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Towards an Empirical Definition of Graduate School Healthcare Informatics

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I. Introduction

Healthcare informatics is a relatively new field to academia. As with all new innovations, there may be some time before the Healthcare Informatics discipline has a firm foothold on a definition. Although healthcare informatics has spurred many unique degree names, all agree the field is multi-disciplinary in nature. In a new school or program, there may not be any standardized curricula or set course syllabi, which leaves considerable room for creativity and flexibility (HD Covvey, 2001). Oregon Health & Science University has developed a program that includes to the full spectrum of courses, allowing education to be tailored to career goals and needs (Hersh, 2007). Although the field of health informatics encompasses many established disciplines, the field itself is still in a formative state that allows for teaching and curriculum development in a way that may not be possible in more established educational programs. It is difficult to talk of informatics education since the groups that need education in this field are not very homogeneous (Arie Hasman, 2000).

Graduate degree addressing healthcare informatics goes by many names;

- Bioinformatics
- Health Information Technology
- Health Management Information Systems
- Health Informatics
- Public Health Informatics
- Medical Informatics
- Consumer health informatics

Regardless of the health domain, all informatics subspecialties apply the informatics pyramid;(White, Jun/Jul 2013).

- The relationship and transformation of data.
- Information and knowledge, to making decisions and solve problems.

This pilot study was performed at add clarity to the multi-disciplined nature of Healthcare Informatics.

II. Literature Review

Research found Healthcare Informatics course development have included the following disciplines; business, legal, chemical informatics, bioinformatics, new media, copyright, trademark and patents (HD Covvey, 2001). The science of informatics has driven innovation in biomedical research, clinical care, and public health (CAHIIM, 2014). While each Healthcare Informatics program has specific targeted academic goals and audiences, there is overlapand some confusion related to the new field. Until recently, medical informatics focused on developing applications for health professionals - through the eyes of health professionals rather than through the eyes of patients. Today, medical informatics is "the field that concerns itself with the cognitive, information processing, and communication tasks of medical practice, education, and research". (Eysenbach, 2000)

With the diversity of approaches within health informatics, research is looking to define where appropriate relationships exist among information sciences, information technology and informatics. (Dalrymple, Jun/Jul 2013). Today, health informatics professionals contribute to: (AMIA, 2014)

- Moving basic research findings from bench to bedside;
- Evaluating interventions across communities;
- Assessing the impact of health innovations on health policy; and
- Advancing the field of informatics.

Thehealth informatics focus is changing towards usability, specifically for consumers. Currently, healthcare workers see the clinical informatics in discrete pieces (Reese, May 2012). Health informatics is not restricted to the use of computers and telecommunications but also includes the delivery of information to

patients through other media. The computer may not always be the most effective medium for delivering information, especially in dealing with elderly or injured patients(Eysenbach, 2000). Public Health Informatics (PHI) leverages information and computer science to support public health goals and decision-making while defining the science behind the technology (White, Jun/Jul 2013). PHI utilizes a range of disciplines, including information science, engineering, law and the social sciences (Savel, 2012). Discussions are now focused on developing and evaluating methods and applications to integrate consumer needs and preferences into information management systems in clinical practice, education, and research.

Health informatics education has started in the 1960s, primarily in medical schools across the USA and Europe. By 1989 health informatics education had grown into more than 20 countries on five continents (Hovenga, 2000). In 1999, Indiana University created a new school, the School of Informatics, representing a wide range of disciplines (Hook, 2003). All health informatics programs are unique in terms or content and structure - reflecting many foundation disciplines.

The evidence suggests a poor uptake of informatics by the nursing profession (Hovenga, 2000). One contributing factor is the lack of a standardized nursing terminology. In order for the informatics goal of full interoperability across nursing information systems to be realized, this problem must be addressed (Schwirian, 2013).

The Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM) is an independent accrediting organization that enforces quality Accreditation Standards for Health Informatics and Health Information Management (HIM) educational programs. (CAHIIM, 2014)An academic program in health informatics needs to include:

- Information Systems curriculum components focus on such issues as information systems analysis, design, implementation, management and leadership.
- Informatics curriculum components are concerned with the study of structure, function and transfer of information, socio-technical aspects of health computing, and human-computer interaction.
- Information Technology curriculum components focus on computer networks, database and systems administration, security, and programming.
    - Nurses must be supported consistently in their use of standardized nursing terminologies;
    - Cross-mappings among the various terminologies must be completed.

