

Realizing Value Driven e-Health Solutions



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FOREWORD

On behalf of the IBM Center for The Business of Government, we are pleased to present this report, *Realizing Value-Driven e-Health Solutions*, by Nilmini Wickramasinghe and Jonathan L. Schaffer.

As is well known, health care remains one of the most pressing issues facing us today. The U.S. health care system continues down what most experts have concluded to be an unsustainable path, mired by ever-increasing costs, inconsistent quality, and access pressures. The U.S. spends over \$2 trillion on medical care annually which, according to the Organisation for Economic Co-operation and Development (OECD), represents about 2.4 times the average of other OECD countries.

Today, many health care experts are calling for a more collaborative, innovative, and technologically focused health care system. These calls recognize that any real transformation must have specific goals—to improve patient outcomes, to improve access, to reduce cost, and to build a more efficacious paradigm of health and care. e-Health, and the continued adoption and use of health information technology (IT), will play a central role in building a health care system for the 21st century. In an interview during the IBM Center's "The Business of Government Hour," Dr. David Blumenthal, National Coordinator for Health Information Technology, said that "health information technology is just a way of collecting and moving a patient's health information. It's what I think of as the circulatory system. If you think of information as the lifeblood of medicine, then health information technology is its heart and arteries."

This report is unique, in that it brings together Professor Wickramasinghe, an IT expert, and Dr. Schaffer, a physician who is managing director of the eCleveland Clinic in Cleveland, Ohio. Together, they present a convincing case that the increased use of information and communication technology holds the promise of both improving health care and reducing health costs. The report is a good introduction to the barriers that need to be overcome in order to significantly increase the use of technology in hospitals and other health care organizations. Barriers include technological, organizational, human, and economic factors.



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Professor Wickramasinghe and Dr. Schaffer present an informative description of the elements of e-health and the increasing role of the empowered health consumer. The final section of the report presents a framework in which organizations can assess their potential for moving toward e-health and implementing new technologies. This section describes the infrastructure and processes that need to be put in place prior to deriving any benefit from the “eight e’s” of e-health. Organizations can grade themselves on the e-health preparedness grid. Report recommendations include moving to network-centric health care operations and utilizing appropriate change management techniques to implement e-health solutions. As the authors posit, “The e-health preparedness grid developed in this report serves a dual purpose—it acts as a diagnostic as well as a prescriptive tool to facilitate the transition to a state of high e-health preparedness.”

We hope that this report will serve as a useful guide for health care professionals as they move to enhance their organization’s technological capabilities, becoming more network-centric and improving the delivery of health care.



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EXECUTIVE SUMMARY

The current U.S. health care system is in crisis (World Health Organization, 2008). In response, the Obama administration made health care reform a priority and identified the design, development, and implementation of technology solutions as a critical success factor (Healthcare IT, 2009). This report addresses the potential of e-health-enabled health care solutions to meet that need.

Key future trends that will significantly impact health care include:

- Escalating health care costs
- Empowered consumers
- Health adaptability
- A shifting focus on prevention
- External factors such as financing, technology, demographic shifts, and the increased burden of chronic diseases

In turn, key implications of these trends include:

- Health insurance changes
- Health care workforce changes, such as changes in the roles of health system stakeholders
- Health care organizational changes, focusing on standardization
- The need for inclusive, strategic health care technology planning at both the macro- and micro-levels
- The need for health care delivery organizations and administrators to make difficult choices regarding practice management

Patient-centric e-health solutions appear to offer promise for how the U.S. health care industry can meet the anticipated trends and their implications. The recommended characteristics of a strategy to ensure patient-centric e-health include the following eight “E’s”:

- Efficient
- Evidence-based
- Educational
- Ethical
- Enhanced quality
- Empowered patients
- Extended research
- Equitable

Prior to implementation of an e-health solution, it is essential to achieve an appropriate level of e-health preparedness, which includes a focus on:

- Information and communication technology infrastructure
- Standardization, policy, protocols, and procedures
- User access and accessibility
- Government regulations

Finally, it is important to realize that e-health solutions do not occur in a vacuum, but are complex and dynamic operations. Thus, it is essential to be aware of the following influences:

- IT education
- Morbidity rates

- Culture/social dimensions
- World economic standing

When taken together—and correctly designed and implemented—this strategy can help to ensure that the full potential of patient-centric e-health solutions will lead to better health care operations.

Acknowledgements

We wish to thank Jonathan Bruel, Mark Abramson, and Michael Keegan of the IBM Center for The Business of Government for their and the Center's support of this project.

In addition, we extend thanks to the many health care professionals and health care organizations for their assistance in enabling us to gather the necessary data and use case to compile this report. Finally, we thank our respective institutions.

Introduction

The United States' health care system is significantly more costly than any other Organisation for Economic Co-Operation and Development (OECD) country (World Health Organization, 2008). The use of health care services in the U.S. is below the OECD median by most measures, and it is predicted that health care costs will be over 20 percent of the gross domestic product (GDP) before 2020 (World Health Organization, 2008). Given this projection, most experts are in agreement that the current health care system is in crisis. In response to the current untenable situation, the Obama administration made health care reform a priority (Healthcare IT, 2009) and Congress passed comprehensive health care legislation in March 2010. Integral to the health care reform legislation is the need to redesign inefficient and out-of-date processes, and transition to a patient-centric, technology-enabled, health care delivery system.

Barriers to Information and Communication Technology in Health Care

There are four barriers to the adoption and implementation of information and communication technology (ICT) in health care organizations:

- **Technological barriers**—With challenges that include the attributes inherent in the technology, such as compatibility with other systems, complexity, and usability; applicability to the task for which the technology is being adopted; ease of maintenance; quality (in terms of errors, breakdowns, and nonresponsiveness); ease of updating or replacement; and relative ease of use, which will impact the degree of implementation of the technology.

Definitions

Information and Communication Technology (ICT):

In health care organizations, the term refers to various web-based and non-web-based technology solutions such as electronic medical records (EMRs), health portals, automated billing systems, radiology information systems, and a myriad of clinical decision support systems—to name but a few. These systems all have the potential to enable and support superior health care operations and efficient and effective health care processes.

e-Health: The World Health Organization (WHO) defines e-health as “the leveraging of the information and communication technology to connect providers and patients and governments; to educate and inform healthcare professionals, managers and consumers; to stimulate innovation in care delivery and health system management; and to improve our healthcare system” (World Health Organization, 2003).

Technologies that are very complex, not compatible with existing systems, or hard to maintain and to update or replace will limit their adoption by health care providers (Fichman and Kemerer, 1999; Kaplan, 1987).

- **Organizational barriers**—Including the traditional organizational barriers to technology adoption, such as bureaucratic competition, lack of senior management support, and prior negative experience of the organization with similar types of technologies and their implementation.

Unsuccessful past events tend to hinder current attempts to adopt and implement technology. Clinical specialization adds an additional

An Interview with Dr. David Blumenthal, National Coordinator, Health Information Technology

by Michael J. Keegan



The U.S. health care system has a history of innovation marked by the ability to translate basic research into new clinical and therapeutic approaches that sustain human life and health. Such success brings with it significant challenges. Health care costs continue to rise at rates higher than inflation while producing a system

mired with inconsistent quality and ever expanding access pressures. Against this backdrop, the Institute of Medicine has concluded that the American health care system is in need of fundamental change, noting that health care today harms too frequently and fails to deliver its potential benefits. "In the 21st century, for 2.5 trillion dollars, I think we can do better," declares Dr. David Blumenthal, national coordinator for health information technology (HIT) within the U.S. Department of Health and Human Services (HHS).

Dr. Blumenthal leads the office charged with implementing a nationwide, interoperable, privacy-protected HIT infrastructure. "The Office of National Coordinator for Health IT (ONC) was created in 2004 by Executive Order [13335]," explains Blumenthal. "It was initially mandated to provide a coordinating function across the federal government in helping to organize health information technology activities." Blumenthal acknowledges that, at its inception, the office was fairly small with limited resources, but with a uniquely important mission. "Health information technology," explains Blumenthal, "is just a way of collecting and moving a patient's health information. It's what I think of as the circulatory system. If you think of information as the lifeblood of medicine, then health information technology is its heart and arteries."

Many believe that HIT has the potential to transform the practice of health care by reducing costs and improving quality. While HIT offers much promise, there is a need for leadership, coordinated action, infrastructure and incentives, and common agreement for its promise to become reality. The passage of the Health Information Technology for Economic and Clinical Health Act of 2009 (HITECH Act) seeks to transform the promise of HIT into a

health care system built for the 21st century. It has instantiated this office in law, providing the national coordinator with more resources, clearer authorities, and many time-sensitive requirements. "This has required us to look at the office and re-create it as a locus of action and leadership," asserts Blumenthal, "for a very ambitious project, ambitious by any governmental or nongovernmental standard." The HITECH Act allocated \$2 billion directly for his office to do just this and to lay the groundwork for accelerating the adoption and meaningful HIT nationwide. "To take a country that extends from the Bering Strait to Key West, that is as diverse as this country with the variation in its health system from rural Montana to downtown Chicago, is a tremendous project of social change," acknowledges Blumenthal.

Serious barriers to the adoption and use of HIT, specifically an electronic health record, continue to exist. "The barriers are pretty well defined," explains Blumenthal. "The first is money. The second is technical and psychological—fears that providers have of buying the wrong technology or not being able to implement it. The third is a lack of a workforce to support the implementation of health information technology." Blumenthal has begun to tackle many of these issues by using the funding and authority afforded his office under HITECH. This has involved working with the Centers for Medicare and Medicare Services along with the HIT policy and the HIT standards committees, to establish a regulatory regime that defines "meaningful use" as well as set standards and certification criteria for health information systems.

According to Blumenthal, no other country has ever, in regulatory form with such precision and completeness, stated, in effect, what is expected of the most modern health information systems. "I'm not a technical person," explains Blumenthal. "I think in some ways that's been an advantage. I'm here because I care about reforming the health system and helping patients. I used an electronic health record for a decade as a physician, so I know what it's like to use it. I can speak credibly, and with authority, about an electronic health record. I've seen it make me a better doctor. I can tell very specific stories about decisions it has improved, care it has improved, and money it saved for me as an individual physician."

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burden for health care organizations, with each clinical department having different technology needs. The reality is that there is considerable differentiation in how needs are assessed and what they mean to other units across the organization.

Unless the technology under consideration has a wide appeal to a variety of clinical specialties (e.g., a diagnostic innovation), there will be resistance from other units and specialties (Scott et al., 2006).

- **Human barriers**—Including cultural barriers (McDermott and O’Dell, 2001), a complex learning curve needed to implement the technology, and unfavorable perception of the role of the technology, its value to the organization, and its chances of successfully contributing to tasks and goals of the organization (Brender et al., 2006; Martens and Goodman, 2006).

In the health care environment, the technological aptitudes of clinicians as well as staff attitudes toward technological innovations can present serious barriers to the adoption and use of e-health solutions. The usual formula for adoption of technologies by medical professionals is to follow other industries in which such technologies have been implemented and successfully diffused. Only then will health care organizations assume the risk of adoption and will their clinical personnel be willing to adopt and implement the technology.

- **Economic barriers**—The fourth set of barriers concerns the costs associated with procuring, implementing, and using technology. In health care, as in most sectors, capital investments require a solid business case in order to justify the expenditure: ultimately, weighing costs versus benefits. The less costly and more expansively used the technology, the more easily justified the investment.

