

# Computerized Physician/Provider Order Entry (CPOE)

This document presents the results of research by the Physician Order Entry Team (POET) at Oregon Health & Science University. The team is funded by a grant from the National Library of Medicine to study success factors for implementing Computerized Physician Order Entry (CPOE) as well as the unintended consequences of CPOE. This document also provides a historical reference to a collection of resources and links regarding CPOE.

Computerized physician/provider order entry is defined as the computer system that allows direct entry of medical orders by the person with the licensure and privileges to do so. Directly entering orders into a computer has the benefit of reducing errors by minimizing the ambiguity of hand-written orders, but a much greater benefit is seen with the combination of CPOE and clinical decision support tools.

Implementation of CPOE is being increasingly encouraged as an important solution to the challenge of reducing medical errors, and improving health care quality and efficiency. But use of CPOE is not yet widespread, in part because it has a reputation for being difficult to implement successfully.



*“Think before you leap”*

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## Research

Since 1997 the Physician Order Entry Team (POET) in the Department of Biomedical Informatics and Clinical Epidemiology at OHSU has been using qualitative techniques to study the implementation of CPOE systems in various healthcare settings. Through surveys, conferences with experts, and fieldwork consisting of semi-structured interviews, focus groups and observation, POET has gathered thousands of pages of transcripts and notes on CPOE implementation. Analysis of this data has produced detailed descriptions of factors related to CPOE success and insight into the implementation process. Further research by POET has examined the unintended consequences, both positive and negative, of CPOE implementation.

### Considerations and Issues to Explore Before CPOE Implementation

A consensus conference of invited experts was held in May of 2001 at the Menucha retreat center near Portland, Oregon. Thirteen people representing administrative, vendor, clinician, and technology roles discussed success factors for CPOE implementation over a two-day period. The conference succeeded in identifying and agreeing on a list of considerations for successful CPOE implementation, as well as outlining a set of issues that fostered debate within the group and deserve further exploration.

#### References:

1. *2001 Menucha Conference*  
May 10 and 11, 2001  
Menucha Conference Center  
Portland, Oregon
2. Ash JS, Stavri PZ, Kuperman GJ. A consensus statement on considerations for a successful CPOE implementation. *J Am Med Inform Assoc* 2003;10(3):229-234. [PubMed](#) [Full-Text](#)

### Factors for a Successful CPOE Implementation

Fieldwork was conducted at four sites between 1998 and 2003: The University of Virginia, the Veterans Affairs Puget Sound Health Care System, El Camino Hospital in Mountain View, CA and Kaiser Permanente Northwest. Oral history interviews focused on past events and captured the dynamics of implementation issues over time. Focus groups were used either to take a snapshot picture of CPOE use, by house staff for example, or to review the history of CPOE implementation at the facility. Observation was done to verify interview data and gain the current view. Because we wanted to study multiple perspectives, we interviewed and shadowed not just physicians, but also nurses, pharmacists, information technology staff, administrators, and others. Subject selection involved identification of representatives of varying roles and perspectives, including skeptics. Analysis of the combined data from the 2001 Menucha Conference and fieldwork at four sites using CPOE ultimately generated 12 principles for successful CPOE implementation.

## References:

1. Sittig DF, Krall MA, Dykstra RH, Russell A, Chin HL. A Survey of Factors Affecting Clinician Acceptance of Clinical Decision Support. BMC Med Inform Decis Mak. 2006 Feb 1;6(1):6. [PubMed Full-Text](#)
2. Ash JS, Bates DW. Factors and forces affecting EHR system adoption: report of a 2004 ACMI discussion. J Am Med Inform Assoc. 2005 Jan-Feb;12(1):8-12. [PubMed Full-Text](#)
3. Stavri PZ, Ash JS. Does failure breed success: narrative analysis of stories about computerized provider order entry. Int J Med Inform. 2003 Dec;72(1-3):9-15. [PubMed Full-Text](#)
4. Ash JS, Stavri PZ, Dykstra R, Fournier L. Implementing computerized physician order entry: the importance of special people. Int J Med Inf 2003;69(2-3):235-50. [PubMed Full-Text](#)
5. Ash JS, Stavri PZ, Fournier L, Dykstra R. Principles for a successful computerized physician order entry implementation. AMIA Annu Symp Proc. 2003;;36-40. [PubMed Full-Text](#)

## Unintended Consequences of CPOE Implementation

Over the course of their studies POET had learned about various unintended adverse consequences of CPOE. This was a rather startling revelation at a time when CPOE was being touted as the "leap" that hospitals should take in the interest of patient safety. With funding from the U.S. National Library of Medicine, POET has been able to conduct an in-depth study over the past three years, utilizing both qualitative and quantitative methods to discover more about these unintended consequences (UCs) of CPOE. Data were gathered via two expert panel conferences, fieldwork at a total of six sites (one outpatient and five primarily inpatient), and a national telephone survey of all CPOE sites in the U.S. The aims were to identify types of UCs and strategies for preventing, managing or overcoming them, and to provide tools to help implementers address them.

