HEALTHCARE TECHNOLOGIES: EVALUATION AND USE OF COMPUTERIZED PATIENT MEDICAL RECORDS AND OTHER TECHNOLOGY

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ABSTRACT

Information Technology has a very important role in the delivery of quick, high quality healthcare services. This paper will look at some current and possible future uses of Information Technology in the healthcare environment as well as some of the associated pros and cons that result from their implementation. This paper will examine Strategic Healthcare Decision Support Structures/Systems (SHDS), Knowledge Management (KM), Computerized Physician Order Entry (CPOE) and Computerized Patient Medical Records (CPMR).

INTRODUCTION: BACKGROUND AND COMPLEXITY

Information Technology (IT) allows companies to create, process, analyze, store, protect, retrieve, and communicate information. When applied to Health Care, IT can enhance patient and hospital safety, improve efficiency and effectiveness and raise equity.

The establishment of Medicare and Medicaid in 1965 made the Federal Government the health care industry's largest consumer and changed the mission of hospitals from charity-care institutions into business organizations concerned with revenue. The reason for the transformation is because prior to 1965 all patients either paid for their services or an insurer covered the cost of healthcare. After the introduction of Medicare and Medicaid, the federal government became responsible for millions of citizens who previously could not afford healthcare insurance or were not able to obtain coverage. What this did to the healthcare industry was in effect make the federal government their customer. In the period from 1965 to 1983 the federal government noticed a sharp increase in national healthcare expenditures. Regulations such as the diagnosis-related grouping (DRG) reimbursement scheme for Medicare and Medicaid patients in 1983 were enacted by the government as a means of containing the rising costs of healthcare (Menon & Lee, 2000). Prior to 1983, hospitals were reimbursed for services on a cost-plus basis. What this means is that the hospital is reimbursed by the federal government the exact amount that it cost the hospital to perform a procedure plus a percentage. The DRG reimbursement scheme groups all procedures into over 500 different groups and then places a weight on each type of procedure. The hospital is reimbursed a flat fee based on an average derived from the weight assigned to a procedure and the cost of procedures that fall within a particular DRG. Changing regulations, Medicare, Medicaid, changing payment schemes and Health Maintenance Organizations have forced the health care industry to become more cost conscience and thus seek mechanisms to improve efficiencies. As a result, spending on Information Technology to improve efficiency has increased dramatically. IT was first introduced to health care to support business functions, primarily accounting and finance, however, they are increasingly finding their way to the "Point of Care", where physicians, nurses, and other care givers meet with the patient.

The formation of Health Maintenance Organizations has forced the healthcare industry to seek more efficient methods. Spending on information technology and other mechanisms of improving efficiency has increased dramatically. Information technology first began to be used into healthcare primarily for non-clinical purposes. Hospitals invested in mainframes in the 1970's when software applications in use were primarily accounting and financial (Menon & Lee, 2000).

PHYSICIANS VERSUS HOSPITALS

While the described changes have contributed significantly to the difficulty of managing in the modern health care environment, the complexity is more deeply rooted than these recent changes. Physicians and hospital administrators have been educated with different philosophical approaches. Physicians are taught in Medical School that nothing is more important than the physician and his/her patient and that nothing should jeopardize or interfere with the physician's determination of an appropriate protocol and the resulting care. Administrators are typically trained in Business schools and are taught that nothing should interfere with the survival and well-being of the business. Therefore, any physician's decision which requires additional expenditures for the hospital places physicians and administrators in conflict. For example; a decision to prolong the length of stay of a patient may be seen as an important precautionary measure to the physician, while administration would consider this decision detrimental to profit and therefore one which should require sufficient justification.

Physicians are decision makers who are autonomous, independent patient advocates and identify themselves with a profession. Administrators are managers who collaborate and participate as a part of an organization and identify themselves with the organization.(Epperson and Barakat, 2004)

An excerpt from research conducted by Thomas L. Lincoln and Carl Builder at the University of Illinois in 1999 best describes the relationship between Physicians and hospitals:

> *Physicians in the US, just like farmers in the past, have been an independent lot, many, if not most, have chosen the profession because it offered freedom of judgment and freedom of action. As late as the mid 1980's in the US (and still in parts of our south), physicians could be described as a loosely structured tribal culture, socially (but not electronically) networked, who marketed a basket of services to patients who did not pay for these services directly. The bulk of patients' bills were paid for by insurance companies through contracts made largely with business enterprises, who were paid by the government using various programs, often relying on these same insurance entities. (A significant number of the poor were left out, but were presumably served in some manner by charity and teaching institutions and hospitals with non-profit tax agreements). Most doctors worked from independent offices near benignly supportive healthcare facilities. These hospitals organized and controlled an astonishing and ever growing array of equipment and support services, but behaved in a largely hands-off manner toward their accredited staff, who, in a symbiotic fashion peculiar to the US, were responsible for the hospital's income, but did not work for them.*

As noted by many, these arrangements generated open loops without controls that favored ever increasing billable activities (Lincoln & Builder, 1999, p. 8). Information Technology offers a unique opportunity to improve efficiency as well as patient care.