Overcoming Barriers

Two factors may facilitate the adoption of health care technology and enable organizations to overcome these barriers:

- **Pressures from the external environment.** The first facilitating factor is the pressure that the external environment imposes on health care

delivery organizations (Wickramasinghe, 2007). This includes such factors as the requirements, imposed by payors and regulators for billing and reporting purposes, that involve capturing and reporting administrative and clinical procedures. Properly meeting these reporting requirements is possible with the adoption and implementation of health information technology (IT). Thus, given the pressure to deliver and meet the requirements of both payors and regulators, health care delivery organizations are compelled to adopt and use these technologies.

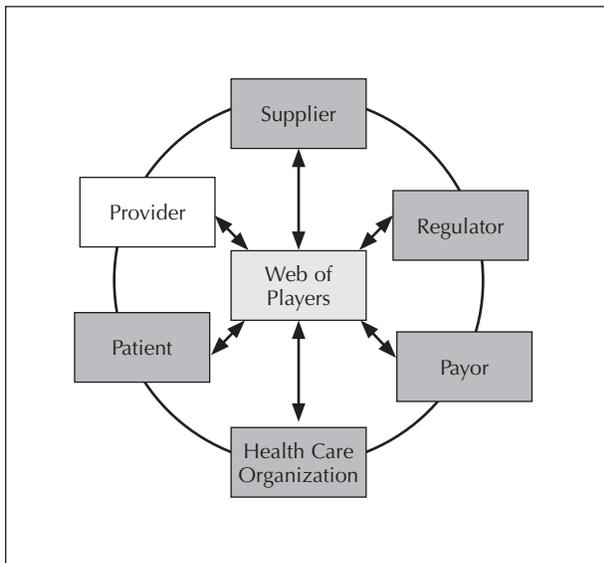
- **Processes of health care.** The second facilitating factor involves the processes inherent in the delivery of health care, and in the need to always make them more productive and efficient. For example, medical errors are often the result of ineffective processes or the lack of established processes. A way to tackle medical errors involves better processes and the adoption and use of health information technologies. (Institute of Medicine, 2001).

The importance of processes includes the need to make health care procedures more efficient. When payors set limits on reimbursements for diagnoses and treatments, in the form of “capitation,” diagnosis-related groups, and managed care, hospitals will explore ways to be more efficient and to reduce the cost of practicing medicine.

Understanding the Health Care Delivery System

In order to understand the essential role of technology in the delivery of health care, it is important to understand the industry, the unique aspects, the key challenges, and the critical components of the health care delivery system. Unlike most other industries, health care in the U.S. has a unique structure, in that the receiver of the services (i.e., the patient) is often not the lead payor for those services; in fact, the payor is often the insurance company.

Health care intervention is complex and typically involves a multiplicity of players, that is, a web of health care players (Figure 1) including providers, payors, patients, and regulators. Because of this complexity, relevant data, pertinent information, and knowledge play vital roles and can be obtained only

Figure 1: Web of Health Care Players

sary to overcome the key challenges facing health care organizations today. It is only through the judicious application of technology solutions that effect superior health care delivery that the challenges can be met (Wickramasinghe and Schaffer, 2006; von Lubitz and Wickramasinghe, 2006b).

via the prudent structure and design of technology (Wickramasinghe and Schaffer, 2006; von Lubitz and Wickramasinghe, 2006b; Wickramasinghe, 2007).

Of equal significance are the major external forces facing today's health care organizations: demographic, technology, and finance challenges (Wickramasinghe and Schaffer, 2006; Wickramasinghe, 2007; WHO, 2000; Brailer and Terasawa, 2003; Porter and Teisberg, 2006). Demographic challenges are reflected by longer life expectancies and an aging population; technology challenges include the incorporation of advances that keep people younger and healthier; and finance challenges are exacerbated by the escalating costs of treating everyone with the latest technologies.

Health care organizations can respond to these challenges by focusing on three key components, which taken together form the health care value proposition (Wickramasinghe and Schaffer, 2006):

- **Access**—Caring for anyone, anytime, anywhere
- **Quality**—Offering world-class care and establishing integrated information repositories
- **Value**—Providing effective and efficient health care delivery

These three components are interconnected, as they continually impact on the other and all are neces-

Moving to e-Health

e-Health is a very broad term that encompasses various activities related to the use of many e-commerce technologies and infrastructures, most notably the Internet, for facilitating health care practice. WHO, a major global health body, defines e-health as “the leveraging of the information and communication technology to connect provider and patients and governments; educate and inform healthcare professionals, managers and consumers; stimulate innovation in care delivery and health system management; and improve our healthcare system” (World Health Organization, 2003)

In contrast, a technologically oriented definition of e-health is offered by Intel, which refers to e-health as “a concerted effort undertaken by leaders in healthcare and hi-tech industries to fully harness the benefits available through convergence of the Internet and healthcare.”

Practitioners report that a growing number of patients arrive at their offices with questions related to appropriate websites to visit or with a large variety of health-related content gathered from the Internet. Some of this content may prove extremely helpful to the health and/or recovery of a patient.

Because the Internet has created new opportunities and challenges to the traditional health care IT industry, e-health presents both opportunities and challenges. The possibilities for facilitating effective health care delivery are presented in Table 1.

A more comprehensive definition of e-health would incorporate health care, business, and technological perspectives. We define e-health as the intersection of medical informatics, technology, public health, and business. In this report, e-health encompasses the delivery of health services and health information

Table 1: Approaches to Facilitating Effective Health Care Delivery

New Approaches to Health Care	Business Analogy
P2D: Patient (P) to Doctor (D), in which patients interact with their providers online	B2C: Business to Consumer
H2H: Healthcare Institution (H) to Healthcare Institution (H), which can improve transmission of data between institutions	B2B: Business to Business
P2P: Patient (P) to Patient (P), communication between healthcare consumers	C2C: Consumer to Consumer
D2D: Doctor (D) to Doctor (D)	B2B: Intranet
D2H: Doctor (D) to Health Care Institution (H)	B2B: Extranet

through web-based platforms and the use of IT. In a broader sense, the term characterizes not only a technical development, but also a state of mind—a paradigm shift—and a commitment for networked, global thinking, to improve health care locally, regionally, and globally by using information and communication technologies.

The e’s in e-Health

The preceding definition of e-health is broad enough to capture the dynamic environment of the Internet. e-Health encompasses a broad range of characteristics beyond simply leveraging technological advancements and using the web as a platform for exchanging data and information. There are a host of other characteristics that combine to make up the promise of e-health:

- **Efficiency.** One of the promises of e-health is to increase efficiency in health care, thereby decreasing costs. One possible way of decreasing

costs would be by avoiding duplicative or unnecessary diagnostic or therapeutic interventions through enhanced communication possibilities between health care establishments, and through patient involvement. The Internet will naturally serve as a great enabler for achieving this goal.

- **Enhancing quality of care.** Increasing efficiency should be viewed as a goal beyond that of simply reducing costs, as a means of improving the quality of care delivered.
- **Evidence based.** e-Health capabilities are critical to advancing evidence-based medicine. Information and clinical data are key to making sound diagnostic and therapeutic decisions. The evidence-based medicine component of e-health is currently one of the most active e-health research domains, and much work still needs to be done in this area.
- **Empowerment of consumers and patients.** By making the knowledge bases of medicine and EMRs accessible to consumers over the Internet, e-health opens new avenues for patient-centered medicine, and enables patient education—and thus increases the likelihood of informed and more satisfactory patient choice.
- **Education.** The education through online sources of physicians (continuing medical education) and consumers (health education, tailored preventive information for consumers) makes it easier for both groups to keep up to date with all of the latest developments in the medical areas of their respective interests. This, in turn, is likely to have a positive impact on the quality of care vis-à-vis the use of the latest medical treatments and preventive protocols.
- **Extending the scope of health care.** By going beyond health care's conventional boundaries, in both a geographical sense as well as in a conceptual sense, ICT leads to enabling techniques such as telemedicine and virtual operating rooms, both of which are invaluable in providing health care services to places where it may otherwise be difficult or impossible to do.
- **Ethics.** e-Health involves new forms of patient-physician interaction and poses new challenges and threats to ethical issues, such as online professional practice, informed consent, privacy

and security. Many of these issues are not specific to health care delivery, but are related more to the advent of new tools and technology that can be found in other fields. However, many of these issues become magnified when they concern people's health and their health care.

- **Equity.** The Institute of Medicine (2001) notes that health care quality involves also making health care more equitable. However, at the same time there is a considerable threat that e-health, if improperly implemented and used, may deepen the gap between the "haves" and "have-nots," hence the need for a robust framework to ensure the proper implementation of any e-health initiative. In particular, some of the key equity issues surrounding e-health involve access and familiarity with the technology that makes e-health possible.

The Role of the Empowered Consumer

Today, a large number of patients and consumers already use the Internet to retrieve health-related information in order to interact with health providers and even to order pharmaceutical products (e.g., www.drugstore.com). Physicians use the web to access databases such as Medline or to read electronic publications, but in many parts of the (developed) world, health care clearly lags behind other industries in the use of modern IT. In contrast, unlike in other industries, health care consumers have taken the lead in adopting the Internet and other e-commerce technologies for retrieving and exchanging health information.

Informed and Internet-savvy patients will play a crucial role in being a major driving force for e-health in general as well as in providing the impetus for clinicians to "go online" and for evidence-based medicine. Consumers accessing online information will inevitably increase the pressure on caregivers to use the latest evidence, and will compel them to acquaint themselves with IT to deliver higher-quality health services.

For the first time in the history of medicine, consumers have somewhat equal access to the knowledge bases of medicine, and they are making heavy use

of this fact. The Internet is acting as a catalyst for evidence-based medicine, in particular, and for e-health, generally, in two ways: First, it enables health professionals to access timely evidence. Second, it enables consumers to draw from the very same knowledge base, leading to increased pressure on health professionals to actually use the evidence [PriceWaterhouseCoopers (PWC), 2003].

In 2005, 110 million adults used the Internet to find health information, shop for health products, and communicate with affiliated payors and providers through online channels (California HealthCare Foundation, year). Today, the e-health consumer demand includes the need for specific health services such as obtaining information when faced with a newly established diagnosis, including obtaining an online medical second opinion through a secure portal (Schaffer et al., 2002).

Some key challenges must be addressed to develop optimal partnerships between consumers and other groups of health care stakeholders. Some of these include the need for:

- Meaningful collaboration with health care recipients
- Efficient strategies and techniques to monitor patterns of Internet use among consumers
- Preparation for upcoming technological developments
- Balancing between connectivity and need for privacy
- Better understanding of the balance between face-to-face and virtual interactions
- Equitable access to technology and information across the globe

e-Health Issues

Three important issues must be carefully considered (Cyber Dialogue, 2000): procurement, connectivity, and benefits.

e-Procurement. Health systems must begin to contemplate how their organizations will adapt and leverage Internet-based tools to manage their medical supply chains. Procurement in health care supplies must move toward an e-business platform for

data interchange because of the ubiquity and cost-effectiveness of the Internet, the primary e-business platform.

The Internet decreases many of the restrictions placed by geographic and time barriers and also facilitates the incorporation of artificial intelligence solutions, such as intelligent agents that can be deployed to hunt for best buys. Buyers and suppliers also must work together toward standardization, including the development of a universal product numbering system to facilitate e-procurement. e-Procurement of medical supplies grew to 15 percent of medical supply spending in the U.S. by 2003, according to a Deutsche Bank report (PWC, 2003).

e-Connectivity. Health care has traditionally been locally delivered, because a patient's usual first port of call is the local primary care physician. To reorient such a tradition, connectivity companies, which have a global rather than a local focus, must be pragmatic and move in incremental steps when connecting health care organizations.

Technology is the integral tool, but it will not achieve its full potential or live up to its promise unless health care organizations successfully deploy it and then track whether or not their clinicians and administrative staff are using it effectively. To do so, managers must design processes and metrics for productivity; otherwise, it's like expecting someone to drive a car, when his/her previous experience is limited to a 10-speed bicycle. However, health care organizations will find that achieving web-enabled connectivity offers the most opportunity initially, and that other functions such as disease management, outcomes management, and demand management can be web-enabled at a later point.

