

## Implementation of Computerized Physician Order Entry (CPOE) towards Patient Safety in Saudi Hospitals

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**Abstract:** In the last 10 to 15 years, the healthcare industry has clearly shifted its focus from implementing financial information systems to clinical information systems in order to improve outcomes, reduce medication errors, increase healthcare efficiency, and eliminate unnecessary costs. This paper describes the experience of one of the leading health organization in Saudi Arabia in implementing a Computerized Physician Order Entry (CPOE) solution to meet patient safety measures. The realized benefits gained from the CPOE implementation are explained and the lessons learned are discussed. The paper also explains the main Critical Success Factors (CSF) used to increase the likelihood of project success.

**Index Terms**—CPOE, CSF, Health Information Systems, Patient Safety, CPR, Saudi Hospitals.

### INTRODUCTION

As healthcare is getting more and more complex with more healthcare providers involved in patient health, paper-based patients' records cannot keep clinicians completely informed. Paper records can only be in one place at a time, and thus cannot be shared between two or more health specialists at different locations simultaneously. This has a negative impact on optimization of information management in healthcare and as a consequence reduces the productivity and the quality of care provided. Therefore, records must be available in an electronic format so that health specialists can easily access and review patient record, including allergies, medication, investigation, and laboratory tests and other investigations.

Between 44,000 and 98,000 Americans die each year as a result of medical errors that could have been prevented, according to the Institute of

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Medicine report (IOM).<sup>1</sup> Beyond their cost in human lives, preventable errors also result in an estimated total cost of between \$17 billion and \$29 billion per year in U.S. hospitals. Medical Errors are also costly in terms of loss of trust in the healthcare system by patients. One of the main conclusions of the IOM report is that medical errors are commonly caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them.

In response to the shocking IOM report, some healthcare organizations have introduced information and communication technology (ICT) to improve outcomes, reduce medication errors, increase healthcare efficiency, and eliminate unnecessary costs.<sup>2</sup> Information Technology in healthcare has expanded steadily from being primarily administration and financial oriented to more clinically oriented systems including the current focus on Computerized Physicians Order

Entry (CPOE) systems. CPOE represents a monumental step forward for healthcare organizations because it embodies a shift from traditional, paper-based care coordination activities to automation of the order entry processes. This shift can be an agent for change, eliminating confusing or illegible hand-written order documentation, minimizing transcription errors and reducing clinical mistakes.<sup>3-10</sup> However despite their knowledge, investments, and best intentions, most health organizations have not realized a return on their investments.<sup>11-13</sup>

The deployment of health information systems including CPOE is especially challenging for Saudi hospitals because of high implementation cost, technical complexity, lack of ICT infrastructure, and lack of well-trained employees.<sup>14</sup> There are only two hospitals in Saudi Arabia, representing only 1% of Saudi hospitals, that have implemented CPOE solutions. These hospitals are the National Guard

Health Affairs (NGHA) hospital and King Faisal Specialist hospital in Riyadh, Saudi Arabia. This challenge is not unique to Saudi Arabia but rather exists in many hospitals across the world and has not been resolved even in most advanced countries. In reality, less than 10% of the US hospitals have implemented CPOE according to a recent survey.<sup>15</sup> The main purpose of this article is to introduce the experience of implementing CPOE at the National Guard Health Affairs (NGHA) for the purpose of improving patient safety. The paper explains the project scope, the critical success factors used, and the lessons learned.

### **CPOE System Overview and Benefits**

CPOE is a process of electronic entry of physician's orders and instructions for the treatment of patients. These orders are usually communicated over a Computerized Patient Record (CPR) system to other medical staff (nurses, therapists, or other physicians) or to the

departments (pharmacy, laboratory, or radiology) responsible for fulfilling or documenting the order.

