

## Editorial Overview

# The Role of Information Systems in Healthcare: Current Research and Future Trends

### Guest Senior Editors

Robert G. Fichman

Carroll School of Management, Boston College, Chestnut Hill, Massachusetts 02467,  
fichman@bc.edu

Rajiv Kohli

Mason School of Business, College of William & Mary, Williamsburg, Virginia 23187,  
rajiv.kohli@mason.wm.edu

Ranjani Krishnan

Broad College of Business, Michigan State University, East Lansing, Michigan 48824,  
krishnan@bus.msu.edu

Information systems have great potential to reduce healthcare costs and improve outcomes. The purpose of this special issue is to offer a forum for theory-driven research that explores the role of IS in the delivery of healthcare in its diverse organizational and regulatory settings. We identify six theoretically distinctive elements of the healthcare context and discuss how these elements increase the motivation for, and the salience of, the research results reported in the nine papers comprising this special issue. We also provide recommendations for future IS research focusing on the implications of technology-driven advances in three areas: social media, evidence-based medicine, and personalized medicine.

*Key words:* healthcare information systems; special issue

---

## Introduction

The importance of healthcare to individuals and governments and its growing costs to the economy have contributed to the emergence of healthcare as an important area of research for scholars in business and other disciplines. Information systems (IS) have much to offer in managing healthcare costs and in improving the quality of care (Kolodner et al. 2008). In addition to the embedded role of information technology (IT) in clinical and diagnostics equipment, IS are uniquely positioned to capture, store, process, and communicate timely information to decision makers for better coordination of healthcare at both the individual and population levels. For example, data mining and decision support capabilities can identify potential adverse events for an individual patient while also contributing to the population's health by providing insights into the causes of disease complications. Despite its importance, the healthcare domain has been underrepresented in leading IS journals. However, interest is increasing, as demonstrated by the proliferation of healthcare tracks in IS conferences, special interest groups, and announcements of special issues among leading journals.

Research anchored in the healthcare context must begin by reflecting on what is distinctive about healthcare and on how such distinctions could or should inform our theorizing. Distinctiveness of the context drives us toward new theory or theoretical extensions that hold greater promise to explain IS phenomenon (e.g., adoption and impacts). At the most general level, a striking feature of the healthcare industry is the level of diversity that characterizes patients (e.g., physical traits, and medical history), professional disciplines (e.g., doctors, nurses, administrators, and insurers), treatment options, healthcare delivery processes, and interests of various stakeholder groups (patients, providers, payers, and regulators).

Because of this diversity, research in healthcare is eclectic and spans many disciplines, including economics, public health, business, epidemiology, sociology, and strategy. This is reflected in the diversity of papers comprising this special issue, not only in terms of the theoretical frameworks but also in the unit of analysis employed. In the remainder of this section we identify six theoretically distinctive elements of the healthcare context that tie together the research results reported in the nine papers comprising this special issue.

### The Stakes Are Life and Death

Healthcare influences the quality of our lives and how we function within the society. Healthcare mistakes have serious consequences that can affect our ability to carry out social and productive endeavors. Recent reports highlight the gravity of adverse events in hospitals and the dangers such events pose to individuals and the public (Piontek et al. 2010). More generally, medical errors (a leading cause of adverse events and other ills) are expensive, increase patient hospital length of stay, and cost human lives (Classen et al. 1997). At the population level, the failure to control infectious diseases can cause serious public health issues. Therefore, healthcare quality is diligently pursued and vigilantly executed, and IS can facilitate such pursuit by highlighting and monitoring errors at various stages along the continuum of care.

In this issue, Aron et al. examine the association between IS and medical errors in three primary healthcare processes—sensing, controlling, and monitoring. They focus on two types of errors—procedural and interpretive. Using an agency framework, the authors explore the relationship between hospital management and clinicians and the complementarities between training and automation systems. After all, humans are the primary response agents when the technology detects a potential error. The tension between innate and often subjective human experience and dispassionate automation poses challenges, especially in the presence of conflicting situational signals that demand an urgent response.

The findings emerging from Aron et al. are consistent with conventional beliefs that automation complements professional training and that in particular, improved training enables professionals to exploit automation. However, their findings in the domain of error detection are counter to contemporary thinking that the role of IS in enforcing quality is most effective when promoting compliance with procedures and other routine work. They find that training, combined with automation, overcomes *interpretive* errors in decision making but not *procedural* errors. This points to the importance of IT complementarities and provides instances where technology may, in fact, increase the incidence of errors (Fernandopulle and Patel 2010). Finally, Aron et al. find that automation indeed influences agents' behavior by serving as a record for their actions, thus encouraging agents to act in the interests of the principal. Previous IS literature has proposed a panoptic role for IS in enforcing agency relationships (Sia et al. 2002).