Health plans and hospitals are beginning to migrate to the Internet for claims-related transactions as the first step of a broader Internet strategy. Since many organizations continue to use electronic data interchange (EDI) for claims submissions, transactions surrounding claims—e.g., eligibility, referrals, etc.—they logically will be the first to be targeted for e-health connectivity. Those health plans that are adopting Internet connectivity for these functions view them as the foundation on which to build other Internet-enabled partnerships with patients and providers.

The number of health care transactions is outpacing the growth of health spending, creating a critical need to automate the handling of such transactions, that is, through the adoption of e-health. The number of health care transactions is outpacing the growth of health spending, creating a critical need to automate the handling of such transactions; i.e., through the adoption of e-health. For instance, the number of payor-provider transactions is huge. In 2006, there were approximately 3.4 billion claims, which equate to roughly 1.1 billion payments (compared to 9.3 billion business-to-business payments). However, by 2008, health care spending growth in the U.S. had slowed.

Health plans must understand physicians' needs when designing Internet-based solutions, and that a "first-mover advantage" isn't as important as a system that works. Many non-health care organizations have benefited from the first-mover advantage in adopting e-commerce initiatives, which means that they had access to the most capital and the best partners and could establish solid brand recognition. However, this is not necessarily an appropriate strategy for health care, as health care is more pragmatic—a "show-me" industry wherein successful models replicate, specialty by specialty.

e-Benefits. American industry has discovered the benefits of e-business. Like the conundrum of the chicken-and-the-egg, many employers and health plans are awaiting the development and implementation of e-benefits and e-insurance products. Health plans don't want to deliver web-based products if employers aren't ready to use them. Employers can't deliver e-benefits products until health plans develop them. However, starting with online benefits enrollment, this aspect of e-health is evolving in stages. A by-product of this evolution is the fusion of employee responsibility and empowerment; hence, employers will gradually cede more control for health benefits to employees themselves.

One of the primary drivers of e-benefits is the delivery of self-service capabilities in which employees can customize their own insurance plans and have ready access to the data, just as they do with their brokerage accounts. By putting this information at their fingertips, employees may become more fiscally responsible about their use of those benefits, and ultimately, may want complete control over

more and more aspects of the same. To empower employees toward that end, some employers will have to embrace a "defined contribution" model, also called "self-directed" or "consumer-directed" health plans. This builds on the findings of the report, *Defined Contribution Healthcare*, which specifically discusses the various models of defined contribution health plans (ibid).

The national research conducted by PWC (2003) indicates that few employers are willing to adopt self-directed, otherwise known as defined contribution, health plans today, but more likely will move incrementally toward web-enabling benefits processing, hence shifting more responsibility to employees. As employers adopt more e-health initiatives and web-enabled functions, they will move more responsibility for choices to employees. As that balance tips toward employees, employers will need to assess how ready their workforce is to accept increasing levels of responsibility.

If a significant portion of the health care insurance market moves to self-directed and Internet health benefit accounts, physicians may be most directly and adversely affected. Some contribution health plans have medical savings accounts as a centerpiece. In these accounts, employees pay out of a medical savings account for routine expenses of up to \$1,500 or \$2,000. Physicians will need to contend with patients who are paying cash for their visits and who may shop around for the best value.

As the utility function of benefits moves toward the Internet, insurers then must develop products that serve new and existing customers, such as e-quote products that assist brokers and other intermediaries. Further, they also must follow the changing needs of consumers, whose response to defined contribution health products is—to date—largely untested.

To sum up, the effective addressing of the key e-health issues of procurement, connectivity, and benefits requires standardization, a pivotal prerequisite for the implementation of successful e-health initiatives. Without such standardization, the exchange of documents and other procurement information, connectivity and e-commerce-enabled benefits clearly become more problematic. Unfortunately, standardization is woefully lacking in too many areas of health care, let alone in e-health

solutions. Therefore, the imperative is for frameworks and models not only to bring to the forefront the key e-health issues, but also to provide guidelines for how to effectively bring to bear successful e-health initiatives for health care organizations.

A Framework for Assessing e-Health Potential

This report proposes a framework shown in Figure 2 to assess the e-health potential and preparedness of health care organizations for the adoption of e-health. Our framework highlights the key elements that are required for successful e-health initiatives, and provides a tool that allows analysis into the systematic synthesis of the major impacts and prerequisites of e-health efforts. The framework contains four pre-requisites, and their implications for the eight e's of e-health. By examining both the prerequisites needed and the impacts associated with e-health, we can assess the potential of a country and its preparedness for e-health, as well as its ability to maximize the eight e-health implications.

The Framework: Prerequisites for e-Health

Information Communication Technology (ICT) Infrastructure. The ICT infrastructure includes phone lines; fiber trunks and submarine cables; T1, T3 and OC-xx; ISDN, DSL and other high-speed services used by businesses as well as satellites, earth stations, and teleports. A sound technical infrastructure is an essential ingredient to the undertaking of e-health initiatives by any nation. Such an infrastructure also should include telecommunications, electricity, access to computers, a number of Internet hosts, a number of Internet service providers (ISPs), and available bandwidth and broadband access. To offer good multimedia content and thus provide a rich e-health experience, one would require a high bandwidth. ICT considerations are undoubtedly one of the most fundamental infrastructure requirements.

Networks are now a critical component of the business strategies in order for organizations to compete globally. Having a fast microprocessor-based com-

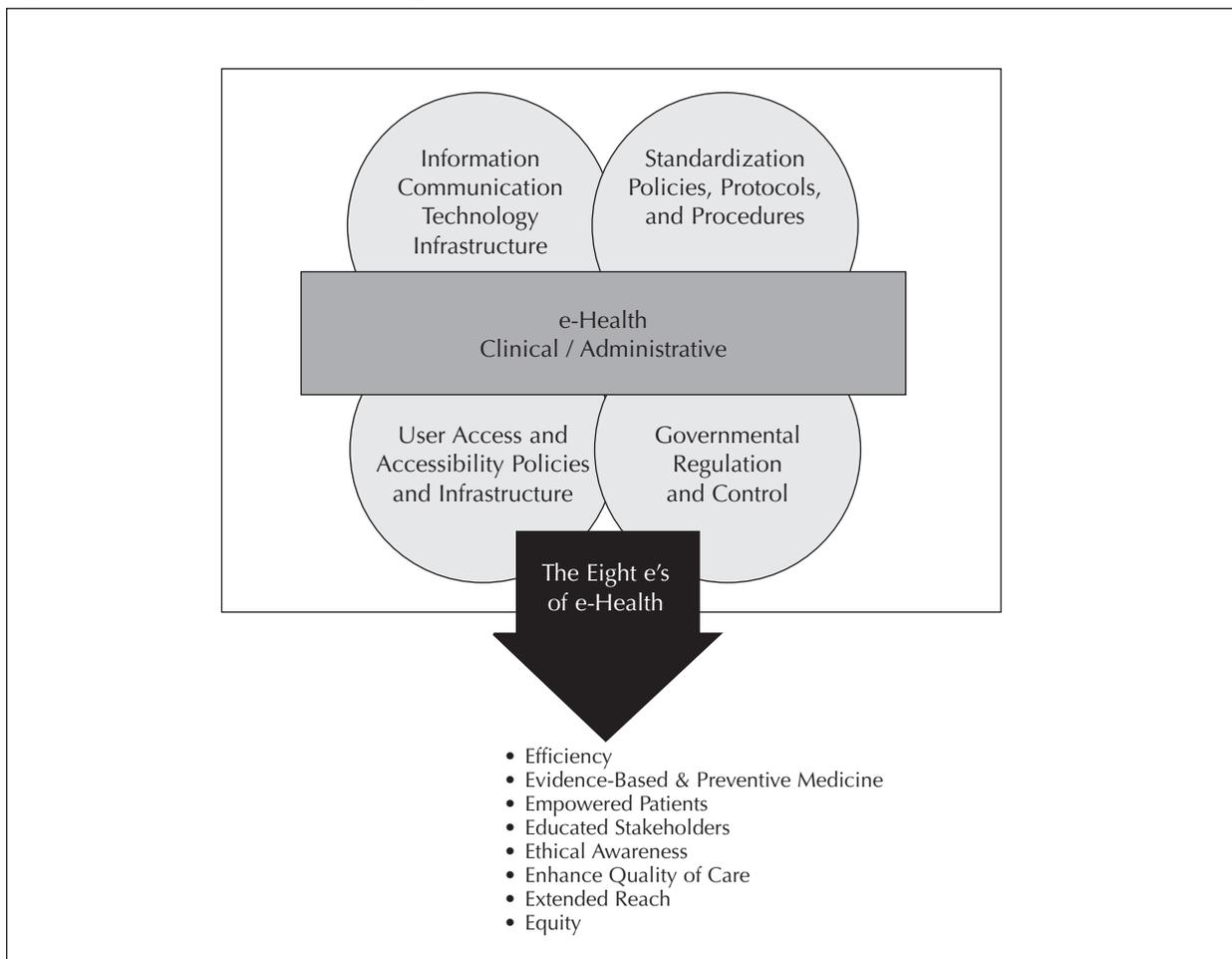
puter at home has no meaning unless you have the high-bandwidth-based communication infrastructure available to connect computers with the ISP. With the explosion of the Internet and the advent of e-commerce, global networks need to be accessible, reliable, and fast to participate effectively in the global business environment.

Telecommunications is a vital infrastructure for Internet access, and hence, for e-commerce. One of the pioneering countries in establishing a complete and robust e-health infrastructure is Singapore which is in the process of wiring every home, office, and factory up to a broadband cable network that will cover 98 percent of Singaporean homes and offices (ibid).

Standardization Policies, Protocols, and Procedures. e-Health by definition spans many parties and geographic dimensions. To enable such far-reaching coverage, significant amounts of document exchange and information flows must be accommodated in a standardized methodology. Once a country decides to undertake e-health initiatives, standardization policies, protocols, and procedures must be developed at the outset to ensure the full realization of the eight e's of e-health. Fortunately, the main infrastructure of e-health is the Internet, which imposes the most widely and universally accepted standard protocols such as TCP/IP and http. It is the existence of these standard protocols that has led to the widespread adoption of the Internet for e-commerce applications.

The transformation to e-health cannot be successfully attained without the deliberate establishment of standardization policies, protocols, and procedures, which play a significant role in the adoption of

Figure 2: A Framework for Assessing e-Health Potential



home computers (Samiee, 1998), many in the population still exist without access to PCs and the Internet. In addition to access to PCs and the Internet, computer literacy is important, and users must be familiar not only with the use of computers and pertinent software products but also the benefits and potential uses of the Internet and World Wide Web (ibid). These issues must be addressed, if the full potential of e-health initiatives can be realized.

Governmental Regulation and Control. The key challenges regarding e-health use include:

- **Cost-effectiveness**—It is less costly than traditional health care delivery
- **Functionality and ease of use**—Products should enable and facilitate many uses for physicians and other health care users by combining various types and forms of data as well as be easy to use
- **Security**—Products must be secure.

One of the most significant legislative regulations in the U.S. is the Health Insurance Portability and Accountability Act (HIPAA) (Protegrity, 2001). Given the nature of health care and the sensitivity of health care data and information, it is incumbent upon the government not only to mandate regulations that will facilitate the exchange of health care documents between the various health care stakeholders but also to provide protection of privacy and the rights of patients. Irrespective of the type of health care system; i.e., whether 100 percent government-driven, 100 percent privately run, or a combination thereof, it is clear that some governmental role is required to facilitate successful e-health initiatives.

