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ITB12779

This paper appears in the book, *Emerging Trends and Challenges in Information Technology Management, Volume 1 and Volume 2* edited by Mehdi Khosrow-Pour © 2006, Idea Group Inc.

Improving Hospital Performance: A Framework for Designing Medical IT Systems

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INTRODUCTION

This study originated with strategic management work done at Jamaica Hospital in Queens New York and the Jewish Home and Hospital for the Aged in Manhattan, New York. As background for the project, the initial phase involved industry-wide studies of healthcare institutions throughout this country and abroad. During these studies, which involved both field research and a review of the research literature, many samples of which are given throughout this paper, it became apparent that advances in hospital Information Technology (IT) are having a dramatic impact on improving patient healthcare services. After a brief overall review of the hospital industry, this paper describes that impact and provides a framework for systems developers interested in creating medical IT systems, hospital managers and others considering introducing or expanding such systems, and readers generally exploring the nature of these systems. The concluding section of the paper summarizes the overall benefits of such systems.

THE HOSPITAL INDUSTRY

Hospitals have one major strategic function: deliver the best possible healthcare services they can to their patients. This is done through the services rendered in the hospital directly by doctors, nurses, technicians, and other hospital staff and treatment facilities from the time patients enter the hospital to the time of their discharge and continues with follow up visits.

Professionals (either physicians or those working in the many hospital healthcare facilities) treating the patient need to record information at each point in the treatment process in order for each professional to be able to effectively identify the nature of the ailment and to recommend and then perform the appropriate treatment. Problems arise with this process when it is largely paper-based or stored in nonintegrated systems. These types of errors alone have been estimated to kill over 7000 U.S. hospital patients yearly and drive up healthcare costs by an estimated $2 billion [1; 2; 3].

A number of hospitals in this country are leading the way in developing and using information systems to solve these problems by creating the "Digital Hospital", in spite of the substantial costs involved [4; 5; 6]. Evidently in 2004 not enough U.S. hospitals were moving into the digital area, however. As a result, in mid-2004 Secretary of Health and Human Services, Tommy Thompson supported by President Bush, unveiled an ambitious 10-year initiative to transform hospitals in this country more aggressively and rapidly [3; 7]. Individual states, for example Massachusetts, were also considering both government and private financial support for this effort [8]. The focus will be on computer entry of prescriptions, improved intensive-care unit (ICU) staffing, and easier access to individual patient records for both the patient and hospital staff by integrating patient and other hospital records into integrated databases.

Figure 1. Major areas medical IT systems are generally developed in

Client/Patient Orientation
An Integrated Accessible Electronic Database
Prescription Writing and Delivery
Intensive Care Units (ICUs)
Telemedicine/Telesurgery
Healthcare Facilities and Their Financing
Other IT Related Systems

ROLE OF ADVANCED AND BASIC INFORMATION TECHNOLOGY APPLICATIONS AS IMPROVED HOSPITAL HEALTHCARE ENABLERS: A FRAMEWORK

During the studies done at the Jamaica Hospital, as well as at the Jewish Home and Hospital, a major segment of the strategic plans involved new medical IT systems. This grew out of both the needs of the institutions in improving healthcare services as well as from the successful IT application models at other hospitals which had introduced successful new medical IT systems. The discussion in the following section provides an overview framework developed from that study, a framework which might help provide guidance to those thinking about understanding, developing, and introducing such systems. This framework is outlined in Figure 1.

Client/Patient Orientation

Hospitals have many divisions, such as radiology, emergency room care, test labs, prescriptions, medical nursing assistance, hospital rooms, and kitchens and food service, which provide services to patients. The doctors deal with these different divisions, as well as with individual patients, as do nurses and other staff members whose time needs to be scheduled and managed. Tracking is needed to bill patients, preferably in a coordinated way, to maintain staff schedules, and to manage all operational areas efficiently and effectively.

Interestingly, many hospitals studied do not even have an integrated billing system for patients, who receive separate bills for different department services and room accommodations. This creates some confusion among patients and their insurance companies.

