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**A**ssociation for **I**nformation **S**ystems

## **INFORMATION SYSTEMS AND HEALTHCARE XIX: DEVELOPING AN INTEGRATIVE HEALTH INFORMATICS GRADUATE CURRICULUM**

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### **ABSTRACT**

This paper details the development of a Masters in Health Informatics (MHI) program. It traces the design from conception through environmental scanning and curriculum development and into survey validation. One of the underlying characteristics identified in the analysis of other programs was that there seemed to be two subgroups or themes in health informatics programs: clinical and health administrative foci. A draft curriculum addressing the interest of both subgroups was developed, and a focus group of local health care industry professionals was conducted. The draft curriculum was the basis for surveys targeting the two potential subgroups. In addition to validating the interest in a masters program from both groups, the data was analyzed for potential differences between the two groups. These results confirmed the initial premise that a well-designed health informatics curriculum must address both the clinical and healthcare administration subgroups.

**Keywords:** IS curriculum, healthcare, integration

### **I. INTRODUCTION**

Without question the healthcare industry is huge and growing larger. The U.S. Census Bureau reports that healthcare was a \$1.3 trillion industry in 2003 [Healthcare Financial Management 2005]. Predictions have healthcare providers in North America spending almost 40 billion U.S. dollars on IT by 2008 [Krizner 2006]. The electronic medical record mandate is expected to spur growth in IT healthcare spending to double digits [Gillette 2004]. National and regional initiatives in the adoption of electronic medical record systems will create more IT jobs and require healthcare employees, nurses, and physicians to become more IT-savvy.

The key drivers of IT spending in healthcare include reducing medical errors, improving patient safety and developing electronic health records [Schwartz 2004]. Many healthcare organizations

are implementing bar-code systems, clinical information systems, and electronic medical records to reduce the chance of errors resulting from manual processes such as dispensing medication. It is reasoned that technology and information systems can improve the efficiency and effectiveness of health care services and provide higher-quality care for patients.

The field of information systems (IS), by design, applies information technology (IT) to real world, business-oriented problems. It seeks to use IT to improve effectiveness and efficiency of the area in which it is applied. Clearly, the needs of the healthcare industry and the ambitions of IS professionals coincide. This paper examines the potential growth areas for IS with the development of health informatics programs and proposes a health informatics curriculum that recognizes and integrates IS and health care effectively.

## II. HEALTH INFORMATICS

Several different definitions of health informatics exist. For example, Imhoff et al. [2001, p. 179] define health informatics as the “development and assessment of methods and systems for the acquisition, processing and interpretation of patient data with the help of knowledge from scientific research.” Peel [1994] defines health informatics more broadly, as the discipline that integrates biomedical sciences, computer sciences, healthcare policy, management, and organization. In this way, providing better healthcare has moved into proactive areas such as education, statistics, research, and cost management.

One such movement is with the practice of evidence-based medicine. Sackett et al. [1996] describe the practice of evidence-based medicine as the integration of individual clinical expertise with the best available external clinical expertise from systematic research. The basic contention is that by combining the two areas, the total healthcare industry benefits. Combining these definitions, health informatics deals with more than just patient data. It also deals with the collection and analysis of pertinent health care data to create information and knowledge on which communities and health policy decision makers can act. The desire for better decision making in healthcare drives the need for more data analysis and for better understanding of information systems. In this way, the growth of evidence-based medicine becomes a complementary force driving the use of information technology in the healthcare industry.

The demands for education and training in health informatics go well beyond basic computer skills. Information literacy courses designed to teach the basic information management skills and quantitative courses designed to teach how to better analyze data are becoming increasingly helpful in providing the knowledge needed for patient care delivery. Charters [2003] reports the need for better information retrieval skills and Bailey [2006] finds data accessibility can impact error reduction and patient safety. The ability to synthesize data, to put it together in different ways in order to spot trends, is becoming a key component in diagnosis and treatment in health care.

