IS CPOE SAFE FOR PATIENTS?

An early experience.

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Abstract

In a 1999 report from the Committee on Quality Healthcare in America, *"To Err is Human"* [1], indicated that health *care* in the United States needed to improve safety measures. Medications errors alone contributed to 7,000 deaths annually. With that as a backdrop, Mayo Clinic Jacksonville in 2005 embarked on a major strategic initiative to automate St. Luke's Hospital by replacing the paper chart with an electronic chart.

Introduction

This paper examines the challenges and methodologies used to incorporate and measure patient safety as part of a major automation implementation. This project redesigned inpatient care processes that affected physicians, nurses, pharmacists and any personnel who interacted with the paper chart.

The goals included a replacement of the St Luke's Hospital paper record, incorporating patient safety, transformation of information into knowledge, and promoting the development of rules and alerts to enhance the care and safety of patients. The Paperless Project was divided into to three areas of concentration: Computer Provider Order Entry (CPOE), Documentation, and Medical Records.

This paper provides details regarding project structure and overall planning. Additionally, it includes an overview of project governance that incorporated an emphasis on patient safety, including members from other committees that oversee medication rules and alerts. In order to determine and quantify patient safety metrics, the paper reviews results of pre- and post-implementation data regarding medication errors. Finally, the paper concludes with lessons learned (e.g. training, communications, methodology) and future plans for enhancements of the Electronic Medical Record (EMR).

Project Goals

The goals included a replacement of the St Luke's Hospital paper record, incorporating patient safety, transformation of information into knowledge, and promoting the development of rules and alerts to enhance the care and safety of patients. The Paperless Project was divided into to three teams with specific areas of concentration.

- Computer Provider Order Entry (CPOE)
- Documentation
- Medical Records

Project Goals/Teams

Each team utilized a Standard Implementation Methodology (SIM) that incorporated a collection of principles, tools and techniques for designing and implementing projects**.** The first SIM phase is Operational and Strategic Planning where the project scope (objectives, expected benefit, deliverables, and exclusions), project plan, and timeline are established. Current State Evaluation and Future State Design comprise the second phase. The third SIM phase includes a Design and Build component, which covers the actual design and build, as well as, the more detailed planning to support conversion. This phase also includes testing methodologies. During the Implementation phase, management and review processes must be in place to monitor project progress. Lastly, a Post-Implementation phase includes validation of the established project goals and metrics.

Teams

Each team included representation from Information Technology (IT), end-user coordinator, and vendor representation. The three teams reported to an established hospital automation committee with approved project scopes.

CPOE – To enable the direct entry of orders by providers to enhance the clinical care of patients. To improve safety of the ordering process by eliminating legibility concerns, providing drug-drug interactions checking and drug-allergy checking along with the development of clinical rules and alerts.

Documentation – To provide technology based solutions that enable the transformation of information into knowledge to improve clinical and business decision-making by getting the right information to the right person and the right time and place.

Records Requirements – Provide functionality within the EMR to meet all of the regulatory requirements for Medical Record documentation, authentication, access, deficiency tracking and release of information.

Governance

Physician led project governance was established with emphasis on patient safety, incorporating members from other committees that oversee automation, patient safety, and pharmaceuticals and therapeutics. (See **Chart A**)

Other members included representatives from Administration, Hospital Practice Committee (HPC), Software vendor, Applied Informatics, Information Technology, Systems and Procedures, Medical Records, and Nursing. Ad Hoc members included representatives from Radiology, Laboratory, Infection control, Clinical Practice, Surgery, and Anesthesia.