CPOE is not a technology, rather it is a workflow design of clinical processes that integrates technology to optimize physician ordering of medications, laboratory tests, and other clinical investigations.<sup>16</sup> CPOE uses clinical decision support systems and links to CPR systems to generate prompts and alerts during the ordering session to notify of potential errors such as contra-indicated medications or routes or duplicate orders.<sup>4</sup> Some of the potential benefits of CPOE systems are categorized as follows:

Physicians' orders are placed electronically which prevents wrong interpretations by ancillary departments. Physicians benefit from the real-time alerts (drug-drug, drug-food, or allergy) that enhance the quality of healthcare. Moreover, as an integral part of the CPR, the CPOE helps reduce the time of locating and reading patient charts. The CPOE

system helps free up resources in ancillary departments from administrative tasks which allows them to have more time to provide a higher care value and improve regulatory compliance measures. The system reduces the amount of time spent on phone calls to physicians to enquire about and verify the orders. The system helps prevent medication error resulting from handwritten orders and enhances interdisciplinary communication towards patient safety. The system helps move information instantly around the organization, reducing turnaround time for medication delivery, obtaining and processing laboratory work, scheduling and completing radiology exams, and other tasks. It also helps standardize the healthcare process.

In May 2001, thirteen CPOE experts from around the world met for the purpose of developing recommendations for CPOE implementation.<sup>17</sup> A list of high-level considerations was generated to benefit

organizations thinking about implementing CPOE as follows:

- Motivation for Implementing CPOE
- Costs
- Integration/Workflow/Health Care Processes
- Value to Users/Decision Support Systems
- Vision/Leadership/People
- Technical Considerations
- Management of Project
- Training and Support
- Learning/Evaluation/Improvement

### **The National Guard Health Affairs**

The National Guard Health Affairs (NGHA) is a large health organization which provides a modern medical care to National Guard employees and their dependents. Under the umbrella of NGHA, there are four hospitals and sixty primary and secondary health centers around the Kingdom having 2000 in-patient beds in total. NGHA serves more than 2.5 million out-patients and around 60,000 in-patients

annually. NGHA is accredited by the Joint Commission International.

NGHA has determined that its future success will be closely tied to its ability to effectively deploy and utilize information and communication technology (ICT). NGHA therefore embarked on an ICT strategic planning process in 1999 that resulted in a strategic plan that provides the opportunity to use ICT as a tool to enable healthcare systems integration as well as to deliver information as a strategic resource. Moreover, in its effort to standardize processes and systems across all its hospitals, NGHA adopted an Application Service Provider (ASP) Model as a primary concept in the infrastructure design of its ICT Strategic Plan; ASP Model requires that Applications such as CPR and CPOE be hosted in a central location at the King Abdulaziz Medical City (KAMC) in Riyadh. However, they can be accessed remotely through the web (Internet) or Intranet from any NGHA facility as shown in Figure 1.

With the vision of the NGHA to provide an efficient and accountable healthcare delivery system that supports the continuum of care, NGHA purchased an international CPR system in 2001 to be implemented in all NGHA facilities. The CPR system has been implemented in a phased-approach in which the scope of the first phase includes the implementation of the CPR in the main hospital of the Central region of NGHA (Figure 1). Phase two of the project includes the roll-out of the CPR system to the other hospitals in the other regions.

NGHA concluded the first phase of the installation process in September 2004, replacing its existing system with a fully automated, enterprise-wide CPR. The functions implemented included medical records, patient scheduling, order results management, medical imaging, nursing, pharmacy, patient administration, an interface to the NGHA's existing laboratory

information system, and other healthcare services.

With the CPR now fully installed at KAMC in Riyadh, the NGHHA is currently rolling out the system to its other facilities in the Eastern and Western regions.

### **Methodology**

As a result of a quality accreditation process decided to give more emphasis on patient safety issues. A taskforce was formed, in early 2006, with a main charge to enhance patient safety and reduce medication errors. The taskforce reviewed research articles which in general support the adoption of CPOE solution to reduce medication errors. However some research articles raised some concerns about the success of CPOE implementations.<sup>11-13</sup> As a result, NGHHA decided to start with a pilot project to assess the CPOE potential benefits and risks in a pilot department. The result of the pilot project would determine whether CPOE worth the investment and hence be rolled-out to other

departments and hospitals or not.