Effective use of IT and IS in the healthcare industry is paramount to the industry moving forward. Electronic medical records, imaging technology, and the massive amounts of data are driving this use. The primary goal of increasing patient care remains, but the means by which this can be accomplished have grown significantly. One such area that demonstrates this integration of IT is nursing informatics.

Nursing is the diagnosis and treatment of human response to disease and development [ANA 1980]. Karras et al. [2002] have positioned nursing informatics as one component of the general informatics field. As with informatics in general, nursing informatics is a relatively new specialty in healthcare. The interdependency of nursing informatics with health informatics can be seen by comparing the following nursing informatics definition from the America Nurses Association [2001] with our previous definitions. “Nursing informatics is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice. Nursing informatics facilitates “the integration of

data, information, and knowledge to support patients, nurses, and other providers in their decision-making in all roles and settings” (p. 17) [America Nurses Association 2001].

Informatics nurses use IT and nursing to support patient care. Recently, the definition of nursing informatics focuses on gathering and processing information to create knowledge. Today, informatics nurses may be involved in selection, development, and testing of various clinical IS such as medication barcode technology, electronic physician entry order sets, and clinic documentation systems for patient care. While our institution does not have a medical school, we expect our current pool of students in the nursing school would be interested in the more general health informatics area when thinking of additional education.

## **THE ENVIRONMENT**

IT is changing the healthcare industry; it impacts what, when, why, and how patient care is delivered. A survey conducted by the Healthcare Information and Management Systems Society with bedside nurses and other healthcare workers shows that health IT applications are used in such areas as: patient results (76.9 percent); electronic documentation/notes (63.1 percent); remote access for physicians (55 percent); wireless telephone (47.2 percent); alerts (42.7 percent); medication administration records (39.7 percent); electronic plan-of-care (37.8 percent); bar-code medication administration (31.1 percent); and computerized prescriber order entry (25.2 percent) [Sensmeler 2006].

Nurses are the largest consumers of healthcare IT and Johnson and Ventura [2004] report that there is an increasing need to use IT to improve patient safety and quality of care. IT systems can contribute significantly to the monitoring and provision of healthcare [Georgiou and Pearson 2002]. The goal of these systems is to assist nurses and other professionals to promote patient safety and to improve the overall outcome of healthcare to the patient. However, with each new adoption of a healthcare IT/IS system, new roles are assigned to nurses and other healthcare providers. In turn, the successful implementation and use of these systems is dependent on training and education [Korhonen and Lammintakanen 2005; Mantovani et al. 2003]. In this environment, computer and information literacy has become a core competency for healthcare professionals.

Jiang et al. [2004] developed a comprehensive list of computer competency for nurses containing seven categories: concepts of hardware, software and network, principles of computer applications, skills in computer usage, program design, limitations of computers, personal and social issues, and attitude toward computers. Using this list as an evaluation tool in a Delphi study, the “attitude toward computer” category proved most important. This finding is not unique. McNeil et al. [2005] surveyed deans/directors of 266 nursing programs to identify competencies and knowledge of their undergraduates and graduates in their nursing programs. More than 80 percent of the nursing undergraduate programs expected students to graduate with basic computer literacy and information management skills.

## **CASE STUDY OVERVIEW**

The objective of this paper is to relate the development of a master’s level curriculum for a health informatics program. The school in question is a Carnegie Masters Level institution with a regional scope. One of the key focus areas is community outreach. The university has a flourishing nursing program and has recently created a College of Informatics. The college was constructed by bringing three established departments together: Computer Science, Communication, and Information Systems. Historically, the Information Systems program was in the College of Business. The department retains its business heritage with an AACSB accredited curriculum and a recent name change to Business Informatics.

Health informatics has been a formal field of study since the early 1970s [Coiera 2003]. Given its complexity, there are several different ways to organize and approach this field. Academic programs generally approach the field from an applications perspective. Health informatics is

based upon (a) clinical informatics, with a principal focus on patient care, and (b) general health IS, with a principal focus on institutional administration. Thus, issues range from storage, retrieval, and interpretation of information in patient care to implementation and management of the complex IS used in the administration of healthcare. The natural environment of health informatics includes hospitals, physician networks and practice groups, third-party payers and regulatory agencies, and industry suppliers such as pharmaceutical companies, biotechnology companies, and vendors of hospital equipment and medical supplies. Figure 1 shows the relationship of health informatics to clinical informatics and health IS.