CURRENT USES OF INFORMATION TECHNOLOGY

Healthcare is a major industry in all developed countries where thousands of millions of dollars are spent each year and many millions of people are directly or indirectly employed. As a consequence, modern healthcare systems are extremely complex. This imposes constant

demands for information at virtually all levels of the healthcare system, including decision making, policy development, short-term and long-term planning, budget forecast and planning, management, research and development, and most importantly patient care and clinical services (Egan & Liu, 1994). In 1979, delegates from the International Federation for Information Processing (IFIP) concluded that information technology in itself would not solve the problems that faced healthcare but that "the key [was] not so much the technological capability [of information systems], but technological performance [of the computer systems] conjoined with medical, nursing, and administrative staff's perceived need to improve the effectiveness of their components of Health Care" (Ball, 2003, p. 4). Healthcare organizations have had to re-engineer the structure of their organization so that they could take full advantage of the increased efficiency brought about through the use of IT tools (Abidi, 2001). The first step is to evaluate what data they already had available from day-to-day operations. Healthcare enterprises [are] 'data rich' as they generate massive amounts of data, such as medical records, clinical trial data, hospitals records, administrative reports, benchmarking findings, and so on (Abidi, 2001). The key is using this information to help the organization make informed decisions that will increase the quality and efficiency of patient care while reducing the costs of performing the procedures that make this care possible. Hospitals have "learned" to convert "raw materials" or input factors such as medical equipment, IT technology, and labor into a certain level of service or patient care (Menon & Lee, 2000).

Today, hospitals in the US are increasingly focused on technology-enabled clinical improvement, to control costs and respond to demands for quality care (Ball, 2003). Effective information management and communication of data require that healthcare systems install computer networks both within and between various healthcare institutions, particularly between urban and rural healthcare institutions (Egan & Liu, 1994). Healthcare professionals have always been quick to adopt focused applications based on (or augmented by) computation which offer evident diagnostic and therapeutic advantage such as CAT scanners, sound activated imaging, and laparoscopy, even where virtuoso coordination between professionals and their instrument packages has been demanded (Lincoln & Builder, 1999). Advances in IT in the healthcare area has led to the introduction of systems such as order entry systems and Community Health Information Networks (CHINs) which directly affect the production of healthcare services (Menon & Lee, 2000). An underlying aim of the information access [available today] is to allow increased communications and information exchange on an intra-hospital, inter-hospital and associated clinics basis (Egan & Liu, 1994). Many healthcare establishments now operate heterogeneous IT environments with equipment ranging from stand-alone PCs to minicomputers and mainframe installations (Beuscart-Zephir et al, 1997). "[These accomplishments increase the] …ability for remote clinicians to consult with diagnostic imaging specialists and other specialist clinicians [which] greatly improves the accuracy and speed of patient diagnosis, uses resources more effectively and efficiently, which leads to a positive impact on patient care while minimizing healthcare costs" (Egan & Liu, 1994, p. 2).

STRATEGIC HEALTHCARE DECISION SUPPORT SYSTEMS

Effective delivery of healthcare depends on the organization's ability to deliver appropriate, value-added services to critical decision centers of the organization so that the center can take the most appropriate course of action based on the information provided (Abidi, 2001). This school of thought is known as knowledge management. Knowledge management in healthcare can be regarded as the confluence of formal methodologies and techniques to facilitate the creation, identification, acquisition, development, preservation, dissemination, and finally the utilization of the various facets of a healthcare enterprise's knowledge assets (Abidi, 2001). One computer system that has had a dramatic affect on the efficiency of healthcare

organizations and is part of the knowledge management process is the strategic healthcare decision support system (SHDS). The SHDS can best be defined as a suite of knowledge/data-driven, strategic, decision-support services derived from both healthcare data and the health enterprise's knowledge bases (the past experiences of employees), with the objective to improve the delivery of quality healthcare services (Abidi, 2001). Typical SHDS can perform functions such as trend analysis of reimbursement percentages of insurance carriers, patient length of stay, ER turnaround time, drug usage, increase of elective procedures after a marketing campaign; SHDS also can perform benchmarking and budget variance reporting, etc (Abidi, 2001).