When potential healthcare risks extend to the larger population, the demand for resources increases, as do the consequences of improper resource deployment. Many lives are at risk during outbreaks of infectious diseases, such as severe acute respiratory syndrome

(SARS). In such cases, IS plays an essential role at both patient and population levels. Mobilizing and coordinating hospital and public health resources becomes a race against time, because controlling the spread of the disease is just as important as treating it. Also in this issue, Chen et al. examine the SARS outbreak in Taiwan and develop seven guidelines for coordination of public health IS. Drawing on the loose coupling framework, they find that increased involvement of public health agencies is not always helpful, especially when there is clinical uncertainty about effective treatment mechanisms. They conclude that coordination should be such that public health policy makers and healthcare providers can engage and disengage as warranted during an outbreak. These findings led Chen et al. to identify situations where a decoupling between public health authorities and the healthcare providers can enable parties to conduct a more independent examination. Subsequently, coupling can be reactivated for public policy formulation and communication.

These findings have significant implications for the design and development of IS to support public health policy. Combined with the findings of Kane and Labianca (in this issue) regarding network centrality and influence, the loose coupling approach can facilitate the development of new theory regarding how influential actors in a loosely coupled network can supplement or enhance a formally coupled network, for example, in a disease outbreak. This poses another opportunity for theory development to find the optimal balance of the actor and the technology and their ability to decouple on an "as needed" basis.

### Healthcare Information Is Highly Personal

Another hallmark of healthcare information is that it is highly personal. As a result, any transfer of information between parties via technology involves risks—both actual and perceived—that the information could fall into the wrong hands. Although electronic information can be made as secure as paper records, electronic storage may be perceived as having a higher likelihood of leakage, and such fears get further compounded by media attention. Thus, patients' perceived probability of compromised privacy is often higher than the actual probability.

Variations in individuals' willingness to disclose personal health information (PHI) is the focus of Anderson and Agarwal (in this issue). Consistent with prior research, the authors posit that individuals' privacy concerns and trust in the electronic storage of PHI will affect willingness to disclose. Going a step further, the authors explore how these effects are moderated by three sets of contextual variables: the *type* of information requested (general health, mental health, or genetic), the *purpose* for which the information is requested (patient care, research, or marketing),

and the type of *stakeholder* requesting the information (doctors/hospitals, the government, or pharmaceutical companies). In addition, the authors explore the link between an individual's emotions regarding his/her current medical state and willingness to provide access to PHI. As a framework for their analyses, the authors use privacy boundary theory and the risk-as-feelings perspective. Analyses using a nationally representative sample of 1,089 individuals indicate that the type of requesting stakeholder and the purpose for which the information is being requested are important moderators of the relationship between concern and trust and willingness to provide access to PHI.

An in-depth understanding of individuals' willingness to disclose personal information is critical not only because it has implications for effectiveness of treatment protocols but also because of its impact on public policy in dealing with epidemic outbreaks such as SARS (Chen et al.). Anderson and Agarwal add important insights to the literature on individuals' disclosure decisions and offer guidance for healthcare policy. For example, they find that the negative relationship between privacy concerns and willingness to disclose is particularly acute when the information request comes from government/public health agencies (versus hospitals or pharmaceutical companies). Another interesting result is that individuals trust nonprofit hospitals with electronic health systems to a much higher extent than they trust government and for-profit organizations, which might give advocates of government-sponsored single-payer systems some pause. Their results also suggest that individuals who feel sad, angry, or anxious about their current health status are more willing to provide access to their PHI and that such individuals may more easily fall victim to misuse of health information.

Digitization of health information has several benefits. However, the research of Anderson and Agarwal underscores the need to understand the situational factors that drive individuals' comfort with sharing healthcare information in an electronic format. One implication of this research for policy makers is to explore more stringent regulation of medical information, for example, to require that stakeholders clearly identify who they are, for what purpose they will use the data, and even to set limits on the amount of time that the stakeholder will have access.

### **Healthcare Is Highly Influenced by Regulation and Competition**

While the paper by Anderson and Agarwal examines the factors driving the propensity of *patients* to share personal health information, Bandyopadhyay et al. (in this issue) analyze the propensity of healthcare *providers* to share patients' records. Sharing of electronic health records (EHR) by providers can increase

administrative efficiency, reduce healthcare costs by eliminating unnecessary duplication of medical tests, and most importantly, reduce medical errors. However, such sharing is much lower in the United States relative to many other countries.

Recently, for-profit companies, notably, Google and Microsoft, have made forays into the market for personal health records (PHR). The PHR draws health information from multiple sources, including the physician or hospital's EHR, and provides the individual with the flexibility to manage his or her own PHR. While such platforms are mainly intended to serve patients, they may also hold the potential to improve the incentives for providers to share EHR data. In this context, Bandyopadhyay et al. use an analytical game-theoretic model to investigate three research questions: Do providers resist EHR sharing, even when it increases social surplus? Which providers stand to gain most from EHR sharing? What role can a Web-based PHR platform play in solving incentive problems and encouraging providers to share EHRs? The authors analytically demonstrate that a downside of EHR sharing is that customers will find it easier to switch providers, resulting in loss of provider revenue. To ensure participation the PHR platform provider will have to selectively subsidize healthcare providers. The likelihood of subsidization increases in the heterogeneity of the value provided by healthcare providers to consumers.

