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Order Entry (OE): Improving Patient Care with Informatics

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ABSTRACT

Delivering high quality medical care with improved outcomes while keeping associated costs down is the mantra of today's health care environment. Converting a health care delivery system from paper to the computer-based patient record (CPR) is a complex challenge, but one that must be undertaken to adequately meet the needs of health care providers in highly integrated and diverse care environments. While the effective CPR has the ability to deliver knowledge for decision support to the clinician, order entry (OE) delivers a safe, effective, patient-centered, timely, and efficient method for the clinician to order what is best for his or her patient.

INTRODUCTION: MANAGEMENT APPLICATION DESCRIPTION

Delivering high quality medical care with improved outcomes while keeping the associated costs down is the mantra of today's health care environment. A report from the Institute of Medicine (IOM) calls for six key areas of improvement: l) Safety, 2) Effectiveness, 3) Patient-centered, 4) Timeliness, 5) Efficiency, and 6) Equality. Computerized provider order entry (CPOE) was identified as one of three key strategies by the Leapfrog Group (a coalition of purchasers of health care, including both employer organizations and Fortune 300 companies) to assist in accomplishing improvements in the delivery of health care today (2). The information management application (IMA) chosen for this paper is order entry (OE).

Functional Components & Specific Features of Order Entry

OE provides for fast, accurate entry of order for patient tests and procedures. It allows users to view patient orders and corresponding statuses on line; enter groups of orders for multiple departments as a set with one entry; enter series or continuous orders; generate reports and statistics for nursing areas. The vendor for this particular application is provided within the MEDITECH platform. MEDITECH has a 34 year history of developing, installing, and supporting information systems with major markets in the US, Canada, UK, and South Africa. There are 1,800 customers and MEDITECH employees 2,000. Software revenues in 2002 were $256 million. The privately-held company has a 5A1 Dun & Bradstreet credit rating with 98% customer retention (6).

MEDITECH's OE links nursing locations to clinical departments in an information network, resulting in reduction in staff time required to do the following:

- Enter, review and process patient orders
- Manage patient diets
- View patient results
- Manage Administrative/Clinical data
- Monitor patient population
- Enter and review requisitions
- Monitor patient procedure reports
- Monitor billing
- View statistical information

The OE module plays a pivotal role in MEDITECH's integrated health care information system. OE receives the initial patient information from Admissions and sends information to other applications including the following(6):

- Laboratory
- Pharmacy
- Patient Care System
- Imaging and Therapeutic Services
- Enterprise Medical Record (EMR)

System Architecture

The systems architecture is client server and the software complies with HL7 standards. The system never stops functioning. There are redundant servers, redundant data drives comprised of Raid V redundant disc drives; of those, 3 are live and 1 is tape. These 4 are continuously making back up copies of all information on the system. If there is ever a surge, the hard drives are automatically re-synced. The individual modules may go down for a few moments, but the back-up servers take over. The system is run 100% on battery power. The batteries are charged off the grid. If the grid were to ever lose power, a generator will pick up within 10 seconds. There are 18 batteries all with redundant availability. The health care system is currently in the process of installing blade-servers.

Facility Description

This exercise was conducted in a 118 bed, not-for-profit, acute inpatient hospital, 2 free-standing outpatient dialysis units, 3 clinics that feature family practice, internal medicine, pediatrics, surgery, OB-GYN, and orthopedics. Most of the facility's applications are in the operation, maintenance and evaluation phase of the information systems life cycle. Some of the order entry functions continue to be implemented.

Additional Applications

MEDITECH has a wide range of applications for the health care environment. The following is a list of MEDITECH applications that encompasses clinical, administrative, education and research: abstracting, admissions, accounts payable, accounts receivable, data repository, electronic medical records, executive support system, fixed assets, general ledger, imaging and radiology technology, laboratory, management information systems, materials management, medical record index, NPR (report writer), nursing, order entry, physician practice management, pharmacy, payroll-personnel (employee records), physician report view (electronic signature, access to EMR), scheduling-community wide (6).

