

A Closer Look at Architecting CPOE

A Sequel to “How to Architect the Best CPOE Approach”

James F. Keel, III, M.D. & Arlo Jennings, Ph.D.

In 2004, we wrote a white paper entitled “*How to Architect the Best CPOE Approach (Computerized Physician Order Entry)*.” At that time very few hospitals had undertaken the arduous task of implementing CPOE and basically there was no “best practice” approach for doing so. Our hospital began to undertake this *adventure* in 2000 by putting in the building blocks outlined in the first white paper. As our organization began the transformation from the paper order to the electronic physician order, we learned much through the experience that others can use to manage or avoid the obstacles we had to endure. Over time, much was learned as to the actual requirements for successful use of CPOE by physicians.

In April 2008 we achieved a remarkably smooth and highly successful go-live of CPOE across the entire organization with 100% adoption by a diverse medical staff. While not every physician was enthusiastic about moving to CPOE, all have accepted this new technology and are using it with great skill. Most are finding that their efficiency is either time neutral or takes only slightly longer than order entry on paper. Regardless, the benefits achieved resulting from readable orders, embedded rules and alerts, and more efficient and reliable order deployment, have resulted in measureable improvements for patient care.

Some vital statistics about our hospital need to be mentioned to allow for understanding the complexity of accomplishing CPOE. The hospital provides full service for western North Carolina with 764 licensed beds and 700 physicians on staff. The hospital serves as referral hospital for a network of sixteen smaller regional hospitals, but may be classified as a community hospital in that 93% of our physicians are employed in private, independent practices. We have very few residents (family practice and ob-gyn only) to shield our attending physicians from the chore of entering orders and taking inpatient call.

Currently across the United States, a minority of hospitals are live with some element of CPOE. The majority of hospitals are still using paper orders, but are either actively planning or are in the process of implementing CPOE. Even for hospitals live with CPOE, there is variable and often poor adoption by providers throughout the system. Although each organization has its own unique characteristics and issues, there are a number of common challenges and obstacles that are faced by most in executing this large and complex transformation. Our hope is that you may gather useful ideas from this paper based on what we learned implementing CPOE that may be applied to your own situation, no matter where you are in the process.

The purpose of this white paper is to explain how we planned our CPOE implementation and what we thought was important, while describing some lessons learned. This paper discusses CPOE implementation from two distinct perspectives: 1) **The Product**,

A Closer Look at Architecting CPOE

meaning the design and build of the ordering environment, and 2) **The Transformation**, meaning the preparation and process of transition of the clinical culture. Although CPOE impacts the entire hospital organization as a consequence of its downstream impact on all departments, this paper will focus primarily on the transformation necessary for the physicians and other providers who are users of CPOE.

Reviewing briefly, we made some key statements in our “How To” white paper that merit revisiting before we expound into new territories. We could have entitled this white paper “The Good, Bad, and Ugly of CPOE”, but that doesn’t really convey a correct impression of how we would like to present this information.

We stated: The keys to CPOE success are the proper architecture and implementation of this unique process. The system must encourage physician usage, by leading them with positive enhancements to patient care, versus imposing on them a foreign system through new regulations and bylaws that will lead only to increasing resistance. A crucial element is ensuring appropriate buy-in and involvement by everyone affected. CPOE must be the climax to a chain of system events versus the primary exposure.

In this regard, we reviewed the importance of first leading physicians to engage the computer in their daily clinical workflow. We facilitated this step by making the post-discharge chart available only via the computer, thereby forcing an early transition from paper to computer for results viewing and chart completion. This was accompanied by the provision of a complete set of clinical results on line that would eventually lead to the removal of all charted paper results used in daily patient rounding activities. At the same time we developed, revised, and improved our process for the implementation of a comprehensive array of paper order sets, supporting admissions, consultations, peri-procedure, and peri-operative processes, which were evidence-based, consensus-based, and updated annually.

Prerequisites

Before engaging in a discussion of **The Transformation**, there are a number of prerequisites for the computer system that should be solidly in place before undertaking CPOE.

First, there must be liberally available access to computers for clinical care distributed in a way that supports efficient clinical workflow. This requires a structured walk-through of the nursing units and areas where physicians normally congregate to discuss patient care. This analysis will definitely mean adding additional computer work stations and telephones to ensure appropriate workflow. The adequacy of computer access points must be carefully assessed prior to go-live through careful inspections of the demand for computer terminals during peak rounding hours. Demand for computers will not decrease with CPOE implementation. These observations should be followed by augmentation of those areas in the system that may become deficient when CPOE goes live. Observations should also be conducted to identify any areas that may need renovation to accommodate the required number of devices. New devices and

A Closer Look at Architecting CPOE

renovations should be budgeted, acquired, and deployed, with follow up analysis to confirm the sufficiency of the remedy. It is critical to observe how physicians make rounds. If part of the patient chart is on paper, physicians will want a place to sit and enter information. Mobile access devices may not be first choice.

