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Better Health Through Informatics: Managing Information to Deliver Value

MARION J. BALL

In the correct formulation of the question lies the key to the answer
—Nobelist Max Planck

Learning Objectives

After studying this chapter, you should be able to:

- Explain why the effectiveness of health informatics is dependent on human factors, including the integration of informatics with the business plan and work processes, the existence of teamwork in the health enterprise, and the development of core competencies in the use of informatics.
- Define value creation as it relates to the use of information technology in the health enterprise.
- List and discuss at least three ways in which use of the Internet is reducing costs while improving the effectiveness of healthcare delivery.
- Explain how health informatics is improving health in the areas of (1) disease management, (2) telehealth, (3) patient safety, and (4) decision support.

Overview

The effective use of health informatics involves much more than implementation of hardware and software. It is dependent on human factors, including the development of competencies by those who would employ health informatics and the development of teamwork by information technology (IT) professionals and health professionals. Effective health informatics creates value. It is an enabler that maximizes its potential when its users work as a team to integrate health informatics with the business strategy and work processes. Already we are seeing Internet applications begin to drive down healthcare costs while improving the delivery and effectiveness of health

services. This trend will continue in coming years. We are beginning to amass proof that informatics actually improves health through aiding in disease management, providing specialist support, improving patient safety, and serving as decision support for practitioners. Over the next decade, we will see many more advances in the use of technology in support of the shared missions of health care and public health to improve the life of each individual.

Introduction

In the preface to the *Yearbook of Medical Informatics 1999*, Hans E. Peterson states, “The new challenge is to learn what fundamental values in health care are supported by information technology and how they can contribute to its continued development.” The intent of the *Yearbook* is clear: “To take a critical look both backwards and forwards. What were the early expectations and what was the outcome? What is to be expected for the next decade? In what way and to what extent can health care benefit from the accomplishments of medical and health informatics?”¹

In this chapter, we take up Peterson’s challenge, but from a different vantage point. To begin, we enlarge the context to include the full range of health-related activities, from wellness and population-based programs to illness and patient-focused care. At the heart of our discussion is a simple question: Can informatics improve health? In seeking to answer this question, we do not look to academia or to theoretical models. Rather, we look to health practices as they are today and draw evidence from actual informatics applications, which to date have been more generously supported in traditional healthcare institutions. At the same time, we note that the changes brought about by the Internet and by patient empowerment are already beginning to affect the broad set of functions, practices, disciplines, and other factors that affect how well people live their lives.

Drilling Down

As we proceed, we will drill down to a series of specific questions:

- What is health informatics and what are its components?
- What factors affect organizational success in using health informatics?
- How is the Internet affecting the provision of health services?
- What evidence is there that informatics actually improves health?

What Is Health Informatics and What Are Its Components?

In Chapter 1, we defined public health informatics as “the systematic application of information and computer science and technology to public health practice,

research, and learning.” However, it is important to note that, as an evolving discipline at the intersection of rapidly changing fields, health informatics in general lacks a single definition. In some quarters, it is viewed as a management and engineering discipline, and in others, as a science that may be theoretical, applied, or both. For our purposes in this chapter, we define health informatics as the demonstration of how organizations can use IT to bring their strategic goals from theory into practice. Within this context, IT serves as an enabler.

While success in the 21st century will be predicated upon harnessing and managing information, it will require a focus on value and the elements contained therein. Value resides in the relationship between cost containment, customer service and satisfaction, and superior clinical results or outcomes. Expressed conceptually,

value is a function of (cost, service, outcome).

Achieving this value proposition is no simple task. Supporting and measuring its components require that we receive and generate data, transform data into useful information, and transform information into knowledge. The capabilities provided by information technology function as key enablers in this process, supporting information management and knowledge creation. Informatics addresses these areas through its four cornerstones, described by Nancy Lorenzi and Bill Stead.² These involve the “systematic integration ... from intellectual development of how information assets are organized and managed, to what work processes should look like and how information systems should be implemented to support them.”

