades are implemented, study hospitals also provide training (can be as much as 30 minutes) and go-live support.

Management of Clinical Decision Support

Key points:

- Study hospitals favored institutional order sets over personal order sets and invested in their development and maintenance.
- They proceeded more slowly with rule-based checking of medication orders, but all were using some at CPOE go-live.
- The Pharmacy and Therapeutics Committee plays a big role in managing medication-related clinical decision support.

One of the primary objectives for implementing CPOE is to provide an additional safety net for physicians to avoid events such as adverse drug reactions and to make it easier for them to incorporate evidence-based care recommendations as they write orders. CPOE applications include a set of clinical decision support tools that hospitals can employ as they work toward these two objectives. The study hospitals separated their work on clinical decision support into two different categories, employing slightly different governance and processes for order sets and rule-based prompting.

Every study hospital invested significant effort in building order sets before go-live. Order sets not only present an opportunity to increase compliance with recommended practices, but also speed physician order entry. For this reason, one hospital without pre-existing standard order sets set a requirement that at least three relevant order sets be built into the system for physician use before go-live on any unit.

Four hospitals discouraged (or would not allow) personal order sets. Personal order sets express how the individual physician typically writes orders for a particular clinical situation, as opposed to institutional (or standard) order sets, which are reviewed and approved as recommended practices for the hospital. (Note that they *encouraged* the use of "Favorites" that facilitate quick access to orders in the order master file that physicians frequently write.) One initially allowed personal order sets to encourage adoption of CPOE, but is now pushing use of standard order sets and reviewing personal order sets in the system to ensure medication orders, in particular, are appropriate.

The level of effort required to develop order sets varied somewhat depending upon on the extent of prior efforts focused on standard orders. The approaches to governance also varied to some degree. Some hospitals already had a formalized process for order set development and approval. In this case, the transition only required taking existing paper order sets and building these into the system.

Process for Order Set Development
Select condition/diagnosis to target
Identify and recruit members of task force or refer to appropriate clinical department
Review current practice • Collect all current protocols and tools such as pre-printed order sheets • Analyze available data on practice patterns • Solicit input from medical staff and pharmacy
Define recommended practice • Review medical literature • Collect and review recommendations of medical and professional associations • Review JCAHO and other regulatory or public reporting • Consult internal experts
Draft order set • Prepare documentation including clinical rationale
Review • Refer to P&T Committee, clinical departments • Provide opportunity for medical staff to review and comment
Finalize order set • Update documentation
Approve order set • Refer to P&T Committee and others as relevant • Refer to group responsible for final sign-off (may be Medical Executive Committee or clinical department chairs or both)
Set up order set in CPOE • Refer design of electronic order set to designated group for sign-off • Test with small number of physicians • Refine as necessary
Rollout new order set • Educate and market to medical staff • Solicit feedback • Monitor use
Maintain • Identify "owner" to watch evolving medical practice • Establish cycle and process for periodic review • Assign responsibility for facilitating periodic review

In one, the Quality Department continued to be the focal point for managing the process. When directed by the Quality Committee, staff convene an appropriate group of physicians and others to develop a recommended order set, refer it to the Medical Executive Committee for review and approval, set up the order set in the system, and ensure that physicians are informed. Staff in the Quality Department also refer existing order sets once a year to a physician "owner" to ensure they reflect the latest thinking about best clinical practice.

One CMIO, who manages a similar review process on a two-year cycle, sends order sets out to the clinical department chairs, sets a deadline of 30 days to respond, and when there is no response de-activates the order set in the system. A common practice in all hospitals was Pharmacy &Therapeutics (P&T) Committee review of medication orders in order sets whenever order sets are created or up for review.

The CMIO in one study hospital was initially responsible for setting up and testing existing institutional order sets, previously accessible via the intranet. With the addition of a new staff member in the Quality Department, he was planning to transfer many day-to-day tasks to that individual, although he expected to still play a major role in managing the clinical content.

In another hospital, CPOE implementation presented an opportunity to build a new process to develop and implement recommended practices. A new subcommittee of the Medical Executive Committee was charged with developing condition-specific and unit-specific order sets. (Personal order sets were discouraged.)

The availability of new order sets was communicated to physicians in a variety of ways. Typical communication methods included email, postings in the physician lounge, discussion at medical staff and department meetings, and displaying notifications/ messages when physicians sign-on to the system. One CMIO rated word of mouth as the most effective form of communication.

As mentioned previously, physician leaders and quality managers used system reports to assess the use of order sets. This helped to identify physicians for outreach and order sets that

might need revision to increase usability or relevance. Study hospitals also provided several feedback mechanisms for physicians and welcomed their input. The most common method was contacting either the CMIO or the physician champion.

A major component of the clinical decision support toolset is the capability to display messages advising a physician of things to consider regarding an order or alerting him/her to a potential contraindication such as a patient allergy. (A comprehensive listing of Clinical Decision Support [CDS] in CPOE developed by FCG for The Leapfrog Group can be found in Appendix C.)