The findings of Bandyopadhyay et al. contribute to the literature on information sharing and switching costs. Their results also provide insights into why the United States lags behind Europe in sharing PHRs. Most European countries have a single (public) payer that has the ability to subsidize, as well as to exert pressure, if required, for providers to share. Moreover, the risk of sensitive health information leaking out and being misused is reduced when there is less need to transmit data across providers and platforms.

However, whether a public platform for EHR sharing (like the European countries) or a for-profit option (like the focus of Bandyopadhyay et al.) is feasible in the U.S. environment is complicated by issues related to privacy and trust. Given the findings of Anderson and Agarwal (that patients are less likely to trust either the government or for-profit organizations), progress toward a public system in the United States may face additional challenges.

### **Healthcare Is Professionally Driven and Hierarchical**

One of the barriers to healthcare technology adoption is that powerful actors in care delivery often resist technology. Part of this arises from professional norms: physicians are primarily concerned with treating the patient to the best of their ability and regard

other activities as administrative irritants. Given the hierarchical nature of healthcare, technology aversion by an influential physician or nurse is likely to affect other caregivers.

Two papers in this issue—Kane and Labianca and Venkatesh et al.—use network theory to examine the factors driving physician resistance to IS and the effects of such resistance on outcomes. Venkatesh et al. develop a model that encompasses physicians, paraprofessionals (such as nurses), and administrative personnel to explore the drivers of system use and the system's effect on patient satisfaction. Kane and Labianca explore the association between preference for IS avoidance and three outcomes: efficiency of care, patient satisfaction, and quality of care. Although the fundamental questions are similar, the two papers differ in the methods used and outcomes studied, and have produced different (albeit complementary) contributions.

Social network theory suggests that an individual's network position influences behavior and performance. Venkatesh et al. argue that variations in healthcare technology use arise from network ties within and across professional domains. Specifically, they posit that more connected doctors are less likely to use technology, owing to their greater acculturation and commitment to traditional medical practices. They find that while the E-healthcare system in their study has a positive effect on quality of care overall, in-group ties among doctors and out-group ties to doctors has a negative effect on system use for all groups, indicating that doctors likely hamper the spread of technology. Physicians' rejection of technology is a serious problem that can lead to poor quality of care, medical errors, and low patient satisfaction. When we add mistrusting patients (Anderson and Agarwal) and nonsharing providers (Bandyopadhyay et al., in this issue) to the problem of doctors who not only make inadequate use of technology but also adversely influence others' usage of technology, the situation is compounded and likely results in errors (Aron et al.) and potentially serious public health consequences (Chen et al.).

Although Venkatesh et al. is a longitudinal study, its focus is primarily on the initial implementation of healthcare technology. Kane and Labianca build on this topic by examining postadoption resistance. They use the term *IS avoidance* to denote passive postadoption resistance where individuals avoid working with an information system despite the need and opportunity to do so. Using archival data they examine the efficiency and quality effects of IS avoidance at three levels: the individual user level (physician), the shared group level (healthcare team, including paraprofessionals and administrators), and the configural

group level (which accounts for the positions of individuals in the team). They supplement their findings with qualitative data.

Quantitative analysis reported in the paper reveals that IS avoidance is negatively associated with patient outcomes only at the configural group level; at the individual and shared group level there is no association with outcomes. The qualitative analyses provide insights into this pattern of results. At the individual level, users who avoided the system were able to compensate by using brokering relationships, i.e., assigning a representative to interact with the system on their behalf. At the shared group level, clusters of usage were observed, whereby individuals who used or avoided the system tended to work with other users with similar usage patterns. Thus, these clusters could use a different mechanism (such as Post-it notes or paper flags) and ensure that the entire shared group had the same level of information. These results also provide insights into why IS avoidance at the configural group level was associated with negative patient care outcomes. That is, the network structures that evolved to compensate for IS avoidance were less effective in compensating for the adverse effects of avoidance when the avoiding individuals had a central position in the social network.

### Health Care Is Multidisciplinary

The findings reported in the previous sections indicate that there are multiple barriers to the adoption and use of IT in healthcare organizations, despite robust findings that IT can improve patient outcomes. Oborn et al. (in this issue) make a further contribution in this regard by studying whether, despite a diversity of use of IT across different groups (which could include avoidance), an overall unity in use can emerge because of the multidisciplinary nature of healthcare.

Most healthcare is provided in interdisciplinary teams. For example, surgery requires a team consisting of the surgeon, the physician, anesthesiologists, diagnostic staff such as radiologists and pathologists, and nurses. These specialists may either be housed within the same organization, or they may be collaborating from different organizations. Regardless of the organizational form, speedy access to reliable health information is essential to ensure good patient outcomes.