An Integrated Accessible Electronic Database

Based on hospital experiences with information technology development, the starting point almost always involves building accessible integrated electronic databases, especially in relation to individual patient information, as suggested in the preceding section. The most significant applications of such databases are in the prescription writing and delivery area and in the ICU area. These findings are consistent with

the authors' studies of individual hospitals and the areas which might benefit most from improvements.

Prescription Writing and Delivery

Probably the most visible evidence of the new Digital systems at the Children's Hospital in Pittsburgh, a pioneer in advanced hospital digital hubs, is the trolley used by physicians when visiting individual patients. The trolley has a laptop computer and wireless network card, which physicians use to log into a program containing all the clinical information on each of their patients, ranging from past treatments and CAT scan images to various test results. The physicians fill out medication orders **online** and send these orders from the ward on the seventh floor to the in-house pharmacy in the basement, where a robot puts the prescribed drugs in an envelope for the nurses to dispense. All of this is made possible by the electronic patient database.

This laptop enabled system significantly reduced the major problems encountered from medication errors under the old paper-based system, errors which generally in the U.S. caused over an estimated 7,000 deaths annually industry-wide. While medical information technology applications do not necessarily eliminate all errors—in fact they introduce some new ones—they do substantially reduce these errors [2; 11].

Intensive-Care Units (ICUs)

In addition to major benefits in the prescription writing and delivery area, a major benefit of medical IT systems is found in the management and running of ICUs. For example, in late 2004, intensive care patients at Inova Alexandria Hospital were scheduled to be monitored around the clock by more than doctors and nurses at their bedside [9]. Intensive-care specialists will also monitor ICU patient care from miles away through digital cameras, microphones, and special software which link ICU patients and their distant caregivers. This system will enable these distant caregivers to remotely monitor heart rates, blood pressure, respiratory rates, and other vital signs of critically ill patients even more closely than the on-site duty staff can and so provide guidance to that duty staff. Such rapid medical intervention can at times mean the difference between life and death. The hospital's new intensive-care system (developed by VISICU, a Baltimore company) is a major early step in bringing an "eICU" or "Virtual ICU" into its four hospital complex. It is part of the industry wide struggle to improve intensive care while coping with the shortage of intensive-care medical specialists. Sutter Health hospitals in Sacremento, California, have a similar ICU system [12], as does New York Presbyterian hospital [13].

BENEFITS CAN BE SUBSTANTIAL AND IMPRESSIVE

In addition to these benefits already discussed, Cincinnati Children's Hospital Center, for example, which won the 2003 Nicholas E. Davies EMR (Electronic Medical Record) Recognition Award of Excellence after implementing an integrated clinical information system (ICIS) to provide clinical decision support tools including Siemens Medical Solutions (INVISION®). The results were elimination of transcription errors, a 50% reduction in medication errors, a 52% improvement in medication turnaround times, a 24% reduction in verbal orders for controlled substances, and 100% compliance with pain assessment documentation requirements defined by state regulatory agencies [17].

Delnor Community Hospital also showed impressive results with Heartmath's customized technology Freeze-Framer®. After the first year, the overall employee turnover was reduced from 28% to 20.9% which led to an $800,000 in annual savings, Medicare length of stay decreased by 9%, equaling a $1.4 million savings annually, customer satisfaction improved from the 73rd percentile to the 93rd percentile, and the hospital was ranked first in employee satisfaction based on Sperduto and Associates. During the second year the results were maintained with turnover down to 14% and the hospital was ranked second in employee satisfaction [18].

In addition to the benefits already discussed in this paper, hospitals across the U.S. and overseas have used medical IT systems and other supporting digital systems to reduce patient waiting times, slash wheelchair inventories, prepare operating rooms faster and move patients through a hospital stay or doctor visit quickly, seamlessly and error free, creating major cost reductions along the way in addition to improved patient healthcare.

CONCLUSION: A SITUATIONAL ORIENTATION

While it is important to review industry practices, the ultimate decision is a situational one. Individual hospitals have their own special needs. For example, Jamaica Hospital and the Jewish Home and Hospital were each very distinct in the services they provided and the kind of clients they served; as a result the IT systems they developed were different in many ways. Kapolani Medical Center in Hawaii was uniquely situated to develop its telesurgery program. At University hospitals, their relationship with their physicians on staff on occasion enabled them to move more quickly into automated prescription processing.

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