All study hospitals were implementing CDS alerts slowly, partly because of the need to manage CDS closely and partly to achieve the right level of alerting. Too many messages that seem irrelevant to the patient can result in "alert fatigue" for physicians. In addition, some of the decisions involved in managing CDS are contentious. One CMIO reported a protracted debate by members of the P&T Committee about levels of medication checking for drug-drug interaction ("severe" or "moderate" reaction, also status of clinical evidence upon which alerting is based.) After much discussion, another hospital determined that physicians receive only "severe" level alerts, with others displayed for pharmacists during medication order verification.

All of the study hospitals were using clinical decision support to generate rule-based prompting and alerting at go-live. Typically, medication alerts included drug/drug and drug/allergy interactions. (A list of medication order categories that The Leapfrog Group recommends addressing can be found in Appendix D.) Two of the study hospitals also implemented non-medication alerts such as presenting pertinent lab value at the time of ordering a specific intervention.

Study Hospital CDS Alerts Implemented
Drug-drug interactions
Drug-allergy interactions
Drug/dosing alerts
Alerts flagging look alike/sound-alike medications
Duplicate checking for laboratory tests
Duplicate checking for medication orders
Display of relevant laboratory results at the time of ordering interventions

Several CMIOs expressed frustration with checking medications for duplication/therapeutic overlap. For example, one hospital had to turn duplicate checking off for narcotic medications because it was erroneously flagging drug combinations commonly used in pain management.

To manage medication-related clinical decision support, three of the study hospitals relied upon the P&T Committee. One hospital tasks the nurse informaticist and physician champion with bringing recommendations to the P&T Committee for discussion and approval. Another hospital created a Healthcare Informatics Committee, with members including nursing, pharmacy, physician department chiefs, and quality department staff, and charged it with managing clinical decision support.

Typical Practices for Managing CDS in 10 Community Hospitals	
Agenda Setting/ Targets	• Individuals and committees request new application • Physician Advisory Group reviews and prioritizes request • Major changes to policy referred to Medical Executive Committee for approval
Setup and Testing	• Analysts in IS setup and test new CDS in development system • One or more physicians may test new CDS in own practice on a provisional basis
Review	• Physician Advisory Committee reviews and approves • May require sign-off of Pharmacy and Therapeutics Committee or Department Chair • Some hospitals require physician sign-off on personal order sets
Release	• New order sets available immediately • Batches of new CDS released at regular system updates • Major (dangerous) situations addressed immediately • Physician community notified of major new CDS in advance
Update	• Responsibility of committee authority • Monitoring of physician response • Physician feedback may prompt further fine-tuning

(Source: CHCF Community Hospital study.)

Leadership

Key point:

- Hospital executives and physician leaders all play formal roles in CPOE implementation and ongoing management.

One of the axioms about what it takes to be successful with CPOE is that "leadership" is critical. In every one of the study hospitals, hospital executives and senior physician leaders played formal roles. In this regard, as well as the committee structures created to provide the necessary direction and oversight, they were very similar to the 10 community hospitals in the CHCF study.

Each hospital has an IS Steering Committee that meets regularly to review plans, budgets, and progress with major IT initiatives, as well as another group that provides direction to the implementation team. Members of these groups always included senior level executives, physician leaders, and other key department managers.

For example, the membership in the IS Steering Committee at one small hospital included the following:

Chief Executive Officer	Director of Finance
Physician Champion	Director of Finance, Foundation
CIO	Director of Home Care Services
Chief Operating Officer (COO)	Director, Residential Care Facility
Director of Physician Clinics	HCIS Manager
Director of Clinical Services	Network and Support Manager

This group received regular progress reports and acted, as necessary, to remove barriers. A second group – Provider Order Management (POM) Committee – was led by the CIO and included the physician champion, pharmacist, medical records, and IS specialists. An important role for POM was to ensure the IS Steering Committee, P&T Committee, Patient Safety Committee, and other groups were aware of and involved in key decisions and consulted as issues arise.

At another hospital, the IS Steering Committee included the:

Chief Financial Officer	Director of Pharmacy
Chief Nursing Officer	VP, Medical Affairs
Chief Operating Officer	Chairs, Non-Surgical Departments