Other applications that interface with the MEDITECH system include: Lake Superior Software (LSS) (physician billing), PCTC (home health), 3M, cardiopulmonary (EKGs), Lanier dictation, Vianeta, and Health Stream education for employees.

An HL7 interface is utilized for communication.

BACKGROUND

The history of the information system for the facility began in 1985 when an IBM System 30 main frame was purchased- followed in 1990 when an IBM System 32 main frame replaced the 5-year old IBM System 30. In 1999, mid range client servers were installed. Today, the health care system is installing blade-servers to increase memory, speed and efficiency.

Facility Information System Design and Development

Making the choice of medical information vendor began in 1997. A technical advisory committee from each division and department in the hospital that included nurses, physicians, finance, business office, and behavioral services, home health, and executive administration was formed. Additionally, a medical information system consultant was contracted. An information systems search of medical/hospital information systems revealed 33 different systems. From the 33 original systems identified, 14 requests for proposal (RFPs) were distributed. Seven companies were selected because the applications within these systems were compatible with each other and were available on the same platform.

MEDITECH was ultimately chosen for the organization. In Summer 1998, representative end-users of the product comprised the implementation team. 'Go-live' occurred in June 1999. MEDITECH has many applications. OE is the application focus of the paper as the implications for patient safety are paramount.

The OE application in the described facility is being effectively used for nurses' notes and observations. The radiology department utilizes the OE and scheduling components. Other ancillaries such as laboratory, physical therapy, physician/provider progress notes and orders are in the implementation phase.

Historical Perspectives of OE

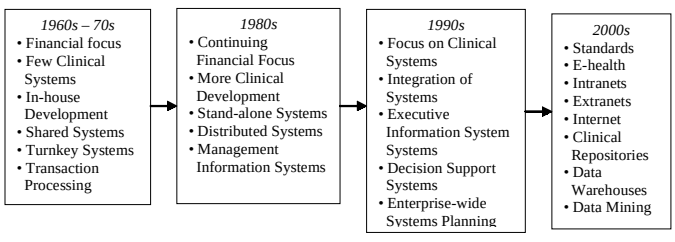
OE cannot be appreciated without understanding the strategic part it plays in the computer-based patient record (CPR). Medical records have historically been kept in paper format. However, as technology has progressed, the CPR is becoming the standard for a patient's health care data. Paper-based records have limitations that reduce the effectiveness for the use of an ever-increasing amount of data. The CPR is a repository of electronically maintained information that can serve a number of users. It effectively integrates elements of a patient's health and illness acquired by multiple providers (10).

Health care information systems have been paper-based for more than a century. Even though 30 – 40 years ago applications for financial functions began to be seen in health care, clinical applications for a paperless record are not the norm even today. Not until 1991 when the IOM published "The Computer-Based Patient Record: An Essential Technology for Health Care", did the need for the CPR come to national attention. The following table (Table 1) illustrates the health information systems evolution timeline (4):

Converting a health care delivery system from paper to the CPR is a complex challenge when one considers that health care organizations can often not be collaborative in nature. In contrast to this, health care delivery systems consist of processes with highly interdependent functions impacted by diverse rules and regulations. The CPR is made up of and supported by many technologies while multiple data sources are required to support the CPR concept. To summarize, the CPR is a combination of technology, software, and data subsystems that come together to accomplish accurate, complete, and timely information for providers and patients with the ability to reach the ultimate goal of improved care and outcomes (4). OE is an integral part of the CPR.

The goal of the CPR is to provide the clinician with the most effective means of making decisions based on the patient's condition. The CPR can provide quick access to the patient's active medical problems, current medications, and drug allergies (10). The paper-based record further reinforces communication barriers among members of multidisciplinary health care teams. Each professional needing to document patient care/findings often waits until the end of the shift to document in the paper-based record. Another problem inherent in this type of documentation is that of legible handwriting (5). Within the CPR resides the function of OE that provides clinicians clear methods for making informed choices in caring for their patients and has been shown to substantially reduce errors when ordering.