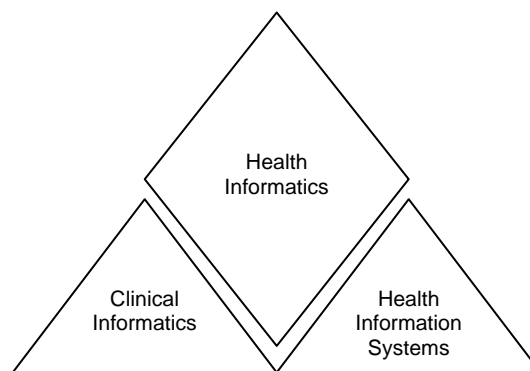


Figure 1. Relationship of Health Informatics to Clinical Informatics and Health Information Systems

According to Wikipedia, "Clinical Informatics is a subfield of health informatics. It focuses on computer applications that address medical data (collection, analysis, representation). Clinical informatics is a combination of information science, computer science, and clinical science designed to assist in the management and processing of data, information and knowledge to support the practice and delivery of clinical care." The Healthcare Information and Management Systems Society (HIMSS) defines the objective for their organization as it deals with healthcare information systems as ". . . providing leadership for the optimal use of healthcare information technology (IT) and management systems for the betterment of human health" [HIMSS 2007]. As represented in Figure 1, Health Informatics is the bridging component between the clinical and administrative side; it is supported by both sides and offers a higher level of information computer technology competence than the two supporting components.

While sharing infrastructure, data and other components, clinical informatics and health IS are typically treated as separate departments and operating units within healthcare organizations. In fact, the lack of communication and technical interoperability between these areas is seen as one of the greatest problems in healthcare [Commonwealth Fund 2006].

Following a mandate by the U.S. Department of Health and Human Services for a national healthcare information infrastructure (including electronic health records) by 2014, interoperability and transparency of healthcare systems and records have become a major focus for the industry. This is driven, in part, by proposals to tie Medicare and Medicaid reimbursements to the use of interoperable electronic health records and "pay for performance" measures that require these records" [Brailer 2004].

### III. METHODOLOGIES

McGrath et al [1982] suggest the use of multiple methods in the knowledge accrual process. In that effort, we combined McGrath's [1994] field strategy, by making direct observations of ongoing systems, with a respondent strategy, by conducting surveys.

**FIELD STRATEGY - DIRECT OBSERVATIONS**

For direct observations, we scanned the health informatics education environment. We looked at and analyzed curricula from current health informatics programs. From this analysis, a matrix (Appendix A) of the courses found in various curricula was created and an analysis was undertaken to extract potential courses. As a preliminary validation of our work, we met with and interviewed executives, CIOs, CEOs, and directors within the local healthcare industry (Table 1). The courses were then evaluated as to their feasibility for delivery in our environment. The final set of courses was identified, and a curriculum was proposed (Table 2).

These interviews provided valuable feedback for the development of the curriculum. Every executive interviewed in our planning process across a range of organizations indicated a need for employees who have the skills identified within the curriculum. The foundation courses and the capstone idea were positively received. In fact, many interviewees, without prompting, offered their organization’s participation in the capstone course by providing residency opportunities. One major change brought on by the interviews was the idea of dividing the elective pool into three main areas: Health Informatics Policy,

Table 1. Interviewees for Preliminary Validation

<b>Role</b>	<b>Industry Category</b>
CEO	Hospital
Dean & M.D.	University College
Executive Director	Community Health Consortium
Center Director	Medical School - Research
Senior Architect	Health Information Systems Company
Vice President	Medical Research Laboratory
CEO	Biomedical Company
Program Director	Graduate Program
Research Director	Community Health Consortium
CEO	Hospital
Associate Dean	University College
Teaching Faculty	Graduate School
Program Director	Medicine School - Graduate Program
Clinical Informaticist	Hospital
President	Community Health Consortium
Business Integrator	Hospital
Vice President – Technology	University College
Vice President	Community Health Consortium
Industry categories are representative names; any names that match company or organizational trademarked names exactly are purely chance.	