## References:

1. *2006 Menucha Conference*  
May 4 and 5, 2006  
Menucha Conference Center  
Portland, Oregon
2. *2004 Menucha Conference*  
April 8 and 9, 2004  
Menucha Conference Center  
Portland, Oregon
3. Campbell EM, Sittig DF, Ash JS, Guappone KP, Dykstra RH. Types of unintended consequences related to computerized provider order entry. J Am Med Inform Assoc. 2006 Sep-Oct;13(5):547-56. [PubMed Full-Text](#)

4. Sittig DF, Ash JS, Zhang J, Osheroff JA, Shabot MM. Lessons from "Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system". *Pediatrics*. 2006 Aug;118(2):797-801. [PubMed Full-Text](#)
5. Aarts J, Ash J, Berg M. Extending the understanding of computerized physician order entry: Implications for professional collaboration, workflow and quality of care. *Int J Med Inform*. 2006 Jun 22; [PubMed Full-Text](#)
6. Ash JS, Sittig DF, Dykstra RH, Guappone K, Carpenter JD, Seshadri V. Categorizing the unintended sociotechnical consequences of computerized provider order entry. *Int J Med Inform*. 2006 Jun 20; [PubMed Full-Text](#)
7. Smith DH, Perrin N, Feldstein A, Yang X, Kuang D, Simon SR, Sittig DF, Platt R, Soumerai SB. The impact of prescribing safety alerts for elderly persons in an electronic medical record: an interrupted time series evaluation. *Arch Intern Med*. 2006 May 22;166(10):1098-104. [PubMed Full-Text](#)
8. Ash JS, Berg M, Coeira E. Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. *J Am Med Inform Assoc*. 2004 Mar-Apr;11(2):104-12. [PubMed Full-Text](#)
9. Dykstra R. Computerized physician order entry and communication: reciprocal impacts. *Proceedings / AMIA Annual Symposium*. 2002:230-4. [PubMed Full-Text](#)

## Recommendations

1. Considerations for a Successful CPOE Implementation
2. CPOE Issues Still Under Debate
3. Principles for a Successful CPOE Implementation
4. Types of Unintended Consequences of CPOE

### Considerations for a Successful CPOE Implementation

Funded by a research grant from the National Library of Medicine, the 2001 Menucha Consensus Conference succeeded in its goals of identifying and agreeing on a list of considerations for successful implementation, as well as outlining a set of issues that fostered debate within the group and deserve further exploration. A list of ten high level considerations (which includes 36 sub-considerations) was generated and is presented here for the benefit of those thinking about implementing CPOE.

#### The 2001 Menucha Conference Considerations

1. Motivation for Implementing POE
2. Foundations Needed Prior to Implementing POE
3. Costs
4. Integration/Workflow/Health Care Processes
5. Value to Users/Decision Support Systems
6. Vision/Leadership/People
7. Technical Considerations
8. Management of Program/Strategies/Processes from Concept to Implementation
9. Training/Support/Help at the Elbow
10. Learning/Evaluation/Improvement

#### *Consideration #1:*

##### **Motivation for Implementing Physician Order Entry (POE)**

Motivation: consider what is motivating you and others in your organization to think about implementing POE.

##### 1. Environment:

A. *Regulations:* Are you predicting that POE will be required for your organization at some time in the future? For example, in the state of California, hospitals and surgical clinics must have a plan for adopting technology to reduce medical errors by January 1, 2002 and have implemented POE by January 1, 2005.

B. *Labor shortages*: Will you have enough nursing and ancillary support personnel to staff clinical services? POE can save clinician time through streamlined processes.

C. *Other pressure*: Do you sense other environmental pressure? The Institute of Medicine report [To Err is Human](#), insurance company demand, the [Leapfrog Group \(leapfroggroup.org\)](#) representing healthcare purchasers, and consumer demand all represent other pressures.

2. Workflow issues:

A. *Administrative needs*: Are administrators pressing for POE implementation? Administrative needs may include response to the above environmental pressures plus billing, quality assurance, and accreditation needs.

B. *Clinical needs*: Are clinicians pressing for POE implementation? Clinician needs may include the desire to apply information technology to improve patient care.

C. *Efficiency needs*: Is there pressure to improve efficiency? These needs may include lowering costs and/or increasing revenue.

*Consideration #2:*

### **Foundations Needed Prior to Implementing POE**

There are several necessary but not sufficient conditions that must be in place before one should consider implementing POE. These are:

**1. Vision:** Is there an overall vision for the organization that would allow staff to embrace the concept of POE?

**2. Leadership:** Is there top-level leadership commitment that would provide unwavering support for POE? Institutions per se cannot really commit; ultimately, it is people who commit.

**3. Resources:** Does the organization have adequate resources?

A. *Infrastructure*: Is the technical network infrastructure appropriate?

B. *People*: Is the staff available and ready?

**4. Trust:** Does the clinical staff trust administrative staff?

**5. Learning organization:** Is there a mental model throughout the organization that values feedback, change, quality, and continuous learning?

**6. Sense of urgency:** Is there a compelling sense of urgency about implementing POE?

**7. Vendor Readiness:**

A. *Quality*: Are you satisfied with the quality of the product? Consider the quality and maturity of the product and service offered by the vendor. Are sites similar to yours using the product as you plan to use it?

B. *Stability*: Have you considered the long term stability of the vendor in making your selection?

C. *Relationship*: Can you put time and effort into forging a productive two-way relationship with the vendor? The vendor is your partner and helpmate in this endeavor.

D. *Innovation*: Is this vendor likely to have more useful products over time than other vendors? Consider the speed with which the vendor is improving its product.

E. *Flexibility*: How flexible is the vendor? Is the vendor able to integrate its systems with your existing suite of applications?

F. *Reliability*: How reliable is the vendor in meeting deadlines and delivering high-quality code?

**8. Maturity**: Can the organization be considered mature and stable?

### *Consideration #3:*

#### **Costs**

##### **1. Consider several economic aspects concerning the decision to implement POE:**

A. *Timing*: Can you take a long term view? Financial benefits may not be realized for a long time and expenses short term may be significant. In the long term, the purpose of POE is to help patients.

B. *Total cost of ownership*: Can you afford additional costs beyond those of hardware and software?

C. *Productivity*: Can you afford a temporary loss of productivity? Consider that there will be a loss of productivity during training so that staff can take time to become comfortable with the new system; patient loads may need to be reduced or staffing increased.