Specifically, these cornerstones include the following:

- “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.”³

As Lorenzi notes, these cornerstones “extend well beyond the skills associated with traditional data processing and information systems.” 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, constitute the greatest obstacles to informatics success. As Reed Gardner stated in his 1998 Davies Lecture, “The success of a project is perhaps 80% dependent upon the development of the social and political interaction skills of the developer and 20% or less on the implementation of the hardware and software technology!”⁴

The International Medical Informatics Association Working Group 1 recently

published competencies for different categories of health informaticians.⁵ Further, Janise Richards has defined informatics competencies in public health informatics in her doctoral dissertation at the University of Texas.⁶ (Ms. Richards' definitions form much of the subject matter of Chapter 6 of this textbook.) Well-defined competencies are increasingly important, as the emphasis shifts from the *how*—the technique and/or technology—to the *why*—what can be accomplished with health informatics, and how information can be managed and used to improve health.

What Factors Affect Organizational Success in Using Health Informatics?

Optimizing information management requires a focus first on values. Successful organizations understand that their strategy, set by their business plan, is the driver. Informatics is the enabler, and information technology provides the tools. As Paul Strassman remarks in his book, *The Squandered Computer*, “The principle 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 improve performance, IT and health professionals need to work as a team. Both need to understand the problem being addressed; both need to contribute their expertise toward its solution. Increasingly, trained health informaticians are playing a critical role in developing, selecting, and implementing applications. This role includes helping health professionals understand what informatics can offer in order to make wise decisions about IT.

Although allocations for IT in healthcare sectors reached record levels at the close of the 1990s, expenditures do not guarantee solutions. Investment analysts Volpe Brown Whelan and Co. estimate that health care wastes as much as \$270 million a year on inefficient computer systems.⁸ We do not dispute there is waste, but we question whether it is the result of inefficient computer systems. It is more likely, we believe, that ineffective *use* of those computer systems is the cause.

One striking example comes in the aftermath of year 2000 (Y2K). To avert problems associated with older systems, many institutions installed new applications without leveraging them to add value to their core business. Recent studies show this to be a common failing in health care and in industry in general.⁹ Institutions need to make concerted efforts to target objectives and processes as they acquire and integrate IT. Those with newly installed and incompletely leveraged systems should revisit such critical activities and establish a clear agenda for change.

This need to establish and measure value is manifest in another area, specifically that area involving work processes. We mentioned the importance of human factors earlier, and the need for both organizational skills and techni-

cal know-how. In the broadest sense, human factors extend to include organizational and professional development, both of which imply redesigned work processes. Such efforts must be ongoing. If staff are to learn new skills, use new tools, and make optimal use of new technology, “unlearning” old ways is critical—and even more difficult than learning the new.

New ways of doing work are the end point of the classic three-stage model for technology adoption: substitution, innovation, and transformation. Medical imaging provides an excellent example of this model; the old radiology departments disappeared gradually and are gone forever, and new tools support diagnoses and interventions previously impossible. Changes in informatics of the sort we discuss here will proceed in the same fashion. After being used in specific places for special uses, new technologies will become more widespread, and the changes they enable will become more commonplace.

How Is the Internet Affecting the Provision of Health Services?

The Internet can help control costs; more importantly, it can change information flow in health-related areas. In industries such as banking, the Internet has cut costs and transformed the way business is carried out. While a teller transaction costs between \$1.25 and \$1.50, an Internet transaction costs only \$.015. Healthcare organizations choosing the Internet for simple business processes also stand to realize major cost reductions, estimated at 10:1 to 100:1, in routine transactions, both business to business and business to consumer.¹⁰

However, as John Naisbitt states, “The new source of power is not money in the hands of a few, but information in the hands of many.”¹¹ In health care, where information can literally be a lifesaver, the power of the Internet lies in its unprecedented capability to make information available when, where, and how it is needed. Given the number of Americans on the Web, this capability is staggering. In 1999, almost half of US adults, or 97 million, were on-line, and three out of four of these had used the Internet to search for health and medical information.¹² Another estimate, by Harris Interactive, a research firm, puts the number of people visiting Internet health sites at 60 million or more.¹³

The National Cancer Institute is developing a Cancer Informatics Infrastructure (CII) that will optimize Web technology and enterprise systems to translate cancer research into clinical care.¹⁴ The CII will create a knowledge environment that serves multiple stakeholders, including consumers, and supports the continuum of cancer research: basic, clinical, translational, and population-based research.¹⁵ The initial focus of the CII will be on easing and speeding the clinical trials process, which reaches across sectors. Another federally supported site introduced in early 2000, www.clinicaltrials.gov, reflects the emphasis on consumer needs for valid health information.¹⁶