The project team selected that Adult Intensive care unit (ICU) at King Abdulaziz Medical City in Riyadh to be the pilot area. The Adult ICU consists of nine beds. On the provider side, there are approximately 25 physicians, 18 nurses, 3 respiratory therapists and there is a specialized pharmacy satellite located in the ICU area. The characteristics of Adult ICU (from CPOE perspective) are as follows:

1. Physicians are highly specialized and have high degree of computer literacy.
2. Physicians use specific order sets and protocols
3. The Nurse to Patient ratio is 1 to 1 for 24 hrs
4. There is specialized pharmacy located in the area
5. Each room is equipped with a Computer for each patient

After the finalization of the pilot project, the project team would conduct meetings with all departments and individuals

involved in this project to assess the visibility of the project and to recommend the roll-out to other departments. The team used "brain-storming" and "Delphi" techniques to reach to decision.

### **Implantation of CPOE**

Rather than invest in new "stand-alone" clinical information system, NGHA decided to use the CPOE features already in the CPR which has been already used at KAMC across all in-patient and out-patient departments. Physicians are familiar with the system as they use it to view the results of the procedures and orders. Moreover, NGHA would benefit from the data integration between the CPR and the CPOE. This integration would provide decision support capabilities supported by the aggregate data within the CPR.

The CPOE system is a huge undertaking project and hospitals should carefully plan the implementation because it deals with physicians who will be the primary user. The scope of the project is to implement

the CPOE Adult ICU first and upon the success of the pilot project the CPOE would be implemented for all physicians. The project management team would gain momentum by selecting a pilot site with a high likelihood of success. The lessons learned at the pilot site would make the other implementation sites go smoother.

The project life cycle used in the CPOE implementation at NGHA consisted of six phases (Figure 2). Within each phase, there were various processes with each process consisting of a number of tasks. A project team was formed to drive the implementation, which consisted of multidisciplinary key stakeholders from various beneficiary departments: The chairman of adult ICU (project champion), the CPR Team leader (project manager), and the director of pharmacy, the nursing manager, and respiratory therapy manager. The project team also included "super users" from the ICU (physicians, nurses, and pharmacists) as well as application

analysts from the CPR department. The selection of the super users was based on several criteria; computer proficiency, understanding of the business process within the ICU, and the willingness to support other ICU employees to properly use the CPOE system. The CPOE Team studied the work process in the ICU and proposed an ideal workflow (Figure 3).

The implementation plan took around 3 months in adult ICU. In December, 2006, CPOE was implemented in the adult intensive care unit as a pilot group and rolled out to the Intermediate care unit. Currently, the NGHA is working in parallel to cover the Cardiac center and the Burn unit area. The CPOE implementation plan will continue forward to cover all departments at the inpatient area by 2008.

#### **CPOE project challenges and assessment: Lessons learned**

NGHA was confronted with a serious lack of expertise internally in the area of CPOE design and implementation. As a

result, NGHA focused on developing a core team specialized in CPOE system by providing this core team with the necessary training required. The core team works very hard to support the heavy customization requirements of CPOE. However, due to the small size of the team, a longer implementation time is expected. Moreover, switching from handwriting to CPOE requires a significant change in physician work flow. After the pilot project was concluded, the project team had assessment meetings with all of the concern departments and all physicians representing the ICU. The assessment indicated that the benefits realized by the CPOE justify the investment and the rollout to other department should be made. In fact physicians, as the learned about this experience in the ICU, have been requesting from the management to expedite the implementation of CPOE in all physician offices.

