Application for 2008 University of California Larry L. Sautter Award for Innovation in Information Technology

Date: April 27, 2009

Project Title: University of California Davis Health System
Computerized Provider Order Entry – CPOE delivered with the full Electronic Medical Record (EMR)

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Table of Contents

A. Summary

In 2008, the University of California Davis Medical Center (UCDMC) initiated a key phase of its transition to a fully electronic health record with the implementation of Physician Order Entry. The main project goals were to improve the quality care and patient's experience at UCDHS. Success criteria included adoption of physician order entry in all relevant care venues, reduction of medication and transcription errors, standardization of care processes, and improvement of operational efficiency.

To achieve these goals, Information Technology teams developed a systematic process to engage clinicians at all levels of the organization and leverage the support of health system leadership. The strategy employed an incremental rollout that kept the clinical community engaged with short-term successes building to a hospital-wide "big bang" deployment. In addition, to aid physician adoption and connect with the busy physician community, the organization developed an innovative, on-line process to revamp over 200 outdated paper order sets. Order sets were important to the project's success because of the ability to speed and guide the order entry process, standardize processes of care, and embed required regulatory reporting requirements and clinical alerts.

B. Project Leaders and Team Members

One of the key elements leading to the success of this project was the deep level of partnerships created throughout UCDHS. The level of physician involvement in both project leadership and to create and manage knowledge based guidelines was unique and a key reason for the success of the project.

Executive Leadership

Michael Minear, CIO
Ann Rice, CEO
Dr. Allan Siefkin, Physician Executive Director
Betty Clark, Nursing Executive Director

Information Technology - Clinical Information Systems

John Cook, Program Manager
Sharon Schmitt, Rx Project Manager
Jennifer Burger, Orders Project Manager
Terri Rosas-Nichols, Ambulatory Manager
John Gubbels, Technical Manager
Carol Christensen, Training Manager
Many Physicians, Nurses, Therapists, Analysts, Trainers, Technicians and Support Staff

Department Leadership

Marci Hoze, Hospital Service Departments
John Grubbs, Pharmacy Department
Phil Schneider, Perioperative Services
Nathan Kupperman, Emergency Services
Darrell O'Sullivan, Pathology Department
Marge Gorthy, Radiology Department

Physician Champion Team
Five physicians dedicated more of their time to the electronic medical record (EMR) and CPOE. For two days a week they devoted their time to these clinical deployments and in helping to train and support physicians.

Hien Nguyen, MD
Assistant Clinical Professor
Infectious Disease
EMR Medical Director

Craig Keenan, MD
Director, Primary Care Internal Medicine Residency Program
Medical Director, General Medicine Clinic
Associate Professor
Associate Medical Director, Electronic Medical record (EMR)

Mark Avdalovic M.D., M.Sc., FCCP
Assistant Clinical Professor
Division of Pulmonary and Critical Care, UCDMC
Medical Director, UCDMG Outpatient PFT Lab
Associate Medical Director, Electronic Medical record (EMR)
Staff Physician, Northern California VA Health System

Douglas Taylor, MD
Associate Professor
Pediatric Hematology/Oncology
Associate Medical Director, Electronic Medical record (EMR)

Tamas J. Vidovszky, M.D., F.A.C.S
Assistant Professor
Gastrointestinal Surgery
Associate Medical Director, Electronic Medical record (EMR)

Scott MacDonald, MD
Internist, UC Davis Medical Group, Sacramento
PCN Associate Medical Director for Clinical Information Systems

In addition, there are fifty three Physicians from all areas of UCDHS that met (and continue to meet) frequently to advise and help with clinical software issues.

C. CPOE Project Context

It has been known for generations that one of the most powerful tools in a hospital can be the physician's pen. When a physician writes a clinical order, many things go into motion; to perform an ancillary test, to administer medications, to perform a procedure, to discharge or transfer the patient. Most of the cost incurred by patients during an hospital stay is defined by what orders their physicians write for their care.

At the point of ordering clinical services and medications, each physician has the opportunity to order a cost effective or expensive clinical treatment, a safe or harmful medication, or an effective or non proven treatment.

While each physician is very diligent to order effective clinical services, it is very difficult to be an expert on all medications, and to have memorized every nuance of every patient's condition and allergies. It has been a dream for many years to assist physicians as they order clinical services with better online software functionality that is linked to accurate and dependable online clinical knowledge.

This dream was formalized in the 1999 report from the Institute of Medicine called 'To Err is Human.' This report was a call to action to recognize the harm that was occurring to patients due to medical errors.