Clearly healthcare informatics graduate program are in their formative state. A review of the literature that describes the growth of these programs indicates the varied nature of the programs;

- multi-disciplinary
- full spectrum
- tailored
- diversity
- include curriculum components from all three facets

Despite the agreement on the growth and the multi-disciplinary nature of the discipline, there has not been an effort to define what the spectrums of courses that comprise a healthcare informatics degree.

III. Research Methodology

Research purpose and questions

The purpose of this pilot study was to start to define the cross-disciplinary nature of a Healthcare Informatics graduate degree. Researchers in the field agree on that the discipline includes a full spectrum of courses, but the diversity of courses remains vague. Consequently, many prospective students are confused by the goals of the degree

- What courses comprise a Healthcare Informatics graduate degree?
- What disciplinescontribute courses/curriculumto the Healthcare Informatics graduate degree programs?

Methodology

For this study, a content analysis of courses in a Healthcare Informatics graduate degree program was conducted, using a representative sample of universities.The design goal was to construct a sample frame corresponds to the population (Universities / Colleges)(Fowler, 2002).

Content analysis requires two processes: definition of the content characteristics (basic content elements) being examined and application of rules for identifying and recording these characteristics. An objective coding scheme must be applied to the courses (Berg, 2001). For this pilot study, each course was placed into an academic discipline. Four disciplines were selected for this study; Business (BUS), Healthcare (HC), Information Systems (IS) and Healthcare Informatics (HCI).

The guidelines for identifying a discipline for each category were;

Discipline Category	**Course content**
Business	Administration Business of Informatics in Healthcare Communication Skills Ethics & Legal Issues in Health Informatics Leadership Development Legal and Social Issues in Health Informatics Management Theory Negotiations & Conflict Resolution Operations Organizational Behavior Organizational Communication Organizational Management and Total Quality Management
Healthcare	Bioinformatics Epidemiology Genomics and Health Care Data Health Education Health Systems Lab Nursing Research The American Health Care System
Healthcare Informatics	Biostatistics and Decision Analysis Capstone HIT Research Project Capstone Project Foundations of Health Information Management Health Care Informatics Health Care Informatics Internship Health Informatics Capstone Experience Human Interactions, Integration and Interoperability Introduction to HealthCare Informatics Medical Terminology Medical Terminology Principles of Health Informatics Research and Evaluation Seminar in Biomedical and Health Information Sciences Seminar on Current Issues in Healthcare Informatics and Enterprise Management Social & Org. Issues in Health Informatics Strategic Inquiry in HIS Survey of Health Information Management Topics in Health Informatics

Discipline Category	Course content
Information Systems	Application of Health Care Info. Sys. Artificial Intelligence Computational Models of Decision Making Computer Applications Computer Networks Creation and Application of Medical Knowledge Data Architecture and Modeling Data Communications Data Security Data Security Design for Usability in Health Care Electronic Networking and Information Services Emerging Technologies in Healthcare Health Care I.T. Administration Health Care Information Security Health Care Project Management Health Info. Sys. Analysis & Design Health Informatics Applications Health Information Technology Procurement Healthcare Information Technology Information Sources & Services Information Systems Analysis Infrastructure for Electronic Business Introduction to Computer Security IT Vendor Management Knowledge Management in Healthcare Organizations Knowledge Representation Managed Care & Integrated Health Networks Management Information Systems Management of Health Care Comm. Sys. MIS Concepts & Languages Mobile Health Informatics Natural Language Processing Object-Oriented & Visual Paradigms Project Management System Analysis and Design Topics in Computer Science Work Flow Design, and Change Management

One design issue is how well the sample frame corresponds to the population a researcher wants to describe. (Fowler 1993). Is this a true picture? By using a reprehensive sample, the goal was that the information derived from the sample and the conclusions reflected the same conditions that exist in University settings as a whole (Glebocki, 1984). Specifically excluded from the sample was "for-profit universities", defined as colleges that are owned and operated by businesses and are ultimately accountable by law for the returns they produce for shareholders. (Senate Committe on Health, Education, Labor and Pensions, 2014). The sample selected for this pilot study (January 2014) will be one university that is;