Second, there must be carefully designed downtime procedures, including appropriate backup software and workflow processes in place. All downtime solutions should be tested by regularly scheduled drills to ensure familiarity with downtime procedures and to identify potential gaps in process. We learned quickly that having paper forms available on each unit for downtime, but secured during normal up time, expedited continuing patient care by all providers.

Third, computer performance should be assessed and optimized with appropriate network, hardware, and software installations that will facilitate rapid screen-to-screen times. Computer processor utilization on the backend as well as user screen-to-screen timings on the front end should be monitored and reported at regular intervals. We learned no matter how fast the back end processing might be, the ease and quickness of screen response on the front end, in fact, defined the physicians' perception of satisfactory computer performance.

Fourth, efficient access to clinical results should be provided on line, and other supporting computer applications should be up and working smoothly prior to CPOE implementation. For example, integrated software and equipment to support medication administration, including the medication profile, the electronic medication administration record, medication dispensing equipment, and appropriate pharmacy support software should be in place and working efficiently prior to attempting to implement medication ordering in CPOE.

The final two components are the functionality and use of the ordering system, or what we have already referred to as **The Product**, and The Transformation of the organization, which are the topics of the remainder of this paper.

The Transformation – of the medical staff for adoption of CPOE

In our initial white paper we stated that CPOE failure occurs for several key reasons. One great concern is that *hospital administrators, often complicit with an IT-driven initiative, decide to implement CPOE systems with insufficient involvement and collaborative cooperation on the part of the medical staff.* It is imprudent to succumb to the notion that adequate physician engagement is impractical to achieve. Physician involvement is facilitated by the inclusion of physician champions very early in the formative process of decision-making.

Physicians are commonly resistant to the notion of moving forward with CPOE for a variety of reasons. Some of these include: “It will take me too long to enter my orders”; “I will be spending more time in front of a computer than in front of my patients”; “We are just trading one system of errors for another”; “There is conflicting literature on the

A Closer Look at Architecting CPOE

efficacy and safety of CPOE”; and “You’re asking me to do the work of a secretary.” A review of the 2008 KLAS data shows how serious this issue of physician adoption has become. KLAS reports only 17.4% of hospitals greater than 200 beds have implemented CPOE at some level. At these sites, only about 60% of orders on average are entered using CPOE and tellingly only 3% of physician users report increased satisfaction with use of CPOE. Our argument still is made more difficult by the small number of published reports in the literature that have provided objective data supporting the case for CPOE adoption. Furthermore, available information indicates that CPOE does indeed take clinicians more time to enter orders than using the traditional handwritten paper process.

The Transformation of the medical staff may be broken down into a number of components, ranging from the development of an initial, basic understanding of CPOE process to the formulation of implementation strategies. These will be discussed in the following paragraphs.

The first step in transformation is to help the clinical staff understand the rationale behind the decision to proceed with CPOE. This argument may be summarized as follows:

- Clearly CPOE resolves the chronic problem of deciphering physician handwriting that has plagued healthcare since its inception and led to countless errors.
- A properly built CPOE system provides the opportunity for unmatched clarity and standardization in order entry format, which in turn removes much of the ambiguity and misstatements found in handwritten orders, even when they can be easily read.
- CPOE ordering has the advantage of not being confined to one location and one chart, such that orders can be implemented from any computer access point.
- CPOE represents not just the simple rote process of effecting the entry of orders, but instead involves the deployment, notification, coordination, completion algorithms, check lists, safety elements, and for all departments downstream of these orders.
- CPOE has been repeatedly demonstrated to significantly shorten the time of order implementation as a result of both the clarity of orders and the speed of order transmission, resulting in a system that provides for reliable execution of the intended orders in far less time than in the paper world.
- **Perhaps most importantly**, CPOE holds the promise of leveraging true clinical decision support to influence clinical decision making. By deploying well designed, evidence-based clinical order sets, appropriate rules and smart alerts that fire only when an unsafe or undesirable action is invoked, and a series of prompts and reminders, such as pre-populating medication orders with the most commonly used medication order sentences, clinicians are provided with state-of-the-art decision support tools. These tools allow physicians to practice medicine at an enhanced level of performance not otherwise achievable.
- Finally, CPOE is one of the fundamental components that can make up a searchable clinical data repository, permitting analysis of practice patterns and

A Closer Look at Architecting CPOE

resource utilization tied to clinical and financial outcomes. This process, in turn, creates the opportunity to engineer true continuous quality improvement.