> "Medication-related errors occur frequently in hospitals and although not all result in actual harm those that do, are costly. One recent study conducted at two prestigious teaching hospitals, found that about two out of every 100 admissions experienced a preventable adverse drug event, resulting in average increased hospital costs of $4,700 per admission or about $2.8 million annually for a 700-bed teaching hospital.10 If these findings are generalizable, the increased hospital costs alone of preventable adverse drug events affecting inpatients are about $2 billion for the nation as a whole." [i]

Many groups have rallied to this call to action; the JCAHO has updated their goals and audit processes, the Institute for Health Improvement (IHI) has worked to teach clinicians to improve their processes and outcomes and created the 100K lives campaign. The Institute for Safe Medication Practices has worked to improve medication safety. The Leapfrog group, made up of large employers has pushed hard to make healthcare safer, and has said they will direct their employees and dependants only to health providers that seek to improve their safety. The Leapfrog group has summarized some of the research around medication errors below.

> "Research estimates that more than one million serious medication errors occur each year in U.S. hospitals, with 7,000 deaths annually from adverse drug events (ADEs). In addition to the human price paid, each ADE adds $2,000 on average to the cost of a hospitalization. This translates to more than $7.5 billion per year nationwide in hospital costs alone. CPOE systems can reduce the number of ADEs by up to 88%, preventing three million serious medication errors in the U.S. each year.
>
> CPOE systems are electronic prescribing systems that intercept errors when they most commonly occur — at the time medications are ordered. With CPOE,

> physicians enter orders into a computer rather than on paper. Orders are integrated with patient information, including laboratory and prescription data. The order is then automatically checked for potential errors or problems." [ii]

Computerized Provider Order Entry (CPOE) is relatively new software functionality to assist physicians entire their clinical orders directly into a computer system (EMR) vs. the old method of writing orders on paper; where nurses, clerks, pharmacists, and others had to carry, copy, and restate these orders using an antiquated paper based process.

A key element of CPOE is not just software that physicians can use, it also must include sophisticated ways to embed and link to online clinical knowledge. Examples of this knowledge include;

- Pre-defined common order sets with the optimal services and medications for a given condition
- Drug to drug adverse events – if drug A is given with drug B – there will be harm to the patient
- Drug to allergy (or adverse reaction) – is this patient allergic to that drug?
- Dose range checking – calculation and checking of safe drug doses based on patient weight and body surface area
- Other links to evidence based clinical knowledge

Some of this knowledge is purchased from specialized firms that create and maintain knowledge (such as drug to drug knowledge sets), other knowledge is summarizes and created by UCDHS clinicians.

The combination of real-time software functionality linked with online clinical knowledge is thought to be the safest and most effective way to order medications. The knowledge can also help to order the most cost effective medications and treatments.

The goal of delivering CPOE has recently taken on another motivation. The Federal Stimulus plan for healthcare information technology has elements to provide temporary Medicare and Medicaid payments ranging from $40,000 to $65,000 for physicians, and up to $11 million for hospitals that have demonstrated 'meaningful use of electronic medical records' over four years. It is likely that the definition of 'meaningful use' (to be defined by HHS by 2010) will include the use of a fully deployed CPOE capability.

D. Project Description

The UCDHS followed a phased system implementation approach to minimize technical risks as well as to allow time for clinicians and staff to adjust to the sweeping transformation in their daily workflow. Foundation work included implementation of a clinical data repository, nurse and clerk order entry of handwritten orders, nursing assessments and flowsheet documentation. There were also a number of bi-directional orders and results interfaces application interfaces that had to be created including; laboratory, blood bank, clinical imaging (PACS), pharmacy and dietary systems. Special integration capability of PACS DICOM clinical images was created so, while using the EMR, clinicians can also access and view clinical images. A similar integration program with a content management system that holds scanned paper medical records is in process of being deployed now.

One of the key lessons learned by previous organizations implementing CPOE was the importance of engaging physicians early in the system design. One method to gain input from busy clinicians was to develop specialty-specific admission, diagnostic and procedural order sets that speed order entry. UCDHS created an interactive workshop that gave clinical stakeholders hands-on access to the test environment to validate their clinical order set content on-line.

Following a style guide, clinicians determined which orders were defined as default, what data needed to be entered (with the required parameters), specific order or administration instructions, and links to clinical guidelines and to hospital policy and procedures as relevant. The UCDHS order sets were designed not to just optimize care, but also to support the education of medical students and residents who will use CPOE in their training.

When appropriate, data was required to fulfill reporting to regulatory agencies or financial organizations. For example, UCDHS created a Best Practice Alert for Pneumococcal and Influenza vaccinations. Generation of the alert provides clinicians the option to order a vaccination to be given prior to patient discharge. Web links to clinical indications and other online clinical knowledge is also easily accessible by clinicians.