- Online
- Traditional
- Public
- Private
- Large School
- Small School

The following working definitions for this study were used;

Term	Definition
Large university	Large Universities have more than 15,000 students (Anonymous, 2014). Although a more detailed criteria, credit hours is not readily available - "Large university" means a university that produces more than 150,000 student credit hours per academic year (State of New Mexico, 2014).
Small university	Small Universities have fewer than 5,000 students(Anonymous, 2014). Although a more detailed criteria, credit hours are not readily available - "Small university" means a university that produces 150,000 or fewer student credit hours per academic year. (State of New Mexico, 2014)
Private University	The term "private" simply means that the university's funding comes from tuition, investments and private donors, not from taxpayers. (Grove, 2014)

Term	Definition
Public University	The term "public" indicates that the university's funding comes partly from state taxpayers. (Grove, 2014)
Online	100% of the courses are offered online

Research Findings

For this pilot study, six universities were selected as a representative sample of Healthcare Informatics graduate programs. The six were;

	Institution	Rationale for Selection	Website
Online	University of Illinois at Chicago	The continuum of our online health informatics degree programs enables professionals from various backgrounds to acquire the skills necessary to transition into a wide variety of health informatics roles.	http://healthinformatics.uic.edu/ http://healthinformaticsdegree.uic.edu/masters-health-informatics/
Traditional	Northeastern University	Both online or on campus http://www.ccs.neu.edu/graduate/degree-programs/m-s-in-health-informatics/program-overview/	http://www.healthinformatics.neu.edu/overview/index.html
Public	University of Wisconsin–Milwaukee	Public University	http://www4.uwm.edu/chs/academics/hia/his/ms-hci/
Private	Adelphi University	From its beginnings as a private preparatory school in Brooklyn, Adelphi has steadily pursued its mission of providing quality education while serving the needs of an ever-expanding community. Even in the most challenging times, Adelphi has expanded into new academic disciplines.	http://nursing.adelphi.edu/academics/healthcare-informatics/
Large School	University of Central Florida	The University of Central Florida and its 12 colleges provide opportunities to 60,000 students from all 50 states and 140 countries.	http://graduatecatalog.ucf.edu/programs/Program.aspx?ID=5852
Small School	New England College	Student enrollment 3,536	http://www.nec.edu/pdf-files-1/grad-prof-studies/msm/health-informatics/?searchterm=informatics

Once the six academic institutions were selected, the website for each Graduate Program for Healthcare Informatics was visited. All of the courses (required and / or electives) were documented and recorded. The courses included in each program were;

Institution	Courses
University of Illinois at Chicago	BHIS 406 Medical Terminology HIM 486 Foundations of Health Information Management **Course Work** BHIS 437 Health Care Data BHIS 499 Info. Sources in Biomedical & HIS BHIS 503 Communication Skills in Health Informatics BHIS 505 Ethics & Legal Issues in Health Informatics BHIS 510 Health Care Information Systems BHIS 511 Application of Health Care Info. Sys. BHIS 515 Management of Health Care Comm. Sys. BHIS 520 Health Info. Sys. Analysis & Design BHIS 525 Social & Org. Issues in Health Informatics BHIS 537 Health Care IT Vendor Management BHIS 593 Health Informatics Capstone Experience **Additional Core – Course Only Track** BHIS 530 Topics in Health Informatics **Additional Core – Research Track** BHIS 500 Strategic Inquiry in BHIS BHIS 595 Seminar in Biomedical and Health Information Sciences BHIS 597 Research in Biomedical and Health Information Sciences BHIS 598 Research in Biomedical and Health Information Sciences **Electives – Other Courses Offered** BHIS 543 Health Care Project Management BHIS 527 Knowledge Management in Healthcare Organizations BHIS 508 Q-Methodology Research Methods BHIS 509 Informatics for the Clinical Investigator BHIS 517 Health Care Information Security BHIS 528 Consumer Health Informatics BHIS 538 Health Care I.T. Administration BHIS 546 Leadership Development in Health Informatics BHIS 580 Practicum in Biomedical and Health Information Sciences BHIS 596 Independent Study BHIS 522 Mobile Health Informatics
Northeastern University	**Required Courses: 2 Courses** HINF 5101 Introduction to Health Informatics and Health Information Systems HINF 5105 The American Health Care System **Health Informatics: Choose 2 courses** HINF 6225 Health Systems Lab HINF 6202 The Business of Health Care Informatics HINF 6205 Creation and Application of Medical Knowledge **Technical: Choose 2 Courses** HINF 6220 Database Design, Access, Modeling, and Security HINF 6230 Strategic Topics in Programming for Health Professionals HINF 5102 Data Management in Health Care HINF 6355 Key Standards in Health Informatics Systems **Business Management: Choose 2 Courses** HINF 6201 Organizational Behavior, Work Flow Design, and Change Management HINF 6215 Project Management HINF 6335 Management Issues in Healthcare Information Technology **Elective Courses (choose 2 courses)** HINF 6345 Design for Usability in Health Care HINF 6330 Emerging Technologies in Healthcare HINF 6340 Introduction to Genomics and Bioinformatics HINF 6325 Legal and Social Issues in Health Informatics HINF 6350 Public Health Surveillance and Informatics **Capstone (one course)** HINF 7701 Health Informatics Capstone Project