In the private sector, health plans and integrated delivery networks are developing e-health offerings, using the Internet to improve consumer ser-

vices and business-to-business processes. In early 2000, most organizations were still in the early stages of development but had ambitious plans for the near future, according to unpublished First Consulting Group surveys.¹⁷ According to Figure 3.1, most such organizations had reached Stage 1 of the five stages in Internet business development/maturity; they published information online. Others had advanced to Stage 2 by allowing the community to interact with their organizations—for example, with member services. Fewer had deployed online transactions—Stage 3—while none had entered fully into Stages 4 and 5 by integrating multiple transactions and transforming the entire process. Most healthcare organizations will shortly be or already are in the later stages of development and revisiting the work they did in the early stages to reflect their business transformations.¹⁸

As traditional healthcare settings move toward wellness and population-based health, they are using the Internet to link consumers and various organizations across health care. Web-enabled applications will soon become the new standard. They are already proving of value in bridging the gaps between existing legacy applications to create enterprise-wide patient records and in linking computing and communications technologies to provide state-of-the-art call centers. As these applications grow, they will support data reposi-

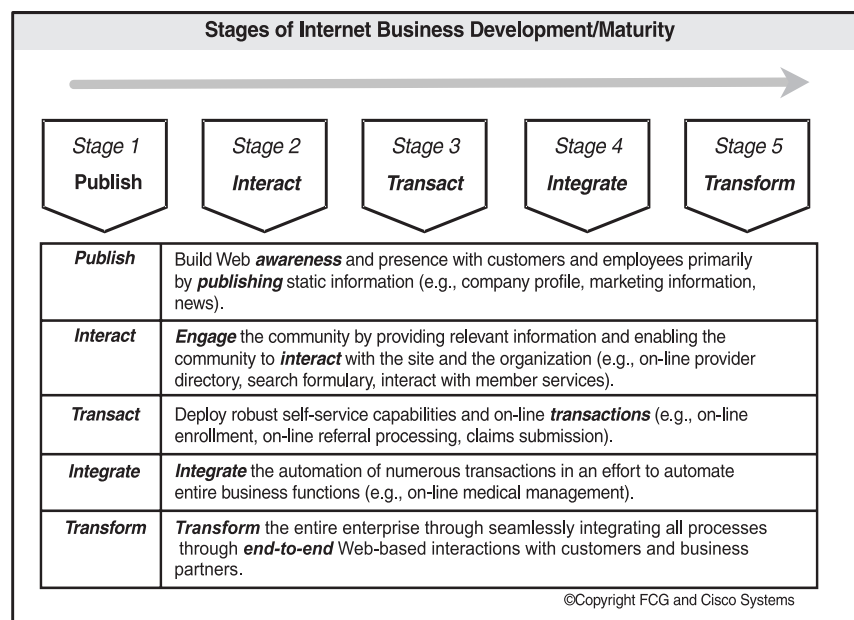


FIGURE 3.1. Stages of Internet Business Development/Maturity (Source: First Consulting Group and Cisco Systems. Used by permission.)

tories to serve patients and providers and support activities in epidemiology and prevention, facilitating the interface between medicine and public health.

Estimates by CyberDialogue in early 2000 put the number of health-related Web sites at about 17,000, including a growing number of consumer-oriented sites. In addition to simply seeking information online, consumers can seek consults and post their medical records on the Web. Such sites offer new capabilities, but they also pose new problems.¹⁹ For example, consumers can opt to make personal health records available to authorized professionals during emergencies, but those consumer-controlled records may not always be up-to-date, or they may not include all relevant health information. Similarly, sites may provide consumer advice, but they may not identify their sponsors or potential conflicts of interest, and consumers may not be able to validate a given site's credentials.²⁰

One of the early organizations to recognize the transformational potential of the Web—and the need to validate information appearing on it—was the Geneva-based Health On the Net (HON) Foundation. In 1995, 60 participants from 11 countries, including representatives from the World Health Organization, the European Commission, and the National Library of Medicine, among others, concluded an international conference by voting unanimously to create a permanent body to “promote the effective and reliable use of the new technologies for telemedicine in healthcare around the world.”²¹ Six months later, www.hon.ch became one of the very first URLs to guide both lay users and medical professionals to reliable sources of healthcare information in cyberspace. Today, HON offers two widely used medical search tools and the HON Code of Conduct (HONcode) for the provision of trustworthy Web-based medical information. The statement that a site adheres to this code appears on a number of US-based sites.