For example, UCD Medical Center had significant problems determining if an order to 'admit the patient' was written for every hospital admission. Failure to write an admit order could result in costly payment denials. To address this risk, the CPOE function was designed to have admission orders defaulted in all standard order sets, and the physician's Admission Navigator tool. Integrating the admission order requirement into the physician's workflow has significantly improved admission order documentation compliance. (See Figures 1 and 2 in Appendix A)

In addition, the two UCDHS Committees that approve physician order sets transitioned to a new on-line clinical order set validation process and software. This reduced their review timeline from six months to 30 – 45 days. As a result, over 250 electronic order sets were produced and approved prior to go-live, significantly easing the transition to CPOE. Currently, there are 318 Order Sets in use at UCDHS.

Almost all types of clinical orders are online and in production at UCDHS using the Epic EMR and CPOE functionality. The two exceptions are Total Parenteral Nutrition (TPN), and chemotherapy orders. TPN is highly complex to automate, but is in process of going online with CPOE. Chemotherapy order forms and details are even more complex (and risky if not done correctly), and the software functionality is not yet ready at this time for this order type. It is anticipated that within 6-18 months, the software will be ready to also bring CPOE functionality to chemotherapy.

Clinical Order Types In Production Use at UCDHS			
Activity	Imaging	Consult	Pathology
Admit	Immunization/Injection	Diet	POC
Apheresis	Isolation	Discharge	Precaution
Assessment	Laboratory	Drip Management	Referral
Blood Bank	Line Care	DVT Prophylaxis	RT
Blood Gas	Medication	Education	Therapy
Cardiology	Micro	Epidural	Tubes & Drains
Cast Room	Newborn	GI Lab	Vitals
Code Status	Nursing	Hygiene	Wound Care/Dressings
Communication	Otolaryngology		

Order Types still on Paper	
TPN	Chemotherapy

Table 1 – Order Types used at UCDHS

There are many advantages to automating clinical orders with CPOE functionality. In addition to the efficiencies gained by eliminating handwritten orders (that are often illegible), CPOE creates a discrete and encoded data set that is the foundation of much more precise and accurate clinical orders.

Prior to CPOE, clinical orders were done with pen and paper forms. Once the physician created the order, the nurse manually entered the orders to a paper order tracker (Kardex), the unit clerk entered into an older generation computer system (or carried the order to the ancillary department), the ancillary department or pharmacy manually copied the orders into their departmental processes, the order and fulfillment process became very long.

The manually based order process was very error prone, orders could be lost or delayed, and a massive amount of clerical time was required to process clinical orders. ***For example, the UCDHS Pharmacy Department reports a 75% decrease in the number of transcription errors due to the CPOE implementation.***

Also, Illegible and incomplete medication orders have been eliminated due to the direct entry of discrete data into the system by physicians.

By leveraging the efficiencies gained, such as eliminating the manual steps associated with transcribing orders, the ***UCDHS' Pharmacy Department is consolidating the majority of its adult pharmacy services into one satellite pharmacy from two satellites pharmacies.***

The following is an example of the manual steps and time savings associated with the physician computerized entry of lab orders.

Lab Order Process Improvement Example

Before Automation

1. Physician goes to unit, checks previous day's results, reviews paper chart, makes notes, sees patient, and handwrites order in chart.
   The physician has to physically go to unit, and often the paper chart was not available (was being used by another clinician, or sometimes it was lost.)

2. Nurse or Clerk periodically checks chart, writes order on Order Tracker (Kardex), fills out paper order requisition or enters into legacy system.

3. The nurse collects the specimen, records collection date and time on the requisition and a patient demographic label, label is placed on specimen, specimen and paper requisition are placed in bag and sent to lab.

4. Lab receives specimen, enters orders on paper requisition into laboratory information system, prints specimen label, re-labels specimen, and sends to section for analyzing.

After Automation

1. Physician reviews previous day's results online, and enters new order. A pop-up alert will appear if the test has already been ordered and the physician can choose options to reorder or cancel.
   The physician can now access the EMR in essentially any location; in a hospital care unit, in their clinic, at their home, and even in London while attending a clinical conference (all with highly secure remote connections).
   Cost savings in eliminating redundant tests.

2. Nurse prints specimen label, collects specimen and initials label, places label on tube (which includes order information and collector information) and sends to lab.
   Time savings and error reduction in re-entry of transcribed order.

3. Lab receives specimen, barcode wands in patient information and tests, and sends test to section for analyzing.
   Error reduction in re-labeling of specimens, time savings and error reduction in re-entry of transcribed order.