Oborn et al. conduct a field study of electronic patient record use across multidisciplinary teams using a practice theory lens (Orlikowski 2000) to examine how healthcare IS applications become objects that are embedded within embodied practices and how individuals coordinate and align their uses of technology with others across diverse practices. By such a process of coordination and alignment, connections are established between specialist groups. Such

connections are effective even if they are partial in the sense that the elements of one specialist practice do not get subsumed into that of another but are translated by the other practice in a different manner. Oborn et al. refer to this process of coordination and alignment of healthcare information technologies in use as *unity in diversity*. They examine this process using a year-long interpretive field study of a regional breast care center in England that had recently introduced a Web-based clinical information system that interfaced with the hospital's administrative system and used tablet computers to record information.

The breast cancer treatment was coordinated in a team consisting of oncologist, radiologist, pathologist, surgeon, and specialist nurses in surgery and oncology. Results reveal a dynamic interplay between unity and diversity. Regarding diversity, different specialties differed in the type and the extent of use of the new technology. For example, surgeons, who have to perform physical exams, found it cumbersome to carry around tablet computers and instead relied on nurses to provide more extensive documentation. This finding is similar to that of the study of Kane and Labianca, which found evidence of brokering relationships among different professionals. By contrast, radiologists were especially comfortable with the use of technology in their assessments (because of the high-tech nature of their profession) and actually used the technology to obtain more influence in the group. Oncologists found the technology bothersome in emotionally charged patient encounters. However, they used the technology in the patients' absence to support oncology research via easier access to information from other disciplines. Pathologists exhibited idiosyncratic use, such as including narratives rather than just tick boxes, perhaps owing to their academic orientation. Despite this diversity in use, all parties to care managed to coordinate their use of the technology to facilitate the multidisciplinary teamwork essential for the success of the care.

Several implications for implementation and adoption of healthcare IS arise from Oborn et al. For example, usage patterns are complex and entangled; therefore, it is highly simplistic to classify usage as use and nonuse (or rejection). Most individuals involved in patient care have a variety of relationships with others involved in the care of the same set of patients, and these relationships vary across practices and individuals. For example, nurses perceived technology as depersonalizing the patient-nurse relationship and, hence, continued to use their paper records, which provided added flexibility to record important personal information. Nurses' nonuse was not driven either by their rejection of the technology or by their lack of familiarity with it; nurses understood the technology, supported surgeons in their patient

encounters, and assisted with data entry during the multidisciplinary meetings. Taken together, the studies of Oborn et al., Venkatesh et al., and Kane and Labianca provide a nuanced understanding of the factors driving variations in the type and extent of use of healthcare information technology by different types of professionals involved in the treatment process.

### **Healthcare IS Implementation Is Complex with Important Implications for Learning and Adaptation**

The healthcare delivery setting is characterized by a tension between the need for orderly routines and the need for sensitivity to variation in local conditions. The need for routines arises from the importance of high reliability in what are often life-and-death situations involving very personal matters. The need for sensitivity to variation arises from the diversity of (a) healthcare providers (with differing professional roles, training, and experience), (b) patients (with differing personal characteristics, conditions, and medications) and (c) medical procedures and treatments—all of which converge during healthcare delivery.

This tension between the routine and the variable magnifies both the complexity and importance of effective learning and adaptation surrounding healthcare IS implementation and use. Systems and implementation techniques that work well in one setting may fail in another. In many ways, learning and adaptation are two sides of the same coin when it comes to new IS. Learning is required to determine the best way to adapt both technology and organization to achieve a good fit between the capabilities the technology affords and the desired patterns of actual use. Once the needed adaptations have been identified, a different kind of learning is required to incorporate these adaptations into organizational routines and to ensure continuous improvement going forward.

Two papers from this special issue explicitly address different facets of learning and adaptation surrounding IS implementation and use. Goh et al. focus on the implementation of a new clinical documentation system to develop a model of how to achieve effective routinization of new IT, while Mukhopadhyay et al. look beyond initial implementation to identify—for users of an IT-enabled physician referral system that has already been thoroughly routinized—the factors affecting the rate of productivity improvement from learning-by-doing.

Goh et al. examine the mechanisms underlying successful healthcare IS deployments from the perspective, of organizational routines—relatively stable “action repertoires” executed by actors to accomplish organizational work (Feldman and Pentland 2003). The routines perspective, together with observations from a longitudinal field study of a clinical documentation system (CDS) implementation, allows the

authors to unpack the “black box” of adaptation and learning surrounding new IT. The CDS provides critical support to daily operations by serving as a shared information repository and facilitating communication among various care providers (nurses, physicians, fellows, medical residents, and others). The quality and efficiency of healthcare delivery is heavily dependent on the efficacy of the daily routines for creating, accessing, modifying, and using these documents, and so the shift from paper-based to system-based charts is a high-stakes endeavor.

