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Educating Students in Healthcare Information Technology: IS Community Barriers, Challenges, and Paths Forward

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Abstract:

Healthcare information technology (HIT) is an exciting field to which information systems (IS) scholars have much to contribute. As the IS community continues to tackle enrollment and growth issues across the nation, HIT becomes an attractive topic for the IS educators to embrace. Careful consideration and domain understanding are needed to ensure a suitable depth and balance in curricula. The intent of this article is to provide guidance to the IS community to support and promote successful HIT educational courses and programs by investigating three important questions: (1) Does IS have a role in HIT? (2) Where does an IS educator look to begin with HIT education? (3) How do IS educators frame their vision for HIT curricula leveraging the discipline's strengths? Our hope is that this article will illuminate HIT curriculum matters for the general IS faculty and generate purposeful debate regarding how best to position HIT education within the IS discipline if IS faculty want to join in the quest to successfully educate and place graduates in the growing health technology sector.

Keywords: healthcare information technology, healthcare informatics, healthcare information systems, health informatics education, healthcare curriculum, information systems education

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I. INTRODUCTION

Healthcare Information Technology (also referred to as *healthcare* or *medical informatics*) is an emerging and growing discipline that deals with biomedical information, data, and knowledge, including their storage, retrieval, and optimal use for problem solving and decision making [Shortliffe and Cimino, 2006]. Because of HIT's many connections with the information systems (IS) field, it has become an attractive topic for the IS community to embrace in research and increasingly in educational offerings. Yet there are many salient differences and issues in the healthcare context that makes this exciting field complex to understand and teach from a traditional IS perspective.

Healthcare is one of the biggest sectors of Gross Domestic Product (GDP) for many countries. In 2006 alone, the U.S. spent nearly 2.3 trillion dollars on healthcare [NCHC, 2011]. On February 17, 2009, President Obama signed the American Recovery and Reinvestment Act (ARRA) of 2009. One section of ARRA is called the "Health Information Technology for Economic and Clinical Health Act" or the "HITECH Act." The HITECH Act provides various means of advancing the use of health information technology that allows for suitable exchange and use of health information, thereby establishing a foundation for improving care for each individual in the United States [HHS, 2010b]. The HITECH Act authorizes payment incentives through the Medicare and Medicaid programs to qualifying eligible professionals and hospitals for their "meaningful use" of certified electronic health record (EHR) technology. These incentives are intended to drive the adoption and the appropriate use of such technology and electronic exchange of health information to the level that is needed to achieve the vision of HIT facilitating the transformation of the U.S. health system. While bioinformatics programs started in the early 1990s with the sequencing of the human genome [Human Genome, 2001], HIT training and education programs gained national visibility after HITECH only in 2009. Notably, similar efforts in HIT are underway in European and Asian countries.

Increasing reliance on IT in healthcare raises demand for trained workers [Wilson and Tulu, 2010]. The HITECH investment has not only spanned activities in practice and research, but also activities to develop courses and programs to educate and train those that might pursue health IT career paths. It is widely recognized that even physicians, nurses, and hospital administrators need IT education and knowledge to be effective in the current healthcare environment. Given this demand, a growing number of business colleges and, specifically, IS departments are considering or already participating in HIT educational efforts.

Figure 1 presents a Healthcare IT Education Framework. Regarding input/genesis, HIT and Health Information Management (HIM)[1] educational activities at various campuses are being initiated today by different disciplines and schools/colleges. The curriculum offered generally depends on the source discipline and its strengths, although general and specialized curriculum guidelines are beginning to appear through federal and national association efforts (e.g., Office of National Coordinator for HIT and American Health Information Management Association—AHIMA) aimed at HIT national workforce training initiatives. The desired output is skilled graduates equipped to fill gaps and vacancies at local, state, and federal health facilities, thereby meeting various stakeholder goals. Participating in this multidisciplinary endeavor during a time of tremendous change in healthcare policy at the national level and processes and tools at the healthcare organizational level can be a daunting and challenging task. The purpose of this article is to provide insights regarding the opportunities for IS faculty, as well as to outline issues IS faculty may face as they embark on an HIT educational journey and considerations regarding curricula. Our end goal is to facilitate successful IS community participation in HIT educational courses and programs—to provide insights on the barriers, challenges, and paths to move forward through collaborative engagement. To meet this end goal, we further explain and develop the framework as it relates to the IS community through the discussion of the following questions:

1. Does IS have a role in HIT education?
2. Where does an IS educator look to begin in HIT education?
3. How do we shape the vision for HIT curricula leveraging the IS discipline's strengths?

[1] We use the term *HIT* to collectively refer to Health Information Systems, Health Informatics, Health Information Management, and related programs. While there are subtle differences among the individual programs, all have a strong health technology component and may present opportunities for IS. Therefore, for the rest of the article we do not make any distinction among these concentrations.

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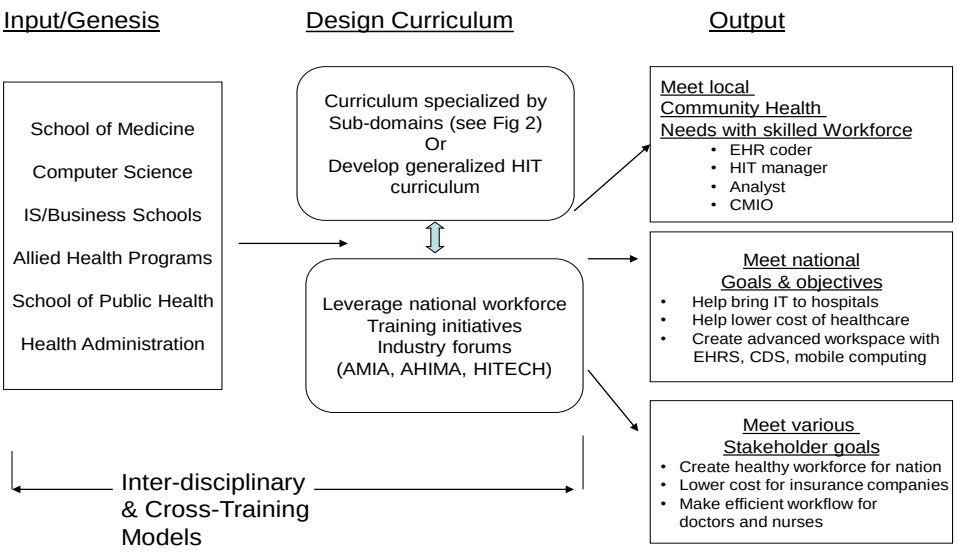