To ensure a higher degree of success

for CPOE implementation, the project team should consider certain critical success factors as presented in the introduction. CPOE projects should not be viewed as another ICT project rather should be viewed as a business project. Patient safety with an emphasis on the reduction of medication errors was the driver and motivator of the CPOE adoption at NGHHA. The secondary objective of the project was to complete the electronic medical records of patients and move one step forward towards a paper-less environment. It is essential that the vision of the CPOE project be clear to the project team and to the concerned departments. The vision was emphasized by the senior executives of the NGHHA and a top-level leadership support existed along with a shared vision of the project objectives and goals. At the clinical level, the chairman of the ICU was the project "champion" who invested a lot of his time to lead clinicians towards accepting the CPOE. The project manager is a skilled

individual who has health informatics background and strong project management skills. Even though the team size was adequate for implementing the CPOE in the pilot department a larger team is needed to roll the system out to other departments and hospitals.

The integration of CPOE and CPR is very important to the success of the CPOE deployment. NGHHA benefited from the data integration between the CPR and the CPOE, which provided decision support capabilities supported by the aggregate data within the CPR. As a result, there was no need for integration engines to link CPOE with other modules like pharmacy, lab, radiology, and nursing. It's now clear to every one that CPOE is not just a technology but rather a smarter way to treat patients. What made this proposition easy was the fact that most of physicians at NGHHA were trained in the best hospitals in North America and when they came back there was no need to sell these ideas to

them, rather they were demanding these systems.

Hospitals should adopt strong project management techniques and tools to ensure the success of CPOE deployment. NGHA formed a project team which devised the project life cycle of the project. Project management training was conducted within NGHA and it was attended by the project manager. The project team started by documenting the problem statement, solution, key deliverables, requirements, dependencies of the project and time frame. A project charter was issued indicating the official start of the project with names of project team and responsibilities assigned. NGHA used matrix project structure where a project team member reported to the project manager in addition to the functional manager. Communication was done through meetings, emails, and news letters. Organizations should control scope changes. Inevitably, employees will keep

requesting additional features that are not planned for the first phase. Organizations should establish a process for scope changes and decisions on making the changes should be based on a cost/benefit analysis. The "go-live" day is not the end of the CPOE project. In NGHA, it was realized that many issues come months after the "go-live" day as end-users gained more knowledge about the system and its capabilities. Finally, Organizations should not push the project to finish quickly.

Hospitals should make sure that they have the right technical infrastructure prior to considering CPOE implementation. In NGHA case, project team worked hard to ensure the technical infrastructure before the "go-live" of the CPOE. The technical infrastructure included network wireless access points and Laptop workstations. The project team made a balance between customization and standardization where physicians of a similar specialty would have a common CPOE screen which might be

different of other specialties. CPOE was interfaced to all CPR modules; however, there is a need to implement out-patient pharmacy prior to rolling out CPOE to out-patient clinics.

Training is a major success factor for CPOE projects. Organizations should not underestimate the need, time, and resources for training. This should include functional training as well as technical training. NGHHA used the "train the trainer" approach, where training was given to selected users (key users) who, in turn, conducted training sessions to other users.

It is important to remember that the main goals of implementing CPOE at a pilot department were to test the system without putting patients at risk and learn from mistakes. The project team documented lessons learned to be used in the roll-out

process. As end-users gain more experience with the system, more improvements on the CPOE functionalities are expected.

#### **Futuristic plan for CPOE Project**

The CPOE implementation plan will continue forward to cover all KAMC in-patient departments by 2009, when the system will be rolled out to outpatient areas as well as to the primary care centers. After stabilizing the CPOE at KAMC, NGHHA will roll out to the Eastern and Western regions to implement CPOE at their facilities and primary care centers. This is expected to be accomplished by the end of 2011. The author recommends that, after the CPOE is fully deployed in the NGHHA hospitals, a comprehensive review to be conducted in order to list the issues that are specific to Saudi healthcare.