Through all this innovation, certain factors hold constant. Although the Internet is changing the terms on which physicians and patients interact, their relationship remains primary. Anecdotal accounts abound of the patient arriving at the physician's office with printouts. For these to have a positive influence on care, however, patients have to understand the complexity and variability of information online, and doctors have to adjust to a new role as information mediators. As patients gain access to health information, they look to their physicians for help in evaluating and acting upon the information available. A recent report indicates that this is indeed happening. According to Saurage-Thibodeaux Research, “74 percent of online health site users would be more likely to trust a Web site recommended by their doctor or pharmacist.”²²

An innovation such as recommending a Web site to a patient enhances the role of the physician, rather than diminishes it. Yet, such a change in role requires a change in attitudes and in the doctor/patient relationship itself. The learning curve will be steep for both parties, once again underscoring the importance of human factors to the development of health informatics.

Patient health records are one tangible expression of these changing roles. Now available on a limited number of Web sites, essentially for personal

record keeping, these records represent the next generation of the computer-based patient record. Institutions will continue to maintain their own records, which will increasingly be available across the healthcare enterprise as Web applications provide linkages to legacy systems. Clearly, consumer-owned records on a banking model represent the best hope for maintaining comprehensive information over time.²³ The true coordinators of patient care—the patients—will manage their own records. They will control who accesses what in their record, while healthcare institutions maintain their own records, just as financial service organizations do today.

We cannot leave this look at Internet resources, however, without noting two instances in which they have delivered financial benefits. According to United Healthcare, Optum Online, that organization's Web-based nurse line and call center, yielded savings of \$4.50 for every dollar invested in the project.²⁴ In Seattle, Swedish Medical Center worked with an on-line solution provider to build a sophisticated Web site that has attracted over \$50,000 a month in referrals.²⁵ We expect more such documented successes as dot.com hype subsidies and health offerings on the Web mature.

What Evidence Is There That Informatics Actually Improves Health?

We are beginning to amass proof that informatics can deliver value and improve health. Although multiple factors have made hard data difficult to come by, the primary reason for the lack of hard data is simple. Until recently, most large-scale implementations targeted administrative aspects of facility-based care. Clinical applications tended to be much smaller in scale and did not extend to address evidence-based medicine or population-based health. Today, applications do more. The Health Plan Employer Data and Information Set (HEDIS) measures widely used in managed care, for instance, have the potential of improving health in two respects: first, by giving plans an incentive to improve services, especially preventive services, and second by giving consumers and purchasers information to guide their choice of health plans. More specifically in the public health area, a 1997 Institute of Medicine (IOM) report, "Improving Health in the Community: A Role for Performance Measurement," extends these ideas to community health settings.²⁶ Informatics is essential to either of these strategies having an impact on health. Today we are beginning to see the impact of informatics on clinical systems, as they begin to address the need for decision support, for both healthcare providers and patients, whatever the care context.

Disease Management

Consider disease management programs that capture and manage information to better support intervention and thereby prevent or minimize the impact of chronic conditions on the patient and the health system. With chronic disease accounting

for 80% of all deaths, 90% of all morbidity, and 70% of all medical expenses in the United States, these attempts can have measurable results.²⁷ For example, one program for diabetes patients reported that none of its enrollees had been hospitalized over a four-year period, and net savings for one year totaled \$510,133.²⁸ One program for congestive heart failure patients reduced the 30-day readmission rate to zero and cut the 90-day readmission rate by 83% through a combination of telemonitoring and patient education.²⁹

Telehealth

Consider also the provision of specialized services, where telehealth capabilities offer savings. The Veterans Administration (VA) has consolidated its imaging services in the state of Maryland; radiologists at the VA's Baltimore facility read digital transmissions of procedures conducted by technicians at multiple facilities.³⁰ As of this writing, IC-USA is launching efforts to provide specialist support for intensive care units (ICUs). Estimates put the number of intensivists needed to staff all the ICUs in the country all the time at 35,000, while there are only 5,500 physicians specializing in this area. The concept of providing specialist support for ICUs was tested in a four-month clinical trial that covered more than 200 patients. The test found that adding telemedicine coverage around the clock to normal staffing reduced patient mortality by 60%, complications by 40%, and costs by 30%.³¹ IC-USA claims that a hospital utilizing telemedicine can realize gross savings of \$150,000 per year per intensive care bed, and net about half of that amount.