Figure 1. A Healthcare IT Education Framework

We address these questions through reflective, collective commentary among the team of authors. Author affiliations are with United States universities, which may create some bias, although it is our intent to include some insight that could cross boundaries. That said, the current climate of national interest in HIT education in the U.S. and national economic interests related to HIT create a rich and dynamic environment from which to address HIT education. The authors' insights were based on individual reviews of the literature and the HIT expertise and experience each author brought to the general topic of this article. The authors' expertise and experiences were gained through their direct involvement with the creation of successful HIT/HIM courses and degree programs and personal teaching experiences. The authors also draw from their experiences in working with informatics communities that are pushing the frontiers of HIT accreditation and education. Moreover, the authors' looked to their collective experience in leadership positions related to healthcare within the IS community (Association for Information Systems [AIS] Special Interest Group in Healthcare [SIG-Health], leading and organizing HIT conferences, tracks, workshops, and special issues, HIT grant experience, and serving on HIT grant review panels) as formative background to their perceptions on the topic of HIT education. Finally, the authors' also draw on their collective HIT research experience. Unified commentary in this article was generated via group consensus among the authors using in-person, phone, and e-mail communications.

II. DOES INFORMATION SYSTEMS HAVE A ROLE IN HIT EDUCATION?

Information Systems as a discipline differentiates itself from sister disciplines, such as computer science and software engineering, because it draws its problems and issues from the intersection of technology, organization, and society. In HIT, we develop and assess methods and systems for the acquisition, processing, managing, and interpretation of patient data with the help of findings from scientific research. Applying information systems skills and concepts to the healthcare setting would seem to be a perfect fit, given the current model of the healthcare process which is patient-centered, with healthcare organizations controlling the processes and technology enabling the exchange of information. However, there are subtle differences between healthcare and other industries that may best be illuminated through a brief description of the evolution of the HIT field. In addition to providing evolutionary perspective to the nuances, the following section will showcase the topical areas where IS can contribute significantly in educating the next generation of health informaticians.

Evolution of the HIT Discipline

Computers have been used in medicine and healthcare since the 1960s [Shortliffe and Blois, 2006]. People then referred to the field as *medical computer science*, a subdivision of computer science that applied the methods of the larger field to medical topics. In the early 1970s, the term *biomedical computing* was used, which implied the use of computers for some purpose related to biology or medicine. The term *medical informatics* dates from the second half of the 1970s and was borrowed from the French expression *informatique médicale.* The term *informatics* means "automation" and became popular in the U.S. in the late 1990s. During the 1990s, bioinformatics (which studies

genes and proteins) rapidly expanded. Given the rise of bioinformatics, many feel that the term *biomedical informatics* is potentially easily confused with bioinformatics and too "doctor"-oriented [Hersh, 2008]. Many in the community prefer the term *health informatics* or *HIT*, where health is defined by the World Health Organization (WHO) "*as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" [WHO, 1946]. The terms *healthcare informatics* and *HIT* have now gained broad acceptance.

Evolution of Specialties in HIT

Today, HIT is a rapidly growing discipline that has branched into many unique niche areas (sub-domains) under a common set of themes fueling its evolution. In Figure 2, we present a framework to enable the IS educator to understand some of the predominant specialized tracks/themes that have emerged and where IS may play a role. On the vertical axes, we show that there is a range of basic research and applied research happening in the field. From basic research conducted in wet labs, we develop methods, techniques, theories, and tools that are then applied to practice healthcare in the real world. It is increasingly felt that students who can bridge this gap must have interdisciplinary training and a more holistic view of the many facets that affect IT implementation at a medical organization [Wilson and Tulu, 2010].