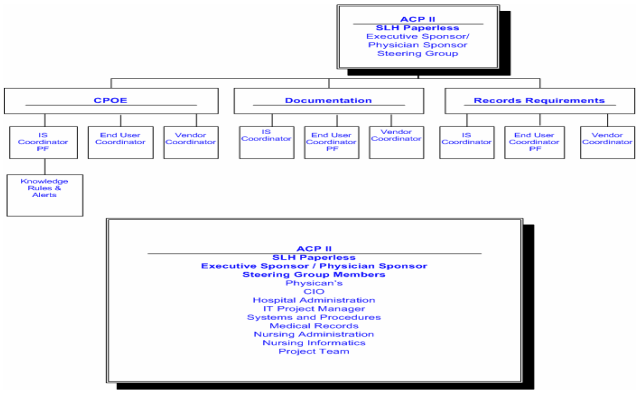


Chart A

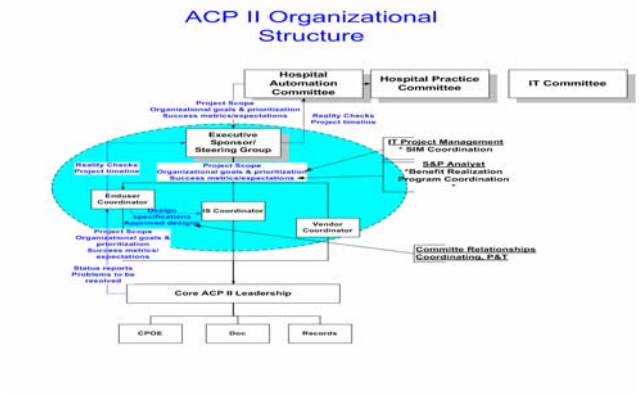


Chart B

The Hospital Automation Committee having direct project oversight reports directly to HPC (HPC provides institutional management for the hospital practice) and up to the Clinical Practice Committee (CPC provides institutional management for the entire organization). The project team also has permanent relationships with Coordinating, Patient Safety, Pharmacy & Therapeutics committees. (See **Chart B**)

Coordinating Committee provides coordination of all chart forms, powernotes, chart structure, etc. Patient Safety Committee includes suggestions on implementation of patient safety rules into CPOE. Periodic scheduled reviews with Pharmacy & Therapeutics provides suggestions on the incorporation and implementation of all alerts and drug interaction rules in CPOE.

Other factors to consider for a safe and successful project include a commitment at top level, adequate finances, technical infrastructure, and project management experience. In addition, organizational structure for productive feedback and timely communication must be addressed. Last but not least, stability and quality of vendor product must be considered. The manner in which CPOE alters and integrates into existing environments and workflows is critical to its success and safety. Users resent disruption of their patient care activities.

Constituencies affected by CPOE implementation (e.g. physicians, nurses, ancillary personnel) must understand the CPOE implementation value proposition. They must understand doing things differently will lead to some benefit in return. Certain benefits may be global and may not be a direct benefit to the individual.

Technology plays a key role in a safe and successful automation project. Considerations include:

- Speed of application and supporting infrastructure
- Adequate number of workstations
- Wireless network options
- Application access out of hospital
- Customizable and easily changeable
- User interface and navigation
- Integration with existing systems for Laboratory, Pharmacy, and Radiology