##### **2. Dollars and cents considerations:**

A. *Plan*: Do you have a good financial plan? Consider that by having a good financial plan, you will be ready to evaluate and address unexpected situations. The plan might take a broader view and look at other projects that may compete for money, time, and other resources.

B. *Dedicated funds*: Are there funds put aside for POE? Consider the level of adequate financial backing needed and assure that it remains dedicated to the project at hand.

### *Consideration #4:*

#### **Integration/Workflow/Health Care Processes**

##### **1. Time is of paramount importance to clinicians and there are several facets of it to be carefully considered:**

A. *Response time*: Is it good enough? Consider how fast the system's response time should be for it to be tolerable to clinicians.

B. *Ordering time*: Is it time neutral?

Weigh the tradeoffs so that the time spent entering an order is worth it or is at least time-neutral for the clinician. These tradeoffs might be easier access to information, ordering from multiple locations, and fewer calls about legibility.

C. *Communication time*: Will it be increased or decreased? Consider whether more (or less) total time will be spent gathering data and communicating using computerized POE rather than today's method.

## **2. Workflow issues also need careful consideration:**

A. *Process*: Has the impact of POE on the work process been considered? POE needs to be seen as part of one's job, it must be integrated into the individual's workflow and that of the order communication process necessary for the execution of orders, and used for all orders.

B. *Work will change*: Is it understood that work will change as a result of POE? POE may cause a redistribution of work and changes in the communication and decision-making process, so people's work will change. Users need to visualize this change.

C. *Strategy*: Is there an organization-wide change strategy? These workflow changes can be seen as a part of larger strategy of process change, an institutional strategy.

## **3. Integration must be planned carefully as well:**

A. *Scope*: Will all orders be done using POE? Consider the scope of POE to include the whole range of orders.

B. *Retrieval*: Is information retrieval easy? Retrieval of other information such as medical records and medical literature needs to be integrated seamlessly into the workflow.

C. *Embedding POE*: How well does POE fit with other systems? POE needs to be embedded into other systems like the electronic medical record.

## **4. Readiness for integrating POE into the clinical workflow must be considered:**

A. *Readiness*: Are the users ready for POE? Consider the level of physician readiness for POE and the communication and planning needed to increase readiness. At the same time, consider nursing readiness and staffing issues, plus the readiness of those who will receive orders generated by POE.

## **5. Other related considerations include:**

A. *Paper*: Have you decided how much paper can actually be eliminated in the process? Consider the role of paper and where in the ordering process its use might be tolerated.

B. *Other projects*: What are other high priority projects? Consider other projects with which POE will compete, both technology and other resource intensive projects.

C. *Fostering use of POE*: Is there a plan for promoting usage? Will the project be mandatory for all medical staff? Hybrid situations introduce frustrations and higher operating costs. Consider mechanisms you might be able to put in place to facilitate and incent physicians to use the system.

## Consideration #5:

### Value to Users/Decision Support Systems

#### 1. Consider the following high-level decisions related to providing value for clinicians:

- A. *Benefit*: How will clinicians benefit? The user must derive visible benefit in terms of improved workflow and a perception of doing a better job for the patient. The benefit of patient safety is a more intellectual and somewhat removed concept.
- B. *Results*: Have you implemented results review before POE? Experience with results reporting prepares users for POE.
- C. *Analyze needs*: Have you done a needs analysis? Analyze user needs carefully; do not just give people what they ask for.
- D. *Communication*: Have you considered the impact of POE on communication flow? Consider that POE decreases face-to-face communication.
- E. *Involvement*: Is there a plan for involving physicians? Physician involvement is needed from the start and throughout the process.

#### 2. Being able to provide decision support is an important benefit of computerized POE. The following issues need consideration:

- A. *Content determination and maintenance*: Is there a plan for ongoing decision making about decision support content? Consider putting a process in place to determine the kind of decision support that should be implemented and how to oversee and maintain it.
- B. *Efficiency*: Will decision support improve efficiency? Consider how to implement decision support in such a way that physician efficiency can be improved. Examples are the use of order sets and therapies based on diagnoses.
- C. *Alerts*: Will you provide alerts? There is value to POE even without alerts and reminders. Decision support can help the clinician to make faster and more confident decisions; offering constrained choices is a form of decision support. Alerts can become noise and aggravate users. Drug-drug interactions and drug allergies alerts are useful and fairly easy to obtain.
- D. *Readiness*: Are users ready for decision support linked to POE? Consider decision support when assessing readiness for POE.

#### 3. Other considerations concerning value to users:

- A. *Perception of efficiency*: What is in it for the individual physician? There needs to be a clinician perception that the software makes the physician more efficient.
- B. *Technology*: Is the proposed technology far enough advanced?
- C. *Benefit*: Are benefits for clinicians easy to see and describe? Demonstrable benefits are needed for continued sustained use.

D. *Education*: Is there a plan for educating as well as training users? Educate users about the limitations of POE as well as its capabilities.

E. *Patient care*: Are there clear benefits for patient care? Emphasize that POE is for the good of the patient, not the bill.

F. *Order sets*: Is there a plan to implement order sets? Order sets provide local control as well as perceived benefit.

G. *Intentions*: Is the system designed so that the clinician easily understands the status of an order? Make sure the system does what the user intended.

#### Consideration #6:

### Vision/Leadership/People

Effective leadership is needed at several levels in the organization: at the executive level to get funding, at the clinical level to get champions and buy-in, and at the project manager level to make practical, effective, and useful decisions. Both the leadership and software need to be flexible enough to be able to make modifications that address identified concerns and problem. The leaders may or may not be the same person. A shared vision needs to underscore work at all levels.

#### 1. Consider the existence of a shared vision:

A. *Shared vision*: Is there a shared vision regarding the purpose of POE to improve patient care and are there stated goals for fulfilling the purpose? Do physicians regularly play a role in strategic planning and IT decisions?