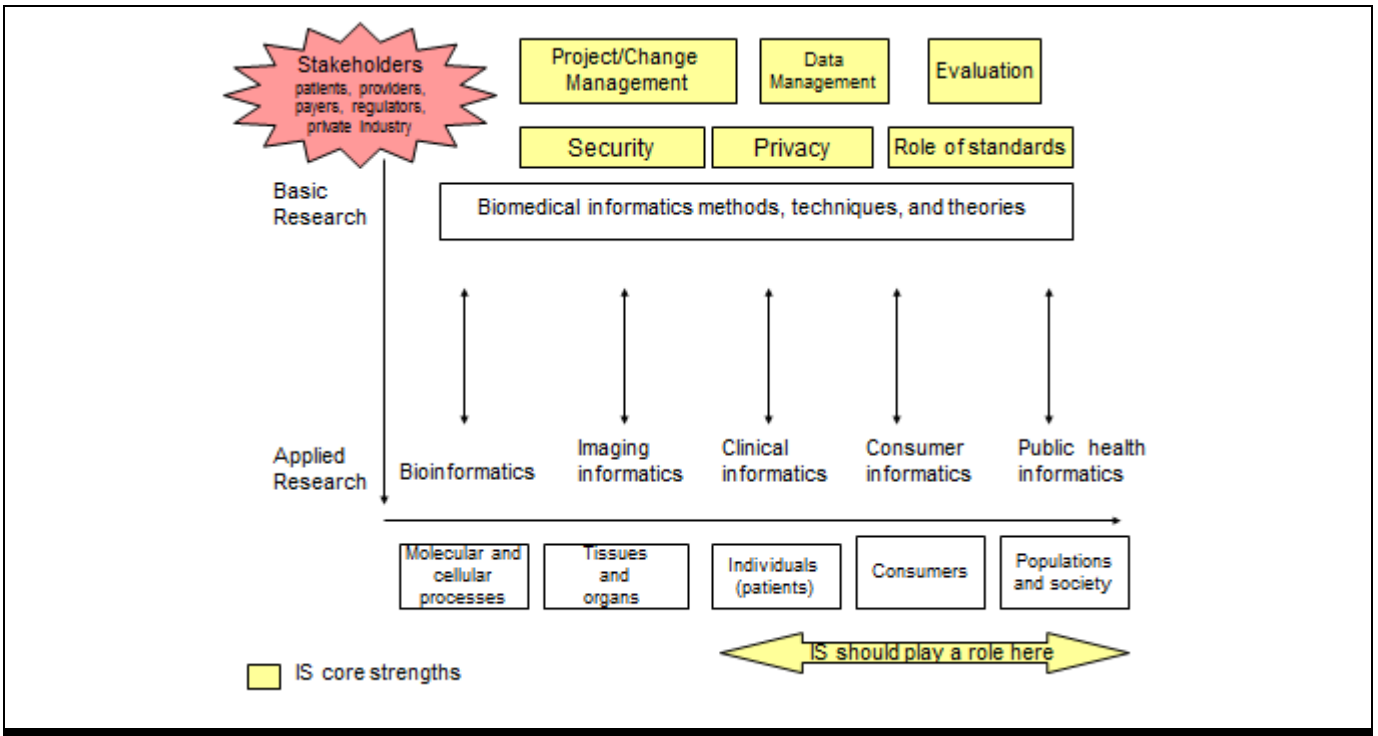

Figure 2. A Framework to Understand HIT (adapted from Shortliffe, 2006)

The boxes beneath the horizontal axis in Figure 2 represent the focus of HIT research and practice attention, from molecular and cellular processes to patients to health consumers as users to entire populations. Above the horizontal axis, there are a variety of HIT sub-domains associated with each area of research and practice.

At the far left on the horizontal axis is *bioinformatics*, which focuses on the molecular and cellular levels. Bioinformatics, which is a well-established discipline today, takes the findings from wet labs and develops new ways to understand diseases using gene sequencing and proteomics [Hogeweg, 2011]. This is a rapidly changing field with tremendous implications. Its goal is to one day enable scientists to customize medicine based on a patient's individual genetic profile (pharmacogenomics) and to use special techniques, such as gene therapy, to cure major diseases such as cancer or HIV/AIDS [NIH, 2009]. *Imaging informatics* is a growing field that studies tissues and organs within the human body [Branstetter, 2007]. Technologies such as X-rays, CT scans, MRIs, and ultrasound give doctors the ability to test for specific causes of ailments and symptoms. It is a long-established field with its root in engineering medicine. Resulting from the highly technical specialization of the aforementioned sub-domains, we do not see IS departments participating in imaging informatics and bioinformatics educational programs, although exceptions are possible. The specializations where we see most potential for IS to offer courses, programs, or degrees are in clinical (bedside), consumer, and public health informatics (the right side sub-domains in Figure 2).

Clinical informatics [Degoulet and Fieschi, 1997] is sometimes called "bedside informatics." In clinical informatics, a host of IT tools are used to assist in the treatment of the patients at a clinic or hospital. EHRs and other mobile technology solutions are increasingly being adopted in this space. The latest push to mandate the introduction of EHRs in all medical facilities (outpatient clinics, single-doctor practices, medium and large hospitals, university medical centers, and acute care services) is driven by the desire to reduce costs and improve care. Informal discussions with IS schools that currently offer degree programs in HIT/HIM indicate that their participation in HIT education started with a single course centered around the implementation, use, and adoption of EHRs. As more and more clinicians are turning to data-driven, computer-assisted clinical decision support to provide care for their patients, the American Board of Medical Specialties (ABMS) has now recognized clinical informatics as a subspecialty.

A new area of focus in the HIT domain is the healthcare consumer, including both patients and non-patients. *Consumer health informatics* [Eysenbach, 2000] is an emerging field (that includes mHealth) that engages healthcare consumers in maintaining and monitoring their health using technology, including the Internet, smart phone applications, and monitoring devices. For example, social networking is being used by consumers for a variety of purposes [FDASM, 2009; Sarasohn-Kahn, 2008]. Patients are finding others with similar conditions, looking up information on their condition, spreading awareness, talking to family members, and creating a virtual support network to deal with their symptoms. Another growing area of consumer interest is the personal health record (PHR), which is typically a health record that is initiated and maintained by an individual (health consumer). An ideal PHR would provide a complete and accurate summary of the health and medical history of an individual by gathering data from many sources (including health providers) and making this information accessible to anyone who has the necessary electronic credentials to view the information [Tang et al., 2006]. Google Health, Microsoft Healthvault and KP.org are examples of PHRs that are commercially available. Targeted courses in the areas of system analysis and design, usability, and human computer interaction provide foundational knowledge to those interested in working in the consumer health informatics.