Goh et al. use key concepts from narrative networks (Pentland and Feldman 2007) and adaptive structuration (DeSanctis and Poole 1994; Markus 2010) to conceptualize healthcare IS as an intervention that alters the flow of events in a narrative network. Specifically, they propose a dynamic, process model of adaptive routinization of healthcare IS that delineates the major channels through which IS and routines interact, identifies the different stages in the dynamic coevolution process, and isolates the pivotal role of two forms of agency (leadership and personal innovativeness) in enabling the virtuous cycle of coevolution. They find that the key to successful implementation is to manage the coevolution process between routines and IS and to actively orchestrate a virtuous cycle through agent action.

Mukhopadhyay et al. look beyond implementation to address the ongoing processes of learning-by-doing that occur after IS has become thoroughly routinized. They use the distinctive contextual features of IT-enabled physician referral systems (IT-PRS) as an occasion to extend learning curve models of organizational improvement. A physician referral is the transfer of care from one physician to another, an act that has major financial implications and requires extensive coordination to ensure quality and continuity of care. The success of this coordination process depends on how effectively human agents use the multitude of capabilities provided by the IT-PRS. The IT-PRS provides the “glue” that ensures an accurate and timely transfer of patients.

Learning curve scholars seek to model precisely how the rate of learning in performing a routinized task relates to cumulative experience with the task and to individual and contextual factors. Prior work has focused mainly on single types of workers performing single types of tasks. However, the diversity of the healthcare context means that, as in the case of IT-PRS, the same basic task can be performed by different kinds of actors with different initial skill sets, which provides an interesting context to examine how human agents learn. The authors develop learning curve modeling extensions that account for multiple agent skill types, multiple referral task types, and the possibility of learning spillovers across task types.

Findings reveal that skill and task type do influence learning rates. Specifically, medical domain experts are initially more productive but learn more slowly on the medically intense referrals (i.e., emergencies) compared with nondomain experts. In contrast, systems experts are initially more productive but learn more slowly on the most procedurally intense referrals (out-of-network nonemergencies). Across all skill types, the rates of learning increase with overall task complexity, and significant learning spillovers occur.

The studies by Goh et al. and Mukhopadhyay et al. both provide excellent examples of researchers who have used the distinctive characteristics of the healthcare delivery setting to anchor their theoretical framing and contribution. Although they utilized frameworks developed outside of systems—narrative networks in the former case and learning curve models in the latter case—they have utilized the contextual nuances to extend and enrich these frameworks in ways that are bound to be recognized and appreciated by organizational researchers beyond IS.

## Future Directions for Healthcare IS Research

The nine the papers in this issue are representative of the primary streams of healthcare IS work to date (Agarwal et al. 2010), and we believe much can be done to move forward in these areas. However, we also see some notable gaps. In particular, we see three areas where major technological advances are opening new vistas of IT-driven healthcare practice that have not yet received much attention from IS researchers: (1) social media in healthcare, (2) evidence-based medicine, and (3) personalized medicine.

### Social Media in Healthcare

The intersection of healthcare and social media represents a promising space for future IS research. Social media communities have been particularly active in the healthcare domain (Kane et al. 2009), and this is no accident: the primary driver of value in these communities—commons-based peer production (Benkler 2002)—appears especially well suited to healthcare.

Peer production is a mode of production in which individuals (usually unpaid) collaborate on a large scale to produce work products without hierarchical control (firms) or market exchanges (prices, contracts) to guide them. Increasingly there is a trend for individuals, often amateurs, to self-select and self-organize to edit medical articles on Wikipedia or to share detailed information about their own medical conditions and treatments in online communities like Braintalk.com or Inspire.com. Although some specialists have found impressive generation and sharing of

medical knowledge in these communities (e.g., Hoch and Ferguson 2005), such a process challenges the status quo in the medical discipline, which is characterized by rigid hierarchies and strong norms about who should be providing medical information.

Benkler (2002, 2006) notes several conditions that increase value of peer production relative to markets and hierarchies as applied to the production of knowledge products, and these conditions certainly hold in the case of healthcare. First, in healthcare there seem to be especially strong *appropriation mechanisms* (such as a desire to make a social contribution or to increase one's social standing) to substitute for monetary compensation in motivating participation. As shown by Anderson and Agarwal (in this issue), individuals are more willing to share personal healthcare information when they think it could help others. Second, a large pool of potential contributors is available that is diverse in knowledge and motivation. Finally, there exists a wide range of granularity of potential contributions (to ensure that people with varying levels of knowledge and motivation will each have suitably sized contribution opportunities) and mechanisms to effectively aggregate these diverse contributions. This is where emerging social media platforms come into play, as these platforms provide for effective aggregation through the mechanisms of information filtering and knowledge synthesis (Kane et al. 2009). We see a number of worthwhile questions for future research at the intersection of healthcare practice and social media:

- What conditions lead to the formation and vitality of health-oriented social-media communities?
- What are the most effective design rules for the platforms supporting these communities? Greater or fewer restrictions on who can participate? Anonymous or nonanonymous?
- What posture should large providers be taking with regard to these platforms? Should they actively encourage participation by their professional staff and patients? How?
- Should data from social media communities be used in medical research (as was recently done in a study of off-label lithium use among ALS sufferers on PatientsLikeMe.com (Wicks et al. 2011))?