B. *Communication*: Are there physician leaders and champions who can effectively communicate the shared vision? Is there ability at all levels to communicate the vision and articulate tangible objectives?

C. *Current state*: Are there enough people who feel that the current state is intolerable and that change is needed?

#### 2. Considerations at the highest level in the organization:

A. *Commitment*: Is there real and visible financial and administrative commitment by leadership at the chief executive officer level?

B. *Persistence*: Does the leadership exhibit persistence in striving toward ultimate project goals?

C. *Trust*: Is there a sense of trust, credibility, and communication between the administration, implementation team, and clinician users?

D. *Strength*: Is the leader someone who can make a decision on his or her own if strategies for reaching consensus fail?

E. *Function*: Can the leader differentiate between POE functionalities that clinicians want and those that they need for patient care?

F. *Urgency*: Does the leader sense a level of urgency, from either external or internal motivators, about implementing POE such that it is a top priority?

G. *Style*: Does top leadership understand its own leadership style? Leadership does not need to be charismatic: different leadership styles can be equally effective.

H. *Value clinicians*: Does leadership have faith in, value, and depend on individual clinicians in the organization to make implementation succeed?

### **3. Considerations at the clinical leadership level:**

A. *Ability*: How well do leadership skills fit different phases of implementation? The clinical information technology leadership must have the ability to use the management style appropriate for needs at different stages of the project.

B. *Pre-implementation*: develop a vision, get funding, identify individuals who will be key for the implementation, elicit involvement from these key people, and exhibit other strategic and tactical planning skills.

C. *Implementation*: hire staff, deploy staff where and when most needed, keep up the spirit of the staff doing the work, and use other communication, publicity, and personnel management skills.

D. *Post-implementation*: establish the maintenance phase, create an environment for ongoing system improvement, and provide management systems for the long term.

E. *Attributes*: How well do leadership attributes fit the task? This leader must have clinical credibility (be respected by physician peers), be persistent, consistent, accountable, and thick-skinned.

F. *Realism*: How realistic a view does the leader have? This leader must maintain an organizational anticipation and excitement for the project without overselling it and creating unrealistic expectations.

G. *Educator*: Can the leader educate administrators? The leader must be good at educating executives and keeping them up to speed.

H. *Feedback*: Will leaders listen to constructive feedback? The decision makers need to come to user feedback sessions. They need to actively solicit negative as well as positive feedback and respond to it in a timely, demonstrable fashion. Identified problems must be addressed expeditiously.

I. *Golden rule*: Does leadership follow the golden rule? This person should remember the golden rule when dealing with people: do unto others as the leader would have done to himself or herself.

J. *Teamwork*: Does the leader foster teamwork? The person should be able to form a great team, foster clinician involvement, and be viewed as an advocate by clinicians.

### **4. Clinician or physician level champions and project leaders:**

A. *Clinical skills*: Are they clinically trained? At least one leader at this level needs to be a clinical person, but not necessarily a physician. This should be a paid person with visibility who is at least partially excused from competing clinical duties.

B. *Involvement*: How heavily involved in implementation should the clinical champions be? The clinician leader(s) may not be at the top of the project leadership hierarchy, but a clinician must be involved at a visible and influential level.

C. *Technical knowledge*: What is the leader's level of technical knowledge? At least one of the clinical project leaders must have enough technical knowledge to be able to challenge technical staff and vendors.

D. *Sympathy*: Is the leader sympathetic? Leaders need to be charismatic and clinically credible but not necessarily technically trained. It is most important that these individuals be seen as understanding of and sympathetic to the needs of clinicians.

E. *Opinion leaders*: Are there other opinion leaders identified? The effective clinician leader will enlist the assistance of both senior credible champions and people perceived to be technical opinion leaders.

F. *Role*: Is there one identifiable top leader in this group? There must be only one clinical project leader; the roles and duties of the clinician leader must be clearly delineated.

#### *Consideration #7:*

#### **Technical Considerations**

##### **1. Strategic level considerations:**

A. *Security*: Is there a security plan? Data backup and disaster recovery are significant considerations for mid-level managers and higher. While downtime may be necessary for data backup, it should be minimal to cause the least disruption to clinical workflow.

B. *Customization*: How customizable is the system? Consideration needs to be given to the amount and level of customization allowed by a particular POE system. It should be customizable by an analyst to accommodate variations in workflow and procedures from department to department, unit to unit, and shift to shift.

C. *Replacement*: What are special considerations for replacing older systems? There are special considerations for replacing present POE systems: even sophisticated users may have difficulty adjusting to a new system that may not meet workflow needs as well as the older already customized system.

D. *Data*: Is there assurance of high level data quality? Accurate and reliable data must be maintained at the highest possible level to ensure clinician acceptance.

E. *Connections*: Can the POE system interface with existing and planned systems? Interfacing capability among systems from different vendors is important. Interface engines or hubs and HL7 protocols need consideration.

F. *Access*: Has a risk analysis been done? Security of access and confidentiality issues must be seriously considered, especially with impending enforcement of HIPAA regulations. A risk analysis should be done. Advantages and disadvantages of a single sign-on need consideration.

G. *Remote access*: Is there a need for access from remote locations such as home, nursing home, etc.? If this is needed, does the vendor support this capability?

H. *Infrastructure*: Is the network infrastructure stable?

## **2. User considerations:**

A. *Escapes*: Are there escape routes for frustrated users? Consider establishing escape mechanisms for nonstandard, unusual, and complex orders. An example is allowing a section in the interface for plain free-text typing.

B. *Interface*: How easy to use is the interface? There needs to be a consistent user interface which is intuitive, easy to navigate, and efficient. This should include a logical flow from one screen to the next.

C. *Time*: How time consuming is the system from the user point of view? A new POE system will likely tax a clinician's time or be time neutral and, at the least, it needs to be secure, fast, and reliable.