At the far right of the horizontal axis, the focus is on population-level and society-level diseases or trends; this emerging field is called *Public Health Informatics* [Friede, Blum and McDonald, 1995]. Health information exchanges facilitate the aggregation of individual health data and align with the IS acumen in data management education. These data repositories can be mined and analyzed to assist with community assessment, identification of disease patterns, and tracking of epidemics. When highly infectious diseases, such as the bird flu or H1N1 virus, strike, public health agencies such as the Centers for Disease Control and Prevention (CDC) can track them using public health informatics systems and suggest clinical guidelines to handle them. The vision of a "Nationwide Health Information Network Exchange" (NwHIN) enhances the need for strong data management courses. Summary data from individual EHR systems can be shared through Health Information Exchanges (HIEs) and Regional Health Interoperable Organizations [Vest and Gamm, 2010]. Regional or local HIEs and RHIOs can serve as the backbone to Statewide HIEs, and in turn help with the creation of a Nationwide Health Information Network Exchange) [HHS, 2011]. The U.S. Department of Health and Human Services (HHS), the National Institutes of Health (NIH), or the CDC for public health can use data from these HIEs. These public agencies would ideally receive data in real time and use sophisticated data mining tools to analyze disease patterns, trends, and solutions. Identified best practices (findings) can then be pushed to the individual EHRs via clinical protocols or recommended guidelines. Conceptually, a doctor with an EHR connected to an HIE site could input patient information and receive the most up-to-date recommended guidelines. The general belief is that such evidence-based information has the potential to cut waste and reduce costs. The time for this type of data management education is upon us as several states are beginning to hire trained HIT graduates to build such a NwHIN [Guyatt et al., 1992]. Public health informatics may be extended to Global Health Informatics where the target of interest is current and future global health challenges, and the goal is to use technology to improve health worldwide by improving quality, safety, and effectiveness of health services across communities, countries, and continents.

IS Can Offer Expertise Across Sub-domains

HIT is interdisciplinary, and there is an ever-growing body of work supporting the fact that IS can and should play a contributing role. Multiple research methods (qualitative analysis, usability testing, survey, etc.) and statistical analyses (structural equation modeling, ANOVA, etc.) used in IS studies are suited to the HIT domain. Furthermore, there is increasing cross-pollination of theories used in IS studies to the HIT domain, particularly in the areas of consumer health informatics, public health informatics, and clinical informatics (see annotation in yellow on Figure 2). Figure 2 further illustrates that the common IS themes of security, privacy, project management, standards and interoperability (data communications), evaluation, and data management (that are addressed in multiple IS courses) span across the HIT sub-domains. Some of these topics take on special meaning in the HIT context. For example, the Health Insurance Portability and Accountability Act (HIPAA) of 1996, which addresses the release and transmission of patient information, must be considered in relation to security. In the growing environment of consumer health informatics, standards and interoperability are critical to enable various devices and stakeholders

(patient, provider, and/or others in the patients care network) to capture, share, and summarize data. These devices and this type of user network would not exist in other contexts. Indeed, it seems evident that existing and potential areas of IS common ground and interdisciplinary insight can be leveraged for educational purposes in program/course design, for example, in bridging communications and concepts within HIT related courses taught in IS or in recommending electives from existing IS courses focused on complementary techniques, tools, and/or theories. IS can play a role in HIT teaching and research, but it may be best played as a cooperative role in the expansive interdisciplinary HIT landscape.

The need for interdisciplinary research and education in HIT is driven by the inherent complexity of healthcare, the desire to explore problems and questions that are not confined to a single discipline, the need to solve societal health issues, and the power of new technologies. Unfortunately, the academic silos that introduce multiple obstacles and disincentives into interdisciplinary research can also impact the potential for viable interdisciplinary HIT education. The Committee on Facilitating Interdisciplinary Research, comprised of the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, noted that, "As a mode of discovery and education, it [interdisciplinary research] has delivered much already and promises more—a sustainable environment, healthier and more prosperous lives, new discoveries and technologies to inspire young minds, and a deeper understanding of our place in space and time" [Committee on Facilitating Interdisciplinary Research, 2004 p. 1]. If challenges related to disincentives for interdisciplinary research and programs can be addressed, it is conceivable that HIT research and education can contribute to fulfilling many of the aforementioned promises of interdisciplinary work. The Committee on Facilitating Interdisciplinary research report provides prescriptive measures that include, but are not limited to, the following educational program suggestions for overcoming these challenges:

- Institutions should support interdisciplinary education and training for students, postdoctoral scholars, researchers, and faculty by providing such mechanisms as undergraduate research opportunities, faculty team-teaching credit, and interdisciplinary research management training.
- Undergraduate students should seek out interdisciplinary experiences, such as courses at the interfaces of traditional disciplines that address basic research problems, interdisciplinary courses that address societal problems, and research experiences that span more than one traditional discipline. In fact, the report provides evidence that students, especially undergraduates, are strongly attracted to interdisciplinary courses, especially those of societal relevance.
- Graduate students should explore ways to broaden their experience by gaining "requisite" knowledge in one or more fields in addition to their primary field [Committee on Facilitating Interdisciplinary Research, 2004].

Each of these prescriptive measures supports the creation of interdisciplinary HIT curricula.

This brief overview of various facets of HIT conveys where IS expertise may play a role in educating the IT workforce needed by healthcare. The reader should take away from this section the conclusion that there exists a practicable opportunity for IS programs to participate in designing unique, interdisciplinary HIT curriculum to meet the needs of students who wish to work in the healthcare context and need HIT education. To translate this possibility into a strategic option, an understanding of the most important skills required in this domain is needed.

A Summary of the Skills and Opportunity

A survey by Hoffman and Ash [2001] and later a study by Hersh [2006] indicated that the most important skills for the HIT workforce include knowledge of the following: using information in clinical care, change management, understanding relational databases, project management, and best practices for IT use in the healthcare setting. For several decades, the IS community has taught courses to develop many of these skills in both graduate and undergraduate Management of Information Systems (MIS) programs. Although this creates an opportunity to participate in HIT education, a decision to participate in HIT educational endeavors begets an exploration of demand and visibility.