### Evidence-Based Medicine

Evidence-based medicine (EBM)—“the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients” (Sackett et al. 1996)—is an idea that goes back decades but has been gaining increased attention among researchers and in the popular press (Carey 2006) as a tool to address concerns about healthcare costs and quality. EBM stands in contrast to anchoring decisions on personal habits, tangible

and intangible incentives unrelated to care, or medical traditions that have little or no empirical validation. The marked variation across geographic locations in how clinical interventions get prescribed for the same conditions shows that factors other than evidence influence medical decision making (Timmermans and Mauck 2005).

The barriers to widespread adoption of EBM are substantial; however, IS can play an important counteracting role. We highlight three barriers and potential IS contributions. The first is the dearth of knowledge about the actual efficacy of many common treatments. The rise in digital storage of personal medical information gives researchers opportunities to discover knowledge about the link between treatments and outcomes on a scale that was not possible previously. Another emerging avenue for knowledge discovery arises from using digital technology to enable new kinds of mathematical healthcare modeling and simulations (Lumpkin 2007). This implies that implementation and use of healthcare analytics tools and how they should be integrated with electronic health records warrants future research attention.

A second barrier is the difficulty of getting newly discovered knowledge into the hands of practitioner's in a way that actually influences practice. It often takes a decade for medical research results to be translated into clinical guidelines and an additional decade for the guidelines to be widely diffused (Green et al. 2009, L'Enfant 2003). A move to Internet-enabled directed searches when confronted with specific cases (rather than generalized journal reading) can enable practitioners to more efficiently utilize their scarce reading time (Sackett et al. 1996). IS researchers could investigate the antecedents and consequences of directed searches, including which Internet resources (e.g., search engines, medical information portals, and social media communities) are most effective and which contextual factors (e.g., culture norms, incentives, routines) might enhance their effectiveness.

A third barrier arises from practitioner resistance to adoption of EBM, which is often connected to aversion to the standardized clinical guidelines that form the basis of much EBM. Such resistance arises from physicians' desire for autonomy, incentive conflicts, and fear of litigation. Potential solutions include treating guidelines as a rallying point for a comprehensive program of change and involving end users (i.e., caregivers) in the design of guidelines (Timmermans and Mauck 2005). It is interesting to note that these recommendations parallel longstanding IS implementation wisdom. IS can also be used to promote education of other stakeholders (e.g., patients, payers) on the efficacy of diagnostic and treatment options so that they can hold caregivers more accountable.

## Personalized Medicine

Personalized medicine means using knowledge about an individual's unique physiological makeup and medical history to tailor medical care most appropriately to that individual. It promises to allow earlier and more precise diagnoses, cheaper and more effective treatments, and minimization of treatment side effects (Glaser et al. 2008).

Some of the best-known success stories come from genetics-driven personalization, such as Herceptin, a monoclonal antibody treatment that can be quite effective—but just for women with a particularly aggressive form of breast cancer. Another example is warfarin, a coagulant that can now be more precisely dosed based on certain gene variations that affect individuals' drug metabolism, thereby avoiding thousands of cases per year of serious bleeding and strokes (Aspinall and Hamermesh 2007).

When integrated with electronic medical records (EMR) systems, IS tools can help practitioners use this rich profile data to identify the best candidates for particular interventions in much the same way that marketers use consumer profile data to identify the best prospects for a particular product. For example, Duke University used EMR data to identify patients who had risk factors predisposing them to complications from the H1N1 virus, thus allowing caregivers to provide focused outreach efforts (McGee 2009). The Cancer Biomedical Informatics Grid, launched in 2004, provides researchers with a shared repository of medical data, together with analytics tools that can help to identify the best candidates for clinical trials. Success in sequencing the human genome in a cost-effective manner may usher in a future where a person's genome is a standard part of his or her electronic health record (Singer 2010).

We see four broad implications for future IS research related to personalized medicine. The first relates to infrastructure design. What architectures will be needed to provide the processing cycles and storage required to analyze detailed medical profile data (including possibly entire genomes) on a large scale? The second relates to analytics. What context-specific factors will affect the adoption and use of analytics to support personalized medicine in a clinical setting? The third relates to decision support. Could the move to personalized medicine trigger increased attention to rule-based systems and other forms of advanced clinical decision support? Finally, we see potentially dramatic implications for research on privacy and security. Although genetic discrimination has been outlawed in the United States, for many people fears persist that knowledge of their genetic predispositions could fall into the wrong hands and be used against them in decisions about insurance and employment. Here again, IS solutions

can ensure anonymity of personal data, whether it is about genetic predispositions or treatments. IS can also enforce authorization controls and usage tracking to ensure that all access is recorded.

## Special Issue Process

In February 2008, an ISR announcement on ISWorld and other outlets invited scholars from around the world to submit papers for a special issue entitled "The Role of Information Systems in Healthcare Organizations: Synergies from an Interdisciplinary Perspective." In light of the diversity of healthcare delivery systems across nations, the call encouraged submissions addressing all segments of healthcare, including providers (such as hospitals, physicians), payers (such as government, insurers, and employers), and consumers (patients). The special issue also encouraged submission of papers encompassing a variety of theoretical and methodological perspectives.