D. *Clerical tasks*: Will users view it as clerical work? Consideration should be given to how the rationale for a new system is communicated so that clinicians do not perceive it as clerical work.

## **3. Flexibility in task completion:**

A. *Style*: Can the system fit different work styles? Because individual work styles differ, consider allowing multiple ways to do the same thing. For example, keyboard equivalents for mouse actions help accommodate differing work styles.

B. *Customization*: Can users customize some things themselves? In addition to allowing systems analysts to modify the system, there should be options for users to customize screens as well.

C. *Decision support*: Has the addition of decision support been carefully considered? Carefully consider decision support to avoid overloading the clinician with messages. One approach to this is to allow tuning of a drug interaction alert to account for the severity of the interaction.

### *Consideration #8:*

## **Management of Project or Program/Strategies/Processes from Concept to Implementation**

### **1. Highest level considerations:**

A. *Impact*: Have you carefully considered the impact on workflow? Too narrow a concept of implementation can derail the project. Realize that re-engineering the order entry process will impact other clinical and ancillary processes.

B. *Strategy*: Is there an overall strategy for improving care? POE needs to be part of a larger strategy to improve patient care.

C. *Management*: Are people issues carefully considered? Sound project management during implementation and ongoing program management post-implementation must be planned with people issues in mind.

D. *Scope*: Is there a defined scope to the project? An emphasis of sound project management is management of the scope of the project.

E. *Treatment of others*: Do you adhere to the golden rule? Remember the golden rule: do unto others as you would have them do unto you.

F. *Detail*: Are plans detailed enough but not overly so? Perfection is the enemy of the good; do not allow exaggerated attention to details to jeopardize the overall implementation goal. Keep it simple; strive for excellence, not perfection.

G. *Goals*: Are there clear and measurable goals?

H. *Communication*: Is there a plan for constant communication with users and implementation staff?

I. *Expectations*: Are expectations reasonable and achievable and do they also maintain excitement for the project?

J. *Relationships*: Have you anticipated significant changes in clinical relationships and planned accordingly?

K. *Ambition*: Have you carefully considered how ambitious your goals can realistically be? Without disciplined project management, outside influences may force a project implementation pace that is too ambitious.

L. *Consensus*: Can you balance consensus with directive leadership? Too much emphasis on consensus will slow project implementation; too directive an approach can decrease user involvement.

M. *Downtime*: Have the implications of downtime been considered and procedures been established?

## **2. Mid-level considerations:**

A. *Consultant expertise*: How will consultants be used? Weigh the need for internal expertise vs. consultants; avoid becoming too dependent on outside consultants by developing internal expertise.

B. *Critical mass*: Will you be ready for the important moment? Recognize that a critical window of opportunity will arrive where a critical mass of users is using the system. It is vital that the implementation team capitalize on this important moment.

C. *Long term view*: Can leaders adopt a long term view? The administration and information technology team need to take a long term view of POE implementation.

D. *Early objectives*: Have you identified early wins? Categorize implementation objectives as easy, hard, or hardest to implement; start where early success is expected. Consider gaining an early victory by making results reporting available early.

E. *Vendor*: How carefully have you chosen a vendor? Choose an experienced vendor with care. Realize that the implementation's success may depend on cooperation, if not synergy, with the vendor. Expect and depend on a long term relationship with the people in the vendor organization.

F. *Clinicians*: Is there a plan for involving clinicians? Allow interested (and encourage uninterested) clinicians from all specialties to participate in product selection and local customization efforts. Turn ardent opponents into ardent supporters; convince the skeptics and curmudgeons.

G. *Users*: Have you considered all clinical users? Carefully consider that the P in POE can stand for professional, physician, provider, or practitioner. Realize that the POE function will have impacts on organizational workflow beyond order entry alone and that other functions such as results reporting will also be impacted.

### **3. Lower level considerations:**

A. *Workarounds*: Are workarounds available? Provide simple workarounds for occasional users such as a text entry option, but provide some mechanism by which all users may improve their skills so that dependency on the workaround does not develop.

B. *People*: Are variations in people's ways of doing things being considered? People engineering needs to be concurrent with software engineering: realize that workflow redesign and attitude maintenance may be required with POE implementation.

C. *Metrics*: How good are your metrics? To do good project management, you must have specific metrics; it is vital to know what is working and what elements must be improved. Have before as well as after metrics.

### **4. Roles:**

A. *Accountability*: Who is accountable for what? Assign and expect personal accountability for all project tasks.

B. *Clinician*: Is there clinical involvement at the leadership level? There must be a clinician representation within the project leadership. Recognize that providers play a pivotal role in the implementation's ultimate success.

C. *Champions*: Have champions been identified? Clinician champions have to be identified early and supported and relieved of some other duties.

D. *Leader*: Is there an identified clinical leader? There is need for a strong leader with a foot in both the clinical and technical camps, possibly someone with medical informatics training.

### **5. Localization:**

A. *Modification*: Can you modify the system on site? You need to be able to do some modification at the institutional level.

B. *Customization*: Can users customize some things themselves? For a fast win, allow more individual customization.

C. *Balance*: Have you considered the balance between customization and standardization? Consider how local modifications affect vendor upgrade paths. Too many local modifications may make it difficult to implement the vendor upgrade, as the upgrade may not support the modifications. Even if it does support the modifications, each modification will slow down the ability to upgrade.

#### *Consideration #9:*

#### **Training/Support/Help at the Elbow**

Considerations for training and support include the concept of help at the elbow. This means ongoing, readily available help.

## **1. Support:**

A. *Help:* Is there a plan to provide help at the elbow? Provide help at the elbow: skilled support staff available all the time during implementation and much of the time post-implementation; err on the side of too much user support.

