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Health Informatics: Managing Information to Deliver Value

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Abstract

Can informatics improve health? This paper answers yes, exploring its components, benefits, and effect on a wide variety of health-related activities. We first examine how information technology enables health informatics, supporting information management and knowledge creation through its four cornerstones. Success factors in using informatics are covered next, including human factors, the role of trained health informaticians, and the importance of matching informatics initiatives with business goals and establishing and measuring value. We demonstrate the potential effect of the Internet on health services through such e-health applications as enterprise-wide patient records, state-of-the-art call centers, and data repositories. For current evidence that informatics is already improving health, we turn to such topics as disease management, telehealth, patient safety, and decision support. As more organizations move informatics from theory into practice and realize its value, they will transform inefficient processes and improve care for all.

Keywords:

Health Informatics; Information Technology; Information Management; Internet; E-Health

Introduction

We often cite the preface to the ***Yearbook of Medical Informatics 1999,*** in which Hans E. Peterson observes that the new challenge of medical informatics is "to learn what fundamental values in health care are supported by information technology and how they can contribute to its continued development."[1] The Yearbook's intent is clear: to assess early expectations and outcomes and examine what is expected of informatics in decades to come.

In this paper, we enlarge this context to include a spectrum of health-related activities, from wellness and population-based programs to illness and patient-focused care. One question drives our discussion: Can informatics improve health? We look not to academic or theoretical models, but to current practices and applications. At the same time, we examine how the Internet and patient empowerment are influencing the functions, practices, and disciplines that affect health and wellness. Specifically, we will establish:

- Components of health informatics
- Success factors in using informatics
- The effect of the Internet on the provision of health services
- Current evidence that informatics improves health

Health Informatics Components

Although the rapidly evolving discipline of health informatics lacks a single definition, we define it as the use of information technology (IT) to bring strategic goals from theory into practice. This will require a focus on value,[2] which resides in the relationship between cost containment, customer service, and superior clinical outcomes. Expressed conceptually,

$$(\text{Service} + \text{Quality}) \div \text{Cost} = \text{Value}^{3}$$

To achieve this value proposition, we must receive and generate data, transform it into useful information, and transform information into knowledge. Information technology enables this process, supporting information management and knowledge creation through its four cornerstones, described by Nancy Lorenzi in the *1999 AMIA Proceedings*:

- "Producing **structures to represent data and knowledge** so that complex relationships may be visualized.
- "Developing methods for **acquisition and presentation of data** so that overload can be avoided.
- "**Managing change** among people, process, and information technology so that the use of information is optimized.
- "**Integrating information** from diverse sources to provide more than the sum of the parts, and

> integrating information into work processes so that it can be acted on when it can have the largest effect."[4]

As Lorenzi notes, these cornerstones "extend well beyond the skills associated with traditional data processing and information systems."[5] They stress the need to transform data into information and from accumulated information to create knowledge. They also acknowledge that human factors, not technical considerations, are the greatest obstacles to informatics success.

Success Factors

According to investment analysts Volpe Brown Whelan and Co., health care wastes as much as $270 million a year on inefficient computer systems.[6] Undoubtedly, waste exists, but it may result less from inefficient systems than from ineffective use of them. Attempts to redirect investments should be guided by this assumption. In his book, ***The Squandered Computer***, Paul Strassmann remarks that

> "the principal purpose of investing in IT is not overhead cost reduction but value creation. Cutting costs can contribute to profitability, but in the long run one does not prosper through shrinkage. The objective of all investments is to improve overall organizational performance."[7]

To optimize information management, successful organizations focus first on values. Human factors are key. Throughout an implementation, IT and health professionals must work together to understand problems and construct solutions. Trained health informaticians play vital roles in these partnerships, helping health professionals understand informatics and make wise decisions about IT.

In the broadest sense, human factors include organizational and professional development, both of which imply redesigned work processes.[8] Such efforts must be ongoing. If staff are to learn new skills, tools, and technology, "unlearning" old ways is critical—and even more difficult than learning the new.

As they acquire and integrate IT, organizations also must target objectives and processes that match their business goals. Establishing and measuring value will be an ongoing obligation. Those with newly installed and incompletely leveraged systems should revisit such critical activities and establish a clear agenda for change.

In short, a sound strategy set by the business plan is the driver of success, informatics is the enabler, and information technology provides the tools. New ways of doing work are the final reward. After being used for specific purposes, new technologies and the changes they enable will become more widespread. As in the classic three-stage model for technology adoption, substitution will give way to innovation, which will give way to the ultimate achievement: transformation.

Effects of the Internet

John Naisbitt has aptly noted that "the new source of power is not money in the hands of a few, but information in the hands of many."[9] Because information saves lives in health care, the Internet's real power is its ability to deliver information when, where, and how it is needed.

Many organizations are already harnessing this power. For example, the National Cancer Institute (NCI) is developing a Cancer Informatics Infrastructure (CII) to optimize Web technology and translate research into clinical care. The CII will create a knowledge environment that serves multiple stakeholders and supports the continuum of cancer research.[10-12] Initially, the CII will focus on easing and speeding the clinical trials process, which reaches across sectors.

In the private sector, health plans and integrated delivery networks are developing e-health offerings, using the Internet to improve consumer services and business-to-business processes. In early 2000, most organizations were still in the early stages of development, but had ambitious near-term plans. Most had published online, while some allowed limited interaction. Although all had yet to integrate multiple transactions and transform the entire process,[13-14] organizations are moving slowly toward the later stages of development and revisiting their early work.