Patient Safety

The landmark study by the IOM reported in *To Err Is Human: Building a Safer Health System* highlights issues of value through its focus on patient safety. In addition to citing horrific cases of and staggering statistics on medical errors, the IOM reviews the literature documenting the ability of computerized information systems to identify and prevent such errors.³² According to David Bates et al., from 53% to 89% of adverse drug events were identifiable, and a small but significant number of them were judged "preventable by using such techniques as guided-dose, drug-laboratory, and drug-patient characteristic software algorithms."³³

The IOM cites other work by Bates, estimating cost savings attributable to the prevention of adverse drugs events at more than \$4,000 per event, totaling over \$500,000 at one teaching hospital. Even more significantly, this study of automated physician order entry showed "an overall savings from all decision support interventions related to order entry of between \$5 to 10 million per year."³⁴ The IOM concludes, "A computerized system costing \$1 to 2 million could pay for itself in three to five years, while preventing injury to hundreds of patients per year."³⁵ Still another study by Bates showed that decision support systems reduced the number of adverse events by 55%.³⁶

In a second report released in 2001, *Crossing the Quality Chasm: A New Health System for the 21st Century*, the IOM intensified its focus on the use of information technology to improve health care, while simultaneously identifying specific strategies for doing so. This second report clearly underscored the significance of informatics and related issues such as organizational development and priority conditions.³⁷

Decision Support

More than 30 years ago, Larry Weed prefaced his book *Medical Record, Medical Education, and Patient Care* with the following words:

“The medical record must 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 and proper corrective measures taken when lapses in thoroughness, disciplined thought, and reasonable follow-up occur.”³⁸

As father of the problem-oriented medical record, Weed did much to advance his theories and to improve care, serving as an advocate of the empowered patient decades before the concept began to find its way into the mainstream. Certainly the structured record is the *sine qua non* for the computerized record, as are the consistency and maintenance of the database that he stressed in his work was critical to the care of the individual patient health.

According to Jonathan Teich, clinical decision support (CDS) systems are “up and running in several different healthcare environments,” from acute care to ambulatory practice.³⁹ Teich continues:

“Right now, [some] physicians are using CDS systems to enhance their decision making and to be more efficient in their everyday clinical practices... Furthermore, CDS systems are not only a tool for physicians; they can also be used by patients who are active participants in their own care and who will appreciate having a technological partnership with their physicians.”^{39(p46)}

As CDS systems become more commonplace, they will feed the clinical data repositories that are key to evidence-based medicine by the individual practitioner, the institution, and ultimately the scientific community. They will also, through intelligent linkages, make it possible to identify and respond to epidemics and bio-threats. Indeed, such a system exists now, constructed by the US Air Force by using commercially available technologies: laptop computers in the field linked by satellite to centralized databases back in the United States.⁴⁰ Called Desert Care, the system maintains records on individuals, tracks illnesses, and analyzes illness trends area-wide in the hope of preventing another Agent Orange or Gulf War Syndrome. This application, as Bill Gates notes,

“provides a good template for civilian applications. With digital records we’ll be able to study illness in a variety of population groups to help discover long-term correla-

tions in environment, genetic predisposition, age and gender, without having to institute special studies.”^{40(p351)}

Initially developed with only \$200,000 in four months and incrementally enhanced, this application serves as a remarkable example of the value health informatics can deliver.⁴¹

Desert Care is far more than a military application. It demonstrates how information can function to improve care for individuals by permitting an understanding of the context in which their symptoms occur. By supporting evidence-based medicine, Desert Care furthers population-based health. Expanded beyond the military setting, it could change our understanding of disease and of wellness among populations.

Looking Ahead

Can informatics improve health? The answer, we believe, is yes. Information is key to the science that underlies health, and technology can—and clearly does—improve the flow of information, making it accessible, usable, and meaningful. Over the next decade, we expect to see many more advances, as the worlds of health care and of public health support one another in their shared mission of improving the life of every individual.

Questions for Review

1. Value is said to be a function of cost, service, and quality. What is the interrelationship between these variables? How does changing one (e.g., cost) affect service or value? To what extent does an increase in investment in IT result in an increase in the value of healthcare services?
2. Why does effective utilization of information technology in support of a healthcare concern’s strategic plan inevitably require (a) changes in work processes, (b) increased teamwork, and (c) emphasis on well-defined competencies?
3. Aside from the obvious benefits of use of the Internet to improve customer services and business-to-business processes, what major challenges does the use of the Internet for such purposes pose to physicians and other health practitioners?
4. What factors are now causing health concerns to consider information technology as a route to increasing the value of their services?

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