The second step in transformation is to build a realistic understanding and expectation of CPOE and how it affects the users in their daily lives. This goal may be accomplished by an initial communication of the intention to move to CPOE through announcements in meetings, posters, emails, intranet/Internet postings, mailings, and informal discussions. These efforts should be accompanied by the presentation of a series of scheduled, structured, live demonstrations of CPOE to all practice groups. In our experience, these demonstrations were well attended when folded into regularly scheduled group practice meetings. Interest in the subject matter and live demos could be described only as very high, with the result that many questions and much discussion followed at each encounter.

Many groups requested follow up presentations. As these presentations were rolled out, physicians' preconceived notions of CPOE (almost uniformly negative), were successively replaced by an educated understanding of the actual facts of the matter. In this regard, the importance of being brutally honest about the expected impact of CPOE on the workflow of the providers cannot be overemphasized. **Any attempt to oversell or market CPOE will be perceived as disingenuous and will likely boomerang, creating loss of confidence in those putting forward the effort.** These initiatives to build understanding and an appropriate expectation will take a significant period of time. This time should be factored into the cost and the timeline for CPOE. Any plan to minimize this component of the preparatory process is likely to lead to serious problems with adoption later in the course of the project.

The third important element is engaging actively practicing physicians in the hospital with CPOE design and the implementation processes. Initially there was reluctance to impose upon physicians requesting their time to help with CPOE. It was wrong to be reluctant. In most cases, there were ample physicians who were willing to step forward and become involved in many aspects of the project. Some of these aspects included participation in leadership roles, site visits, assistance with the design of orders and order sets, assistance with the design of specialty-specific folders of order collections, and participation in CPOE pilots and go-live support. In virtually every case, their participation improved the execution of the project and led to improved adoption.

Fourth, any project of this magnitude and controversy will require strong leadership. The role of the physician leadership in the design and support of CPOE implementation is a critical element in the success of the project. If the implementation is to proceed with high adoption, the project should be primarily led by the physicians themselves. This begins with the need for a lead physician in a Chief Medical Information Officer (CMIO) or leader in a similar role who is afforded the necessary time and resources to effectively organize and lead the overall process. Our CMIO enlisted a group of interested physicians to form what may be termed an information technology clinical advisory committee to review and make formal recommendations to the hospital and the medical

A Closer Look at Architecting CPOE

staff on clinical IT initiatives. These physicians termed themselves the Physician Information Group, otherwise known as the “PIG”.

The chief and vice chief for medical staff played pivotal roles in the leadership effort for CPOE. Their clear and articulate understanding of the value of CPOE and their willingness to aggressively support the aim of the project was very important. These individuals, in turn, worked to provide the medical staff service line and departmental clinical leaders, usually during meetings of the medical executive committee, with presentations and opportunities for input and decision-making that directed the implementation.

During this process the chief and vice chief of medical staff addressed a number of critical questions:

- 1) whether they would endorse the decision to proceed with CPOE and, if so, over what timeframe;
- 2) whether as a critical point CPOE would be mandatory or optional for all providers. In this regard, it was important to be apprised of a comprehensive list of pros and cons, including the patient safety risks inherent in a protracted dual process (paper and computer) should an optional strategy be chosen;
- 3) whether CPOE would be implemented by a “big bang” or a sequential go-live process with consideration of the potential risk associated with dual ordering methods during a prolonged sequential approach;
- 4) whether physician education would be a sufficiently important factor in adoption and patient safety such that this education should be mandatory, requiring significant time in class on the part of the each physician.

In our institution these questions were bitterly debated in our medical staff leadership meetings, but eventually the **physician** leadership agreed to certain decisions.

Agreement was reached that CPOE would be implemented in an appropriate time frame with any encountered patient care issues resolved prior to go-live. CPOE would be mandatory for all providers, and this decision was backed up by appropriate changes in medical staff policy to require participation. CPOE would be implemented with a big bang strategy. This was perhaps the most controversial decision and was later modified significantly as will be explained more fully later in this white paper. Finally, education prior to CPOE use would be required of all providers who ever intended to enter orders in the inpatient environment. These decisions represented the most important ingredients in the recipe for a successful implementation of CPOE with full adoption by the medical staff. They incorporated the critical role of physician leadership with the necessary mandatory elements to bring along those members of the medical staff who inevitably would resist the transformation.

In any organization facing change, there is usually a bell-shaped curve ranging from a relatively small number of ready adopters to a much larger number of individuals who are less opinionated and adopt a wait-and-see attitude, to the deeply entrenched, highly

A Closer Look at Architecting CPOE

resistant naysayers. The challenge is how to bring along even the most resistant elements without allowing the naysayers to convince the much larger group of “undecideds” to also become resistant to the proposed change. **Following the decisions of the medical staff leadership, rules and regulations required amending to incorporate the mandatory components, including binding clauses that would specify accompanying consequences for noncompliance.** It was believed that without these required elements, there would have been a substantial percentage of the medical staff electing not to utilize CPOE.