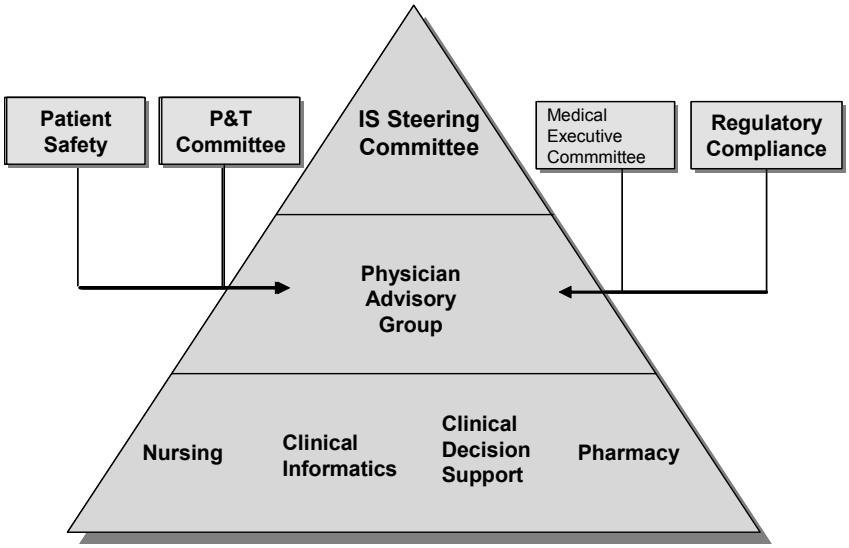
Typical Role of the Physician Advisory Group
• Oversee project • Participate in system setup • Suggest, collect, review, and prioritize system change requests • Review system enhancements • Make policy recommendations to Medical Executive Committee • Participate in setting agenda for clinical decision support • Push for universal CPOE and encourage MD utilization • Reinforce communication between clinicians and administration • Coordinate with the Pharmacy and Therapeutics Committee and other quality improvement committees and task forces • Monitor physician training • Spearhead education initiatives • Identify and address areas of resistance • Monitor physician utilization statistics

(Source: CHCF Community Hospital study)

Here the Physician Advisory Committee that met frequently with the implementation team included the CMIO, CIO, COO, Director of Pharmacy, and Chairs of Non-Surgical Departments.

Not every hospital included the CEO on the IS Steering Committee. The project leaders interviewed pointed out that the chief executive was fully in support of the effort, made it clear to the wider community that the effort was important and would be successful, and could be relied upon to take other actions when needed. One CMIO reported referring particularly reluctant physicians to the CEO for a conversation.

Sample CPOE Project Organizational Chart



Appendix A
Annotated Bibliography

Although there is no CPOE cookbook detailing one path to guaranteed success, there is growing literature sharing the practical insights of project leaders in hospitals that have implemented CPOE successfully. Unless otherwise noted, documents are publicly available.

1. **Ash, J.S., et al. "A Consensus Statement on Considerations for a Successful CPOE Implementation." *Journal of the American Medical Informatics Association* (June 2003): 10(3); 229-234 (Requires subscription).**

   Thirteen experts from around the world participated in a conference to develop a consensus statement about successful CPOE implementations. Participants included administrators, clinicians and IT implementers, and vendors. The participants identified nine considerations for organizations to consider when implementing a CPOE system.

   - *Motivation for implementation* – this can come from internal or external sources or a combination. The authors urge hospitals to develop a set of specific objectives.
   - *CPOE vision, leadership, and personnel* – "Successful implementations require effective leadership over extended periods of time – in different forms and at multiple levels of the organization." The authors go on to emphasize the executive role in promoting the vision, champions to ensure buy-in, and strong project managers.
   - *Costs* – The total cost of ownership is often underestimated, especially in organizational areas, such as training.
   - *Integration: workflow, healthcare processes* – Aside from pointing to all of the effort required to integrate CPOE into workflows, the authors recommend an organization-wide change management strategy and also that workflows be developed for downtime.
   - *Value to users/decision support systems* – Hospitals need a plan for managing all of the clinical content and make it clear to users where embedded logic is providing a safety net of alerts and where it is not.
   - *Project management and staging of implementation* – "People issues must have the highest priority." It is also important to actively solicit input and feedback, especially from physicians.
   - *Technology* – User considerations including ensuring quick response time ("one expert cited 0.7 seconds as too slow), remote access, and determining how customization should be allowed/supported for individual users.
   - *Training and support* – A constant theme is the need for "at-the-elbow" support. "Most successful implementations have had more post-go-live support than pre-go-live training."
   - *Learning/evaluation/improvement* – "CPOE implementation is an ongoing effort that benefits from continuous improvement." Organizations need to learn from their mistakes, respond to problems quickly, and be prepared for an ongoing effort to maintain/improve the system.

   These considerations are described in more detail in the article.

2. **Briggs, B. "CPOE: Order from Chaos." *Health Data Management* (February 2003): 11(2); 45-58.**

   This article briefly discusses the benefits of improved patient safety with the use of CPOE and discusses the challenges of implementing CPOE, mainly focusing on the cultural challenges and the difficulty of engaging physicians.

   - To engage physicians, the article recommends that the benefits of system be used to help drive physician participation.
   - It is also important for organizations to pay attention to physician users when designing the system.
   - The CPOE initiative should be a clinical improvement project rather than an IT project.
   - Offering physicians remote access to the system also builds physician buy-in.