CURRENT IT AT THE "POINT OF CARE": COMPUTERIZED PHYSICIAN ORDER ENTRY

Another computer system that is currently in its infancy, but is proving to be a valuable asset to healthcare is computerized physician order entry (CPOE). Computerized physician order entry has become a priority since the publication of the article 'To err is human' in the National Academy of Sciences Institute of Medicine in November 1999. This article highlighted the staggering number of complications and sentinel events (an unfavorable occurrence in a clinical setting that can have possible life altering effects due to clinician error), and stated that a large majority of these events were due to patients having multiple physicians that did not know what the other physicians were prescribing (To Err Is Human, 1999). The CPOE system allows physicians to electronically enter their orders into the health information system and then sign their orders using an electronic physician signature (Ball, 2003). The CPOE system displays all physician orders for a patient and allows clinical personnel to read the order of each of the patient's physicians clearly, thus avoiding the possibility of administering medication to the patient that would interact with other prescribed medications and could cause a sentinel event (Ball, 2003). Another advantage to CPOE is that it creates a paperwork trail that can be used in evaluating and trending clinical outcomes in order to improve overall quality in the healthcare system (Ball, 2003). CPOE is a relatively new technology and currently has not had widespread implementation at healthcare institutions across the country. A 2001 study reported that only 16% of healthcare organizations had CPOE up and running in 2001, but 67% planned to add CPOE in the next few years (Ball, 2003).

FUTURE IT AT THE "POINT OF CARE":COMPUTERIZED PATIENT MEDICAL RECORDS

Thomas J. Watson, Chairman of IBM, assured the world in 1945 that "there is [a] world market for 15 computers" (Kaku, 1998, p.6)." In 1977, Ken Olson, President of Digital, said that 'there is no reason to… have a computer at home" (Kaku, 1998, p.6). These two statements are great illustrations of what visionaries of the past thought about the usefulness of computer information technology. In more recent times it should be noted that more human knowledge has been created in the last decade of the 20th century than in all previous human history (Kaku, 1998). The future of healthcare appears to be a bright one. The healthcare environment is currently experiencing increased emphasis on the prevention and early detection of disease, primary care, intermittent healthcare services provided by medical centers, home care, and continuity of care (Tsiknakis et al, 2002). One of the instruments that is currently being developed to aid in the efficient and effective delivery of healthcare is the computerized patient medical record (CPMR). The CPMR or non-paper medical record can be either scanned text, patient data entered into a generic form, or fully coded data (van Ginniken, 2002). The record could be used in only one department of a hospital or health care clinic, or it could be used across multiple health care facilities (van Ginniken, 2002).

ARCHITECTURE OF CPMRS

There are several different architecture types for CPMRs. Before discussing the different architecture types of the CPMR, it is important to understand what the architecture of a computer system is. "An [computer system] architecture is a formal description of an IT system, organized in a way that supports reasoning about the structural properties of the system. It defines the components or building blocks that make up the overall information system, and provides a plan from which products can be procured and systems developed, that will work together to implement the overall system" (Tsiknakis et al, 2002, p. 7). The architecture of a CPMR system may be composed of various types of computer hardware and software. Hardware can include, but is not limited to Servers, PC workstations, Document imaging equipment, Data Warehouses, etc. The network of a CPMR can be made up of various networking media such as fiber optics, CAT-5 twisted-pair cable, coaxial cable, wireless networking technologies, etc. The data formats for CPMRs can vary tremendously. The CPMR can be in the form of scanned images or text files, or it can be fully coded using SEQUEL coding or other web-enabled languages such as XML (extensible markup language). There are certain technological requirements for the CPMR that are defined by user needs and specifications. These specifications ware documented by the Professionals and Citizens Network for Integrated Care (PICNIC, 2002) and are the following:

> *round the clock availability; provision of fast responses even at high workload periods (therefore, workload balancing and redirection be considered); restricted access to information; easy maintenance (remotely in some cases-automatic notification in place); low usage cost; role-based access to information; secure communication of information; activity monitoring; access to reliable, and up-to-date information; native user interface; support direct access to multimedia clinical data communication; scalable (new IT systems should be easily incorporated…); support for standardized coding (semantic unification is a real need); customizable user interface (both adaptive and adaptable to the expertise level of the end user—allow for the isolation and identification of clinical significant information); and highly available(i.e. across various networks and platforms)* (Taken from PICNIC web page).

CONCLUSION

The healthcare industry has evolved into an industry that is powered by sophisticated knowledge and information resources. Information Technology has been an instrumental tool for ensuring the reduction of overall costs while efficiently maintaining quality patient care. These gains would not have been possible without the technological advances in computer systems that have enabled integrated multi-level health information systems that are being used today. Current systems such as the strategic healthcare decision support systems will continue to help managers make educated decisions, while new systems such as computerized physician order entry and computerized patient medical records will aid clinicians in assuring quality patient care while minimizing waste.

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