B. *Training:* Is there a training plan for support staff? Train as support staff high quality, patient, thick-skinned support people who have good people and communication skills and can teach others to use the application.

C. *Translators:* Can support staff act as translators? Support staff should be able to translate between the clinical and technical realms.

D. *Online help:* Are there provisions for online help? Also provide different mechanisms for help such as online help in addition to on site help.

E. *Help Desk:* Does the Help Desk operate 24 x 7? Is it staffed by experienced technical support personnel? Are the processes and tools mature?

## **2. Training methods:**

A. *Training:* Will users train users? During implementation, consider using successful users to train the next set of users.

B. *Tools:* Will multiple training methods be used? Provide multiple learning tools and methods, including computer based training.

C. *Plan:* Is there an initial plan? Plan to provide sufficient initial training, erring on the side of too much training.

D. *Updates:* Will there be updates? Consider providing ongoing updates that also go back and reiterate prior information.

E. *Monitoring:* Is there provision for monitoring proficiency? Consider monitoring proficiency and having continuous retraining to make sure that physicians are using systems effectively.

## *Consideration #10*

### **Learning/Evaluation/Improvement**

POE implementation is an ongoing effort that benefits from continuous improvement. It is important that mechanisms for feedback and modification of the system be in place.

## **1. Higher level considerations:**

A. *Problems:* How will problems be addressed? Consider carefully planning a process for problem identification and problem resolution involving the users.

B. *Feedback:* What is the formal evaluation plan? As formal evaluation takes place, feed results of the evaluation back to the users so that they can gauge responsiveness.

C. *Testing:* How will you test the system? Think about how you test whether it is good enough to go.

D. *Continuous improvement*: How will you continuously improve the system? Understand that you are never done: continuous improvement is needed.

E. *Learning*: How will your organization learn? Be a learning organization: learn from evaluations.

F. *Revisiting*: Is there a plan to revisit decisions? Revisit strategic decisions on a regular basis.

G. *Continued Training*: Is there provision for regular training sessions (e.g., brown bag lunches)?

## **2. Strategies:**

A. *Response*: Is there a process for responding to problems? Provide a quick response to system flaws.

B. *Escapes*: Is there an escape mechanism? Provide an escape mechanisms such as free text entry: it can be a great source of feedback, allowing you to see how to improve the system.

C. *Test*: How will the system be tested? Have moonlighting house staff test the system. Have adequate integrated testing.

D. *Pilot*: How will pilots be conducted? Pilot software in small groups and improve it if necessary before rollout.

E. *Mentoring*: Is there a mentoring system? Set in place a buddy or mentoring system so that clinicians can share their expertise in developing order sets and templates and exchange tips.

## Summary of CPOE Issues Still Under Debate

### **1. Is decision support a crucial part of POE?**

Although decision support is considered one of the most positive contributions of POE, too many alerts can aggravate providers and provide "noise." How many alerts are appropriate to have a positive effect on behavior? How many alerts will users tolerate before beginning to ignore them? How important is it to link decision support to evidence from the literature?

### **2. How specific should goals be?**

Good project management calls for specific metrics, but flexibility might be hampered by control that is too tight. Goals should be actionable but results do not need to reach scientific "significance."

### **3. Should you make it mandatory?**

Although requiring usage can guarantee success by certain measures, mandates can often be subverted, even in teaching hospitals where compliance is technically mandatory.

### **4. Are escape mechanisms for avoiding CPOE necessary?**

Even though allowing free text entry of orders and other workarounds makes providers happy, in some ways, it defeats the purpose of structured order entry systems. Consider the situation.

### **5. Do you give the clinicians what they say they want, or what you think they need?**

If you merely ask them what they want, you may either limit the vision of what is possible or, on the other hand, you may create unrealistic expectations. Filter what you are told by considering the practicalities of technical implementation and cost.

### **6. What happens when legacy systems need to be replaced?**

Often the new system will be an improvement in many respects but will lack some of the functionality of the old already somewhat customized old system.

### **7. Can you implement CPOE in isolation or does it need to be part of some other system?**

Although CPOE is integrally related to results reporting and documentation, there is debate about the order in which these systems should be implemented.

### **8. What are the easy wins for a new installation?**

Although medication ordering seems to have the greatest payoff in terms of error reduction, it is more difficult to implement than laboratory, radiology, consult ordering and results reporting.

### **9. What part of CPOE should be under local modification and control?**

The vendor supplies standard software so that it can be easily updated, but local ways of doing things may necessitate modification. It is also crucial to decide how much local modification will be allowed.

## **Principles for a Successful CPOE Implementation**

Fieldwork was conducted at four sites using CPOE between 1998 and 2003. Oral history interviews focused on past events and captured the dynamics of implementation issues over time. Focus groups were used either to take a snapshot picture of CPOE use, by house staff for example, or to review the history of CPOE implementation at the facility. Observation was done to verify interview data and gain the current view. Analysis of the combined data from the 2001 Menucha Conference and fieldwork at four sites using CPOE ultimately generated 12 principles for successful CPOE implementation.

### **Computer Technology Principles**

#### **1. Time Concerns**

From the user's viewpoint, the most important CPOE consideration is that it shouldn't take any extra time to use.

#### **2. Technology / Meeting Information Needs**

There are several technical details to consider as part of a CPOE implementation. These include strategic considerations, user considerations, and task completion flexibility as well as the quality of the application, from customizability to user friendliness.

### **3. Integration of Multiple Systems**

From a technology viewpoint, integration of different systems was desired by users for ease of use and timesavings. They wanted seamless access to different systems through CPOE and they wanted CPOE to be integrated into their workflow so that it did not disrupt their work.

### **4. Understanding the Financial Costs**

Financial considerations cannot be underestimated: they include not only the cost of hardware and software, but all the costs associated with system implementation. In addition, they must include training and support costs, ongoing maintenance expenses, as well as any hidden costs related to decreased productivity in each unit as CPOE is initially rolled out.