   The article provides examples from a variety of health organizations that have implemented CPOE and how they overcame the challenges of physician adoption and cultural change.

3. **Clinical Advisory Board. "Computerized Physician Order Entry, Lessons from Pioneering Institutions." 2001.** (*Need to be members of The Advisory Board to obtain this report).*

   The "Computerized Physician Order Entry, Lessons from Pioneering Institutions" uses a lot of data and graphics to build the case for CPOE, discuss the challenges ("not for the faint of heart"), and review what the authors learned from interviews with several hospitals, distilled into five lessons for hospitals not yet committed to CPOE and another five for those about to implement.

   - *Start with less expensive practices* – To achieve high impact on adverse drug events, they recommend interventions such as diagnosis-specific standing orders, unit pharmacists, pharmacy-managed protocols, and pharmacist order entry, with examples presented for each.
   - *Invest first in pharmacy ordering system* – Here the goal is to better empower the pharmacy system to detect and help avoid potential adverse drug events. Building up the rules and incorporating laboratory results can improve the safety net today and provide a good testing ground for rule-based medication checking with CPOE.
   - *Invest in clinical IT infrastructure* – The combination of a clinical data repository fed by departmental systems and a rules engine can deliver rules-based alerts and flag information even in advance of CPOE. (Often this is called automated surveillance with notification/alerting.)
   - *Provide results reviewing to physicians* – This demonstrates the value to physicians and is good preparation for CPOE.
   - *Engage executive-level ownership* – Senior executives not only serve as champions for the clinical system effort but typically participate in activities such as vendor selection.
   - *Build physician support from the start* – "Ultimately, the success of a CPOE system will be determined by its rate of physician utilization." Physician involvement in all phases, including vendor selection, is emphasized.

- *Ensure ease and speed of physician ordering* – Order sets reduce the time burden as does ease-of-task completion.
- *Test system with physician-developed patient scenarios* – One CPOE project leader characterizes this as "kicking the tires."
- *Pilot CPOE on diverse, representative unit* – They recommend selecting a unit with variation in orders lacking standardization such as a general medical unit.
- *Guarantee rapid response to physician calls*. – Physicians must be able to resolve issues of physicians and other users around the clock.

Before starting down the CPOE path, the Advisory Board recommends:

- Quantifying the opportunity to reduce ADEs and the related cost savings.
- Determining the costs of implementing CPOE, including time commitment of staff.
- Assessing physician readiness.

Worksheets are provided for each exercise.

Eight implementation considerations are reviewed.

1. *Selecting an appropriate system* should be driven by the priorities of the hospitals and include ease of use and ease of implementation. A physician-driven process including patient scenarios and site visits is recommended.
2. *Establishing the implementation agenda* should be done by a team with "strong clinical representation." The sample post-vendor-selection timeline covers 2-2.25 years.
3. *Customizing to encourage physician use* includes screen design and layout, terminology, required fields and defaults, and other system capabilities such as order sets and patient data displays.
4. *Incorporating clinical decision support* starts with understanding the spectrum of clinical decision support tools available in the system.
5. *Communicating system utilization policies* is important to set the expectations. This requires developing an explicit policy.
6. *Staging system rollout* includes piloting and then either house-wide or phased rollout depending upon the capacity to train and support users. Unit-by-unit rollout requires clear policies and practices with respect to patient transfers.
7. *Providing training and support* is critical to physician adoption. This requires offering a variety of training methods and a big investment in "at-the-elbow" support.
8. *Tracking physician utilization* can leverage utilization reports available from the system to understand progress and target specific users for outreach.

4. Davidson, G., et al. "Keys to Successful CPOE Implementation." *Health Management Technology* (September 2004): 64 – 66.

This article is a brief case history of the successful CPOE implementation at the Hospital of Saint Raphael, an academic center in New Haven, CT. The article provides details on the reasons why the hospital decided to implement CPOE and discusses the strategies the Hospital of Saint Raphael deployed to roll the system out to physicians.

To obtain physician buy-in to use the CPOE system, the hospital focused on how CPOE would improve patient safety. The case was built that, although CPOE make take more time than handwritten orders, the effort yields a significant increase in patient safety. The hospital

also strongly believed that the simultaneous implementation of eMAR significantly enhanced the safety net.

A major contributor to the success of the CPOE implementation is the time invested in improving ease of use for clinicians. User interfaces were carefully designed to meet clinician workflow, and order sets were created to ease the order entry process. The CPOE system was rolled out incrementally throughout the hospital unit by unit. Not all processes lend themselves to use online; developing complicated orders for services such as anesthesiology was particularly challenging.

The greatest benefit of using CPOE has been improved order turnaround time, especially with medication orders. Pharmacist time has also been freed up to work on clinical interventions. Although the system has improved patient safety, it has not necessarily reduced costs at the Hospital of Saint Raphael.