The current climate of change in healthcare, with its push to the adoption of HIT, is stimulating the creation of HIT jobs. In a new trend study from the University of California San Diego Extension, healthcare information technology is the hottest career option for college graduates. The study was based on enrollment figures, national employment statistics, and interviews with San Diego business executives [Casserly, 2010]. The current demand does not seem to be filled from existing programs and means of education. At a recent panel in Chicago, several members of the

Education Strategy Committee discussed job opportunities for graduates.[2] There were four key themes that emerged from the panel:

- Healthcare IT companies are growing and hiring.
- There is a shortage of talent.
- The HITECH funded educational programs are failing to meet their target enrollment numbers and recent graduates from quick one-year programs are falling short in real-world environments.
- There needs to be a fundamental change in how computer science is taught in our schools so that the best and brightest can get excited about a career in HIT.

Websites such as www.healthcareitjobs.com or even Monster or Hotjobs indicate a strong need for individuals who can manage EMR projects; develop and support in-house applications and data warehouses (with a mandatory understanding of the healthcare environment); direct and/or manage IT with multiple platforms, operating systems, software, and network protocols; and consult with vendor integration. To prepare students to fulfill such roles, curricula that includes internships, experience with projects, and partnerships with industry is required.

Although there seems to be opportunity, owed to the increased visibility of the field, the race to place the proverbial "stake in the ground" is on. Therefore, universities, colleges, and departments that have interest in participating in HIT education need to begin to act now to assess and capture potential opportunities and respond to challenges to have successful courses and programs. In the next section we further discuss our framework Healthcare IT education by outlining sources for information and training and sources for initial students.

III. WHERE DOES AN IS EDUCATOR LOOK TO PARTICIPATE IN HIT EDUCATION?

Leveraging Existing Information and Recently Funded Programs

The influx of funding from the HITECH Act (expected to top $20 billion) has important implications for IS programs that plan to participate in HIT programs either within business schools/colleges or through arrangements with other schools or colleges (such as public health, allied health, engineering, or medicine). In addition to funding programs, this Act infers the curriculum to be used in HIT education and training programs.

The Office of the National Coordinator for Health Information Technology (ONC) was created in 2004, through an Executive Order, and legislatively mandated under the HITECH Act to coordinate nationwide efforts to implement and use the most advanced health information technology and the electronic exchange of health information. Reference to advanced health information technology and electronic exchange of health information includes the adoption of EHRs; the establishment of health information exchanges at the community, regional, state, and national levels; the development of a nationwide HIT infrastructure ensuring that health information is secure and protected; the provision of leadership in the development, recognition, and implementation of standards and the certification of HIT products; and the coordination of HIT policy. (For information on HITECH Programs resulting from these funding opportunities, see http://healthit.hhs.gov.)

Through the HIT Workforce Program, the ONC has awarded $10 million to Curriculum Development Centers, which are institutions of higher education (or consortia thereof) that will support HIT curriculum development (see http://healthit.hhs.gov/portal/server.pt?open=512&objID=1808&mode=2). One of the awardees under this program, Oregon Health and Science University (OHSU), received additional funding to serve as the National Training and Dissemination Center (NTDC) and host events for community college faculty, establish a secure electronic site from which all materials may be downloaded, collect feedback from instructors and students, and coordinate subsequent revisions of the curriculum materials. This material will be useful for those in IS who wish to teach HIT courses.

Organizations such as the American Medical Informatics Association (AMIA, http://www.amia.org/), American Health Information Management Association (AHIMA, http://www.ahima.org/), Health Information Management Systems Society (HIMSS, http://www.himss.org/) and Association for Information Systems (AIS; this organization has an active Special Interest Group for HIT, SIG-Health, which can be accessed at http://www.aissighealth.com), recognize the growing interest in applied informatics and provide sources of training and information.

AMIA is an international, interdisciplinary organization that promotes the effective use of information in healthcare. AMIA is dedicated to promoting the effective organization, analysis, management, and use of information in

[2] The HIM Education Strategy Committee is part of American Health Information Management Association (AHIMA) and has been working since August 2006 to develop a strategy to ensure the future of the health information management profession.

healthcare in support of patient care, public health, teaching, research, administration, and related policy. AMIA's 4,000 members advance the use of health information and communications technology in clinical care and clinical research, personal health management, public/population health, and translational science, with the ultimate objective of improving health. The AMIA 10 x 10 is an introductory overview certificate program for IS professionals wishing to learn more about the field in a convenient online setting complemented by a final in-person meeting. In 2005, AMIA, in conjunction with OHSU, created the first AMIA 10 x 10 offering [Hersh and Williamson, 2007]. Several other universities now offer context-specific 10 x 10 programs in areas such as clinical or health informatics, clinical research informatics, translational bioinformatics, nursing informatics, and public health informatics. Though the AMIA offerings from 2005 to 2010 did not quite reach their original goal to educate 10,000 informaticians by 2010, 10 x 10 has become a popular training tool for MDs, IT personnel, nurses, pharmacists, and other health professionals seeking knowledge about HIT. More information can be found on AMIA's website.

The American Health Information Management Association (AHIMA) was created in 1928, initially to support a community of professionals dedicated to the maintenance, quality, integrity, and security of medical records and has since grown to address many aspects of HIT nationally and internationally as the healthcare industry has embraced IT. They participate in government advocacy and policy development and international health data standards development and offer course materials, best practice guidelines, academic curricula, continuing education opportunities, and networking options for anyone working with health information and electronic health records. AHIMA holds an annual convention and trade show and hosts the Assembly on Education (AOE) Symposium and Faculty Development Institute (FDI), which provides training on current best practices in health informatics education and workforce development as well as networking opportunities for health information and informatics educators.