Submissions were due in February 2009. A total of 53 manuscripts was received. As a first pass, all three senior editors evaluated each of the submissions to assess its fit with the special issue's focus, theoretical and methodological strengths and weaknesses, and novelty of contribution to understanding of the role of IS in healthcare. After this assessment, 26 manuscripts were selected for further peer review, each by two reviewers. At the conclusion of this peer review, a total of 10 manuscripts were chosen for further revision.

Authors receiving a first-round revision decision were invited to present their papers at the Special Issue Workshop at Boston College in September 2009. The goal was to provide feedback at the midpoint in the revision cycle when there was still time to adjust the revision strategy. Prior to the workshop, authors were asked to submit a revision strategy and conduct any revised analysis if requested by the reviewers. All of the editorial review board (ERB) members, reviewers, ISR SEs, and selected others were invited to attend the workshop. Following the workshop, authors documented the key points of guidance that they received, and how they intended to incorporate this guidance. The handling SE worked with the authors to resolve any conflicts between the original review package and the workshop feedback. The authors' report and the SE's response were shared with the reviewers, including those who were not in attendance at the workshop, so that they could consider these issues when handling the revised paper.

The authors resubmitted their papers by January 2010, including a consolidated response document covering both the original review package and advice from the workshop. Eventually, nine papers were accepted for publication in the special issue.



## Acknowledgments

Many people have generously shared their time and effort in keeping the process moving and bringing the special issue into fruition. Jerry Kane served as the associate editor of the special issue and, in this role, was instrumental in framing the special issue and in organizing and hosting the Special Issue Workshop. In addition, Jerry stepped in, on short notice, to provide much needed help as an ad hoc reviewer. The guest editors express our sincere thanks to all the members of the editorial review board and the reviewers for their time and effort and their willingness to work under the tight deadlines, as well as to the attendees to the Special Issue Workshop. The guest editors offer special thanks to V. Sambamurthy, who as then EIC, supported our vision of the salience of healthcare in IS research and to the ISR editorial office in bringing this special issue to print.

## Editorial Review Board Special Issue

Corey Angst, University of Notre Dame  
Ramji Balakrishnan, University of Iowa  
Indranil Bardhan, University of Texas, Dallas  
\*Michael Barrett, University of Cambridge, UK  
Anandhi Bharadwaj, Emory University  
Anol Bhattacharjee, University of South Florida  
Carol Brown, Stevens Institute of Technology  
\*Brian Butler, University of Pittsburgh  
\*Mike Chiasson, University of Lancaster, UK  
\*Elizabeth Davidson, University of Hawaii  
Sarv Devaraj, University of Notre Dame  
Leslie Eldenburg, University of Arizona  
John H. Evans, University of Pittsburgh  
Samer Faraj, McGill University, Canada  
Tina Blegind Jensen, Copenhagen Business School, Denmark  
Mark Keil, Georgia State University  
Bill Kettinger, University of Memphis  
Joe Labianca, University of Kentucky  
Karen Locke, College of William & Mary  
Lars Mathiassen, Georgia State University  
Nirup Menon, George Mason University  
\*Carsten Osterlund, Syracuse University  
Rema Padman, Carnegie Mellon University  
Ajay Vinze, Arizona State University  
Jim Warren, University of Auckland, New Zealand  
\*Molly Wasko, University of Alabama at Birmingham  
\*Attended Special Issue Workshop

## Ad Hoc Reviewers

\*Andrew Burton-Jones, University of British Columbia, Canada  
\*Gordon Gao, University of Maryland  
\*Jerry Kane, Boston College  
Liette Lapointe, McGill University, Canada  
Eric Overby, Georgia Institute of Technology  
Guy Pare, HEC Montréal, Canada  
Brian Pentland, Michigan State University  
Ray Reagans, Massachusetts Institute of Technology  
Sandeep Sahay, University of Oslo, Norway

Matthew Shum, California Institute of Technology  
Jeff Smith, Miami University of Ohio  
Eli Snir, Washington University in St. Louis  
Jonathan Wareham, ESADE, Spain  
Sean Xu, Hong Kong University of Science and Technology, Hong Kong  
Kai Zheng, University of Michigan  
Feng Zhu, University of Southern California  
\*Attended Special Issue Workshop

## Other Special Issue Workshop Attendees

Rob Fichman, Boston College (workshop leader)  
Rajiv Kohli, College of William & Mary (workshop leader)  
Ranjani Krishnan, Michigan State University (workshop leader)  
Jerry Kane, Boston College (workshop coordinator)  
Ritu Agarwal, University of Maryland  
Ravi Aron, The Johns Hopkins University  
Shubho Bandyopadhyay, University of Florida  
Yi-da Chen, University of Arizona  
Ramkumar Janakiraman, Texas A&M University  
Helen Kelley, University of Lethbridge, UK  
Jie Mein Goh, IE Business School, Spain  
Tridas Mukhopadhyay, Carnegie Mellon University  
Eivor Oborn, Royal Holloway University of London, UK  
Zafer Ozdemir, Miami University of Ohio  
Sam Ransbotham, Boston College  
Param Vir Singh, Carnegie Mellon University  
Tracy Ann Sykes, University of Arkansas  
Viswanath (Venki) Venkatesh, University of Arkansas