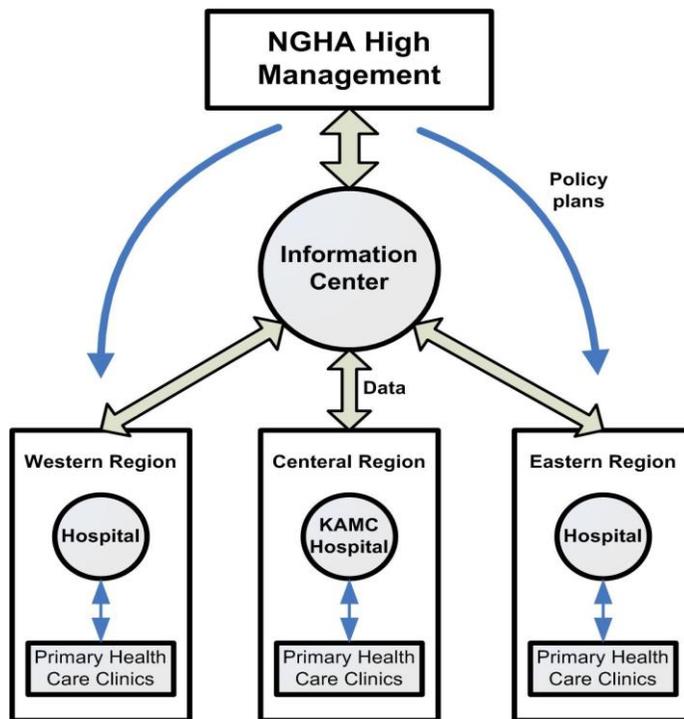


Figure 1: The application service provider model used in National Guard Health Affairs.