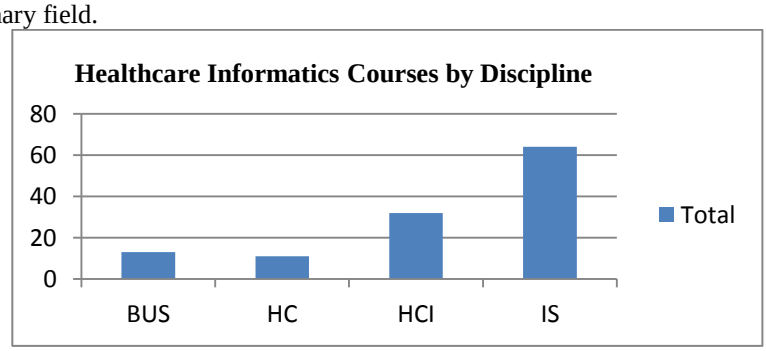
Institution	Courses
University of Wisconsin–Milwaukee	**Systems Analysis and Design** BUS ADM 747: Systems Analysis & Design HCA 441: Healthcare Information Systems Analysis & Design **Database Management** BUS ADM 749: Data Management Systems COMPSCI 557: Introduction to Database Systems COMPSCI 757: Data Base Organization and File Structure HCA 442: Healthcare Database Design & Management **Project Management** BUS ADM 748: Information Technology Project Management **Decision Support Systems** BUS ADM 814: Intelligent Systems for Business COMPSCI 720: Computational Models of Decision Making **Network Design /Telecommunications** BUS ADM 893: Infrastructure for Electronic Business COMPSCI 520: Computer Networks L&I SCI 710: Electronic Networking and Information Services **Technology Procurement** HCA 721: Health Information Technology Procurement **Applications** HCA 723: Health Care Systems Applications - Administrative & Clinical **Technology** BUS ADM 740:MIS: Concepts and Languages COMPSCI 431: Programming Languages Concepts COMPSCI 469: Introduction to Computer Security COMPSCI 536: Introduction to Software Engineering COMPSCI 557: Introduction to Database Systems COMPSCI 757: Database Organization & File Structure COMPSCI 759: Data Security L&I SCI 710: Electronic Networking and Information Services L&I SCI 782:Information Systems A & D **Decision Support Systems** COMPSCI 710: Artificial Intelligence COMP SCI 720: Computational Models of Decision Making COMPSCI 723: Natural Language Processing COMPSCI 790: Advanced Topics in Computer Science COMPSCI 810: Knowledge Representation NURSING 727: Epidemiology in Community Health L&I SCI 817: Information Sources & Services **Administration** BUS ADM 755: Health Care Administration BUS ADM 757: Managed Care & Integrated Health Networks COMPSCI 469: Introduction to Computer Security COMPSCI 759: Data Security NURSING 727: Epidemiology in Community Health
Adelphi University	HED 602 Research and Technology in Health Education HIT 502 Introduction to U.S. Health Care Organization HIT 601 HIT Human Interactions, Integration and Interoperability HIT 603 Decision Support Systems in HIT HIT 650 Field Experience in HIT HIT 701 Capstone HIT Research Project MGT 561 Management Theory and Organizational Behavior NUR 606 Quantitative Analysis for Nursing Research DSC 501 Computer Applications DSC 573 Management Information Systems DSC 574 Information Systems Analysis DSC 678 Best Practices, Operations, and Total Quality Management OPR 576 Data Communications