Project Timeline

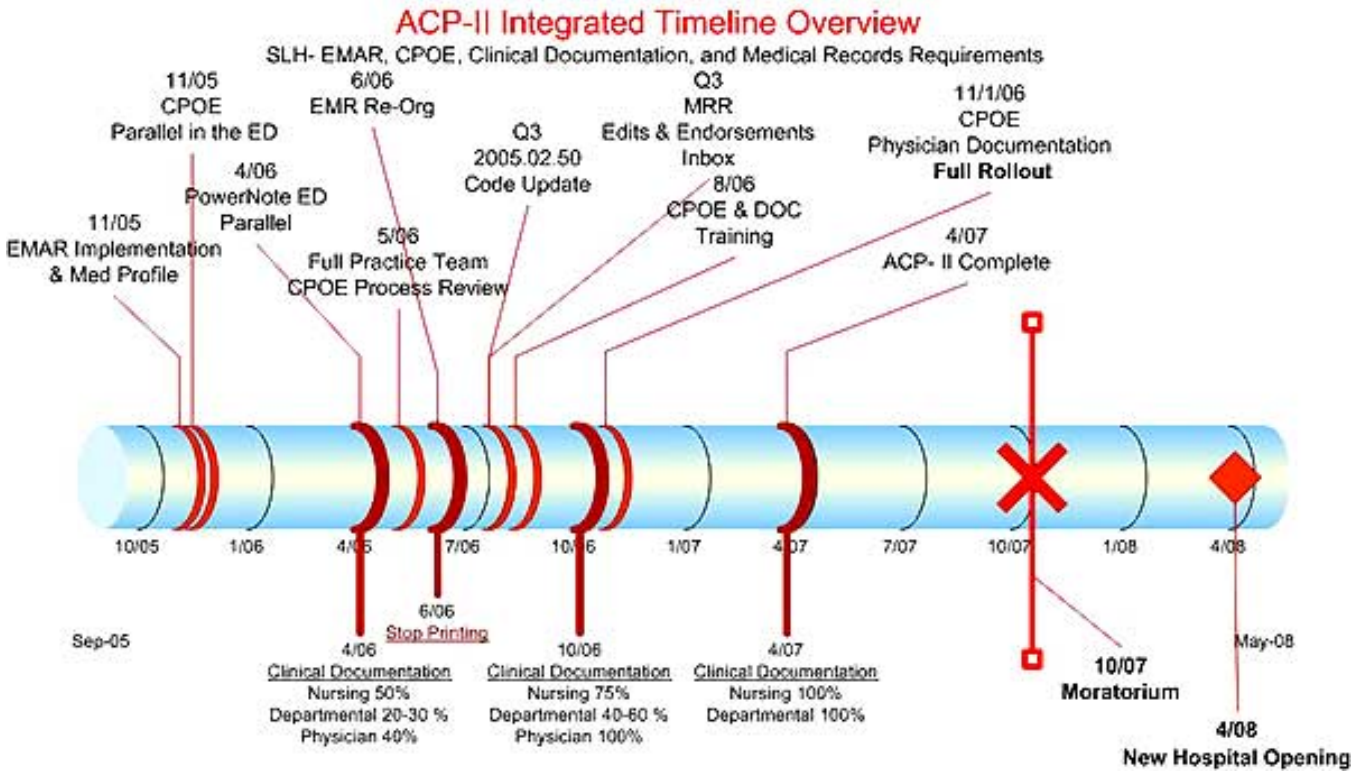
The time to implement a project of this nature varies. It is not the typical 6-month or 1-year project.
(See ACP-II Integrated Timeline Overview)

In fact, according to a recent Leapfrog Group survey of 1,285 hospitals, only 10% have fully implemented CPOE (another 4% plan to implement it by 2008), representing slow progress since Leapfrog began tracking implementation in 2002, when the figure was 2.5% [2].

Training Methods

Mayo Clinic Jacksonville has 316 Staff physicians and scientist, 182 residents, fellows, medical students, and 4,663 support staff (clinic and hospital) for a total of 5,161 employees. St. Luke's Hospital has 313 beds with 17,077 annual admissions, 6,351 annual surgical cases, and 33,290 annual ED visits, and 489 non-Mayo providers. The CPOE training plan considerations included determining who needed training, who will do the training, how and where will training be accomplished.

Practitioners were approved for 2 hours of training each. Nursing and Ancillary Staff who required full training



received 4 hours of training and ancillary staff who needed view-only training received 1 hour of training.

Training was provided at the hospital and clinic, as well as, some community physician offices. Two classrooms were reserved on the hospital campus and one conference room was reserved on the Mayo Clinic Campus for a total of 3,138 seats at St. Luke's and 735 seats at the clinic. Wireless laptops were also available for departmental training. Trainer ratios were 3:1 for MD's and 5:1 for other users.

Training tools used included a copy of the full manual, a Tri-Fold quick reference, Tip Sheets with updates and changes and on-line tutorials. Superusers were selected from the clinical areas to review current paper order sets and assist in design of the automated versions.