In addition, given the passage of recent health reform legislation (see www.healthreform.gov/), it is now essential that appropriate measures are taken by the regulator to ensure that any/all e-health initiatives are less costly than traditional health care

delivery and facilitate the functionality and ease of use for physicians of the myriad of e-health possibilities; otherwise, it will not be possible for the anticipated levels of health care coverage connected with the proposed reform to ensue.

e-Health Preparedness Grid

By taking the four main prerequisites, as well as the four major impacts, identified in our framework in Figure 2, we developed two grids for assessing e-health preparedness (Figures 3 and 4) in which we can plot various countries with respect to these key parameters.

Each grid consists of four quadrants that represent the possible states of preparedness with respect to the key parameters for e-health success. The low-preparedness quadrant identifies situations that are low with respect to both prerequisites for e-health potential. The medium-preparedness quadrant identifies two symmetric situations, namely, a combination of high and low positioning with respect to the two prerequisites for e-health potential. Finally, the high-preparedness quadrant identifies situations that are high with respect to two prerequisites for e-health potential. The two grids not only show the possible positioning of a given country with respect to its e-health preparedness (i.e., low, medium or high) but also the path it must take, and more specifically, the prerequisite factors it must focus on, to migrate to the ideal state of preparedness, namely,

being high with respect to two prerequisites.

From the e-Health Preparedness Grid in Figures 3 and 4, we can see several implications. For entities which are low with respect to all four of the e-health pre-requisites, much preparatory work is required to be e-health ready and thereby fully realize the eight e's of e-health (i.e., efficiency, evidence-based and preventive medicine, educated stakeholders, ethical awareness, enhanced quality care, empowered patients, extended reach, and equity). For entities that map to the medium-preparedness quadrant, more emphasis is needed on upgrading the deficiencies that cause them to score low on the respective prerequisites, while they continue to maintain their high status on the prerequisites on which they currently rank high so that the full benefits of their e-health initiatives can be realized. Entities noted for being pioneers and leaders in the adoption of technology generally as well as e-health particularly would be expected to map on the high quadrant. The challenge for these groups would be to maintain their high status with respect to all of the prerequisites.

It is important to note that, irrespective of their positioning on the preparedness grid (i.e., low, medium, or high), all health organizations must take into account the moderating impact of four major influences (i.e., impact of IT education, impact of morbidity rate, impact of cultural/social dimensions, impact

Figure 3: e-Health Preparedness Grid

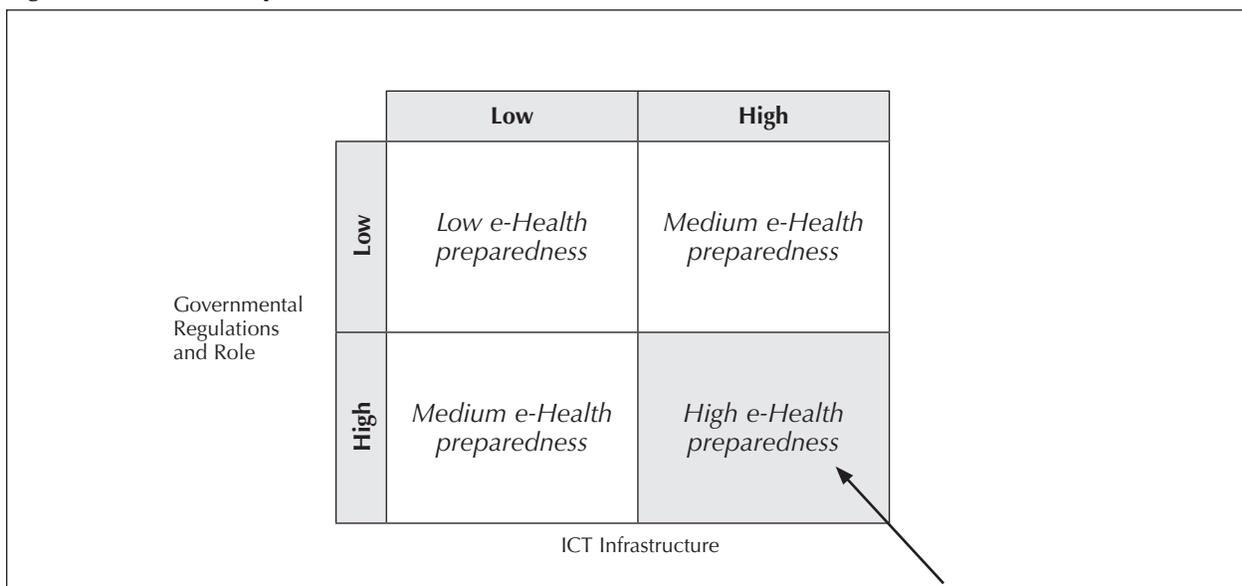
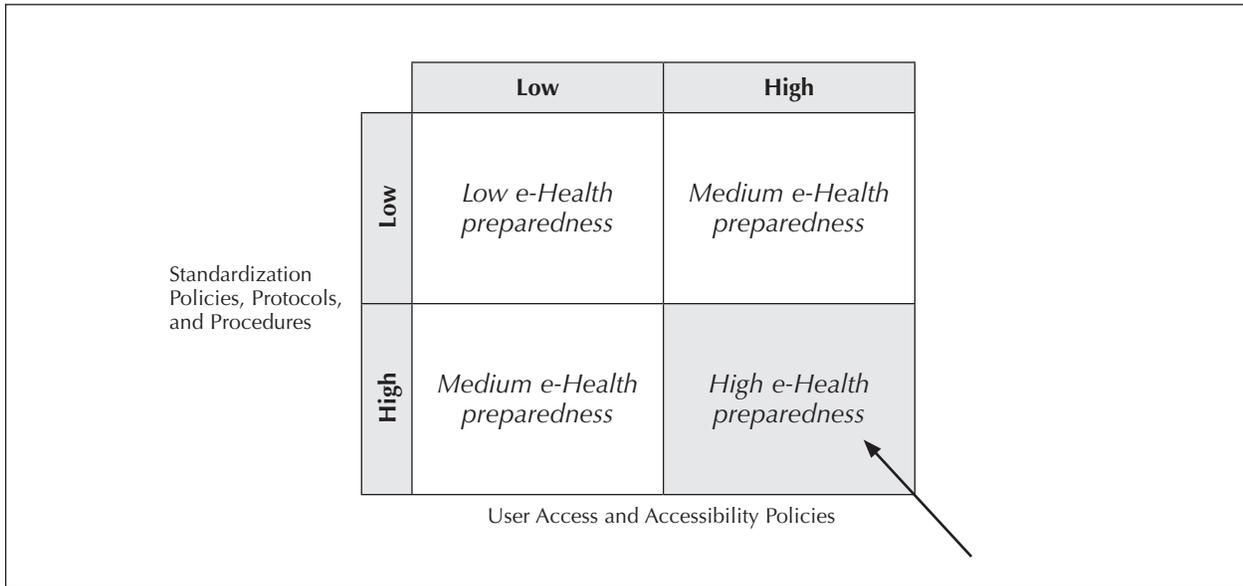


Figure 4: e-Health Preparedness Grid



of world economic standing) on their e-health initiatives. Each of these influences is discussed in the Appendix. If ignored, it will not be possible to fully realize a successful e-health initiative (and thus, a health organization will not be able fully realize the benefits of the eight e's of e-health), even if the organization maps into the high-preparedness quadrant.

Recommendations and Conclusion

Recommendations

The preceding sections have:

- Identified the key barriers for organizations when trying to adopt ICT into any health care context. These barriers include technology, organizational, human, and economic factors.
- Identified prudent areas in which to focus e-health initiatives so that the health care value proposition may ensue.
- Presented a framework for an organization to access its e-health preparedness.
- Taken together, these sections set forth a foundation for moving toward realizing value-driven e-health solutions. The section below provides recommendations on facilitating the realization of superior, patient-centric e-health solutions.

The strategy outlined focuses on key success factors, including the appropriate positioning given external trends, as well as on supporting network-centric health care operability. At the micro level, key success elements include adopting a process perspective and utilizing appropriate change management techniques.

In addition, there are external trends and regulations to be considered. These trends include the aging population, technology advances, financial pressures, pressures to provide effective, quality health care, and the change from episodic care to one based on prevention. Specifically, a prevention focus is more effective in responding to the current leading causes of death, such as chronic diseases, cancer, and cardiac issues (see *Major Trends Affecting Health Care*).

Key Recommendations

Health care organizations should:

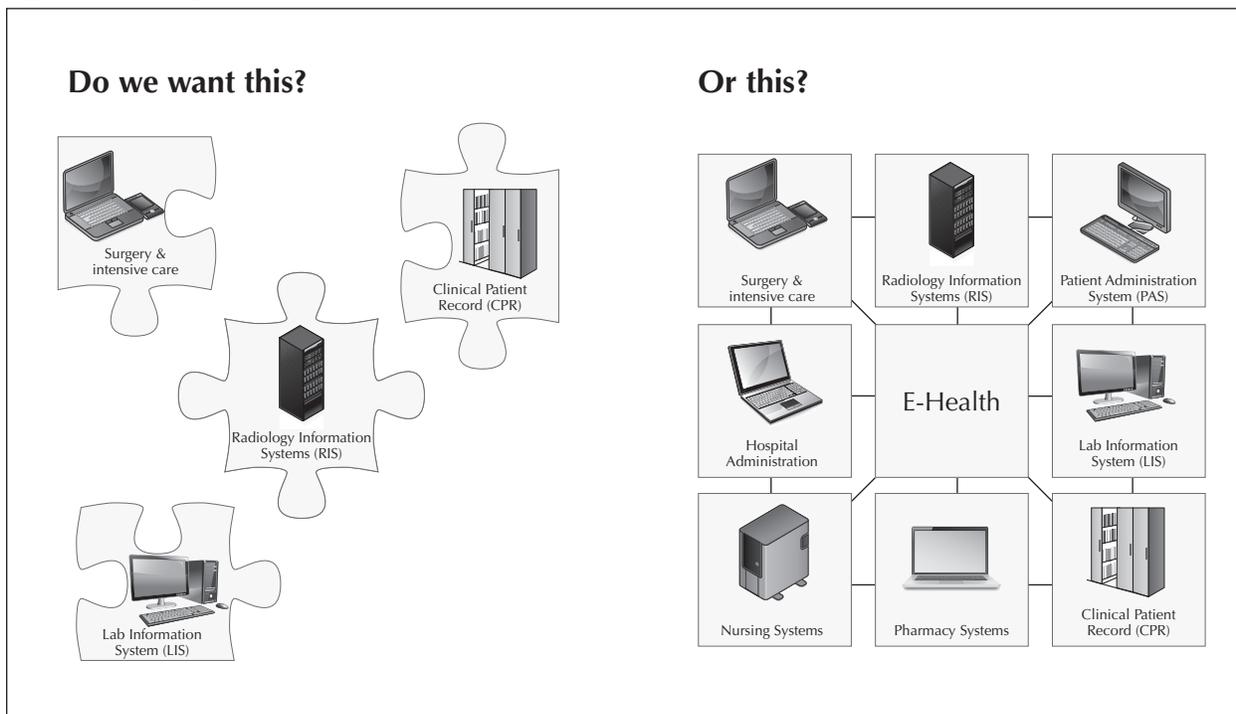
- Move to network-centric health care operations.
- Undertake a critical cost-benefit analysis to identify cost savings and benefits for e-health solutions.
- Take a process perspective on their operations.
- Utilize appropriate change management techniques to implement e-health solutions.