## Personal Principles

### **5. Value to Users and Tradeoffs**

While there are benefits to using CPOE, there are also liabilities. The downsides always involve the time it takes compared to the old way of doing things and the perceived or actual rigidity of the new systems. The upsides usually involve remote entry of orders, legibility and groupings of orders that are often entered together. Useful aspects of the system often include decision support as well.

### **6. Essential People**

There are two large categories of people who are essential to the successful implementation of CPOE. The first group is the leaders. These include both administrative leaders and clinical leaders. Administrative leaders need to be at the highest levels of the organization, at the chief executive officer or presidential level. Clinical leaders include the chief medical officer and, in academic centers, the department chairs. The Chief Medical Information Officer, an informatician, is a key player who can make or break a system implementation. Opinion leaders, who are respected clinical experts, and champions, who are enthusiastic about the system itself, are also critical.

The second essential group, are the talented people who speak the languages of both medicine and technology. These are the staff members who can train, support, and make changes in the system.

### **7. Training and Support**

Help "at the elbow" at the time of implementation is a very important part of implementation. In addition to the symbolic importance of supporting the users by being present while they are first using the application, intensive support at "go-live" allows the implementation team to directly experience what is and is not working well. Most successful implementations have had more post-go-live support than pre-go-live training. Most sites have had 24/7 support for several weeks after go-live.

## Organizational Principles

### **8. Strong Organizational Foundation**

A successful implementation depends on the existence of a firm foundation in organizational terms. Much of this foundation involves aspects of organizational culture that cannot be quickly changed once a decision is made to implement CPOE. If the right organizational culture is not in place, CPOE should not be considered. Top-level commitment from administration, both moral support and financial, is

mandatory, as is a high level of trust between administration and clinicians. There must be a realistic vision about CPOE and a readiness on everyone's part to implement it. Leadership must be open to feedback. Both the organization and the vendor need a high degree of stability.

## **9. Collaborative Project Management**

A theme that emerged from the field data was "collaboration and trust." This is because one of the most important aspects of project management related to CPOE is teamwork and being able to pull different groups of people together. The groups include multidisciplinary teams of clinicians, leaders, and technology staff. An important component of the project management process, in addition to managing resources and timelines, is assuring that team members treat one another with respect.

## **10. Good Communication / Careful Use of Language**

The appropriate uses of language and communication are critical to CPOE implementation success. Collaboration can be improved or undermined, depending on how carefully individuals choose their words. Because multiple clinical disciplines and information technology and administrative groups are involved in CPOE, a common vocabulary with common understanding is needed.

## **11. Improvement Through Evaluation and Learning**

CPOE implementation is an ongoing effort that benefits from continuous improvement. It is important that mechanisms for feedback and modification of the system be in place. The organization should be able to learn from the CPOE implementation project. Environmental Principles

### [Environmental Principles](#)

## **12. Understanding Motivations and Context**

It is important to consider the motivation for implementing CPOE because often pressure from outside the hospital or a desire for increased efficiency will motivate administration to want it, but clinicians may remain unmotivated. If, on the other hand, clinicians are highly motivated because they would like decision support capabilities readily available through CPOE, the likelihood of success is greater.

Context involves attributes of the institution such as geography, the era during which the system is installed, the kind of unit where it is being implemented, and the types of individuals involved. For example, a Silicon Valley hospital might want to be perceived as being on the cutting edge of technology, the era of managed care may pit administrators against physicians, and emergency room personnel may feel CPOE is inappropriate in acute situations. Motivation and context must be analyzed prior to discussions of implementation so that barriers can be assessed.

### [Types of Unintended Consequences of CPOE](#)

Over the past three years, POET has been conducting an in-depth study of the unintended adverse consequences of CPOE. Data were gathered via two expert panel conferences, fieldwork at a total of six sites (one outpatient and five primarily inpatient), and a national telephone survey of all CPOE sites in the U.S. One of the goals for this study was to better classify the various types of unintended consequences of CPOE implementation.

## **1. More/New Work for Clinicians**

CPOE systems can significantly increase clinician workload. This can happen, for instance, by requiring that clinicians enter more information than was previously necessary or having them respond to an excessive number of alerts that may or may not contain useful information. Although improved system design may limit the amount of added work, the lesson here is that more work for the clinician is inevitable, and must be addressed in the planning process. Successful implementations balance required new work with system-based improvements in old work processes (e.g., providing integrated real time results reporting) to make use of the systems by clinicians tolerable.

## **2. Workflow Issues**

Clinical information systems (CIS) in general, and some CPOE systems in particular, can dramatically highlight mismatches between intended and actual work processes in real-world clinical settings. CPOE designers and implementers must consider the appropriate range of workflow perspectives (e.g., those of the nursing staff, clerical staff and pharmacists, as well as of physicians) for the resulting technological system to accommodate comprehensive, fully integrated clinical workflows. But the fact remains, no CPOE system fits all workflows of a given hospital perfectly. Even if a system initially did so, it would not eliminate the need for constant system adaptation to changing workflows in the future.

## **3. Never Ending System Demands**

As CPOE systems evolve (i.e., are reconfigured, enhanced, or replaced) users must be retrained and quality assurance measures must be reassessed. With each change, implementers should expect unintended consequences. Planning must allocate adequate resources for ongoing improvements.

## **4. Problems Related to Paper Persistence**

Many CPOE vendors advertise products as helping an organization to "go paperless." But a key distinction must be made. Paper-based clinical record storage will become obsolete, but use of paper in the clinical setting will not. Paper remains the most malleable, flexible, and easily transportable data medium available, and clinicians often rely on it as a necessary, sometimes superior, cognitive memory aid during patient care. Organizations are understandably hard pressed to limit paper use. The key issue is to decrease or eliminate the dependency on ineffective, paper-based processes that form barriers to optimal health care delivery (such as illegible written orders).