5. **Davis, Daniel C., et al. "Clinical Performance Improvement with an Advanced Clinical Information System at the Queen's Medical Center." The Fifth Annual Nicholas E. Davies Award: Proceedings of the CPR Recognition Symposium (1999): 77 – 1209.**

   Queen's Medical Center, a large community hospital in Hawaii, won the Nicholas Davies Recognition Award in 1999 for its early adoption of an inpatient EMR including CPOE and the value realized as a result. The required essay about how the organization approached the effort covers management, functionality, technology, and value.

   All aspects of the project were aligned with the organization's vision and strategic goals. The booklet briefly describes Queen's Medical Center system selection process and implementation decisions such as their physician engagement and training strategies. The guidelines used by Queen's Medical Center to design the system are also outlined.

   Of particular interest to other hospitals implementing CPOE is the integration of the project into quality governance and quality improvement, which contributed to the focus and ultimately the accomplishments in improving quality and safety. (Note that Queens was also one of the community hospitals contributing to the CHCF community hospital study – see Item 7.)

6. **Drazen E., et al. A Primer on Physician Order Entry. California HealthCare Foundation and First Consulting Group (September 2000).**

   A Primer on Physician Order Entry describes what a CPOE system entails and how it can improve patient safety. The report also examines the reasons why hospitals are slow to adopt CPOE, addresses selecting the best system to support CPOE, and briefly describes the work involved with implementing CPOE. The success factors for CPOE implementation are also outlined – leadership, workflow redesign, change management, and training.

   The report also provides case studies of organizations that have successfully implemented CPOE, two of which are community hospitals.

7. **First Consulting Group. "Computerized Physician Order Entry in Community Hospitals. Lessons from the Field." California HealthCare Foundation (2003).**

   The California HealthCare Foundation (CHCF) and First Consulting Group sponsored this study to start to close the knowledge gap about CPOE in the community hospital. Interviews with key staff in 10 community hospitals heavily using CPOE provided a great deal of practical advice, detailed in this report.

   Much of the content is focused on the work of encouraging physicians in the transition to a new way of integrating the computer into their routine work and accomplishing a smooth rollout. Common approaches key to success in the hospitals interviewed included the following:

   - A clear tie between CPOE and patient safety – in setting objectives, communicating the importance, and guiding expectations around physician use.
   - A governance structure to make decisions and a dedicated project team to do the work.
   - A combination of "carrots" (making the system easy to learn and use, personalized training and support, enabling remote access) and "sticks" (peer pressure, coaching by physician leaders, hospital policies incorporating CPOE as the standard procedure) to bring physicians on board.
   - A big investment in workflow analysis and system setup, fine-tuned during the pilot.

   Some information from the CHCF report has been incorporated in the MTC report. Further resources provided include project organizational charts from three hospitals, a listing of the tradeoffs between big bang and unit-by-unit rollout, and an excerpt from a hospital policy concerning CPOE.

8. **Karow, H. "Creating a Culture of Medication Administration Safety: Laying the Foundation for Computerized Provider Order Entry." *The Joint Commission Journal on Quality Improvement* (July 2002): 28(7*);* 396 – 402. (Requires subscription).**

   The article describes how Beaver Dam Community Hospital (BDCH), prepared for the implementation of CPOE. The decision to implement CPOE was driven by the desire to improve patient safety and also to meet the expectations of external drivers such as The Leapfrog Group and professional organizations within the state of Wisconsin such as the state's Health and Hospital Association. To lay the groundwork for implementation, the team planned a series of rapid-cycle improvements, each with its own action plan and measurements.

   Prep work for CPOE implementation started with bringing together an interdisciplinary team and developing a common vision and goals for CPOE. Specific projects were organized within three domains:

   - *Context* – developing a formal incident disclosure policy, shifting to a non-punitive approach to responding to incidents, improving the reporting structure to reduce paperwork and include "good catches."
   - *Increasing standardization* – developing and implementing clinical paths, standard order sets, and protocols such as administration of pre-surgical antibiotics; computerizing and standardizing documentation of IV medication administration.

- *Vendor selection* – using a highly participatory process to select a vendor based on ease of use, decision support availability, compatibility with existing systems, and availability of support.

9. Kelly, B. "Order Entry Gets Out of Hand." *Health Data Management* (July 2001): 9(7); 20-24.

This article describes how Abington Memorial Hospital, a community hospital in Pennsylvania, used redesign and physician training efforts to obtain universal physician adoption of CPOE. Abington Memorial Hospital originally implemented a CPOE system in the early 1990s. After eight years of having the system in place, approximately 50 percent of physicians used the system, and 60 to 70 percent of orders were entered into the system. After publication of the IOM report on medication errors, Abington Memorial decided it needed to renew its focus on reducing medication errors and to push for universal use of CPOE.