The use of ICT for health care generally and in e-health solutions specifically is key to responding to these trends. However, just identifying e-health solutions is not sufficient to be appropriately positioned. Equally critical is designing and developing an appropriate ICT infrastructure. It is essential to ensure that health care organizations do not develop platform-centric, but rather network-centric solutions (Figure 5).

Major Trends Affecting Health Care

- Demographics
- Technology
- Finance
- Achievement of effectiveness, quality, and efficiency via best practices in clinical, operational, and administrative functions
- Change from cure to prevention

Figure 5: Moving to Network Centric Solutions



Note: Used with permission of Doctrina Applied Research and Consulting (www.consultdoctrina.com)

Network-centric solutions stem from network centric healthcare which relates to the “unhindered networking operations within and among all three domains that govern all activities conducted in healthcare space and are based on free, multidirectional flow and exchange of information without regard to the involved platforms or platform-systems and utilize all available means of ICTs to facilitate such operations” (von Lubitz and Wickramasinghe, 2006a; Figure 6). Critical to the success of network-centric health care operations (NCHO) is the confluence of three key domains:

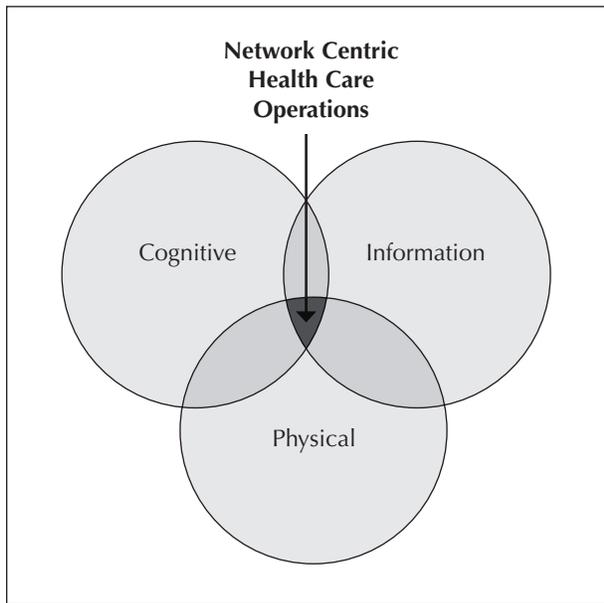
- The *physical domain*, encompassing the structure of the entire environment health care operations intends to influence directly or indirectly (e.g., elimination of disease, fiscal operations, political environment, patient and personnel education, etc.). Information within this domain is the easiest to collect, analyze, and disseminate.
- The *information domain*, containing all elements required for generation, storage, manipulation, dissemination/sharing of information, and the dissemination/sharing of knowledge in all its forms.

- The *cognitive domain*, relating to human factors that affect operations, such as education, training, experience, political inclinations, personal engagement (motivation), “open-mindedness,” or even intuition of individuals involved in the relevant activities.

The essential and enabling element of network-centric health care operations is a Health Care Information Grid that allows the full and hindrance-free sharing of information among individual domains, their constituents, and among constituents across the domains. Given current developments with Web 2.0, there even might be a health care cloud or a collection of various clouds focusing on different health care issues, e.g., diabetes, oncology, etc. The key here is not the technology in and of itself, but a macro understanding of the need to design appropriate solutions in order to facilitate seamless transfer of appropriate data and information rather than continuing to think in health care silos and, therefore, build platform-centric solutions.

Taking a network-centric perspective and designing e-health solutions to support network-centric health care operations are vital steps to position the health care organization and the e-health initiative, in light

Figure 6: Network Centric Health Care Operations



of current trends and external pressures. Thus, the first recommendation is the adoption of network-centric health care operations.

In addition to the adoption of a network-centric perspective, the second recommendation is that a critical cost-benefit analysis must be done so that identifiable cost savings and benefits can be underscored and “delivered to,” then tracked. Too often, e-health solutions transfer costs rather than actually track and deliver identifiable cost savings (Wickramasinghe et al. 2010a).

Taken together, these two recommendations address the barriers of economic factors and technology factors.

Of equal importance to the components of the recommended solution strategy are the adoption of a process perspective and the utilization of appropriate change management techniques.

In examining the barriers discussed earlier, two of the four major barriers are primarily concerned with people issues: human factors and organizational factors. To address these barriers, it is essential to look deeply into health care processes and treatments. Generally, in health care, doctors take a snapshot view rather than a process perspective of the patient (Wickramasinghe et al. 2010b). In addition to efficient and superior quality health care treatment, it is

also essential to view the patient in a process view from start to finish, i.e., from the point of entering the health care system to the point of recovery. From this perspective, not only will resources be used more efficiently and duplications of tests be minimized, but all members within the health care system will take a more participatory role and hence gain a wider understanding of all issues pertaining to the patient's treatment will ensue. Moreover, it is also then possible to generate and gather relevant data and pertinent information which can be transformed into germane knowledge by utilizing the tools and techniques of knowledge management. Such germane knowledge not only supports evidence-based medicine but also ensures continuous improvement and efficient detection of errors (Wickramasinghe and von Lubitz, 2007). When such a process view is adopted, it will in turn be possible to realize the full potential of the e-health solutions initiated. In order to move to a process view, as well as to address many of the other human factors, it is recommended that change management techniques be embraced.

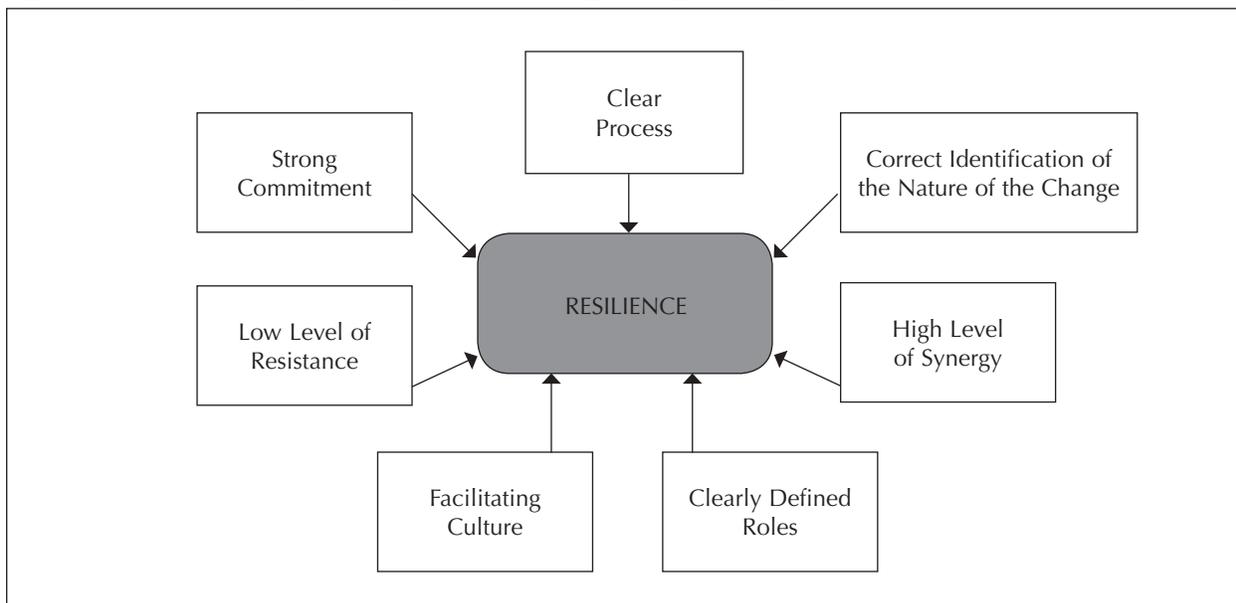
Change management is the systematic approach of ensuring the successful absorption of a new technology or initiative by an organization, while ensuring that minimal disruption occurs—and it requires a focus on individuals within a department or group (Wickramasinghe and von Lubitz, 2007). Underlying any change management effort should be a consideration of the Lewin/Schein model: unfreeze, move and refreeze (Wickramasinghe and von Lubitz, 2007). Thus, what the organization wants to do regarding change management is to:

- Unfreeze a current state problem or process
- Make the necessary changes and move to the desired process or solution,
- Refreeze so these changes will become the way the organization operates, i.e., a desired future state

In structuring the actual change or moving stage, seven key factors (Wickramasinghe and von Lubitz, 2007; Wickramasinghe and Ginzberg, 2001) are the:

- Nature of the change, i.e., is it radical or incremental
- Process
- Roles of all people involved

Figure 7: Resilience is Key for Organizations Going through Change



- Resistance to change
- Commitment
- Culture
- Synergy

The key for any organization going through change management is to exhibit resilience (Figure 7). Resilience is affected by seven key factors:

- Strong commitment
- Clear processes
- Correct identification of the nature of the change—be it radical or incremental
- A high level of synergy
- Clearly defined roles
- A facilitating culture
- Low level of resistance

In order to ensure a high level of resilience, it is essential to address all seven factors before moving forward with the change. This will facilitate appropriate future change. Integral to facilitating appropriate change management is the need for strong leadership and appropriate management. Change management must be driven from the top.

It is also important to note that, in addition to addressing the major barriers—technology, organizational, human, and economic factors—the preceding recommendations also serve to identify key facilitators with regard to the next steps pertaining to e-procurement, e-connectivity, and e-benefits. In particular, it must be recognized that, with regard to improving and/or enhancing initiatives relating to procurement, it is not connectivity and benefits technology per se that is the limiting factor, but rather the process and people issues. By taking a network-centric perspective, this will allow and enable the seamless passing of appropriate information and products when required and, hence, will make it possible to enhance all current procurement and connectivity issues which to date have been restricted primarily because of their platform-centric designs. Furthermore, by coupling this with restructuring around a process view and effecting appropriate change management techniques, it is anticipated that few problems should arise with regard to most e-procurement and e-benefits initiatives.

In addition, it is also noted that it is essential to focus on three equally crucial areas if significant improvements with regard to the areas of e-connectivity, e-procurement, and e-benefits are in fact to be realized. The three areas include:

- Creating a technical framework for connectivity, which is necessary to support network-centric health care operations

- Addressing financial barriers, which is achieved to a large extent by robust cost-benefit identifications and tracking
- Engaging the public

These three areas also have been identified by a Robert Wood Johnson Foundation study that focused on achieving electronic connectivity in health care. As noted in this study, without rapid acceleration of connectivity achieved through the development of common networks, the development of appropriate financial and other related incentives, including but not limited to, standards certification and a concerted effort to engage the public through a consistent message of the need and benefits of e-health solutions, superior and successful e-health solutions on a large scale cannot ensue.