## **5. Changes in Communication Patterns and Practices**

CPOE implementation changes clinical communication patterns. Some describe CPOE as providing an "illusion of communication" because it promotes the belief that entry of an order into the system ensures that the proper people will see it and act upon it. Doctors, nurses and other providers consistently report that clinical systems like CPOE can cause unsatisfactory reductions in face-to-face communication regarding patient care, which in turn may increase the likelihood of errors being made. Improvements in system interface design must pay special attention to the communication needs of health care providers. In addition, a comprehensive communication plan that reaches all levels of the organization must be part of any CPOE project management plan.

## **6. Negative Emotions**

Emotional responses to change are inevitable. Shifting from paper-based order generation to CPOE is bound to evoke strong emotional responses as users struggle to adapt to the new technology. These responses can point out significant problems with the system design, and can lead to solutions. Training and open communication can help to promote better understanding, which may reduce the negative emotional responses to CPOE.

## **7. Generation of New Kinds of Errors**

CPOE systems prevent some types of errors while creating or propagating new ones. New CPOE-related errors result from: problematic electronic data presentations; confusing order option presentations and selection methods; inappropriate text entries; misunderstandings related to test, training, and production versions of the system; and workflow process mismatches. Recognizing current unintended consequences should encourage system designers to optimize human computer interface design, and to exert caution when implementing new alerts.

## **8. Unexpected and Unintended Changes in Institutional Power Structure**

As CPOE systems enforce specific clinical practice patterns, while also monitoring clinicians' behaviors, they may induce changes in the power structure and culture of an organization. Because CPOE-related power changes affect organizational and personal autonomy, they often cause significant unintended adverse consequences for end-users. Most often it is the physician who loses power: this must be recognized and dealt with explicitly during the CPOE planning process.

## **9. Overdependence on Technology**

Health care is increasingly dependent on technology, and this is unlikely to change. The more widely and deeply diffused the technology, the more difficult it becomes to work without it. But dependence on technology must never become so great that basic medical care cannot be provided in its absence. Prolonged CPOE system failures (lasting hours) have the potential to dramatically halt the flow of clinical information to such an extent that outpatient activities may be curtailed or canceled and emergency rooms at trauma centers may divert admissions until vital systems are restored. Planning for management of unexpected downtime is critical.

Furthermore, users of CPOE should maintain a healthy skepticism about the information provided by such systems (e.g., not blindly trusting all information in the system without considering that it might be incorrect, or without seeking verification).

## CPOE Tools

Implementing CPOE? Worried about whether you are making progress, or experiencing unintended adverse consequences that you don't know about? Then read POET's "Consensus Recommendations for Basic Monitoring and Evaluation." POET has drafted sample measures for four main categories of metrics: availability and use, utilization and efficiency, quality, and hazard, or unintended consequence indicators. By regularly monitoring key measures, this tool will help you optimize your CPOE implementation. Remember, you get what you measure!

### POET Treemaps

Learn how POET's "Considerations for Successful CPOE Implementation" may help you avoid unintended adverse consequences (UACs). POET has analyzed a wide range of unintended consequences and categorized them according to the considerations that might help avoid each one. This tool will help you plan for CPOE implementation by giving you questions to consider, and by explaining what might go wrong if you fail to consider them fully. The treemaps help visualize which considerations are most important. For instance, those considerations that address the most UACs will be represented by larger boxes and darker colors.



### CDS Bibliography

Electronic database searches were conducted in September 2005 for dates 1993 through 2005 including Ovid MEDLINE, CINAHL, BIOSIS, and all EBM reviews (which includes the Cochrane Database of Systematic Reviews, the American College of Physicians [ACP] Journal Club, the Database of Abstracts of Reviews, and Effects and the Cochrane Central Registry of Controlled Trials). This search was not limited to peer-reviewed journals and did not reject letters or editorials, a priori, since many such responses contain insight. Bibliographies of documents in the search sets were reviewed for possible additions. In addition, Web-of-Science (Thomson) was searched for references to some included articles.



### ***California Healthcare Foundation***

CHF is sponsoring The Quality Initiative, which includes a CPOE fact sheet

[California Healthcare Foundation site \(www.chcf.org\)](http://www.chcf.org)

### ***The American Hospital Association***

AHA released a 50 page report on CPOE as part of their Quality and Patient Safety Key Initiative.

The complete report may be ordered from the AHA.

[American Hospital Association site \(www.aha.org\)](http://www.aha.org)

### ***The Informatics Review***

This is an on-line serial devoted to helping clinicians and information systems professionals keep up with the latest developments in the rapidly changing field of Clinical Informatics.

[Visit the Informatics Review wiki \(www.clinfowiki.org\)](http://www.clinfowiki.org)

## **The SAFER Guides**

The POET group of researchers was instrumental in developing the SAFER (Safety Assurance Factors for EHR Resilience) guides for EHR safety, published by the Office of the National Coordinator for HIT in January of 2014. This series of self-assessment guides was developed to assist health care organizations, health care professionals, and others to evaluate certain high-risk components of their EHR-enabled clinical work systems. To help improve patient safety, these guides focus on eight specific risk areas: computerized provider order entry (CPOE) with clinical decision support (CDS); clinician communication; patient identification; contingency planning; organizational responsibilities; system configuration; test result reporting and follow-up; and system interfaces. In addition, a guide to the highest priority issues throughout the guides was also developed for use as a starting point for guide users. The overall purpose of the SAFER guides' development effort was to produce proactive self-assessment guides that will help ensure the safe implementation and use of electronic health record (EHR) systems and avoid harm to patients.

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