The hospital created an executive patient safety committee to determine how to decrease all types of medical errors. The committee decided universal use of the order entry system would greatly reduce medication errors and enlisted the help of the hospital's physician advisory committee to increase physician utilization of CPOE. The physician advisory committee solicited input of physicians to obtain an understanding of what improvements and training were needed to get them to use the system for all orders all of the time.

To obtain universal adoption, Abington Memorial Hospital:

- Installed new devices to have more convenient access for physicians.
- Improved screens so that most orders could be completed after clicking through only two screens.
- Interfaced the system with lab and radiology – increasing the physician's ability to view and order patient tests before ordering medications.

Abington Memorial then spent extensive time training or re-training physicians on new CPOE processes and new system enhancements. The organization pushed to be paperless and at one point decided not to accept any written orders.

Increasing ease of use of the system and the extensive training were key to increasing CPOE utilization.

10. Langberg, M. "Challenges to Implementing CPOE: A Case Study of a Work in Progress at Cedars-Sinai." *Modern Physician* (February 2003): 21-22. (Subscription required).

This article, authored by a physician executive at Cedars-Sinai, briefly outlines Cedars-Sinai reasoning behind developing their own clinical system in-house and describes their rollout process. Use of the CPOE system was suspended before the system rollout was complete. The article then continues to explain four complex processes that need to be managed during the rollout of a CPOE implementation, including what went awry during the aborted CPOE rollout – physician change management, the need to make sure physicians have an

optimal working knowledge of the system, workflow change management, and the ability to handle and manage system enhancement requests.

11. Metzger, J., et al. "CPOE from the CIO Perspective." *Healthcare Informatics* (February 2004).

This paper recaps a panel discussion at CHIME in which three CIOs who have successfully implemented CPOE reviewed the CIO perspective on what it takes to be successful. Each hospital had a substantial number of community physicians. One of the CIOs had implemented CPOE in two different institutions and another was the veteran of two stalled efforts before a successful one.

- *Key ingredients* included the call for patient safety, a partnership with physicians, significant physician time devoted to the effort, and aligning with the strategic plan.
- *IS departments* had to beef up skills by adding clinicians (clinical analysts and dedicated physicians) and to provide Help Desk support responsive to physicians.
- On the topic of *system reliability*, CIOs advised that nothing less than 100 percent is acceptable and recommended a big focus on redundancy and disaster recovery.
- About *user devices*, they advised not being cheap and to expect to provide a mix of devices and encourage physician remote access.

12. The National Alliance for Health Information Technology. "Rules of Engagement: Proven paths for Instilling, then Installing a CPOE Approach that Works." (2006). (This report is available for purchase – $395 for NAHIT members, $435 for others. www.nahit.org).

This report is a step-by-step guide to the implementation process, covering the first steps of getting senior management and executive management on board through implementation go-live.

The guide first describes the actions that should be taken after an organization decides to implement CPOE, providing tips such as how to engage the board, and which characteristics to look for in physician champions. The guide then details the vendor selection process, outlining the steps on how to develop a system requirements list and ensuring the selected vendor is the right fit with the organization.

Next the guide focuses on the importance of cultural change, workflow redesign, and training in the implementation efforts. Example methods to most effectively execute the tasks involved in each group are detailed. Then the implementation process itself is described, including the use of order sets and clinical decision support, and making sure the technology aspects of the organization are in place to support CPOE.

Throughout the document, examples and real life antidotes are provided from members of the National Alliance who have successfully implemented CPOE. In the appendix the complexities of a CPOE system are explained. In order to fully achieve CPOE benefits, the system must interface or integrate with several other clinical systems within the organization. The appendix also includes information on the ROI and financial impacts of CPOE and a model vendor contract.

13. Safyer, S. "Highly Evolved: Montefiore Medical Center Rolls Out CPOE Gradually, Successfully." *Modern Physician;* (February 2003): 26-27, 35. (Subscription required).

This article describes how Montefiore Medical Center, an academic hospital in the New York area that is part of an integrated system, successfully implemented CPOE. The vision of Montefiore Medical Center was to create an integrated network seamless through inpatient and outpatient services.

The article briefly describes the steps that Montefiore took to successfully implement CPOE, from obtaining leadership and board support, securing the budget for system purchase and implementation, to rollout approaches. The hospital used the big bang approach for some aspects of the clinical systems such as the patient master index, pharmacy, and results reporting and other ancillary systems. CPOE was part of a second phase implementation that was rolled out on a unit-by-unit basis; the rollout process started in 1999 and was fully implemented in all hospital units in 2002. An advantage of gradually rolling out CPOE was that the organization was able to correct system mistakes at each rollout and tailor the system to the specific needs of each unit.

The benefits Montefiore realized from the CPOE implementation include reduction in physician prescribing errors, reduction in the turnaround time from when a physician places an order to when the patient receives treatment, and better data to analyze outcomes measurements. To get physicians to use the CPOE system, Montefiore had to demonstrate the system benefits to the physicians and had to ensure the system was very user friendly.