In coordination with physician leadership, the hospital administration and Board of Directors, collaborating with physicians, must also be fully informed, engaged, and committed to the success of the project. Their roles include ensuring the development of an appropriate organizational structure for project design and implementation, a credible scope of project, an implementation plan with milestones and oversight, an appropriate budget, and a large bully pulpit from which to engage and support the effort across the organization.

In terms of organizational structure, a number of teams need to be created addressing each of the core elements required to facilitate the design and implementation of CPOE. These include teams for computer access, downtime, performance, completion of on-line results viewing, functionality (the design of build of **The Product**), clinical process mapping for current and future state, and transformation--including communications, education, policy, rules, bylaws, pilot strategy, and go live support. Each team has an assigned team leader. Our team leaders met weekly or as needed to report on progress against plan, to coordinate activities, and to raise, escalate, and track issues. In addition, each team was assigned two sponsors, a physician and a clinical vice president, who advised the team and acted on their behalf within the organization when necessary. The team leaders reported in turn to a CPOE executive committee that for us consisted of the CIO, the CMIO, the CMO, the COO, and the project manager. This committee was responsible for general oversight, review of milestones, and issues resolution. Each team began by developing a scope document and plan requiring sign off at the executive level and that were incorporated into an overall project plan.

The Product

The Product consists primarily of all of the orders, order sets, rules, alerts, and formats forming the basis of the computerized order entry tool. We quickly learned the goal is to construct a product that is fast, elegant, and fun to use. In IT terminology, we would say the system must possess speed, usability, and breadth of functionality. Stated yet another way, if **The Product** does not work well, no amount of transforming will lead to adoption.

A lesson learned early in the implementation of CPOE focused on having a solid budget for the project. Because of the cost and complexity of CPOE design and implementation, specific funding should be allocated to the project and formal project management

A Closer Look at Architecting CPOE

methodologies should be applied, including development of scope of project, a managed project plan, a transparent listing of milestones, and an appointed project manager.

The most basic element of the build is the individual orderable. We built approximately 62,000 such orderables. Each orderable contains within it a set of detail options and values, also known as order entry formats that allow each order to be easily modified to suit individual patient needs. The rules for the construction of orderables are fairly simple, but clearly the design, build, and testing of this massive compendium of orderables may demand a considerable effort to complete, depending on the amount of work preformatted from the vendor. Several key features that should guide a correct approach to orderable build are listed below.

Orderables must be easy to look up as they are not entered as free text, but rather are matched to the terms in a search engine that are commonly used by the providers. Stated differently, ease of look up means as the provider begins typing in the name of an order, the search engine successfully matches and converts the provider's idea into a standard prebuilt order. This requires each orderable name being listed under a variety of commonly used aliases or synonyms, mandating careful attention to completeness in the build. Consider, for example, an order for a CT of the Chest. In our system this orderable is listed variably with synonyms as "CT Chest", "Chest CT", "CT Thorax", and "Thorax CT". Thus, the orderable catalogue must be comprehensive to include nearly any order that may be imagined. In this approach, as the physician thinks of the name of the test, he/she may expect to get a positive match with a pre-built orderable from any reasonable search.

Orderables, for physicians, must be intuitive to modify and complete. Orderables should have the fewest possible required fields to complete. Some required fields are necessary to capture all relevant information to construct a clear and complete order. The number of required fields may be minimized using several techniques. One of the most important fields is a listing of pre-populated order sentences attached to each medication orderable. The most common sentences for all formulary and many non-formulary medications should be prebuilt so the provider may easily select the closest one to the required order, thereby avoiding the completion of additional required fields specifying dose, dose unit, route, and frequency. These pre-populated order sentences also serve a more important function -- they prompt the provider to choose from the most commonly used and safest order sentences, thereby providing useful decision support to assist the physician.

In other orderables, many useful order details otherwise needing to be completed by the provider may be pulled from information already present elsewhere in the system. For example, when ordering a radiology examination, relevant details for mode of travel, monitoring, oxygen support, nurse escort, pregnancy status, and others may be pulled from daily nursing assessments into the order details without querying the physician for this information. The physician, in most cases, shouldn't be required to address any details not defaulted unless a change in the defaulted format is desired. A more complete description of the design and build of orderables will depend upon the format and software design from each particular vendor. Nevertheless, the point here is the ease and

A Closer Look at Architecting CPOE

speed of order entry, facilitated by a smooth search, and the inclusion of all relevant information within the order, is a critical component in the successful adoption of CPOE.

After successful order entry, efficient and effective order fulfillment must follow. The design and build of the downstream flow of orders must include the clear and proper communication of the order intent, the provision of all necessary accompanying information, and the careful design of processes needed to facilitate order completion and documentation. The design of these elements is best facilitated by constructing a detailed analysis of current and future state workflow processes for each clinical support department. Further discussion of this important component is beyond the scope of this white paper.