Business Process Management, and Knowledge Management. This hybrid idea exposes all students to these main healthcare areas while still allowing some flexibility in course choices. Interviewees rebuked our concern of forcing students to take more business-oriented classes. For

example, we were concerned that the elective areas would not appeal to our target audience. We also feared that interviewees would not agree with the idea of a need for financial or accounting exposure. However, we received a very positive response to these as well as other business-oriented courses such as decision support and negotiation.

This program’s design addresses both the areas of clinical informatics and health IS, with a focus on the integration and interoperability of technology and communication within this total environment. It is this combination that will help distinguish the program. The required foundation courses provide broad technical skills as well as providing the organizational competencies required for success by graduates. The elective areas are designed to provide students a base level understanding in these areas complementary to health informatics. The capstone experiences will provide opportunity for practical application of the concepts learned. Graduates will develop competencies and skills that are required to work with leading edge technologies while implementing process change, system design, and management within the unique constraints, requirements, urgencies, and patient-centered practices associated with the healthcare industry.

Table 2. Health Informatics Curriculum

<b>Capstone:</b> 6 credits; 2 semester sequence					
Elective Level ( 1 course from each Area + 3 credits elective*)					
Health Informatics Policy Area (3 credits)		Business Process Management* Area (2-3 credits)		Knowledge Management Area (3 credits)	
<ul style="list-style-type: none"> <li>➤ Leadership and Ethics</li> <li>➤ Information Security</li> <li>➤ Health Communication</li> <li>➤ Social Implications of Computing</li> <li>➤ Negotiation and Conflict Resolution</li> </ul>		<ul style="list-style-type: none"> <li>➤ Basic Accounting</li> <li>➤ Financial Management</li> <li>➤ Organizational Communication</li> <li>➤ Systems Analysis and Design</li> <li>➤ Managing People and Organizations</li> </ul>		<ul style="list-style-type: none"> <li>➤ Enterprise Resource Planning</li> <li>➤ Business Intelligence</li> <li>➤ Decision Support Systems</li> <li>➤ Marketing Management</li> </ul>	
* elective may be course from any area or course chosen by student and approved by program director					
<b>Foundation (18 Credits)</b>					
Introduction to Healthcare Operations (MHI 600)	Technical Foundations of Health Informatics (MHI 601)	Introduction to Management Information Systems (MSIS 625)	IT Project Management (MSIS 650)	Introduction to Database Management (MSIS 635)	Research Methods for Health Informatics (MHI 650)

**RESPONDENT STRATEGY - SURVEYS**

We conducted two surveys to assess the appeal of health informatics degrees among potential students. Characteristics such as IT background, class time preference, intention to get a certificate in healthcare, intention to enroll the master program, and interest in these courses:

Decision Support, Systems Analysis and Design, Database Management, Project Management, Security and Privacy, Health Administration, and Electronic Medical Records were used (Appendix B) The surveys were sent to two groups of potential students: nursing students and business students (including College of Business and Business Informatics students). These two groups were chosen because we felt they represented our target market for the Masters Degree program. If students in these areas did not express an interest, then our curriculum was obviously flawed.