CPOE Benefits/Safety

Orders are checked for potential errors, interactions, adverse effects, and potentially integrated with knowledge database. Additional considerations include:

- Prompts that warn against the possibility of drug interaction, allergy, or overdose
- Accurate current information
- Drug specific information that eliminates confusion
- Disease specific rules
- Improved communication between physician, pharmacist, and nurses
- Elimination of eligible handwriting
- Reduced healthcare costs due to improved efficiencies
- Reduction of adverse drug effects (ADE)
- Standardization of treatment protocols
- Duplicate orders alerts
- Dose limits based on age, weight
- Contraindication/dose limit based on lab studies
- Cost of care recommendations

In summary, CPOE benefits may best be stated by a study [3] in the July 2003 Annals of Internal Medicine reported, "Because CPOE fundamentally changes the ordering process, it can substantially decrease the overuse, under use, and misuse of health care services. Studies have documented that CPOE can decrease costs, shorten length of stay, decrease medical errors, and improve compliance with several types of guidelines."

Pre- and Post- Implementation Metrics

Two internal studies where conducted to measure the safety of the Paperless Project. The Hospital Pharmacy conducted the first study approximately three months after implementation. Karen Nau, RhP reported in her study the "*Impact of Computerized Prescriber Order Entry (CPOE) Implementation on Prescribing Errors*" [4] the following results.

Objectives: This study aimed to investigate the effect of hospital-wide CPOE implementation on the rate and classification of prescribing errors. The primary

objectives were to estimate the rate of orders requiring pharmacist clarification prior to dispensing before and after CPOE implementation. The secondary objectives were to investigate the effect of CPOE implementation on the classification of prescribing errors.

Methodology: Baseline data collection (Sept-Oct 2006) included medication orders requiring pharmacist clarification for two months prior to CPOE implementation. Post-CPOE data collection (Jan-Feb 2007) included entered medication orders that require modifications or clarifications prior to verification as identified by reports generated based on system actions (i.e., rejected orders).

Results:

Primary Objectives

- Per 1000 orders, there were 3.19 (95% CI: 2.42 – 3.96) less orders *requiring clarification* after CPOE implementation ($p<0.001$).
- Per 1000 orders, there were 5.47 (95% CI: 4.48 – 6.46) less *prescribing errors* after CPOE implementation ($p<0.001$).

Secondary Objectives

- When considering all prescribing errors, there is statistically significant evidence of a difference in the distribution of error type, AHFS drug class, practitioner type, and communication type before and after CPOE implementation:
  - **Error type**
    - Decreased proportion of route of administration and miscellaneous errors
    - Increased proportion of duplication of therapy, frequency, and allergy contraindication errors
  - **AHFS drug classification**
    - Decreased proportion of errors associated with CNS and respiratory tract agents
    - Increased proportion of errors associated with anti-infectives, blood coagulation/formation/thrombosis, and hormone/synthetic substitutes
  - **Practitioner type**
    - Decreased proportion from resident physicians
    - Increased proportion from physicians
  - **Communication type**
    - Increased proportion of protocol type orders

The other internal study summarized in Figure 1 was conducted by Systems and Procedures utilizing data collected by a Risk Management system called Midas. Risk Management "Midas" data consist of self reported incident reports (i.e. Medication variance, Procedure variance – Examples A & B) for the selected times before and after implementation of November 2006. In addition to the "Midas" data, Average Length of Stay (**ALOS**) and Mortality data was also colleted.

Pre-CPOE Implementation data was collected for three months (Aug-Oct 2006). Post-CPOE Implementation data was collected for three months (Jan-Mar 2007).