Another necessary element in the build of **The Product** is the creation of a useful array of order sets. An order set may be defined as *a set of related orders required for the management of a series of integrated clinical tasks*. Common uses for order sets include the admission process, transfer, and pre- and post-operative processes. In addition, diagnosis-specific order sets may be constructed. Others may be used to facilitate safety measures, such as vaccinations or venous thromboembolism prophylaxis. Order sets may also be constructed to guide the administration of complex medications, such as titrated medications that may require additional orders for monitoring labs or titration algorithms. These may be additionally supported with relevant guidelines, reminders, supporting lab results, nomograms for administration, and dose calculators.

Occasional medications require the provider to address a list of indications and contraindications prior to use. These may be incorporated into ordering requirements for specific medications. Other order sets may be constructed to support the performance of bedside procedures or the ordering of lab groups. Order set utility may be further enhanced by the inclusion of nested order sets and sequenced order sets. Clearly order sets are highly useful, not only for the purpose of saving time for the user, but also to provide for real time decision support to guide ordering precision, for lists of orders serving as reminders, and for the provision of additional clinical information to support complex ordering to enhance order safety and clarity at the proper point along the continuum of patient care. We developed more than 500 order sets in preparation for CPOE. Physicians from each service line were involved in the construction, revision, and approval of all order sets in advance of CPOE.

Following design and build, **The Product** must be refined and polished prior to productive use. This critical phase involves extensive testing. In a system as complex as the practice of medicine involving more than 60,000 orders, each with numerous ordering options, and with more than 500 order sets, many millions of ordering options are assembled. Therefore, great care must be exercised to avoid errors in the process of assuring their safe application to patient care. In addition to the basic unit testing, application testing, and integration testing that must occur, we performed an additional category of testing which we referred to as **usability testing**.

A Closer Look at Architecting CPOE

Usability testing consisted of making scanned copies of thousands of handwritten paper orders. These images of actual orders were stored on compact discs to be viewed exactly as they had been written by physicians. Users skillful with the computer order entry process were tasked with converting these handwritten orders into computer order entry. Each user recorded on standard forms any difficulty or impedance, however minor, to successful entry of these orders. All such order defects were reviewed by a change control committee evaluating each complaint and recommending appropriate action to amend and improve the order.

Usability testing began for us one year prior to go live and was conducted in four separate waves. The first attempt resulted in a finding that 72% of orders tested had some form of defect or imperfection. After making the necessary corrections, a second wave conducted three months later showed the defect rate had been reduced to 46%. A third wave reflected further improvement to 18%, and a final wave conducted two months prior to go-live revealed a much more satisfactory 2% rate. We should state there was considerable resistance on the part of many of our clinical testing staff to the performance of usability testing. We remain convinced, however, especially in retrospect, that this testing was a critical factor in CPOE adoption. We knew physicians may be expected to exhibit a low tolerance for defects in the build of **The Product**. Other elements concerning the polishing of the build of the orders will be addressed subsequently.

Education

Let's continue our discussion of the challenges faced with **The Transformation** during implementation of CPOE. Because the process differs remarkably from paper order entry, and because many elements of the process are not entirely intuitive, the issue of formally educating the medical staff and hospital staff had to be addressed. Our education process began with the development of an interactive computer-based training module (CBT). Our CBT was internally developed by our education staff and several physicians in conjunction with a professional producer using the software tool, Captivate, and a development team. We used an actual patient care scenario consisting of the case of a patient who presented to the ED with abdominal pain, required admission, went to surgery, experienced complications, improved, and was eventually discharged home.

The CBT offered examples in the use of single orders, order sets, conditional orders, order modifications, rules and alerts, formulary issues, and so on. Some of the ordering steps were automated while others required interactive participation. The CBT took approximately two to three hours to review. The CBT was made broadly available via CDs mailed to all providers, and via Internet and intranet links. Although review of the CBT was not mandatory, it was strongly encouraged for preparation for the classroom education.

Because CPOE could be enabled (turned on or off) for each individual provider, all providers were advised that failure to complete CPOE training would result in the loss of all ordering privileges, both paper and computer, until their education could be completed. Classes were scheduled months in advance of classes to permit physicians

A Closer Look at Architecting CPOE

adequate time to adjust their clinical schedules. The format for the classes consisted of an introduction, followed by a recapitulation of the content of the CBT, but in the format of a manual that contained the same order entry steps as the CBT. In this format the provider was expected to execute each individual keystroke and mouse click to effect entry of each required order. The classroom experience lasted four hours and was structured such that each physician was able to work from his/her own work station. Several educators circulated during the class to offer assistance, answer questions, and document attendance. They also examined the physicians' final completed orders to ensure that their orders had been entered correctly. Although admittedly tedious, by the time physicians had completed this classroom activity, they were able to independently execute the range of basic order entry functions.