The Health Information Management Systems Society (HIMSS) is a cause-based, not-for-profit organization that is focused exclusively on providing global leadership for the optimal use of IT and management systems for the betterment of healthcare. Founded fifty years ago, HIMMS represents more than 30,000 individual members, two-thirds of whom work in healthcare provider, governmental, and not-for-profit organizations. HIMSS members share a mission of transforming healthcare through the effective use of information technology and management systems. HIMSS frames and leads healthcare practices and public policy through its content expertise, professional development, and research initiatives designed to promote information and management systems' contributions to improving the quality, safety, access, and cost-effectiveness of patient care.

Finally, the AIS-SIG Health group maintains a website with teaching material (with sub-sections for each class, e.g., project management, business intelligence), provides workshops at important AIS conferences, and sponsors special issues in IS journals, providing potential course reading references. A list of IS programs that offer some form of HIT/HIM education can be found at http://www.aissighealth.com/wordpress/?page_id=280.

Leveraging Enrollments: Community Colleges and Online Education Opportunities

The ONC established the Community College Consortia to Educate Health Information Professionals to help address the growing demand for highly skilled HIT specialists. The Community College Consortium is part of the Health IT Workforce Development Program, administered by ONC. The consortia is comprised of five regional groups of more than seventy member community colleges in all fifty states. These community colleges received $36 million in grants to develop or improve non-degree HIT training programs that students can complete in six months or less [HHS, 2010a]. Programs established through this grant will help train more than 10,500 new HIT professionals annually by 2012. An enlarged workforce of skilled HIT specialists will be important for supporting providers as they transition to using EHRs.

Although these community colleges are just beginning their programs, IS schools can think of them as feeder channels for their bachelor's and master's degree programs and may want to initiate agreements with community colleges. Some IS faculty may even benefit from these community colleges by taking some courses as a means to come up to speed on unfamiliar topics.

Most existing programs in HIT attract students with a few specific profiles: (1) those who have IT backgrounds and are currently working, but looking to change careers to find a better-paying job; (2) those who have health backgrounds (e.g., nurses, allied health professionals, and sometimes even physicians), but see the need to upgrade their IT skills; and (3) recent undergraduates looking for graduate programs that will give them access to jobs and a future. An online or hybrid HIT or HIM degree program may be the best approach to initially attract students who wish to remain in their current work contexts, but who want to add to their career mobility. Such an approach allows them to continue in the workforce and saves them from long commutes or even from leaving their workplaces on a recurring basis to attend class. However, the literature in distance education emphasizes that distance-based learning is not for all students [Hara and Kling, 1999; Michele, 2004]. From the institutional standpoint, distance education provides a context without borders, which may open up vast opportunities to attract

students worldwide. However, providing robust online or hybrid offerings requires a reliable infrastructure, potential technology investment, and faculty who can teach in the online or hybrid environment.

IV. HOW DO WE SHAPE THE VISION FOR HIT CURRICULA INVOLVING IS EDUCATORS?

Navigating the Internal Challenges to Shape the Vision of HIT Education

Determining how fast and how much to plunge into the HIT education arena will depend on market opportunities, available staff, and funding. A conservative approach would begin with one HIT course championed by a faculty member interested in HIT. If faculty do not have a history in HIT, such a general course initiates discussion and furthers basic understanding of the HIT field. If that course gains acceptance, then an IS program may contemplate a "stepping stone approach" and expand to a concentration or track in which three or four courses are offered. One approach to staffing additional HIT targeted courses with the right faculty may be to collaborate with other colleges or programs (likely in allied health, public health, medicine, or nursing) and jointly create such a concentration track. With time and experience gained, collaborators may decide to offer a HIT undergraduate or master's degree program.

The specific challenges to starting an HIT degree program seem to fall into the following categories: (1) internal university politics, (2) difficulty in specifying curriculum requirements (particularly if trying to work from existing courses), (3) difficulty finding the right faculty to teach HIT classes or IS classes that will include an HIT student representation, (4) accommodating students that may want varying educational formats (distance-based, part-time outside of medical working hours, executive programs, etc.), (5) handling a mixed student audience (e.g., MBA and HIT students), and (6) meeting the standards of accreditation boards.

Is HIT its own distinct discipline or is it an extension of other programs? There are very few schools of HIT. Therefore, an internal political challenge may result from various departments/colleges within the university competing for program ownership of such an interdisciplinary programs (particularly at universities that to do not have strong tuition-sharing programs for interdisciplinary programs) or departments/colleges that wish to offer similar competing programs (see Figure 1, genesis). The interdisciplinary nature of HIT makes it plausible that medical schools, engineering schools, schools of allied health, schools of public health, and/or nursing schools may also wish to own a program or create a competing one. Furthermore, we may see HIT-related course offerings in social work, law, or communication programs that may support a rich and robust HIT program.

Each of these aforementioned schools can likely provide a compelling argument for housing an HIT program. To illustrate this point, many schools of business or public health contain health administration/management degrees. Health Administration is a very established and well-rounded degree accredited by the Commission on Accreditation Healthcare Management Education (CAHME). Given the breadth of health administration/management programs, most health administration departments typically do not offer more than one or two HIT courses as part of their standard course offerings. Yet, perceptions may be that HIT is subsumed in healthcare administration. In fact, a few such departments have extended their HIT position with the creation of an HIT specialization, or hybrid degree, such as a Masters of Health Administration Informatics (e.g., University of Maryland University College). The question is whether this is the right "home" for the HIT program. The core issue is that given the interdisciplinary domain of health informatics, each of the aforementioned disciplines could conceivably make a case for ownership or competing HIT–related programs. The answer is not definitive, as "sole ownership" (outside of a dedicated HIT school or strong department) seems to produce a gap. For example, one could reasonably question the depth and breadth of healthcare understanding for an information systems or engineering department to extend HIT offerings; likewise, it is just as reasonable to question the depth and breadth of technology and systems offerings in schools (e.g., medical schools) that do not traditionally focus on technology as they expand their HIT offerings. Indeed, the innate interdisciplinary nature of an HIT program does not provide a clear direction for program or even course ownership and this creates a major challenge. The natural response may seem to be interdisciplinary programs. Ideally, participating units can create flexible budgeting and/or revenue- and cost-sharing agreements. However, this may not always be possible, given university policies about sharing tuition dollars. With no vehicle for such agreements, internal competition and strife may result. Ultimately, in such cases, the ownership may rest in a "neutral zone," such as a school of graduate studies, vice president's office, or provost's office.