UCDHS CPOE Implementation Timeline

January 2007	Initiate planning for Hospital, ED and Clinic POE Deployment
May 2007	Ambulatory Team begins rolling Clinic deployment Order Set Development Pilot Begins
October 2007	Implement Diet Order Entry and Computrition Interface Transition remaining Procedure Orders from legacy system
November 2007	Implement Patient Tracking and Triage system in Emergency Dept
February 2008	Implement Inpatient Pharmacy System and Order/Billing Interfaces
April 2008	Implement Physician Order Entry in Hospital, Outpatient Surgery and Procedural Areas Deploy Nursing Medication Administration Record and Order Tracking (Kardex)
November 2008	Implement Physician Order Entry, Trauma Documentation, and Nursing Assessments and Notes in Emergency Department
May 2009	Physician, RN, staff entry of clinical documentation into the EMR in the Hospital, Emergency Department and Outpatient Surgery & Procedural Areas

E. UCDHS CPOE Adoption rates

One of the hardest challenges in deploying CPOE is to actually get physicians to use the software and embedded online knowledge. If the software is not optimally designed and adjusted to meet the needs of busy physicians, they will push back or reject the software; as has been done by medical staffs at several American hospitals.

The UCDHS CPOE project has accomplished dramatically high rates of adoption for CPOE use, and in very low time frames after go live dates.

Physician Order Entry - Adoption Rate
Go Live date - April 2008: All Inpatient Units, Main Hospital, Outpatient Surgery
Go Live date - November 2008: Emergency Department

10-29-08 to 11-04-08	
MED Total	81.18955
PROC Total	78.61426
Grand Total	**79.43735**

11-12-08 to 11-18-08	
MED Total	91.75716
PROC Total	87.85679
Grand Total	**89.0324**

04-15-09 to 04-21-09	
MED Total	93.02498
PROC Total	91.39134
Grand Total	**91.89798**

The table above measure Physician Order Entry adoption rates at three intervals – 6 months post go-live in the Main Hospital, Outpatient Surgery and Procedure Areas, one week post go-live in the Emergency Department, and one year to date following implementation.

The vendor (Epic) used by UCDHS for CPOE rates adoption rates over 90% - for an academic teaching facility the size of UCDHS as excellent.

UCDHS' Health Information Management department reported a dramatic 61% decline in Verbal Orders since the implementation of CPOE. Elimination of verbal orders serves to further reduce potential errors associated with interpretation and transcription of data.

F. Hardware Utilized to Support CPOE

A complete facility and care unit work area assessment was performed to determine the need and placement of new computing devices for CPOE use. Due to space constraints and the UC Davis medical center's high occupancy rate, there were few places to install enough computers to support clinical staff access to the EMR and CPOE functionality. Creative solutions were defined to meet requirements.

Physician champions, nurse managers, technical staff and end users participated in a multi-point survey, performed equipment evaluation, pilot tested tablets, and helped determine final configurations.

In addition to the approximately five thousand clinical workstations deployed throughout UCDHS, Information Technology staff deployed over 200 new mobile devices including workstations, laptops, and tablet computers in fixed locations and mobile carts. The wireless network was assessed, and in some areas upgraded to support the expanded use of clinical software. Barcode printers and special tamper proof prescription printers were tested and deployed.

Locations where new computers and printers were installed included; nursing units, resident sleeping rooms, physician lounge areas, operating room anesthesia carts, operating room mobile carts with dedicated EMR/CPOE functionality and also dedicated PACS functionality, and conference rooms.

A tablet for doctors and nurses: the Motion Computing C5 Mobile Clinical Assistant
Clad in a durable white casing with a built-in handle and a splash-proof seal around the LCD screen, the C5 has an Ingress Protection (IP) rating of 54, which means that it can withstand a light liquid spray and wipe clean — ideal for a device that will require regular disinfection. [iii]

As noted, a number of laptop and tablet computers were deployed to meet the needs of rounding teams and mobile clinicians. These include the relatively new Motion Computing C5 Mobile Clinical Assistant; [iv] a tablet computer with many unique features including a highly sealed design that provides the ability to wash and disinfect the computer. In the future, UCDHS plans to use addition options for this tablet computer, such as embedded RFID reader and integrated bar code reader to identify patients, and an integrated camera to take video images for patient education and relevant documentation.

Physician using EMR on mobile cart

Mobile cart in UCDHS Operating Room

H. Customer Satisfaction

While acknowledging how much effort has had to go into designing and deploying CPOE, and creating and assessment knowledge to link with orders and order sets, UCDHS physicians are very positive about the new functionality. Some perspectives from UCDHS physicians are listed below.