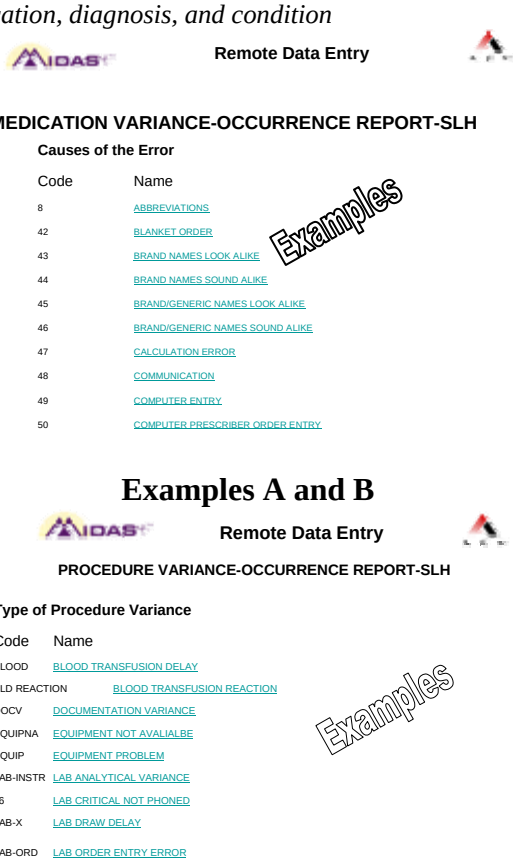
The medication variance example speaks to the issue that CPOE may bring a host of new types of variances. Organizations need to be aware [5] and plan to track and monitor reported errors on an on-going basis.

Medication Variance Example

Multiple medications orders initiated twice on patient by two different prescribers. Both were initiated after surgery.

Procedure Variance Example

Patient was admitted to surgical ICU and orders for ccs/icu not planned and not clarified by RN's caring for patient. Patient should have power plans/orders related to location, diagnosis, and condition



Examples A and B

Pre and Post Metrics Table	Pre	Post
# of Medication Variance Occurrence Reports	186	133
# of Medication Variance Occurrence Reports with Patient Did error reach patient=yes	92	69
# of Procedure variance Occurrence reports	88	113
	6-Feb	7-Feb
ALOS	5.32	5.02
ICU Patient Days	533	504
Mortality Rate # of Deaths/# of Discharges	0.03	0.02

Figure 1. Pre and Post Metrics

Next Steps

Immediately after go live, any issue identified as a patient safety concern received immediate attention and resolution. A process was set up two months post go live to allow users to request new orders and order sets. Patient safety issues continue to be given priority. The process of identifying issues, reporting them, and completing resolution of them can be lengthy. A new project has been approved that is investigating how this process can be improved.

Lessons Learned and Conclusions

The project lessons learned were cumulative and all can ensure a safe system. The ones for this project included:

- Automation will identify and accentuate flaws in current manual processes and workflow
- No process change is small and process flow needs to be well understood
- Superuser support is essential and ongoing support and training is needed long after conversions due to ongoing changes and additions
- Engage all departments, especially those who are most reluctant
- There is a need for a better auditing process/agreed actions for noncompliance
- The process for input and approval of orders sets must be defined and agreed upon in advance of build
- Ongoing collection of data at prescribed intervals to track project metrics is necessary
- No area should be allowed to "op out" as this impacts patient flow
- Ongoing oversight to monitor patient safety is crucial

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Biographical Sketch

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E**xperience**:
25 years of hospital and nursing experience. As staff nurse and administrator, Ms Brown has worked in the areas of Intensive Care, Emergency, and Cardiovascular Medicine. Other roles have included Director of Hospital Informatics, Manager of Clinical Institutional Applications, and Chief Nursing Officer. In March of 2006, she assumed the role of administrator for the paperless project at St. Luke's Hospital that includes Provider Order entry, Clinical Note, and Records Requirements.

Education:
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Associate in Nursing, Pensacola Junior College, 1985

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E**xperience**:
20 years of hospital/clinic experience in IT and Systems & Procedures supporting a wide variety of institutional projects. Other roles have included Systems Analyst, Hospital IT Department Director, and Consultant.

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