Even in cases where revenue- and cost-sharing agreements are achieved, there may be additional political and professional challenges to address. Further academic policy recommendations for facilitating interdisciplinary programs (as provided by the Committee for Interdisciplinary Research) include the following:

- Developing new and strengthen existing policies and practices that lower or remove barriers to interdisciplinary research and scholarship, including "interdisciplinary friendly" review and tenure guidelines and developing joint programs with industry and government and nongovernment organizations.

- Experimenting with more innovative policies and structures to facilitate interdisciplinary, making appropriate use of lessons learned from the performance of interdisciplinary work in industrial and national laboratories [Committee on Facilitating Interdisciplinary Research, 2004].

When the curricula is being developed, a decision must be made regarding whether to create a course specifically for HIT or to add a healthcare component to an existing IS course to accommodate various types of students (e.g., HIT and MBA and/or MIS and/or MACCT). In providing one "generic" course to fit all, servicing different types of students can be challenging, particularly when there is a strong representation of each type of student in the class mix. In the case of the "generic course," the core challenge is determining how much of the healthcare context to introduce into the "generic" course through readings and activities. The HIT student will expect courses in their program to provide some degree of reference and application to healthcare. For example, healthcare students will expect a security course to cover HIPAA. Most IS texts do not have much, if any, representation of the healthcare context and creates an extra challenge in selecting course materials. A mixed audience can create further challenge and discord in maintaining class interest (e.g., HIPPA might not be of interest to the IS student) and conducting group activities.

Another approach is to separate the HIT courses from the IS courses, still utilizing the IS courses and faculty, but tailoring the course to the healthcare industry. Tailoring may not be an easy task, given the interdisciplinary and complex nature of the topic. For example, billing in healthcare settings is quite different from billing in other industry sectors. Automating payment and reimbursement requires systems analysts to understand the different insurance models and the associated codes. Additionally, profit (or, in many cases, reduction in costs) are not the only goal of the use of technology. Patient outcomes and the analytics associated with reporting accountability of patient care are becoming increasingly important and, in many cases, mandatory for reimbursement. Patient data is extremely sensitive, so securing these data is paramount. Trying to strike the balance of using data for the greater good (for example, for public health reporting) and the privacy of a patient is an important challenge. Finally, the data in healthcare settings comes in many shapes and forms: clinical summaries, labs, prescriptions, x-rays, and MRIs, and each of these data have competing standards, making interoperability an enormous challenge. The curriculum has to cover these important areas of billing, privacy and security, interoperability, and analytics. Linking HIT to higher quality and lower cost is key to success of such a curriculum.

Another challenge is finding the right faculty to teach HIT-related courses. Most faculty members are already stretched by existing responsibilities and lean department resources; IS faculty may not have the time (or interest) to invest in additional HIT training or healthcare IT experience. Furthermore, HIT involves people of disparate backgrounds. Thus, it may take extra time for building consensus and for the learning of methods, languages, and cultures in interdisciplinary programs. Caution in investing time to expand one's HIT knowledge and professional network may be exacerbated by promotion and tenure criteria that may not support the time dedicated to this curriculum effort or to related HIT interdisciplinary research (particularly if published outside the faculty member's "home domain"). Instructors from practice may be seen as a solution. However, although there may be a supply of practitioners who would be great instructors, it is often difficult to hire them away from well-paid leadership positions in a full-time capacity, particularly in non-tenure track paths. Time constraints and accreditation issues may also prevent seasoned and knowledgeable practitioners from regularly serving in an adjunct capacity. Besides these supply/demand challenges, a "right" hire must not only understand the material, but also understand the audience. Regarding student composition, it is likely that instructors in these programs will encounter trained and experienced clinicians that require important skill-sets traditionally covered in IS, such as systems design, database administration, project management and/or data management in order to properly administer and adopt HIT implementations (such as EHR and CPOE). However, these individuals may not have the technical background that traditional IS students have and will demand the instructors understand the clinical aspects of their business. Additionally, instructors could also encounter IT professionals who have the technical skills, but wish to cross over to a career in healthcare and need to learn the healthcare context. HIT educators must have the communication capabilities and knowledge that allow them to navigate among the disciplines and the educational audience or to team up with the appropriate counterpart to appropriately address the educational needs of both types of students.

Depending on who offers the HIT program within an institution, accreditation matters can range from simple to complex. If the offering is from an IS program within a business school, it is important to note that the Association of Advance Collegiate Schools of Business (AACSB) does not accredit health-oriented programs. However, prospective students looking for HIT programs expect some kind of accreditation. The Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM) is the independent accrediting organization whose mission is to serve the public interest by establishing and enforcing quality Accreditation Standards for Health Informatics and Health Information Management (HIM) educational programs. Hence, if the program is started within a business school by an IS department other than AACSB, the program should seek accreditation from CAHIIM. The accreditation process requires extensive self-examination with supporting documentation, such as all course syllabi,

faculty bios, and a detailed program evaluation plan, as well as a site visit. CAHIIM is currently reviewing HIT, HIM, and Health Informatics programs for accreditation.