"Physician order entry has been great! It is wonderful to be able to see all the current active orders on a patient in one view in addition to being able to see old orders or orders put in overnight. In the past, you would often need to comb through the entire chart to get the same information that now is available instantaneously. Not only has that made it easier to make decisions about patient care but it also has allowed for more effective communication with patients and their families about the hospital course."

Karnjit Johl, MD, Assistant Clinical Professor, Internal Medicine

"In the 15 years that I have been in medicine, the introduction of EMR Physician Order Entry has been the single greatest change I have seen. For such a large project, it has gone remarkably well thanks to the effort of a great IT team. From a patient care standpoint, having the ability to access the chart at any time and enter orders from anywhere, including home, has been a huge time saver. From a research perspective, being able to record and track orders has been a boon for clinical and translational researchers evaluating the process of care. From a quality standpoint, we can now more efficiently provide feedback to clinicians to directly change practice and directly improve patient outcomes."

Hien Nguyen, MD, Assistant Clinical Professor, Infectious Disease

"CPOE is an invaluable advance in ensuring patient safety, plus it is a major step in creating full online medical records so essential to advancing the efficiency of health care delivery."

James E. Goodnight, MD, PhD, Executive Director, Practice Management Group, Associate Dean for Clinical Affairs, UC Davis Health System

"Computerized Physician Order Entry has helped in a number of ways: On admission, order sets have provided a baseline to help appropriately standardize patient care in certain disease processes and aid in ensuring important aspects of care are more easily met, i.e. DVT prophylaxis and immunizations. For physician cross coverage, it has decreased the time from nurses call to having an order placed as the physical need to be on the floor has been removed. For rounding, it has provided for an easy way to scan the chart to confirm and change active orders saving a significant amount of time per patient and reducing errors by allowing one to easily confirm that an order has been placed, and update orders that are no longer applicable as the patient's care evolves.

Hershan Johl, MD, Physician Associate Diplomat, Hospitalist

I. Assessment of Results from CPOE Deployment

From January 1, 2009 to March 31, 2009, the pharmacy department received 51,495 Medication Alerts using the EMR and CPOE software***. UCDHS pharmacists took corrective action in partnership with physicians on 8.85% or 4,557 alerts, preventing potential medication errors (in three months time).***

Stringent review of the alerting patterns during these past few months by the UCDHS Alerts Committee has resulted in the decision to 'turn on' these prescribing alert messages to physicians (in addition the current situation where pharmacists see and use the alerts). The planned date to make the change turning on alerts for UCDHS physicians is May 12, 2009. UCDHS pharmacists will continue to utilize the alerts.

Further analysis is being done with this data, but it is clear that these initial results not only avoided potential harm to patients, it also reduced the cost of care.

Alert Type	# Removed	% of Alerts removed
Drug-Allergy	2	0.00%
Drug-Drug	16	0.03%
Duplicate Medication Order Alert	4,539	8.81%
Grand Total	4,557	8.85%

Table 2 – Summary of medication orders adjusted due to knowledge based CPOE alerts – potential patient harm avoided 4,557 times during a three month period

J. Comparison Data – How does UCDHS compare with Benchmarks

The Leapfrog Group

"The Leapfrog Group is an initiative driven by organizations that buy health care who are working to initiate breakthrough improvements in the safety, quality and affordability of healthcare for Americans. Leapfrog is a member supported program aimed at mobilizing employer purchasing power to alert America's health industry that big leaps in health care safety, quality and customer value will be recognized and rewarded. The Leapfrog Group was founded by a small group of large employers, initially supported by the Business Roundtable (BRT) and launched in November 2000. Leapfrog is supported by the BRT, The Robert Wood Johnson Foundation, Leapfrog members and others.

A 1999 report by the Institute of Medicine gave the Leapfrog founders an initial focus – reducing preventable medical mistakes. The report found that up to 98,000 Americans die every year from preventable medical errors made in hospitals alone. In fact, there are more deaths in hospitals each year from preventable medical mistakes than there are from vehicle accidents, breast cancer and AIDS. The report recommended that large employers provide more market reinforcement for the quality and safety of health care. Leapfrog's founders realized that they could take "leaps" forward with their employees, retirees and families by rewarding hospitals that implement significant improvements in quality and safety.