In the previous section, the e-health preparedness grid was presented. This grid is a very powerful framework, as it serves the dual role of being both a useful tool for diagnosing the current state of e-health preparedness as well as one providing the possibility for identifying prescriptive solutions for facilitating better e-health preparedness, especially in key areas. For example, if an organization identifies itself as low with regard to ICT infrastructure, it then can focus a concerted effort to designing and developing a more robust and appropriate infrastructure. Conversely, if it is found that the organization

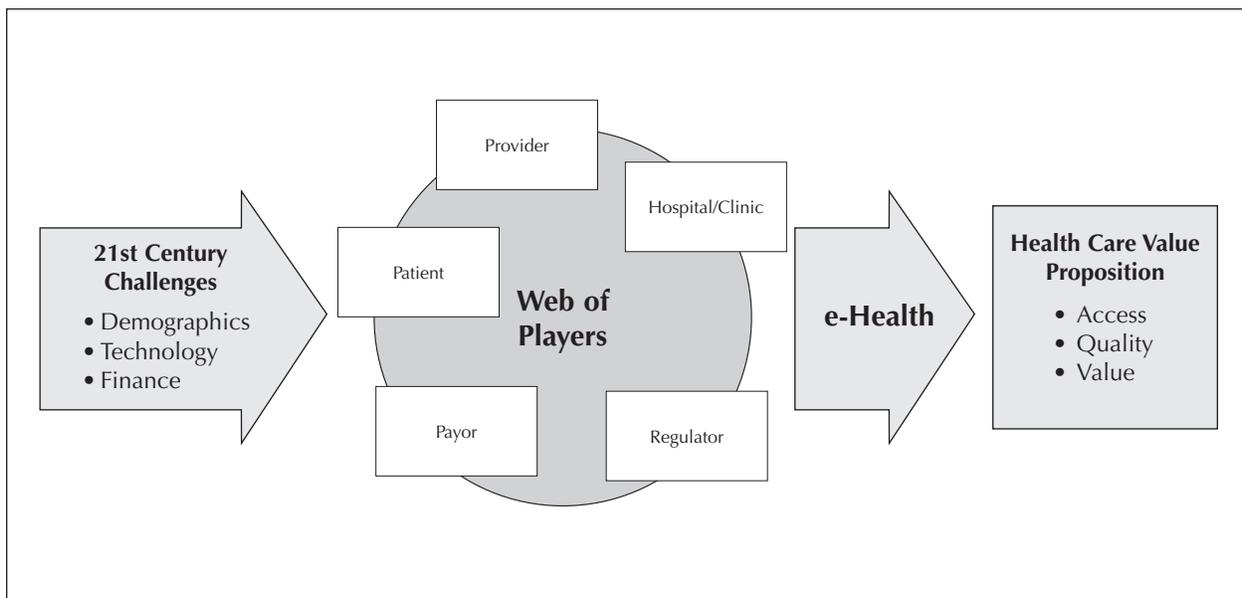
is low with regard to regulations, for example, the solution and/ or organization might be poor with regard to HIPAA compliance then privacy and security issues and/or non compliance must form a critical part of the strategy to transition to a state of high e-health preparedness.

While it is noted that each e-health solution by its very nature will have unique issues, in general the solution strategy for successfully traversing to a level of high e-health preparedness is achieved once again by a focus on the key recommendation solution strategy: understanding the current trends in health care and targeting the e-health initiative to these, adopting a network-centric approach, having solid and identifiable cost-benefit items, designing around health care processes, and effecting appropriate change management techniques. In so doing, it should be observed that any solution strategy must take into account a multi-spectral approach of addressing simultaneously people, process, and technology elements if in fact high e-health preparedness is to be realized.

Conclusion

The major challenges confronting modern health care (demographics, finance, and technology) appear to be insurmountable as health care providers and health care organizations try to reconcile these challenges while realizing the health care value proposition of

Figure 8: Critical Success Factors to Achieve Value Driven e-Health Solutions



access, quality, and value. However, as has been discussed in this report, the correct application of ICT in general and e-health solutions more specifically to provide superior health care delivery can be achieved, as Figure 8 summarizes.

What now becomes essential is how to realize the full potential of such e-health solutions.

The e-health preparedness grid developed in this report serves a dual purpose—it acts as a diagnostic tool as well as a prescriptive tool to facilitate the transitioning to a state of high e-health preparedness. Hence, it is possible to assess ones current e-health preparedness and then identify the areas that need to be addressed in order to achieve a high state of e-health preparedness.

Finally, in closing it is important to note that preparedness is not the equivalent of readiness (Wickramasinghe and von Lubitz, 2007). Preparedness is defined as *the availability (prepositioning) of all resources, both human and physical, necessary for the management of, or the consequences of, a specific crisis event or event complex*. Readiness is defined as the instantaneous ability to respond to a suddenly arising major crisis (e.g., global financial crisis) based on the instantaneously available human and materiel countermeasure resources that may or may not be prepositioned for crisis-related mobilization.

Consequently, it is necessary at all times to continuously evaluate the e-health solution and be ready to effect appropriate and required changes that are consistent with the dynamic and complex nature of health care operations. As a result, the attainment of a high level of e-health preparedness is a necessary but not sufficient step to realizing value-driven e-health solutions. It is also essential at all times to continuously evaluate the e-health solution and be ready to effect appropriate and required changes that are consistent with the dynamic and complex nature of health care operations to ensure that the full potential of ICTs can be harnessed to enable truly superior patient-centric health care delivery.

Indeed, currently health care delivery in the U.S. is at a crossroads. However, we are confident that, if superior patient-centric e-health solutions are designed and implemented, this in turn will realize the health care value proposition and ensure that

superior health care delivery is not only possible but will ensue—with the most important results being effective and efficient health care for all Americans, thereby giving rise to a world-class, cutting-edge, health care delivery system.

Appendix: Main Influences

The significance of the four prerequisites on e-health initiatives will be modified by the influences in the following key areas.

Impact of IT education. A sophisticated, well-educated population boosts competition and hastens innovation. According to Michael Porter, one of the key factors to a country's strength in an industry is strong customer support (Porter, 1990). Thus, a strong domestic market leads to the growth of competition, which leads to innovation and the adoption of technology-enabled solutions to provide more effective and efficient services—such as e-health and telemedicine. As identified earlier, the health consumer is the key driving force in pushing e-health initiatives forward; we conjecture that a more IT-educated health care consumer then would provide stronger impetus for e-health adoption.

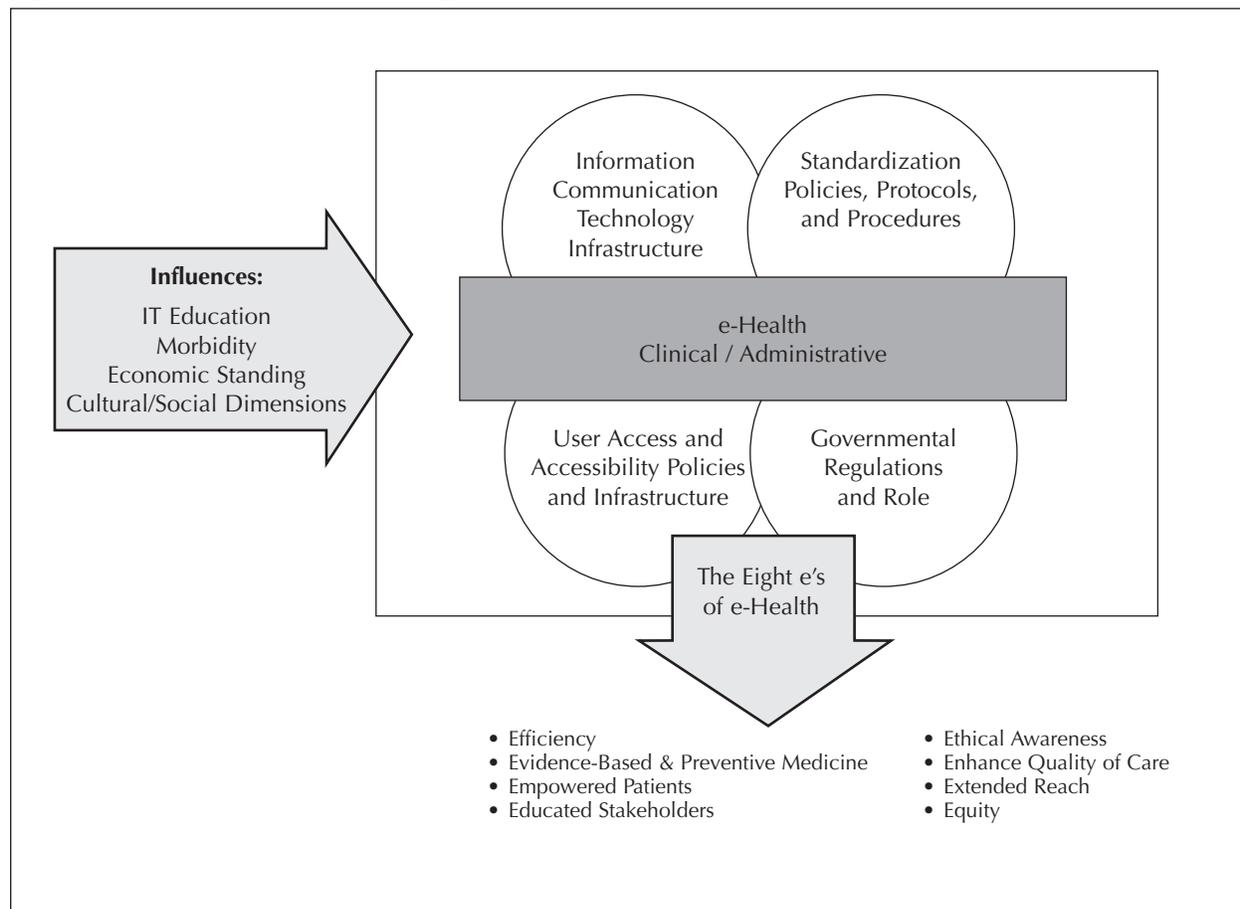
Impact of morbidity rate. There is a direct relationship between health education and awareness and the overall health standing of a country. Therefore, a more health-conscious society, which tends to coincide with a society that has a lower morbidity rate, is more likely to embrace any e-health initiatives. Furthermore, higher morbidity rates tend to indicate the existence of more basic health needs (WHO, 2003), and hence, treatment is more urgent than the practice of preventative medicine. e-Health could be considered an unrealistic luxury and in some instances, such as when a significant percentage of a population is suffering from malnutrition-related diseases, is even likely to be irrelevant, at least in the short term. Thus, we conjecture that the modifying impact of the morbidity rate is to prioritize the level of spending on e-health versus on other basic health care needs.

Impact of cultural/social dimensions. Health care has been shaped by each nation's own set of cultures, traditions, payment mechanisms, and patient expectations. While the adoption of e-health to a great extent dilutes this cultural impact, social and cultural dimensions still will be a moderating influence on any country's e-health initiatives. Another aspect of the cultural/social dimension relates to the presentation language of the content of the e-health repositories. There is a significant number of people, approximately one in five, within the U.S. who speak a first language that is not English (Post and Courier, 2009), which makes it crucial for e-health solutions to be offered in many languages. The e-health-supporting content in web servers/websites must be offered in multiple languages and be supported by pictures and universal icons. This becomes a particularly important consideration when we look at the adoption and diffusion of evidence-based medicine, as it will mean that much of the available evidence and case study data will not be easily accessible globally due to language barriers.

Therefore, for successful e-health initiatives, it is important to consider cultural dimensions. For instance, an international e-commerce study by International Data Corp. indicates that web surfing and buying habits differ substantially from country to country (Wilson, 1999), and this then would have a direct impact on their comfort with using e-commerce generally and e-health particularly, especially as e-health addresses a more fundamental need.

The adoption of e-health is directly related to one's comfort with using the technology, and this in turn is influenced in a major way by cultural dimensions. Also connected with cultural aspects is the relative entrepreneurial spirit of a country. A study conducted

Figure A.1: A Framework for Assessing e-Health Potential



by Geert Hofstede (Hofstede, 1980), for example, indicates that, in a cultural context, Indians score highly on “uncertainty avoidance” criteria when compared to their Western counterparts. As a result, for example, the study asserted that Indians do not accept change very easily and are hostile toward innovation. This then would potentially pose a challenge to the startup of e-health initiatives whose success depends on widespread adoption of their technological innovations. We conjecture that fear of risk and absence of an entrepreneurial mindset, as well as other cultural/social dimensions, also can impact the success of e-health initiatives in a given country.

Impact of world economic standing. Economies of the future will be built around the Internet. All governments are very aware of the importance and critical role that the Internet will play on a country’s economy. This makes it critical that appropriate funding levels and budgetary allocations become a key component of governmental fiscal policies, so that such initiatives will form the bridge between a

traditional health care present and a promising e-health future—the result of which would determine the success of effective e-health implementations and consequently have the potential to enhance a country’s economy and future growth.