Table 1. HEALTH CARE SYSTEMS EVOLUTION (Johns, 2002)



INFORMATICS = COMBINING COMPUTER AND INFORMATION SCIENCES

A discussion of informatics is not complete without giving attention to its definition. Gorn (1983) defined informatics as "computer science plus information science" (3). Graves and Corcoran (3) further explain that with the addition of nursing science, nursing informatics as a discipline is designed to assist in the management and processing of data, information and knowledge related to nursing practice.

Architecture, engineering and technology of hardware, software, and communications are the cornerstones of computer science. Advancements in computer science have increased abilities for nurses to utilize and assist in the development of applications such as the CPR and within it OE modules (9). Evolving computer science occasionally began in universities in the electrical engineering departments due to major concerns being computer architecture and design. However, the computer scientists were also challenged with programming languages and software that differed from the pure characteristic of engineering and seemed more similar to mathematics (10).

Information science has its roots in the field of library science and is related to managing paper-based and electronically stored information. Most recently, the term *information science* is being referred to as *cognitive science* (10). According to Turley (11), Ryan and Nagle (1994) developed the following six criteria for determining a "science of information":

1) Derive from observations of the functions, structures, dynamic behavior, and statistical features of information and the symbols used to represent information.
2) Respect the distinction between limited symbol combinations and the rich human understanding they are used to represent.
3) Fit with our established understanding of nature including the existence of complex living organisms, together with social groups of such organisms.
4) Offer a context into which established but hitherto isolated theoretical aspects of information engineering, e.g., automation theory can be fitted.
5) Offer useful guidance to those engaged in the design of information systems to serve organized groups of people in the most cost-effective way.

The fundamental elements – information technology, information structures, information management and communication – are tools taken and adapted from information and computer sciences to create nursing informatics (1). Graves and Corcoran (3) describe the "management component of informatics" as "the functional ability to collect, aggregate, organize, move and represent information in an economical, efficient way that is useful to the users of the system". New clinical tools, such as the CPR and the particular application of OE, enable workflow changes that ease communication and sharing of professional expertise among health care providers (5).

CPR FUNCTIONAL COMPONENTS

A comprehensive CPR system takes the elements from information and computer sciences to create five functional components as follows (10):

1) Integrated view of patient data
2) Clinical decision support
3) Clinician OE
4) Access to knowledge resources
5) Integrated communication support

Table 2. STRENGTHS AND WEAKNESSES OF THE CPR

STRENGTHS	WEAKNESSES
• Quick access and ease of access to information • Duplicate copies of information retrievable if originals are lost or damaged • Processes large and difficult tasks quickly • Permit ready access to volumes of professional resources • Access and view customization	• Lack of clear definition • Occasional difficulty meeting needs of multiple end-users • Lack of standardization • Potential threat to privacy and security • Potential for increased costs

The CPR as defined by the IOM in 1991 is "…an electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts, reminders, clinical decision support systems, links to medical knowledge, and other aids". One major benefit to the CPR is that the record is centrally located in network files and can easily be updated and maintained. These files can also be backed up onto electronic storage media and filed off-site or in other protected storage area. There are other strengths of maintaining a CPR, however, there are weaknesses, too, as seen in Table 2 (8).

If the ultimate goal of a CPR system is to assist clinicians in making informed decisions, the system needs to present relevant information at the time of OE. The most effective decision support is provided at the time that the provider is making the assessment of the patient's condition and making ordering decisions. The ability of a system to provide summary information about the patient's status with accompanying information regarding protocols for which the patient is eligible during the utilization of the OE function gives instant feedback to the provider for consideration (10).

Data, Information, and Knowledge

It can be said there is a continuum that moves from data to information to knowledge.