We did include a provision to permit providers to test out of the manual exercise. Providers who had carefully studied the CBT prior to class were offered the option of taking a 45 minute competency test. Those who passed the test were not required to perform the manual exercise and were able to complete their educational requirement in less than the allotted four hours. Beyond the education classes, we offered evening supplemental classes for selected groups of physicians who requested additional assistance with order entry education specific to the needs of their specialty. In addition, we set up practice patients in our training domain with the entire order catalogue available on line for providers to have the opportunity to practice additional order entry exercises individually. We positioned educators with computers in our physician lounges to be available to help with questions and assist with useful tips and tricks. Because we broadcast an expectation that the go-live would potentially be challenging for those who were not sufficiently familiar with the order entry application, many physicians, concerned about the impact to their workflow at go-live, took advantage of these additional options.

CME Credit

In one medical staff conference, the question was asked, given CPOE was likely to take providers more time than paper order entry, what advantage was there for providers in embracing this transition. The response was aside from the expected benefit to patient care and cost efficiency, there was no other perceived benefit to the provider. This response was poorly received. In searching for a means to give back some token of appreciation to the medical staff for going through this process, we investigated, with the assistance of our local Area Health Education Center (AHEC) organization, a hospital funded initiative, allowing all physicians who went through the CPOE implementation process to be awarded eight hours of Category I Continuing Medical Education (CME) credits. In addition, for those physicians who agreed to undergo a three phase documentation plan to assess agreed upon outcome variables that the physician would review and provide a written conclusion, we could award 28 hours of CME credits. We had 32 physicians who availed themselves of the 28 hour option. All the remaining physicians who completed CPOE training and implementation were awarded 8 hours each.

A Closer Look at Architecting CPOE

Only six out of approximately 600 physicians on staff who required ordering privileges failed to comply with training and were subsequently denied their ordering privileges. These six subsequently completed training within two weeks of go-live and their privileges were reinstated at that time.

Building Physician Favorite Folders

Because physician specialties tend to select from a limited range of commonly used orders, allowing physicians to build individual favorites folders containing frequently used or complex-to-build orders prior to go-live is expected to be very helpful. Training for favorites folder build was included in our physician education program. In addition, selected members of the medical staff assisted in the build of folders of orders specific to each of their clinical specialties. These folders were useful for assembling collections of specialty specific orders and also served as templates to assist some physicians in the construction of their personal favorites folders. To accommodate the need for physicians to build orders into their personal favorites folders, we devised a technique allowing physicians access to the Production domain prior to go live in order to build their favorites folders, but without allowing them to sign and implement orders until the scheduled go-live. Having a pre-built favorites folder available to use on the day of go-live proved helpful and reassuring to many physicians.

Dealing with Disruption

The primary defenses against disruption consisted of accurate communication, appropriate policies for defining and dealing with disruption, physician involvement at the ground level, and a completely unified leadership team whose members held a consistent position and were able to articulate a consistent and accurate message. After the Medical Administrative Committee rendered decisions that mandating the use of CPOE by all providers intending to perform order entry, policies and regulations were constructed to enforce compliance with the electronic order entry format, including provisions for defined consequences for disruptive physicians and staff.

Despite our efforts, we experienced a serious, organized attempt by a broad-based coalition of physicians to disrupt plans to go live with a mandatory implementation of CPOE. With six weeks to go to the main go-live, a group of about twenty-five physicians across multiple specialties, after becoming dismayed and disillusioned with their experience in the education classes, began a series of off-campus meetings to develop an organized resistance to bring down the CPOE initiative. After several meetings, the resistance group announced they were committed to ensuring that CPOE would not go live in the foreseeable future.

This effort became known to the senior administration and the Board of Directors. Their response to this incident resulted in a called executive meeting of the Board within four weeks of the CPOE go-live. A presentation was made to the Board with relevant facts regarding the planned CPOE implementation with time set aside to answer questions concerning the project. The meeting lasted three and a one-half hours beyond the

A Closer Look at Architecting CPOE

scheduled Board meeting. During the course of the meeting, questions were fielded from every Board member by key physician leaders. At the conclusion of the meeting, the Chairman of the Board of Directors called for a vote to determine whether we should continue on our committed course or abandon it in favor a delayed and optional approach to CPOE. Before the vote was called, our CEO made a remarkable statement indicating that no matter the outcome of the vote, each and every one in the room must leave the meeting speaking with one voice consistent with support for the group's decision regardless of personal reservations. When he asked the group whether any one of them felt he or she could not support this action, not a single hand was raised. The Board proceeded with a vote to unanimously endorse proceeding with CPOE as planned. In this action, the value of true leadership was readily exemplified, as well as the critical value of having a fully unified leadership team.