Appendix B
Hospital Profiles

1. Berkshire Medical Center (Berkshire Health Systems)	725 North Street Pittsfield, MA 01201
No. of Beds	319
Vendor	Meditech
CPOE Rollout Completion Date	Rollout still in progress, ICU/CCU not on CPOE
Percent of Orders Entered by Physicians	80
No. Community Physicians	156
2. Citizens Memorial Hospital	1500 N. Oakland Bolivar, MO65613
No. of Beds	74
Vendor	Meditech
CPOE Rollout Completion Date	December 2003
Percent of Orders Entered by Physicians	100
No. Community Physicians	71
3. Newport Hospital (LifeSpan)	11 Friendship Street Newport, RI 02840
No. of Beds	129
Vendor	Siemens
CPOE Rollout Completion Date	November 2004
Percent of Orders Entered by Physicians	86
No. Community Physicians	219
4. Newton-Wellesley Hospital	2014 Washington Street Newton, MA 02462
No. of Beds	224
Vendor	Meditech
CPOE Rollout Completion Date	February 2006
Percent of Orders Entered by Physicians	100
No. Community Physicians	~400

5. Summa Health System	Akron City Hospital 525 E. Market Street Akron, OH 44304 Cuyahoga Fall General Hospital 1900 23rd Street Cuyahoga Falls, OH 44223
No. of Beds	1,000 (both hospitals)
Vendor	Eclipsys
CPOE Rollout Completion Date	March 2006
Percent of Orders Entered by Physicians	78
No. Community Physicians	~1200 (both hospitals)

Appendix C
The Leapfrog Group Listing – Clinical Decision Support in CPOE

Category of Clinical Decision Support	Description	Contributions to Safety/Quality	Function of Specific Tools
Basic field edits	Setting of basic parameters for contents entered into individual fields including numeric/text, decimal format, required fields; used to edit information entered such as dosage amounts	• Reduced errors due to grossly erroneous information in order fields	• Order field format checking • Required fields • Checks for correct data type
Structured orders	Templates for each ordered service that specify data fields to be completed and guide choices with allowable values, defaults, and required fields	• More complete, actionable orders • Reduced errors of omission or commission through field entry appropriate to the type of intervention being ordered (route of administration) and local practice (dosage dispensed in pharmacy, timing of routine blood draws)	• Structured orders: route, dose, frequency, duration • Required fields • Default values • Series orders/recurring orders • Preset allowable value for route of administration • Preset allowable value for available doses • Check against hospital formulary • Display of cost information
Groups of predefined orders	Pre-defined grouping of orders that can be selected by user as a starting point for patient-specific orders (order set, clinical pathway) or is displayed automatically (corollary order) whenever linked service is being ordered (e.g., a medication order that should be accompanied by an order to test blood levels of the medication to titrate dosing)	• Reduced errors due to incomplete or erroneous information through use of sets of pre-structured orders with appropriate fields and field contents for each type of intervention being ordered and local practice • Increased compliance with recommended care for particular diagnosis, procedure, and/or phase of management (admission, post-op for a given diagnosis or procedure)	• Standard order sets and ordering regimens • Common order sets • Common orders • Personal order sets and favorite orders • Order sets linked to clinical pathways • Order set by diagnosis • Corollary/linked orders for adjunct interventions • Vendor-supplied starter sets

Source: Metzger, J. and F. Turisco. *Computerized Physician Order Entry: A Look at the Vendor Marketplace and Getting Started.* Report by First Consulting Group to The Leapfrog Group, 2001. (www.leapfroggroup.org) Used with permission.

Category of Clinical Decision Support	Description	Contributions to Safety/Quality	Function of Specific Tools
Order checking (with or without a reference database)	Checking of medication orders for drug interactions and contraindications (e.g., drug-drug and drug-allergy checking, min-max dose ranges, duplicate and therapeutic overlap checking.) For medications, likely to include the use of an industry reference database. Also checking of non-medication orders to duplicates within specified timeframes.	• Reduced errors due to flagging of potential contraindications • Improved quality due to facilitated access to reference information on medications • Reduced ordering of unnecessary duplicate interventions	• Drug-drug interaction checking • Drug-allergy interaction checking • Drug-food interaction checking • Drug-disease interaction checking • Therapeutic duplication checking – within the same therapy (same drug) • Therapeutic duplication checking – within a drug class • Therapeutic duplication checking – with components of combination products • Single dose limit checking • Dose limit checking for each component of a combination product • Medication checking of off-formulary items • IV incompatibility checking • Duplicate order checking • Cost-of-care checking • Exception documentation for alert overrides
Complex orders with specialized tools	Templates and tools such as dose calculators to guide entry of orders with complex dosing or administration requirements (e.g., taper dosing, sliding scale, alternate day dosing, custom TPN, chemotherapy).	• Reduced errors of omission and commission in complex orders • More accurate dosing calculations • Ability to capture broader range of patient orders with CPOE and include them in checking for contraindications	• Complex admin times and dosages for medication orders • Patient-specific dosing and dosage checking • Sliding scale orders • Conditional orders • IVs • Patient-controlled analgesics • Adult TPN ordering • Adult chemotherapy ordering • Pediatric TPN ordering • Pediatric chemotherapy ordering
Order-relevant patient data display	Automatic display of patient information relevant to the intervention being ordered (typically laboratory data to be reviewed before ordering a medication)	• Facilitated review of patient information that might influence choice, timing, or dose of medication or other intervention	• Automatic display of relevant patient information for that order