The Leapfrog Group's growing consortium of major companies and other large private and public healthcare purchasers provide health benefits to more than 37 million Americans in all 50 states. Leapfrog members and their employees spend tens of billions of dollars on health care annually. Leapfrog members have agreed to base their purchase of health care on principles that encourage quality improvement among providers and consumer involvement. If all hospitals implemented just the first three of Leapfrog's four "leaps" or recommended quality and safety practices: over 57,000 lives could be saved, more than 3 million medication errors could be avoided, and up to $12.0 billion could be saved (Lwin 2008) each year." [v]

Summary of Leapfrog press release from April of 2009, showing how much progress is still required to advance the use of clinical software and achieve the goals laid out by the Federal government.

> **"**WASHINGTON, DC, April 15, 2009 – Though it has been 10 years since the Institute of Medicine's Landmark report on the failure of U.S. hospitals to adequately protect patient safety, too many hospitals still have failed to implement standards known to improve quality and save lives.
>
> ***According to the 2008 Leapfrog Hospital Survey, released today, only 7% of hospitals fully meet Leapfrog medication error prevention (CPOE) standards*** and low percentages of hospitals are fully meeting mortality standards (see below).
>
> "As the Obama administration and Congress consider health care reform options, it is clear we have a long way to go to achieve hospital quality and cost-effectiveness worthy of the nation's $2.3 trillion annual investment, " said Leapfrog CEO Leah Binder. "According to our data, a majority of hospitals have significant safety and efficiency deficits."

The 2008 Leapfrog Group survey of 1,282 acute care hospitals was recently announced. The Leapfrog Group goals, and survey includes both CPOE deployment and specific clinical process and outcome goals.

> "The 2008 Survey was voluntarily completed by 1,282 acute care hospitals across 37 regions in 44 states – representing more than 50% of targeted inpatient beds in these regions.* This report provides detailed information on 2008 Survey results and comments on trends from earlier years.
>
> **T*he results of the 2008 Survey indicate that only 7% of hospitals fully meet Leapfrog's medication error prevention, CPOE, standard. Although disappointing, this is an improvement from 2002 when only 2% of hospitals met this Leapfrog standard. In 2007, 11% of hospitals fully met the standard, but in 2008 Leapfrog introduced a new requirement for fully meeting the standard: Hospitals must test their CPOE systems with Leapfrog's CPOE Evaluation Tool.***
>
> The Leapfrog Group's CPOE standard includes having hospitals enter at least 75% of their inpatient medication orders through their CPOE system and having hospitals assess the implementation of their CPOE system with the Leapfrog CPOE Evaluation Tool to ensure their CPOE system is alerting prescribers to common, serious prescribing errors." [vi]

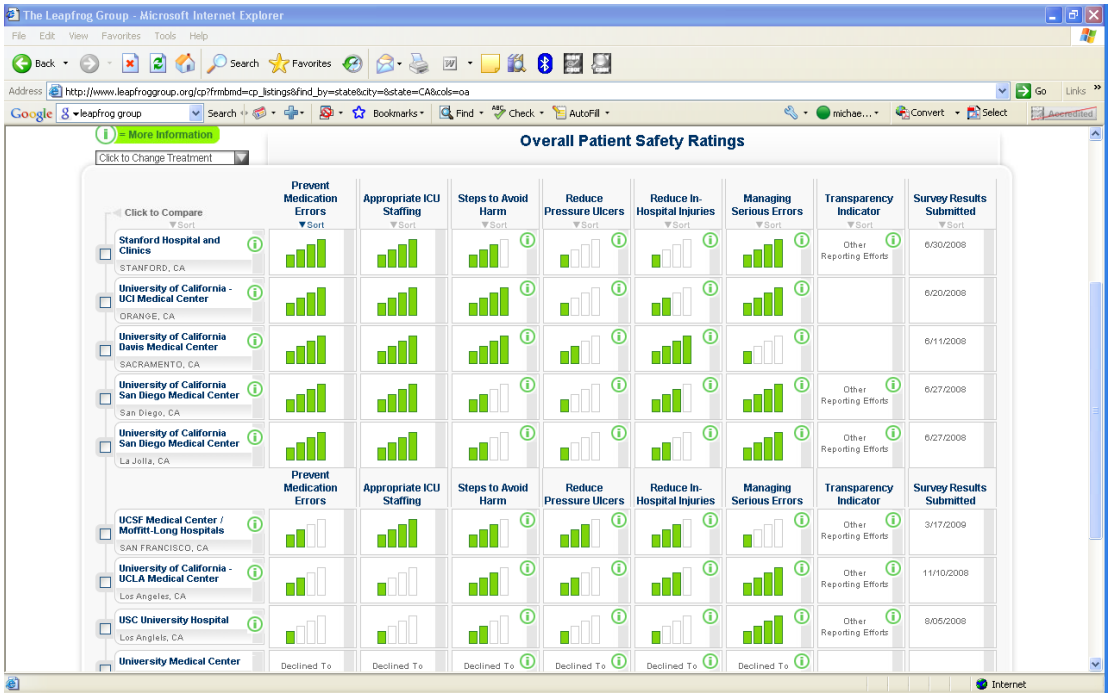
UCDHS meets the initial Leapfrog goal of having at least 75% of all clinical orders created via a CPOE software application supported with online knowledge.