As traditional healthcare settings move toward wellness and population-based health, they are using the Internet to link consumers and organizations. Web-enabled applications will become the new standard, bridging gaps between legacy applications to create enterprise-wide patient records, provide state-of-the-art call centers, and support data repositories to better the relationship between medicine and public health. Consumer health portals will also grow in scope and use. Early 2000 estimates by CyberDialogue put the number of health-related websites at about 17,000, including a growing number of consumer-oriented sites, and Harris Interactive estimates that 60 million or more visit these sites.[15]

In addition to online information, consumers can seek consults, interactive tools, and support groups. They can also post and maintain their medical records on the Web, representing the next generation of computer-based patient records. These records represent the best hope for maintaining comprehensive information,[16] allowing the one true coordinator of care—the patient—to manage his own record.

Such sites and applications offer new capabilities and new problems. For example, consumers can allow caregivers access to their health records during emergencies, but consumer-controlled records may not always include all timely, relevant information. Sites providing consumer

advice may not identify sponsors or potential conflicts of interest, and a site's credentials may be hard to validate.[17] Help is provided by the Geneva-based Health On the Net (HON) Foundation (www.hon.ch), which guides lay users and medical professionals to reliable sources of online healthcare information with its widely-used medical search tools and the HON Code of Conduct (HONcode©).

As Internet applications—particularly consumer-focused ones—change the terms on which physicians and patients interact, compromise will be crucial. Patients must grasp the complexity and variability of online information, and doctors must help them evaluate and act on it. According to Saurage-Thibodeaux Research, "74 percent of online health site users would be more likely to trust a website recommended by their doctor or pharmacist."[18] This enhances the role of the physician, but such a change in role requires a change in attitude that will challenge both parties—once again underscoring the importance of human factors to the development of health informatics.

Will the Internet help control the cost of health care? Witness its effect on banking: While teller transactions cost between $1.25 and $1.50, Internet transactions cost only $.015. Healthcare organizations choosing the Internet for simple business processes will realize major cost reductions, estimated at 10:1 to 100:1. As online health offerings mature, we expect more documented successes.

Current Evidence that Informatics Improves Health

Although multiple factors have made hard data elusive, we are beginning to gather proof that informatics can deliver value and improve health. Areas of special note include disease management, telehealth, patient safety, and decision support.

Disease Management

With chronic disease accounting for 80% of deaths, 90% of morbidity, and 70% of medical expenses in the United States,[19] disease management programs can have measurable results. They can manage information to better support intervention, preventing or minimizing the impact of chronic conditions on the patient and the health system. One diabetes program reported that none of its enrollees had been hospitalized over a four-year period, and net savings for one year were $510,133.[20] One for congestive heart failure patients reduced the 30-day readmission rate to zero and cut the 90-day readmission rate by 83% through telemonitoring and patient education.[21]

Telehealth

Telehealth can improve the delivery of specialized services. The Veterans Administration has consolidated its imaging services in Maryland; radiologists at its Baltimore facility read digital transmissions of procedures conducted at multiple facilities.[22] IC-USA is launching efforts to provide specialist support for intensive care units to address our severe shortage of intensivists. The concept, tested in a four-month clinical trial that covered over 200 patients, found that adding telemedicine coverage to normal staffing around the clock reduced patient mortality by 60%, complications by 40%, and costs by 30%. IC-USA claims hospitals can realize gross savings of $150,000 per year per intensive care bed, and net about half that amount.[23]

Patient Safety

The landmark study by the Institute of Medicine (IOM) reported in *To Err Is Human: Building a Safer Health System* presents staggering statistics on medical error and highlights issues of value through its focus on patient safety.[24] It cites work by David Bates et al., estimating that 53% to 89% of adverse drug events are identifiable and a small but significant number of them can be prevented through techniques like guided-dose, drug-laboratory, and drug-patient characteristic software algorithms.[25]

Bates also estimates that decision support systems can cut adverse events by 55%,[26] that automated physician order entry shows "an overall savings. . .of between $5 to 10 million per year,"[27] and that preventing adverse drug events saves over $4,000 per event, totaling over $500,000 at one teaching hospital. The IOM concludes that "a computerized system costing $1 to 2 million could pay for itself in three to five years, while preventing injury to hundreds of patients."[28]

Decision Support

Clinical decision support (CDS) systems are being used to enhance decision making and improve efficiency in several different healthcare environments, from acute care to ambulatory practice. Medical records are one example; according to Larry Weed, father of the problem-oriented medical record, their function is to:

> "completely and honestly convey the many variables and complexities that surround every decision, thereby discouraging unreasonable demands upon the physician for supernatural understanding and superhuman competence; but at the same time it must faithfully represent events and decisions so that errors can be detected."[29]

As CDS systems become commonplace, they will feed the data repositories that are key to evidence-based medicine and enable identification of and response to epidemics and biothreats. Such a system was already constructed by the U.S. Air Force: laptops in the field linked by satellite to centralized U.S. databases.[30] Called Desert Care, the system maintains records on individuals, tracks illnesses, and analyzes trends. Initially developed in four months with $200,000 and incrementally enhanced, this provides a remarkable example of the value of health informatics. It

furthers population-based health and demonstrates how information helps individuals understand the context in which their symptoms occur.

Conclusion

Can informatics improve health? We believe the answer is yes. Strategic use of technology makes the information on which health care depends not only available, but also meaningful and ready for use. As more organizations focus on launching informatics projects and making the technology more efficent and effective, we fully expect to see more success stories.

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