Following this vote, the Board Chairman made a remarkable decision. He asked that we form a small group consisting of the CMIO, CEO, CIO, COO, the Chief and Vice-Chief of Staff, and the Chair, Vice-Chair, and/or past Chair of the Board to visit each of the major physician practices, listen carefully to their concerns, and form a meaningful response to them. Over the next two weeks, each weekday evening this group scheduled time to visit these groups, listening and cataloging their grievances. From these meetings we learned that their greatest concern was the expectation that CPOE would critically disrupt their workflow due to the belief that order entry would take too much time away from patient care. During the course of these meetings, we made two significant concessions. First, we allowed what we termed a "pop-off" to permit the use paper orders during situations of perceived duress. Significantly, the use of paper order sets would not be allowed. Second, we agreed to not activate alerts for allergies and drug interactions for a period of six weeks post go-live. With these provisions, the resistance group effectively abandoned their mission and allowed CPOE to proceed on schedule.

The Pilot

We did implement a structured physician Pilot for CPOE that served several purposes preceding the primary go-live. First the Pilot served as a final proof of concept for the order entry process. This proof of concept was closely monitored by the entire medical staff throughout the CPOE implementation. Second, the Pilot served as a final "polishing" of **The Product** orders to clear up any final identifiable defects in the build prior to the primary go-live. Issues with orders and processes were carefully recorded by personnel assisting the pilot physicians and sent to the change control team for analysis and remediation. Finally, the Pilot served as a proving ground for workflow effectiveness as orders from a variety of service lines were deployed downstream from the order entry position. Some physicians however viewed the Pilot as an opportunity to engage personally one-on-one support for themselves in order to learn the system before the schedule big-bang go-live.

There was substantial discussion regarding how to structure the primary go-live and the Pilot. Some had advocated a sequential go-live, whereas others had advocated a "Big Bang" approach. In the end, a combination of the two approaches was implemented in

A Closer Look at Architecting CPOE

that we planned for a sequential Pilot phase that involved a significant percentage of the medical staff, followed by a “Big Bang” day that capped the end of the Pilot, incorporating the remainder of the medical staff. The first group to pilot CPOE was the Emergency Department. All physicians in the ED went live twelve weeks ahead of the rest of the hospital. This was followed five weeks later by an orthopedic pilot that consisted of five orthopedic surgeons going live over a two week period. In the final phase we had planned to add five new physicians per week over five weeks, representing a broad range of specialties to test workflow and usability across diverse services. We had limited this number to five new physicians per week based on a limited number of qualified personnel to assist the physicians in the pilot phase. Within a few days vice presidents called on behalf of physicians from a broad range of services requesting we include additional physicians in the Pilot. The vice presidents committed to provide appropriately trained assistants allowing the additional interested physicians to participate as pilots. These additional physician pilots were then also approved. By the week *prior* to go live, there were 107 of the heaviest users of the inpatient service out of 600 eligible physicians live on CPOE *and with most physicians performing very well.*

The Go-Live

The movement toward go-live was afforded additional momentum by the increased number of physicians pilots across a broad range of specialties who were finding the CPOE process reasonably easy to navigate and use. The day of go-live proved remarkably uneventful with few unexpected complications. For the go-live, we staffed all clinical units with two to three super users. In addition we maintained a staff of “roaming” support personnel who could be deployed to any area where the super users had trouble keeping up with the flow. We also maintained a fully staffed command center of eight to twelve individuals for two weeks, staffing a rotating phone system to take calls requesting assistance. Nighttime staff coverage was reduced to two individuals. On the day of go-live we received 380 calls to the command center. By the end of two weeks, this figure had dropped to about 35 calls per day. Most issues fielded could be dealt with through educational reinforcement. A smaller percentage required more detailed analysis by the change control team, of which only about four percent required some type change in the build of the orderable or order set. Within two weeks, with an absence of major issues or adverse events, and with rapid response to identified problems, CPOE was well on the way to cementing itself into the new culture of electronic support of clinical patient care.

The Final Polishing of The Product and Long Term Support

Over the first three months following CPOE implementation, we observed a gradual decrease in calls for assistance with CPOE ordering and an increase in calls for improved functionality in terms of order set modifications and advanced decision support, particularly as the strain of the new processes in downstream departments and services surfaced. These pressures were enhanced by impending CMS and Joint Commission reviews. Support post CPOE was by phone, which was initially maintained 24 x 7 by an on-call team of trained users. Ordering issues were registered through these calls and

A Closer Look at Architecting CPOE

through the work of service line and departmental staff responsible for order sets development. Issues were captured using an Intranet site dedicated to CPOE issues. Issues were routed through a change control group consisting of two physicians, two nurse liaisons, a pharmacist, two clinical informatics staff, one IT staff member, and others from specific departments as needed for dealing with problems relevant to their particular areas.