The new and second element of Leapfrog's goals is to run specialized test software to ensure basic order and alert functionality is operating correctly, and part of the software and knowledge in production use. UCDHS first turned CPOE with the medication alerts only being presented to the pharmacist (who must check every medication order) and not yet have all alerts presented to physicians. This approach was recommended by Epic to not initially overload physicians with the new software, new knowledge-based guidelines, and many alerts. The physician alerts will be turned on May 12, 2009 and UCDHS will take the Leapfrog software test in June of 2009.

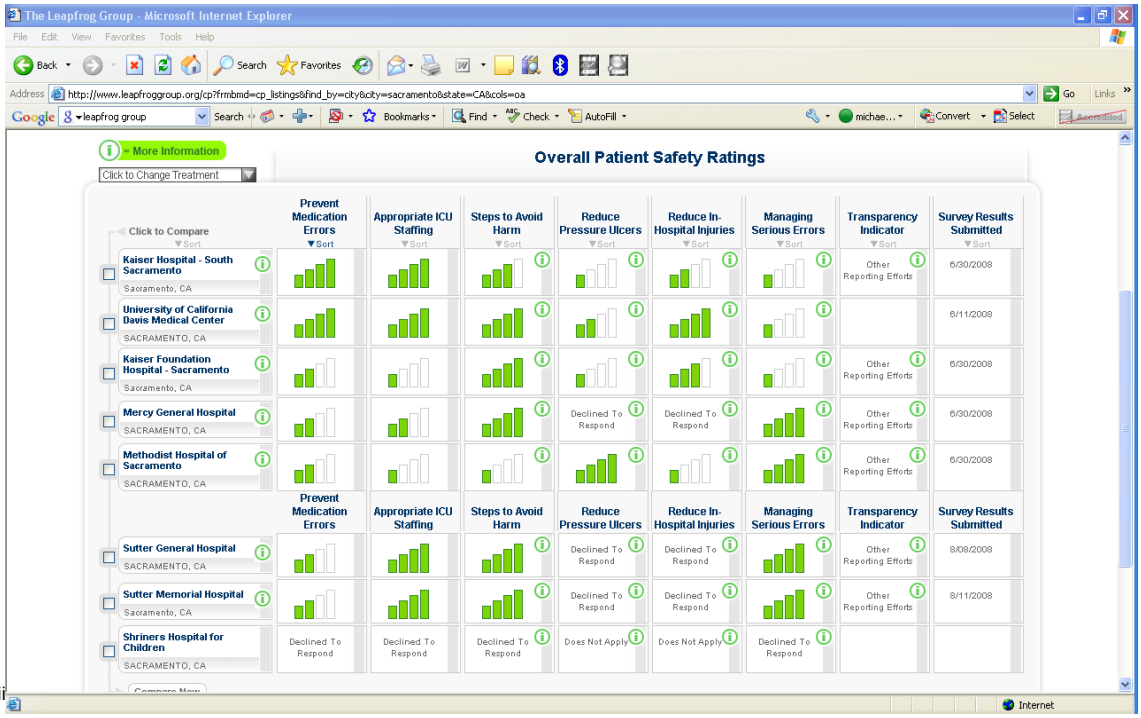
UC Davis Health System

Application for UC Sautter Award
Computerized Provider Order Entry – CPOE

The following two summaries were taken from the Leapfrog Group's website, open to the public. It uses the four step ranking of 'Progress Towards Meeting Leapfrog standards' status (graphic legend showed below); willing to report, some progress, substantial progress, and fully meets current standards.



Leapfrog Group Summary data – California Academic Medical Centers
Left most column shows ''Prevent Medication Errors" shows progress towards meeting Leapfrog's CPOE deployment Patient Safety Standard (UCDHS third on list)



[vii]

Leapfrog Group Summary data – Sacramento California Area Hospitals
Left most column shows ''Prevent Medication Errors" shows progress towards meeting Leapfrog's CPOE deployment Patient Safety Standard (UCDHS second on list) [viii]

Study that assessed full deployment of clinical systems

In a recent NEJM article published on March 25, 2009, a study found;

> "On the basis of responses from 63.1% of hospitals surveyed, only 1.5% of U.S. hospitals have a comprehensive electronic-records system (i.e., present in all clinical units), and an additional 7.6% have a basic system (i.e., present in at least one clinical unit). **Computerized provider-order entry for medications has been implemented in only 17% of hospitals**." [ix]

During the deployment of all Electronic Medical Record components and functions, UCDHS has achieved close to 100% of CPOE deployment; a status achieve by only 17% of American hospitals.