The World Economic Forum’s global competitiveness ranking measures the relative global competitiveness of a country. It takes into account factors such as physical infrastructure, bureaucracy, and corruption. We conjecture that, when weak physical infrastructure is combined with high levels of bureaucracy and corruption, this will lead to significant impediments to the establishment of successful e-health initiatives.

In developing its e-health initiative, a good first step for a nation is to assess its standing with respect to the four prerequisites and four impacts discussed above. In this way, it will be possible to evaluate its preparedness with respect to these parameters and consequently devise appropriate policies and strategies for an effective and successful e-health initiative.

References

- Abel-Smith, B., 1989. Health Economies in Developing Countries, *The American Journal of Tropical Medicine and Hygiene*. 92, 229-41.
- Afford, C. W., 2003. Corrosive Reform: Failing Health Systems in Eastern Europe, ILO Socio-Economic Security Programme, Geneva 2003 (accessible at <http://www.ilo.org/public/english/bureau/inf/features/03/health.htm>).
- Alavi, M. and D. Leidner, 1999. Knowledge Management Systems: Issues, Challenges and Benefits, *Communications of the Association for Information Systems*, vol. 1 Paper #5.
- Alberts, D.S., J.J. Garstka, and F.P. Stein, 2000. Network Centric Warfare: Developing and Leveraging Information Superiority, CCRP Publication Series (Dept. of Defense), Washington, DC, pp 1-284 (available at http://www.dodccrp.org/publications/pdf/Alberts_NCW.pdf).
- Applegate, L., R. Mason, and D. Thorpe, 1986. Design of a Management Support System for Hospital Strategic Planning, *Journal of Medical Systems* (10:1), pp. 79-94.
- Award, E. and H. Ghaziri, 2004. *Knowledge Management*. Prentice Hall, Upper Saddle River, N.J.
- Back, J. and C. Oppenheim, 2001. A Model of Cognitive Load for IR: Implications for User Relevance Feedback Interaction, *Information Res.* 2, (available at <http://InformationR.net/ir/6-2/ws2.html>).
- Berinato, S., 2002. CIOs at the Heart of Health-Care Change, *CIO Magazine*. June 15.
- Bodner, G.M., and T.L.B. McMillen, 1986. Cognitive Restructuring as an Early Stage in Problem Solving, *Journal of Research in Science Teaching* 23, 727-737.
- Boyd, J.R., 1976. Destruction and Creation, in R. Coram "Boyd" Little, Brown & Co, New York.
- Boyd, J.R., 1987. In *Patterns of Conflict*, unpublished briefing (accessible as "Essence of Winning and Losing", <http://www.d-n-i.net>).
- Brailer, D.J. and A.B. Terasawa, 2003. Use and Adoption of Computer-Based Patient Records, California Healthcare Foundation, pp. 1-42.
- Brender, J., E. Ammenwerth, P. Nykonen and J. Talmon, 2006. Factors Influencing Success and Failure of Health Informatics Systems—A Pilot Delphi Study, *Methods in Information Medicine* 45, no. 1, 125-136.
- Buse, K., 1999. Keeping a Tight Grip on the Reins: Donor Control Over Aid Coordination and Management in Bangladesh, *Health Policy and Planning*. 14, 219-228.
- Carlisle, S., and A.J. Sefton, 1998. Healthcare and Information Age: Implications for Medical Education, *eMJA* 168, 340-343.
- Cebrowski, A.K., and J.J. Garstka, 1998. Network-centric Warfare: Its Origin and Future, *US Nav. Inst. Proc.* 1, 28-35.
- Chandra, R., M. Knickrehm and A. Miller, 1995. Health Care's IT Mistake, *The McKinsey Quarterly* (5).

- Choi, J.H.J., J. Blueter, B. Fahey, J. Leonard, T. Omilanowski, V. Riley, M. Schauer, M. Sullivan, V. Krebs, and J. Schaffer, 2007. Optimization of Perioperative Processes Through Innovation and Technology for the Orthopaedic Operating Room of the Future. *Cleveland Clinic Journal of Medicine* 74 eSuppl 1, S26.
- Collins, C., and A. Green, 1994. Decentralization and Primary Healthcare: Some Negative Implications in Developing Countries, *International Journal of Health Services*. 24, 459-75.
- Cyber Dialogue, May 23, 2000. Online Health Information Seekers Growing Twice as Fast as Online Population.
- DoD, 2005. Dictionary of Military Terms, <http://www.dtic.mil/doctrine/jel/doddict/data/m/03513.html>.
- Duffy, J., 2001. The Tools and Technologies Needed for Knowledge Management.
- Dwivedi, A., R. Bali, N. Wickramasinghe, R. Naguib, and S. Goldberg, 2006. Critical Success Factors for Achieving m-Health Success in press *International Journal of Electronic Healthcare*.
- Edwards, J., D. Shaw and P. Collier, 2005. Knowledge Management Systems: Finding a Way with Technology, *Journal of Knowledge Management* 9, no. 1, 113-125.
- Eid, R., 2005. International Internet Marketing: A Triangulation Study of Drivers and Barriers in the Business-to-Business Context in the United Kingdom, *Marketing Intelligence & Planning* 23, no. 2/3, 266-281.
- Endsley, M.R., and D.R. Kaber, 1999. Level of Automation Effects on Performance, Situation Awareness, and Workload in a Dynamic Control Task, *Ergonomics* 42, 462-92.
- Fichman, R. and C. Kemerer, 1999. The Illusory Diffusion of Innovation: An Examination of Assimilation Gaps, *Information Systems Research* 10, no. 3, 255-261.
- Frost & Sullivan, May 11, 2004. Country Industry Forecast — European Union Health Care Industry, . http://www.news-medical.net/print_article.asp?id=1405.
- Gafni, A. and S. Birch, 1993. Guidelines for the Adoption of New Technologies: A Prescription for Uncontrolled Growth in Expenditures and How to Avoid the Problem, *Canadian Medical Association Journal* 148, no. 6, 913-922.
- Garstka, J.J., 2000. Network Centric Warfare: An Overview of Emerging Theory, *Phalanx* 4, 28-33.
- Geisler, E., D. Lewis, M. Nayar and P. Prabhaker, 2003. Information Integrity and Organizational Performance: A Model and Research Directions, working paper.
- Haag, S., M. Cummings and D. McCubbrey, 2004. *Management Information Systems for the Information Age*, 4th Ed. McGraw-Hill Irwin, Boston.
- Manos D., February 18, 2009. Done Deal: Obama Signs Stimulus Package into Law, *Healthcare IT News*.
- HIPAA Security Requirement Matrix, 2002. Website: <http://www.hipaa.org>.
- Hironaka, W, 1992. We Must Tackle Population Problems, *Integration*, vol. 31: 27.
- Hofstede, G., 1980. *Culture's Consequences, International Work Related Values*, Sage Publishing, Beverly Hills, California.
- Holmes, J., P. Abbott, P. Cullen, RN, L. Moody, K. Phillips, and B. Zupan, 2002. Clinical Data Mining: Who Does It, and What Do They Do?; AMIA 2002 Symposium, Nov. 9-13.
- Howard, L.M., 1991. Public and Private Donor Financing for Health in Developing Countries, *Infect. Dis. Clin. North. Am.* 5, 221-34.
- Institute of Medicine, Committee on Quality of Health Care in America, 2001. Crossing the Quality Chasm: A New Health System for the 21st Century, National Academy Press, Washington, DC.

- Jadad, A., R. Haynes, D. Hunt and G. Brondman, 2000. The Internet and Evidence-Based Decision Making: A Needed Synergy for Efficient Knowledge Management in Health care, *Canadian Medical Association Journal* 162, no. 3, 362-367.
- JMIR (Journal of Medical Internet Research).
Website: <http://www.jmir.org>.
- Kaplan, K., 1987. The Medical Computing Lag: Perceptions of Barriers to the Application of Computers to Medicine, *International Journal of Technology Assessment in Healthcare* 3, no. 1, 123-136.
- Kulkarni, R. and L.A. Nathanson, 2005. Medical Informatics in Medicine, *e-Medicine* at: <http://www.emedicine.com/emerg/topic879.htm>.
- Kurtz, S., K. Ong, E. Lau, F. Mowat, and M. Halpern, 2007. Projections of Primary and Revision Hip and Knee Arthroplasty in the United States from 2005 to 2030. *The Journal of Bone & Joint Surgery (JB&JS)* 2007; 89: 780-5.
- Laupacis, A., 1992. How Attractive Does a New Technology Have To Be To Warrant Adoption and Utilization? Tentative Guidelines for Using Clinical and Economic Evaluations, *Canadian Medical Association Journal* 146, no. 4, 473-486.
- Lawrence, P.F., O.L. Lund, F. Eko, E. Sarabi, and J. Wu, 2009. Assessing the Database Needs of Vascular Surgeons, *Journal of the American College of Surgeons*, January, vol. 208, Issue 1, pp. 21-27.
- Lehto, M.R., 1991. A Proposed Conceptual Model of Human Behaviour and Its Implications for Design of Warning, *Percept. Mot. Skills* 73, 595-611.
- Maier, R., 2001. *Knowledge Management Systems*. Berlin: Springer.
- Mandke, V., M. Bariff, and M. Nayar, 2003. Demand For Information Integrity In Healthcare Management, forthcoming in The Hospital of the Future conference proceedings.
- Markoff, J., and J.L. Schenker, 2003. Europe Exceeds U.S. in Refining Grid Computing, *The New York Times*, November 10.
- Martens, B. and A. Goodman, 2006. The Diffusion of Theories: A Functional Approach, *Journal of the American Society for Information Science and Technology* 57, no. 3, 330-341.
- Massey, A., M. Montoya-Weiss, and T. O'Driscoll, 2002. Knowledge Management In Pursuit of Performance: Insights From Nortel Networks, *MIS Quarterly*, vol. 26 No. 3, pp. 269-289.
- McDermott, R. and O'Dell, C., 2001. Overcoming Cultural Barriers to Sharing Knowledge, *Journal of Knowledge Management*, vol. 5, No.1, pp. 76-85
- McGee, M., 1997. High-Tech Healing, *Information Week*, September 22.
- McNeilly, M., 2000. *Sun Tzu and the Art of Business: Six Strategic Principles for Managers*, Oxford University Press (Oxford), pp. 1-260.
- Moore, T. & R. Wesson, 2002. Issues Regarding Wireless Patient Monitoring Within and Outside the Hospital, published in the 2nd Hospital of the Future Conference Proceedings, Chicago, Illinois.
- Newby, G.B., 2001. Cognitive Space and Information Space, *Journal of the American Society for Information Science and Technology* 12, 1026-1048.
- Nykanen, P. and E. Karimaa, 2006. Success and Failure Factors in the Regional Health Information System Design Process—Results From a Constructive Evaluation Study, *Methods in Information Medicine* 45, no. 1, 89-124.
- Odyssey Research, 2003. Website: www.odysseyresearch.org
- Overhage, J.M., P.R. Dexter, S.M. Perkins, W.H. Cordell, J. McGoff, R. McGrath, and C.J. McDonald, 2002. A Randomized, Controlled Trial of Clinical Information Shared from Another Institution, *Annals of Emergency Medicine* 39, 14-23.