## References

- Agarwal, R., G. Guodong, C. DesRoches, A. K. Jha. 2010. The digital transformation of healthcare: Current status and the road ahead. *Inform. Systems Res.* **21**(4) 796–809.
- Aspinall, M. G., R. G. Hamermesh. 2007. Realizing the promise of personalized medicine. *Harvard Business Rev.* **85**(10) 108–117.
- Benkler, Y. 2002. Coase's penguin, or, Linux and the nature of the firm. *Yale Law J.* **112**(3) 369–446.
- Benkler, Y. 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press, New Haven.
- Carey, J. 2006. Medical guesswork. *BusinessWeek* (3986), 72–79.
- Classen, D. C., S. L. Pestotnik, R. S. Evans, J. F. Lloyd, J. P. Burke. 1997. Adverse drug events in hospitalized patients—Excess length of stay, extra costs, and attributable mortality. *JAMA—J. American Med. Assoc.* **277**(4) 301–306.
- DeSanctis, G., M.S. Poole. 1994. Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organ. Sci.* **5**(2) 121–147.
- Feldman, M. S., B. T. Pentland. 2003. Reconceptualizing organizational routines as a source of flexibility and change. *Admin. Sci. Quart.* **48**(1) 94–118.
- Fernandopulle, R., N. Patel. 2010. How the electronic health record did not measure up to the demands of our medical home practice. *Health Affairs* **29** 622–628.

- Glaser, J., D. E. Henley, G. Downing, K. M. Brinner. 2008. Advancing personalized health care through health information technology: An update from the American health information community's personalized health care workgroup. *J. Amer. Med. Inform. Assoc.* **15**(4) 391–396.
- Green, L. W., J. M. Ottoson, C. García, R. A. Hiatt. 2009. Diffusion theory and knowledge dissemination, utilization, and integration in public health. *Ann. Rev. Public Health* **30** 151–174.
- Hoch, D., T. Ferguson. 2005. What I've learned from E-patients. *Health Action* **2**(8) 728–730.
- Kane, G. C., R. G. Fichman, J. Gallagher, J. Glaser. 2009. Community Relations 2.0. *Harvard Business Rev.* **87** 45–50.
- Kolodner, R. M., S. P. Cohn, C. P. Friedman. 2008. Health information technology: Strategic initiatives, real progress. *Health Affairs* **27** w391–w395.
- L'Enfant, C. 2003. Clinical research to clinical practice—Lost in translation? *New England J. Med.* **349** 868–874.
- Lumpkin, J. R. 2007. PERSPECTIVE: Archimedes: A bold step into the future. *Health Affairs* **26** w137–w139.
- Markus, M. L. 2010. On the usage of information technology: The history of IT and organization design in large U.S. enterprises. *Entreprises et Histoire* **60** 17–28.
- McGee, M. K. 2009. Medical IT gets personal. *InformationWeek* (1248) 24–30.
- Orlikowski, W. J. 2000. Using technology and constituting structures: A practice lens for studying technology in organizations. *Organ. Sci.* **11**(4) 404–428.
- Pentland, B. T., M. S. Feldman. 2007. Narrative networks: Patterns of technology and organization. *Organ. Sci.* **18**(5) 781–795.
- Piontek, F., R. Kohli, P. Conlon, J. J. Ellis, J. Jablonski, N. Kini. 2010. Effects of an adverse-drug-event alert system on cost and quality outcomes in community hospitals. *American J. Health-System Pharmacy* **67**(8) 613–620.
- Sackett, D. L., W. M. C. Rosenberg, J. A. M. Gray, R. B. Haynes, W. S. Richardson. 1996. Evidence based medicine: What it is and what it isn't. *British Management J.* **312**(7023) 71–72.
- Sia, S. K., M. Tang, C. Soh, W. F. Boh. 2002. ERP as a technology of power: Empowerment or panoptic control? *Data Base* **33**(1) 23–37.
- Singer, E. 2010. A vision for personalized medicine *Technology Review*. MIT, Cambridge, MA.
- Timmermans, S., A. Mauck. 2005. The promises and pitfalls of evidence-based medicine. *Health Affairs* **24** 18–28.
- Wicks, P., T. E. Vaughan, M. P. Massagli, J. Heywood. 2011. Accelerated clinical discovery using self-reported patient data collected online and a patient-matching algorithm. *Nature Biotechnol.* **29** 411–414.

Copyright 2011, by INFORMS, all rights reserved. Copyright of Information Systems Research is the property of INFORMS: Institute for Operations Research and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.