Table 3 from the article summarizes the findings from the study. UCDHS has deployed the Epic EMR at the level of 'Basic HER with Clinician Notes (only 7.6% of American hospitals have accomplished this level), and with the completion of in-process work to deliver several more interfaces and turn on alerts to Physicians in addition to alerts currently being shared with Pharmacists. ***UCDSH should be achieve the deployment level of 'Comprehensive EHR System' within 6-9 months; a level only achieved by 1.5% of American hospitals***.

Table 3. Electronic Requirements for Classification of Hospitals as Having a Comprehensive or Basic Electronic-Records System.*

Requirement	Comprehensive EHR System	Basic EHR System with Clinician Notes	Basic EHR System without Clinician Notes
Clinical documentation			
Demographic characteristics of patients	√	√	√
Physicians' notes	√	√	
Nursing assessments	√	√	
Problem lists	√	√	√
Medication lists	√	√	√
Discharge summaries	√	√	√
Advanced directives	√		
Test and imaging results			
Laboratory reports	√	√	√
Radiologic reports	√	√	√
Radiologic images	√		
Diagnostic-test results	√	√	√
Diagnostic-test images	√		
Consultant reports	√		
Computerized provider-order entry			
Laboratory tests	√		
Radiologic tests	√		
Medications	√	√	√
Consultation requests	√		
Nursing orders	√		
Decision support			
Clinical guidelines	√		
Clinical reminders	√		
Drug-allergy alerts	√		
Drug–drug interaction alerts	√		
Drug–laboratory interaction alerts (e.g., digoxin and low level of serum potassium)	√		
Drug-dose support (e.g., renal dose guidance)	√		
Adoption level — % of hospitals (95% CI)	1.5 (1.1–2.0)	7.6 (6.8–8.1)	10.9 (9.7–12.0)

* A comprehensive electronic-health-records (EHR) system was defined as a system with electronic functionalities in all clinical units. A basic electronic-records system was defined as a system with electronic functionalities in at least one clinical unit.

Table From NEJM Article, "Electronic Requirements for Classification of Hospitals as Having a Comprehensive or Basic Electronic-Records System" [x]

Appendix A - Screen Shots of CPOE Application

Admission Order Navigator – Admit Patient Order

Figure not available on public version of this document
Figure 1 – Order Entry Admission Navigator – Admission Order Required

Figure not available on public version of this document
Figure 2 – Admission Order Detail

Admission Navigator – Order Set

Figure not available on public version of this document
Figure 3 – Stroke Admission Order Set

Figure not available on public version of this document
Figure 4 – Stroke Admission Order Set Required Patient Care Orders and Parameters

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Figure 5 – Admission Orders Required Section for DVT Prophylaxis

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Figure 6 – Highlighted Patient Specific Medication Alert in Order Set

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Figure 7 – Medication Alert Pop Up Box to Record Action

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Figure 8 – Physician Order Entry – Required MRI (clinical image) Patient Safety Fields

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Figure 9 – Highlighted Best Practice Alert for Pneumococcal and Influenza Vaccines

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Figure 10 – Best Practice Alert Options for Deferring or Ordering Vaccines

Indications for Pneumococcal Vaccine:

Patient is:

- 65 years of age or older
- Resident of nursing home or chronic care facility regardless of age: **OR**

Patient is age 19-64 and has any of the following **high-risk** conditions:

- Serious long term health problem with chronic heart or lung disease (including asthma), diabetes mellitus, or kidney disease including nephritic syndrome.
- Compromised immunity such as: Hodgkin's disease, leukemia, lymphoma, multiple myeloma, generalized malignancy, HIV infection, or AIDS, organ or bone marrow transplant, treatment with long-term corticosteroids, cancer drugs, or radiation therapy.
- Alcoholism, cirrhosis, or chronic liver disease.
- Sickle cell anemia or splenectomy
- Cerebrospinal fluid leaks: **OR**

Patient uncertain about prior vaccination status or history unreliable and meets the above criteria (vaccination recommended). Patients may be revaccinated if greater than 5 years from previous vaccination.

If the above criteria are not met, vaccination is not required.

Figure 11 – Clinical Indications Web Link from Best Practice Alert

Example of clinical knowledge embedded in CPOE functionality at UCDHS

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Figure 12 – Software tool to create / maintain online clinical order sets

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