Table 3 shows the descriptive statistics for the survey items. The sample size for the business survey is 65 and the sample size for the nursing survey is 35. About half of all respondents reported some knowledge about health informatics, and over 90 percent of the respondents find the program appealing;

Table 3. Descriptive Statistics Percentage of students reported somewhat or definitely interested

	<b>Business Survey (%) (n=65)</b>	<b>Nursing Survey (%) (n=35)</b>	<b>Asymp. Sig (Mann-Whitney)</b>
Knowledgeable	50.23	40.00	0.42
Appealing	90.77	97.15	0.92
LikeCertificate	70.77	88.57	0.17
LikeMaster	75.38	91.43	0.21
TakenISCourse	73.44	41.18	0.00
InterestDS	75.01	84.38	0.97
InterestSAD	66.67	65.63	0.91
InterestDM	78.13	87.88	0.86
InterestPM	84.12	96.97	0.39
InterestHealth	74.60	100.00	0.03
InterestSecurity	83.33	93.75	0.83
InterestEMD	76.19	96.97	0.33
PartTime	60.94	57.14	0.71
NightPref	12.70	34.29	0.02

About 70 percent of all respondents liked the idea of a certificate program and three-quarters showed interest in the program at the Masters level. The interest in the courses held up throughout with the lowest levels of interest being recorded for the Systems Analysis and Design course by both groups (65.63 percent for nursing students; 66.67 percent for business students). The course receiving the most interest is the Project Management course with 74.60 percent for business students and 100 percent for nursing students.

We also tested to see if we have heterogeneous subgroups within our potential student population. Table 3 shows the Mann-Whitney test on differences between the two groups of potential students. We found the two groups are similar in their interest in the certificate and master program, their knowledge about health informatics, their interest in Decision Support, Systems Analysis and Design, Database Management, Project Management, Security and Privacy, and Electronic Medical Records. The results in Table 3 shows students' interest in taking the courses proposed for the new health informatics program do not differ. Therefore, we have a positive response to the program in general and to the proposed curriculum by both groups.



However, there are some differences that may impact the design of the program. First there is a difference in preference about when the courses are taught. Nursing students prefer evening or night classes. Second, a higher proportion of nursing students are female, which may have ramifications not identified in this study. For example, can the application of IS to healthcare increase the historically low numbers of females interested in IS? Third, using IS courses as an indicator, nursing students reported significantly less exposure to computers and information management. This data, along with confirmatory interview data, suggests a high need for computer literacy and information management courses in the program. On the opposite side, business students showed less interest in taking healthcare administration classes. More details need to be gathered, but these last two findings may simply document the difference between the clinical and IS perspectives noted in our introduction.

#### **IV. CONCLUSION**

The purpose of this paper was to outline the development of a health informatics program. Given the resources available, the desire to revitalize the curriculum, the community focus of the university, the region's need for healthcare, the existing technology community, the existing healthcare community, the choice of developing a health informatics program was natural.

One of the key enablers of the program was the resources available. In recent years, the interests in IS and IT as a pure major have declined. However, the interest in applying and using IS with a purpose in health informatics has expanded. These dynamic market conditions and global competition made us recognize the needs to refine and redesign our curriculum.

In this paper, we described our method to develop the new health informatics curriculum in response to market needs. This program addresses both of the main areas found in the health informatics industry: clinical informatics and health IS. The distinguishing characteristic for the curriculum is the focus on the integration and interoperability of technology with the management and communication needs within the healthcare environment. We believe that this approach revitalizes our Masters of Science curriculum and for programs with similar characteristics, our model could work as guidelines in revitalizing MSIS curriculum for other universities.

As of this writing, the program proposal has received approval at the college and university level. The university has authorized a faculty line and a search for the first faculty member is underway. Program approval at the state level for a fall 2007 start date is anticipated. Spring 2007 will launch the advertising and promotion of the program.

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EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers, who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

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2. The contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
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## ABOUT THE AUTHORS

**Ben Martz** is a professor and chair of the Business Informatics Department at Northern Kentucky University. His teaching interests include e-business, software development, groupware, and team-based problem solving. Ben received his Ph.D. in Business, with an emphasis in MIS, from the University of Arizona. Ben was one of the founding members, as well as president and COO, of Ventana Corporation – a technology, spin-off firm from the University of Arizona - incorporated to commercialize the groupware software product GroupSystems. Ben has published his groupware research in *MIS Quarterly*, *Decision Support Systems*, and the *Journal of Management Information Systems* and his student learning environment research in *Journal of Cooperative Education*, *Journal of Computer Information Systems* and the *Decision Sciences Journal of Innovative Education*.