- Overhage, J.M., 2004. House Committee on Ways and Means Statement (Testimony before the Subcommittee on Health of the House Committee on Ways and Means), U.S. House of Representatives, June 17, 2004. Accessible at: <http://waysandmeans.house.gov/hearings.asp?formmode=printfriendly&id=1655>.
- Pavia, L., 2001. The Era of Knowledge in Health Care, *Health Care Strategic Management* 19, no. 2, 12-13.
- Perper, J., 1994. Life Threatening and Fatal Therapeutic Misadventures, *Human Error in Medicine*, Bogner, M (Ed.), Lawrence Erlbaum Associates, Publishers, Hillsdale, New Jersey, 27-52.
- Porter, M., 1990. *The Competitive Advantage of Nations*, Free Press New York.
- Porter, M. and E. Teisberg, 2006. *Redefining Health Care: Creating Value-Based Competition on Results*, Harvard Business School Press, Cambridge, Massachusetts.
- Post and Courier, 2009. Website: <http://www.postandcourier.com/news/2007/sep/12/language15626/>.
- Prietula, M.J., P.J. Feltovich, and F. Marchak, 2000. Factors Influencing Analysis of Complex Cognitive Tasks: A Framework and Example from Industrial Process Control, *Human Factors: The Journal of the Human Factors and Ergonomics Society* 42, 56-74.
- Protegrity, 2001. Health Insurance Portability and Accountability Act (HIPAA), *Privacy Compliance Executive Summary*, Protegrity Inc. May 2001.
- Purvis, R., V. Samamburthy and R. Zmud, 2001. The Assimilation of Knowledge Platforms in Organizations: An Empirical Investigation, *Organization Science* 12, no. 2, 117-132.
- PWC (PricewaterhouseCoopers). Health care Practice. Website: www.pwchealth.com
- Roberts, L.W., and R.A. Clifton, 1992. Measuring the Cognitive Domain of the Quality of Student Life: An Instrument for Faculties of Education, *Canadian Journal of Education* 2, 176-191.
- Samiee, S., 1998. The Internet and International Marketing: Is There a Fit? *Journal of Interactive Marketing*, vol. 12 no. 4, pp. 5-20.
- Schaffer, J.L., K.J. Bozic, L.D. Dorr, D.A. Miller, and J.V. Nepola, 2008. Direct-to-Consumer Marketing in Orthopaedic Surgery: Boon or Boondoggle? *Journal of Bone and Joint Surgery* 90: 2534 – 43.
- Schaffer, Steiner, Krebs and Hahn; Orthopaedic Operating Room of the Future, 2004. Unpublished data.
- Schaffer, L.L., S. Plona, S. Omori, H. Miller, and C. Harris, 2002. The Consult is Real, The Visit is Virtual, *JHIMS* 16(3), pp. 30-34.
- Schneider, H., and L. Gilson, 1999. Small Fish in a Big Pond? External Aid and the Health Sector in South Africa, *Health Policy and Planning* 14, 264-272.
- Scott Morton, M., 1991. *The Corporation of the 1990s*, New York, Oxford University Press.
- Scott, T., T. Rundall, T. Vogt and J. Hsu, 2006. Kaiser Permanente's Experience of Implementing an Electronic Medical Record: A Qualitative Study, *British Medical Journal* 331, no. 3 December, 1313-1316.
- Shakeshaft, A. and C. Frankish, 2003. Using Patient-Driven Computers to Provide Cost-Effective Prevention in Primary Care: A Conceptual Framework, *Health Promotion International* 18, no. 1, 67-77.
- Smarr, L., 1999, Grids in Context, *The Grid: Blueprint for a New Computing Infrastructure*, Foster, I., Kesselman, C. (Eds.) M. Kaufman Publishers, San Francisco, pp. 1-14.
- Stegwee, R. and T. Spil, 2001. *Strategies for Health Care Information Systems*, Idea Group Publishing, Hershey, Pennsylvania.
- Stein, P., 1998, Observations on the Emergence of Network Centric Warfare. Website: http://www.dodccrp.org/research/ncw/stein/_observations/steincw.htm.

- The 9/11 Commission Report: Final report of the National Commission on Terrorist Attacks upon the United States, Authorized Edition, Norton & Co. New York, 2004, pp. 1-567.
- Tole, J.R., A.T. Stephens, R.L. Harris, Sr., and A.R. Eprath, 1982. Visual Scanning Behavior and Mental Workload of Aircraft Pilots, *Aviation, Space, and Environmental Medicine* 53, 54-61.
- Troisfontaine, N. et al, 2000. Preparatory Report: Entrepreneurship in Health Care, University of Twente, The Netherlands.
- U.S. Census Bureau, Decennial Census Data and Population Projections, August 14 2008. Website: (<http://www.census.gov/population/www/projections/files/nation/summary/np2008-t1.xls>)
- Valdes, I., D. Kibbe, G. Tolleson, M. Kunik, and L.A. Petersen, 2003. Metcalfe's Law Predicts Reduced Power of Electronic Medical Record Software, AMIA Annual Symposium Proceedings 2003, 1038.
- Van Beveren, J., 2003. "Does Health Care for Knowledge Management," *Journal of Knowledge Management* 7, no. 1, 90-97.
- von Lubitz, D. and N. Wickramasinghe, 2006b. Networkcentric Health care: Outline of Entry Portal Concept, *International Journal of Electronic Business Management (IJEEM)*, vol 1 pp. 16-28.
- von Lubitz, D. and N. Wickramasinghe, 2006d. Creating Germane Knowledge In Dynamic Environments, *International Journal of Innovation and Learning (IJIL)*, vol. 3 no. 3 pp. 326-347.
- Von Lubitz, D. and N. Wickramasinghe, 2006a. Health care and Technology: The Doctrine of Networkcentric Healthcare, *International Journal of Electronic Healthcare (IJEH)*, vol. 4 pp. 322-344.
- von Lubitz, D. and N. Wickramasinghe, 2006c. Key Challenges and Policy Implications for Governments and Regulators in a Networkcentric Health Care Environment, *International Journal of Electronic Government*, vol. 3. no. 2 pp. 204-224.
- von Lubitz, D. and N. Wickramasinghe, 2006e. Dynamic Leadership In Unstable And Unpredictable Environments, *International Journal of Innovation Learning*, vol. 4, pp. 339-350.
- von Lubitz, D., N. Wickramasinghe, and G. Yanovsky, 2006. Networkcentric Health Care Operations: The Telecommunications Structure, *International Journal of Networking and Virtual Organizations*, vol. 3. no. 1, pp. 60-85.
- von Lubitz, D. and N. Wickramasinghe, 2006f. Networkcentric Health care and Bioinformatics, *International Journal of Expert Systems with Applications*, vol. 30, pp. 11-23.
- von Lubitz, D., and N. Wickramasinghe, 2006h. Key Challenges and Policy Implications for Governments and Regulators in a Networkcentric Healthcare Environment, *International Journal of Electronic Government*, vol. 3. no. 2 pp. 204-224.
- von Lubitz, D. and N. Wickramasinghe, 2006g. Networkcentric Health care: applying the tools, techniques and strategies of knowledge management to create superior health care operations, *International Journal of Electronic Healthcare (IJEH)*, vol. 4 pp. 415-428.
- Von Lubitz, D., et al., 2004. Medical Readiness in the Context of Operations Other Than War: Development of First Responder Readiness Using OODA—Loop Thinking and Advanced Distributed Interactive Simulation Technology, Proceedings EMISPHERE 2004 Symposium, Istanbul, Turkey, September 2004. For on-line version at the Defence and National Intelligence Network, see http://www.d-n-i.net/fcs/pdf/von_lubitz_1rp_ooda.pdf.
- Wetherell J.L., C.A. Reynolds, M. Gatz, and N.L. Pedersen, 2002. Anxiety, Cognitive Performance, and Cognitive Decline in Normal Aging, *J. Gerontol (B) Psych. Sci. and Soc. Sci.* 57, 246-255.
- Wickramasinghe, N., 2000. IS/IT as a Tool to Achieve Goal Alignment: A Theoretical Framework, *International Journal of Healthcare Technology Management*, vol 2. No. 1/2/3/4/. pp. 163-180.

- Wickramasinghe, N. and D. von Lubitz, 2007. *Knowledge-Based Enterprise: Theories and Fundamentals*, IGI, Hersey.
- Wickramasinghe, N. and G. Mills, 2002. Integrating e-Commerce and Knowledge Management—What Does the Kaiser Experience Really Tell Us, *International Journal of Accounting Information Systems*, vol. 3. Issue 2, pp. 83-98.
- Wickramasinghe, N. and G. Mills, 2001. MARS: The Electronic Medical Record System. The Core of the Kaiser Galaxy, *International Journal of Healthcare Technology and Management* 3, no. 5/6 , 406-423.
- Wickramasinghe, N. and J.B. Silvers, 2002. IS/IT The Prescription to Enable Medical Group Practices Attain Their Goals forthcoming in *Healthcare Management Science*.
- Wickramasinghe, N., 2006. Building a Learning Health Care Organisation by Fostering Organisational Learning Through a Process Centric View of Knowledge Management, *International Journal of Innovation and Learning*.
- Wickramasinghe, N., 2007. Fostering Knowledge Assets in Health care With the KMI Model, *International Journal of Management and Enterprise Development (IJMED)*, vol. 4 issue 1, pp. 52-65.
- Wickramasinghe, N. and M. Ginzberg, 2001. Integrating Knowledge Workers and the Organization: The Role of IT, *International Journal Healthcare Quality Assurance*, vol. 14, no 6 and 7, pp. 245-253.
- Wickramasinghe, N. and J. Schaffer, 2006. Creating Knowledge Driven Health care Processes with the Intelligence Continuum, *International Journal of Electronic Healthcare (IJEH)*, vol. 2 issues 2, pp. 164-174.
- Wickramasinghe, N., J. Schaffer and F. Moghim, 2010. Designing an Intelligent Risk Detection Framework Using Knowledge Discovery Techniques to Improve Efficiency and Accuracy of Healthcare Decision Making,” presentation 2nd e-Health Symposium, Hoehenheim, Germany June 7-8.
- Wickramasinghe, N. and J.B. Silvers, 2003. IS/IT The Prescription to Enable Medical Group Practices to Manage Managed Care, *Healthcare Management Science*, vol. 6 no 2, pp. 75-86.
- Wickramasinghe, N., S. Misra, A. Jenkins and D. Vogel, 2006. The Competitive Forces Facing e-Health, *Intl J of Health Information Systems and Informatics (IJHISI)*, vol. 1 no. 4, pp. 68-81.
- Wickramasinghe, N., A. Fadlalla, W. Geisler, and J. Schaffer, 2003. Knowledge Management and Data Mining: Strategic Imperatives for Healthcare, Forthcoming at The Hospital of The Future 3 Conference.
- Wickramasinghe, N., E. Geisler and J. Schaffer, 2006. Realizing the Value Proposition for Health Care by Incorporating KM Strategies and Data Mining Techniques with the Use of Information Communication Technologies, *International Journal of Healthcare Technology and Management*, vol. 7. no 3/4, pp. 303-318
- Wickramasinghe, N., I. Troshani, and S. Goldberg, 2010. A Transaction Cost Economic Assessment of a Diabetes Self-Management Wireless Solution, *Healthcare Delivery Reform and New Technologies: Organizational Initiatives*, IGI, Hershey (in press)
- Wilson, T., 1999. Not a Global Village After All? — Consumer Behavior Varies Widely by Country. *Internetweek*, 792, 13.
- World Health Organization, 2003. Website: <http://www.emro.who.int/ehealth/>.
- World Health Organization, 2000. *Health Systems: Improving Performance*, Geneva, pp. 1-215.
- World Health Organization, 2004. *Changing History*, Geneva, pp. 1-167.
- World Health Organization, 2008. *Global Health Indicators*. Website: <http://www.who.int/entity/whosis/whostat/4.xls>.
- Xu, J. and M. Quaddus, 2005. “A Six-Stage Model for the Effective Diffusion of Knowledge Management Systems,” *The Journal of Management Development* 24, no. 4, 362-374.

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