Category of Clinical Decision Support	Description	Contributions to Safety/Quality	Function of Specific Tools
Order-relevant patient data capture	Prompting to verify and/or supply patient-specific information not included in orders, but needed to screen intervention for possible contraindications (e.g., allergy) or to perform necessary calculations (patient weight, body surface area); also includes prompting about clinical appropriateness with documentation of relevant clinical indications	• Expanded availability of relevant patient information for decision support (can serve as additional Q/A check on data routinely captured or supply information not captured electronically) • More appropriate use of targeted interventions and capture of relevant information for subsequent review or analysis of clinical appropriateness	• Requirement for weight, height, or other information necessary for dosing • Requirement for allergy documentation • Linked appropriateness criteria requiring physician entry of data
Rules-based prompting and alerts within order entry	Real-time prompting and alerting at the time of order entry, based on explicit rules and a range of patient-specific electronic information. Includes patient-specific dosing (calculator, suggested dose, and/or dosage checking).	• Reduced errors of omission and commission in ordering	• Customer-definable rules combining logic (nested "if's") and available patient data • User-friendly rule writer • Cumulative dose limit checking • Contraindication/dose limit checking based on patient diagnoses • Contraindication/dose limit checking – based on age/weight – based on lab studies – based on procedures • Patient-specific information drives allowable values for specified fields • Facilitated response to recommendation • Context-specific links to clinical knowledge
Rules-based surveillance with alerts outside of order entry	Prompting and alerting to reconsider ordered interventions based on new information regarding patient characteristics or status, with notification outside of electronic order entry	• Reduced delays in re-evaluating patient management strategy based on new information about the patient	• Expiring orders alerts • Alerts based on new patient information – allergy or diagnostic test result • External notification • Coverage list • Escalation

Appendix D
Medication Order Categories in the Leapfrog CPOE Evaluation

Order Category	Description	Examples
Therapeutic duplication	Medication with therapeutic overlap with another new or active order; may be same drug, within drug class, or involve components of combination products	Codeine AND Tylenol #3
Single and cumulative dose limits	Medication with a specified dose that exceeds recommended dose ranges or that will result in a cumulative dose that exceeds recommended ranges	Ten-fold excess dose of Methotrexate
Allergies and cross-allergies	Medication for which patient allergy has been documented or allergy to other drug in same category has been documented	Penicillin prescribed for patient with documented penicillin allergy
Contraindicated route of administration	Order specifying a route of administration (e.g., oral, intramuscular, intravenous) not appropriate for the identified medication	Tylenol to be administered intravenously
Drug-drug and drug-food interactions	Medication that results in known, dangerous interaction when administered in combination with a different medication in a new or existing order for the patient or results in an interaction in combination with a food or food group	Digoxin AND Quinidine
Contraindication/dose limits based on patient diagnosis	Medication either contraindicated based on patient diagnosis or diagnosis affects appropriate dosing	Nonspecific beta blocker in patient with asthma
Contraindication dose limits based on patient age and weight	Medication either contraindicated for this patient based on age and weight or for which age and weight must be considered in appropriate dosing	Adult dose of antibiotic in a newborn
Contraindication/dose limits based on laboratory studies	Medication either contraindicated for this patient based on laboratory studies or for which relevant laboratory results must be considered in appropriate dosing	Normal adult dose regimen of renally-eliminated medication in patient with elevated creatinine
Contraindication/dose limits based on radiology studies	Medication contraindicated for this patient based on interaction with contrast medium in recent or ordered radiology study	Medication prescribed known to interact with iodine to be used as contrast medium in ordered head CT exam
Corollary	Intervention that requires an associated or secondary order to meet the standard of care	Prompt to order drug levels when ordering aminoglycoside
Cost of care	Test that duplicates a service within a timeframe in which there is typically minimal benefits from repeating the test	Repeat test for Digoxin level within twp hours

Source: Kilbridge, P, C. Classen, and E. Welebob. *Overview of the Leapfrog Group EvaluationTool for Computerized Physician Order Entry.* Report by First Consulting Group to The Leapfrog Group, 2001. (www.leapfroggroup.org) Used with permission.