Accreditation may introduce curricula components with which MIS and even business schools are not familiar. For all undergraduate HIT or HIM offerings, CAHIIM requires that the program includes an internship at a clinical site or a hybrid of virtual simulation and on-site practice experience. At the graduate level, there is no specified requirement for practical experience, but the majority of programs include a practicum, unless they are research-focused. A practicum typically entails individual student or group work at a healthcare facility (e.g., clinic, hospital, VA facility) for a semester-long project. This requirement is primarily intended to give students hands-on experience working on a real-world project at a healthcare facility. This added curricula component may introduce additional staffing needs, namely an internship liaison to recruit potential internship sites, match students with a local mentor and faculty member, and manage the internship placements efficiently. Specific deliverables and expected outcomes should be made available to the students from the start of their internship experience.

Instead of Reinventing the Wheel, Leverage Existing Resources for HIT Curricula

Faculty in IS who are thinking of offering selected courses or starting an entire program in HIT could quickly become overwhelmed when deciding how to structure the curriculum. The discipline is broad and requires diverse expertise that some existing IS programs may lack, though programs need to consider existing faculty and courses for leveraging purposes when designing a curriculum. Currently, HIT specializations are offered to students at three different levels:

1. The associate's degree level (mainly administered by two-year community colleges) focuses on expert technical skills and specialties coupled with introduction to the healthcare industry and work flows.
2. The baccalaureate degree level (four-year institutions) provides general education coupled with health informatics foundations, managerial, and information systems education.
3. Master's degree level (may include post-baccalaureate certificate programs)

The curricula for each of these levels have certain basic core components that are similar; they differ mainly in the topic depth, projects, and learning outcomes, depending on the mission and focus of the academic institution, expertise of the faculty, and the department where the program resides (e.g., computer science, allied health, business). Fortunately, large accreditation organizations such as CAHIIM provide very detailed information regarding the knowledge domains, competency levels, and skill sets required for each of the three levels of education mentioned above, as well as a graduate curriculum specific to health informatics education. A sample list of the core competency domains and skill sets required to earn a master's degree in HIT can be found at http://www.cahiim.org/applyaccred_HI_grad.html. Detailed curriculum maps can be found on the CAHIIM website (http://www.cahiim.org), for the three academic levels of HIT and the master's degree level in health informatics.

An IS program in the process of designing a curriculum and offerings in HIT should not reinvent the wheel, but may want to map the curriculum guidelines provided by CAHIIM to existing courses, examining the depth of instruction required for undergraduate programs as specified in the content topics (knowledge clusters) and the learning levels required. An IS program designing an undergraduate HIT program must consider whether an expected outcome is graduate eligibility for the AHIMA entry-level professional credentials of Registered Health Information Technician (RHIT) or Registered Health Information Administrator (RHIA) (http://www.ahima.org/certification/credentials.aspx). If so, specific CAHIIM standards for accreditation and policies for credential exam eligibility must be met.

For graduate programs, faculty can draw more freely from existing courses (since standards are still emerging), while considering the breadth and depth of instruction required for accreditation of the HIT or health informatics programs. A comprehensive HIT curriculum can draw courses from the following four reference disciplines: IT/computer science, management and organizational behavior, biomedical sciences, and basic statistics. When using existing courses, it is recommendable to infuse reading assignments, projects, and practical experiences from the healthcare industry to increase the relevance of the content and guide the student to apply the fundamental knowledge learned to the healthcare environment. The idea of repackaging existing IS courses with minimal changes is likely to fail because the topics, case studies, and practical projects for a HIT program must be firmly grounded in healthcare settings.

Successful graduate level HIT programs often are staffed by faculty that engage in active HIT research and scholarship. More schools are realizing that to integrate the IT and health domains successfully in curriculum, the faculty must be on top of current research. Hence these schools are actively recruiting faculty who can bridge the gap between teaching and research. This includes IS faculty involved in funded research, which often provides an excellent source of research data as well as teaching material. Funded research can also help IS academics bridge

the language, culture, and knowledge of their HIT collaborators in healthcare fields, where funded research is often held as a research measure of success. Additionally, engaging faculty who are active HIT researchers introduces the opportunity of IS schools to produce doctoral students trained in HIT to fill academic positions. In 2011–2012, a large majority of job opening advertised in AISWorld were looking for candidates in healthcare IT background.

As mentioned earlier, ONC has also provided funding to a few major informatics centers to design and develop curriculum materials. These can be found at http://www.hitechanswers.net/update-on-onc-workforce-projects/. IS faculty can leverage these resources as they design their courses and programs.

V. CONCLUSION

Academic programs in Information Systems across the nation continue to face tough enrollment issues [Beise, 2009; Locher, 2007]. Deans and Chairs are continually looking for mechanisms to grow IS programs. One particular approach that has met success is adding courses, concentration tracks, or even new degree programs in emerging areas. Healthcare is a highly detailed industry with well-established processes of delivery and care that must adjust to the current demands of employing IT in the milieu of medicine. We suggest that now may be the right time to consider participating in HIT education.

In this article, we have presented a detailed discussion of the Healthcare IT Education Framework in Figure 1 to provide guidance to IS educators who want to better understand the complex HIT domain and explore education and training possibilities. In essence, we have canvassed educational possibilities from the perspectives of complexity, challenge, and opportunity to show how IS scholars can significantly participate while being cognizant of its salient issues. Healthcare is a practitioner-oriented field. However, we feel that the HIT domain can be informed through education by IS academics armed with knowledge and theories grounded in a traditional IS path. Success will be easier for those schools that develop collaboration across disciplines and tie up with medical schools and computer science.

Our opinions and actions to date convey encouragement for those in the IS academic community who have the interest and are willing to follow a “bumpy road” to make a relevant contribution to addressing challenging problems associated with using technology to improve human health. That said, we have described many “bumps in the road” and areas of controversy regarding current domain complexities and educational pursuits. It is our hope that this manuscript will put these issues on the radar and lead to productive conversation within the IS community that leads to future-oriented thinking and action. In closing, we assert that the IS community is well poised to take a strategic interdisciplinary education position as one of the fields feeding the HIT domain.

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Editor’s Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
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