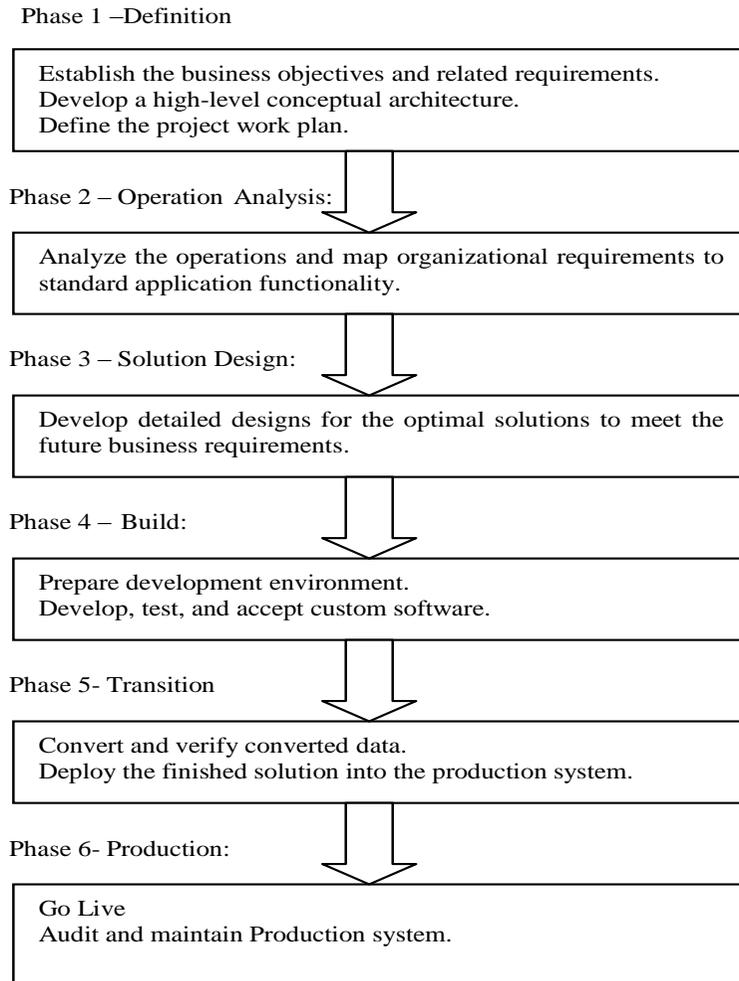


Figure 2: The Project Life Cycle of the CPOE project

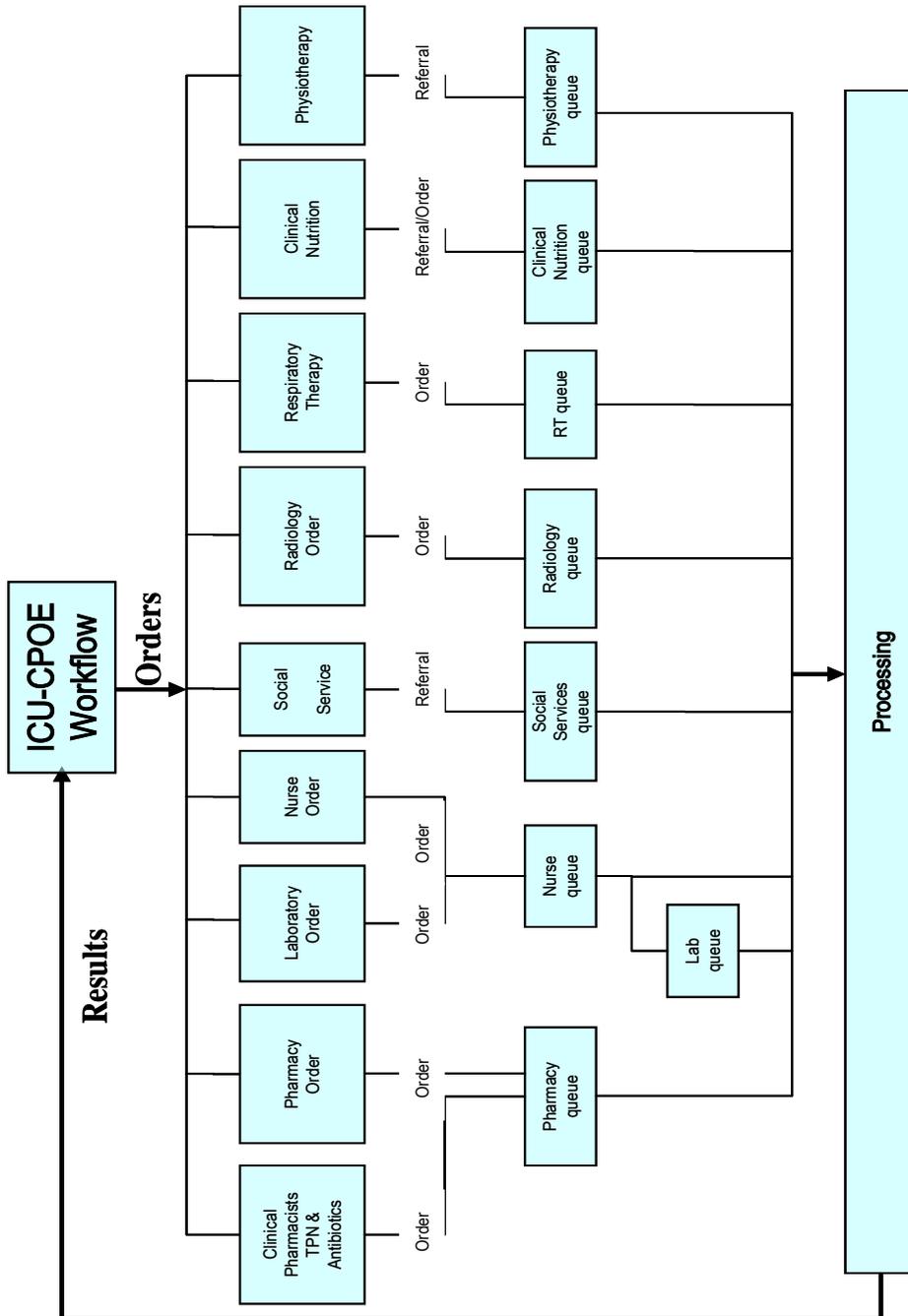


Figure 3: The CPOE workflow implemented in the ICU at NGHHA

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