**Xiaoni Zhang** is an associate professor of Business Informatics at the Northern Kentucky University. She received her Ph.D. in Business Computer Information Systems from the University of North Texas in 2001. Her research interests include business intelligence, Web usability, e-commerce systems, enterprise systems and mobile technology. She is a member of Decision Science Institute and Association for Information System. Her publications appear in *IEEE Transactions on Engineering Management*, *Communications of the ACM*, *International Conference of Information Systems*, *Information & Management*, and other journals.

**Gary Ozanich** is the interim associate dean of the College of Informatics at Northern Kentucky University. He has had a career that spans both the private sector and academe. His academic appointments include being the associate director of the Institute of Tele-Information in the Graduate School of Business at Columbia University, and positions on the faculties of Michigan State University and SUNY-Buffalo. Most recently he chaired efforts leading to the development of new graduate programs in Health Informatics at NKU, a program including curriculum development and industry engagement. He holds a Ph.D. from the University of Wisconsin-Madison.

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Appendix A: Health/Nursing Informatics Program Summary Matrix													
Program & Area	Health Care Administration	Decision Support	Policy Issues	Database Modeling	Network Applications	Systems Analysis	Health Informatics	General MIS	Project Management	Quantitative Analysis	Application Design	Practicum	Other
Alabama - Health Informatics	X		X	X	X	2	X	3			X		
Texas - Health Informatics		X	X	X	X			X	X				X
Maryland - Nursing	X	X			X		X		X		X	X	
Pittsburgh - Nursing	X	2		X	X		X					X	
UC - Davis Health Informatics		X	X	X	X		X					X	
IUPUI - Health Informatics	X	X	X	X			X	X					
Washington - Health Informatics	X	X	X	2	X								X
Louisville - Health Management	2	X	2				X	X					
Missouri - Health Management	X	X	2	X			X			X			
Pittsburgh-Health Information	X	X					X		X	X			
University of Victoria	X	X					X			X			X
Maryland-Health Administration	2		2				X	X					
Duke University - Nursing					X	X			X		X		
NOTE 1.) A 2 or 3 represents multiple courses categorized into the same area.													
NOTE 2.) Chart was developed through analysis of information found on web pages and on referral websites. Clearly, other categorization schemes will yield different results.													

Appendix B: Health Informatics

**NKU WOULD GREATLY APPRECIATE YOUR TIME IN COMPLETING A BRIEF SURVEY TO ASSESS INTEREST IN A PROPOSED NEW MASTER’S DEGREE.**

The degree is called M.S. in Health Informatics that use technologies to facilitate the integration of data, information, and knowledge to support patients, nurses, and other providers in their decision-making in clinical settings.

1. How knowledgeable are you about this area of study? (very knowledgeable, somewhat knowledgeable, not very knowledgeable, not at all)?
  
2. How appealing would a career in Health Informatics be to you? (very interested, somewhat interested, not very interested, not at all interested)?
  
3. Have you ever created any content that has been displayed on a web site, either a personal site or a site for an organization?
  
4. If a program like the proposed one in Nursing Informatics were available when you entered Northern Kentucky University, how likely is it that you would have chosen a major in Health Informatics?
  
5. Please indicate your interest in taking courses in the following areas: (very interested, somewhat interested, not very interested, not at all interested)

	Internet & Health Information	Nursing Informatics	Database Management	Project Management	Data Analysis	Security & Privacy	Application Design & Development
Very Interested							
Somewhat Interested							
Not Very Interested							
Not at All Interested							

6. If the Master Degree in Health Informatics is offered during a standard 16 week semester would you be a full- time student (12 or more semester hours) or a part-time student (less than 12 semester hours):
  
7. If offered during a 16 week semester, when would you have preferred classes to meet? (day or night)?
  
8. Gender: (Male, Female)
  
9. Age:
  
10. Class Standing: (freshman, sophomore, junior, senior)
  
11. Open ended Comments:



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