Over a three month period the change control group addressed more than 3,800 issues. Approximately three fourths of these issues were educational or redundant in nature. Of the remaining quarter, about three fourths were problems requiring changes in operational processes in services and departments downstream from the orders. About four percent of the issues required actual change in the build or design of the orders. The majority of these changes were remediated in a timely fashion. Fewer, but more frustrating, were issues with the performance of the software from the vendor which took significantly longer to resolve, and today many of these remain unresolved.

As a final note, we are now nine months into CPOE and the substantial majority of providers have acclimated well to the new system. We are in the process of studying the impact of CPOE on a variety of processes, including safety, clinical, and financial outcomes, and have completed the initial pre-CPOE arm of the study. Our study also includes a time motion analysis of the order entry process for providers pre- and post-CPOE, as well as an analysis of the order completion time for departmental services. The post-CPOE arm is scheduled to be accomplished in the Spring of 2009, one year following go-live. We look forward to sharing the outcomes of these studies in the coming year.

Summary of Salient Recommendations

- Involve the medical staff at the beginning of the EMR process and have physicians champion innovations at each step along the continuum.
- CPOE ideally should be physician led.
- Focus on and develop teams to support CPOE pre-requisites: performance, ease of use (functionality), provision of supporting results and documentation, access to computer workstations, adequate downtime procedures, communications, policies and regulations, education, and go live support.
- Take whatever time is necessary to carefully document your current processes in present state and then in future state using process flow diagrams in order to properly integrate IT changes into clinical workflow.
- Provide features that save time, effort, and cost, and that improve quality of care, drawing providers to engage and use the system. Measure and publish outcomes.
- Engage physician assistance in leadership, in implementation strategy, design and build, piloting, and go live support, including identification and leveraging of the skills of physician champions.
- Create collaborative alignment among physicians, clinical support staff, administration, and Board of Directors.

A Closer Look at Architecting CPOE

- Develop an appropriate budget for CPOE. Treat the design and implementation as a formal project management initiative.
- Create evidence and consensus based order sets for all clinical specialties and departments, initially on paper and then transition to support CPOE.
- Build a logical case for the necessity to move to CPOE.
- Communicate an honest, realistic expectation for CPOE in terms of workflow. Listen to and answer questions and concerns raised by the medical staff.
- Mandate participation in the use of CPOE
- Mandate education for all users prior to go live.
- Create educational support to make the process as efficient, yet comprehensive as possible, including computer based training, classroom based education, ad hoc targeted education, a train domain for users to practice, and support staff in physician lounges or other easy to access locations to answer questions.
- Enable and encourage the build of orders into favorites folders for users in the production domain prior to go live.
- Offer Category I CME for all users who go through the education and go live process.
- Apply liberal usability testing to ensure that the CPOE application works smoothly and efficiently
- Utilize a progressive pilot strategy, followed by a big, but smaller, bang go live.
- Employ liberal support for all users at go live. Taper support over two to three weeks.
- Employ the use of a command center, tapering to phone support, to provide rapid responses to questions that cannot be easily fielded by on site superuser support personnel.
- Develop a mechanism to capture all problems, issues, and requests for change.
- These issues should be triaged, analyzed, and referred for remediation as needed by a change control group that can provide prompt turnaround on requests for change.

Don't deviate too much from the list above if you want a successful implementation. The key is that physicians must use the system, so physicians must be involved in its development. Remember who writes the orders for patients. Finally, remember the process of order entry is not completed until the order is initiated and follow through is achieved by nursing and clinical support departments downstream for patient care. After all, this is about patient care.

Bottom Line, don't implement CPOE because everyone else is doing it, implement CPOE because it is right for patient care, your hospital, and your medical staff.

To conclude, no one has ever said it better than Charles Dickens from *A Tale of Two Cities* in a statement that holds as true today as when he wrote it one-hundred and fifty years ago:

'It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season

A Closer Look at Architecting CPOE

of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way.'

Now, we must move on to a new era.

Dr. James F. Keel, III is a Board Certified Critical Care Intensivist who for the last several years stepped away from clinical practice to serve full time as Mission Health System's Chief Medical Information Officer and Director of Quality. Dr. Keel devotes his full time to ensuring that clinical information applications are designed and implemented to improve processes for the providers and to improve the process of patient care. You can contact Dr. James Keel at james.keel@msj.org.

Dr. Arlo Jennings has served as Mission Health System's Vice President and Chief Information Officer for twenty-three years. Dr. Jennings has been a strong advocate of patient care, working with Dr. Keel to ensure that the technologies supporting improved patient care processes are aligned appropriately for the development of an electronic medical record. You can contact Dr. Arlo Jennings at arlo.jennings@msj.org.