There is a progression of transforming data into information and information into knowledge and

knowledge can then be applied to make decisions. The use of OE within the framework of the CPR is an example of the processing and application of knowledge (3). Computerized OE systems allow for direct provider/prescriber interaction. As more providers get involved, OE systems are becoming more refined and expanded with increased functionality. Clinical decision support is provided at the time of OE providing guidance and incorporating knowledge to help the clinician in completing appropriate orders (7).

OE falls within the knowledge area of the continuum as it is at this point of encounter with the CPR that the clinician is given decision support. Knowledge can be described as a combination of rules, relationships, ideas, and experience. The provider about to submit orders on a patient must be able to make decisions based on current information in combination with previous experience or knowledge of the situation and this is what the CPR delivers (4).

EVALUATION OF THE IMA

The information management application of OE was evaluated for ease of use, technical support, end-user participation in selection of the IMA, end-user training, and organizational objectives.

MEDITECH is a very integrated and complex system with a multitude of applications Since the implementation of MEDITECH in 1998, many of the original "Core Team Members" have left the facility. This has caused some problems with the availability of employees who are trained in the system and know it well enough to train new employees. With practice, however, navigating through the system is not difficult.

The facility's Information Technology (IT) Department has a close relationship with MEDITECH technical support while MEDITECH has extensive customer technical support with 24-hour coverage. Online information is available for searching and problem solving/trouble-shooting. Problems have been encountered with MEDITECH organization-wide support when applying version updates to the system. There are also issues when integrating applications from other vendors. The problems are primarily those of timeliness and could be attributed to remote problem solving and trouble-shooting.

There is a "Core Team Member" in every facility department who has a contact person assigned at MEDITECH. Other employees can contact MEDITECH directly if necessary. Personal experience with MEDITECH technical support has been excellent. MEDITECH employees are customer oriented and provide real-time solutions.

In 1997 a Technical Advisory Committee from each division and department in the facility was convened to search for an information system. End-users in the facility were involved in every phase of evaluation and selection of the vendor. Regarding MEDITECH's installation planning, end-users are well prepared to roll out OE. MEDITECH's web site also has excellent tools for the ongoing training of end-users of the OE module. However, there doesn't appear to be a consistent and available training program in the facility and training appears to be carried out more on an "as needed" basis. Improvement is warranted in this area.

Interview with the Chief Information Officer (CIO) for the facility revealed the following institutional initiatives for IT: 1) Full patient safety to ensure the rights of patients, and bar coding (possible RFI-biochip technology); and 2) Conversion to a completely paperless system (MEDITECH EMR implementation). Even though these are clearly defined initiatives, they are not well known by employees at-large. A recommendation would include development of a work plan to show accomplishments being made in reaching the stated objectives. There is much activity within the organization related to these objectives, but no defined method to track and report them.

LESSONS LEARNED

There were many issued related to information systems, technology, hardware, software, history of information science, and computer science covered in this experience. The exercise was well designed and followed a logical progression from the identification of the IMA within the chosen facility to observing the IMA at work; gathering historical information regarding the development of the IMA itself as well as the implementation of the application within the facility. Functional components of the IMA were determined and questions asked and answered regarding the integration of a health care system with specific reference to the IMA.

The exercise also encouraged the exploration of the complexities involved with evaluating information systems and lead to the appropriate questions to be asked when determining the best fit of a system with the intended environment. Another important component was the consideration of the IMA and how to determine its place on the continuum of data, information and knowledge.

The most important lesson is, when involved in considering, choosing, planning, and implementing an information system, attention to detail cannot be overstated. Almost as important, is the effort that should be undertaken to understand the management and governance and politics of the facility. Jobs and people are intimately affected by change in processes. Therefore, if all the steps and considerations mentioned here are not carefully followed, poor implementation occurs and only serves to institutionalize bad processes (10).

The many challenges presented for the field of health care informatics necessitate knowing the basics of data, information, and knowledge; understanding the discipline of the environment; listening to the needs and wishes of the users; and finally, bringing all of this together to increase efficiency, reduce costs, and improve patient outcomes. No small task, but one that is worthwhile.

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