Institution	Courses
University of Central Florida	**Health Care Informatics** HCA 700: Introduction to HealthCare Informatics **Programming** BUS ADM 740: MIS Concepts & Languages BUS ADM 813: Object-Oriented & Visual Paradigms **Prerequisites** HIM 6007 Survey of Health Information Management HIM 6267 Foundation of Health Services Administration HIM 6477 Medical Terminology for Informatics Professionals **Required Courses** HIM 5118C Health Care Informatics and Information Technology HIM 6119C Biostatistics and Decision Analysis HIM 6122C System Analysis and Design HIM 6123C Health Informatics Applications—Administrative, Financial and Clinical Project Management HIM 6124C Health Care Data Architecture and Modeling HIM 6125 Health Care Informatics Capstone HIM 6217C Health Care Database Management HIM 6464C Epidemiology, Analytics and Quality Management HIM 6935 Seminar on Current Issues in Healthcare Informatics and Enterprise Management HIM 6947 Health Care Informatics Internship
New England College	Principles of Health Informatics Research and Evaluation Healthcare Technology and Systems Knowledge Management in Healthcare The Business of Informatics in Healthcare MG 6110 Managing Projects MG 5110 Organizational Management and Leadership Development MG 5410 Organizational Communication, Negotiations & Conflict Resolution Capstone Project

The literature review of graduate programs in Healthcare Informatics shows the programs to be multi-disciplinary in nature. Does a review of the specific courses in each program support that generalization?

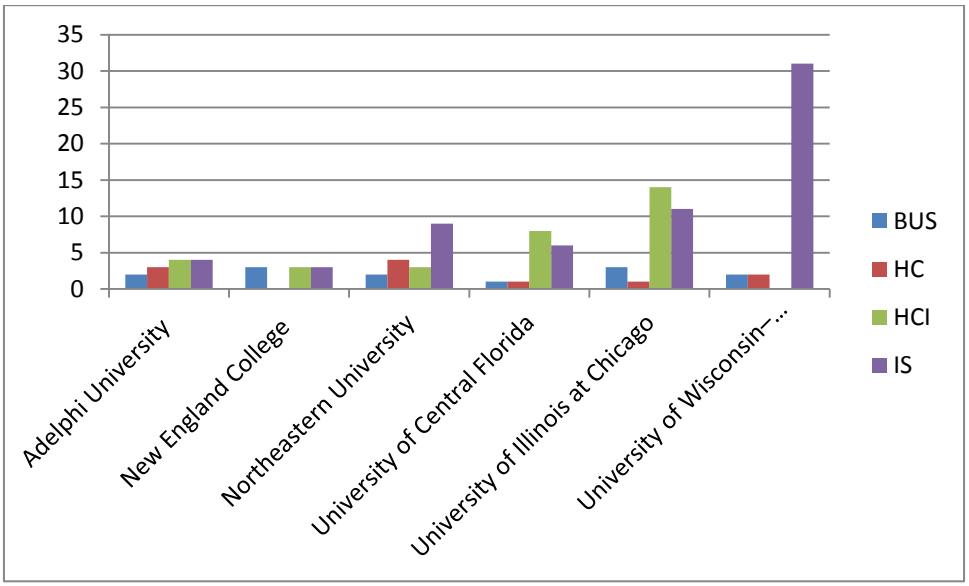
After performing content analysis on the 120 courses from the 6 institutions, the findings do indicate Healthcare Informatics is a multi-disciplinary field. The breakdown is 64% Informations Systems courses, 32% Healthcare Informatics, 10% Business courses and 9% Healthcare courses. The supports the statement of Healthcare Informatics as a multi-disciplinary field.

Discipline	Count of Course
BUS	13
HC	11
HCI	32
IS	64
Grand Total	**120**



A more detailed review of the data shows two anomalies. The University of Wisconsin–Milwaukee had the largest amount of Healthcare Informatics courses, the vast majority being Information Systems related. New England College has the fewest classes – nine (seven of which were 4 credit classes).

University	BUS	HC	HCI	IS	Grand Total
Adelphi University	2	3	4	4	13
New England College	3		3	3	9
Northeastern University	2	4	3	9	18
University of Central Florida	1	1	8	6	16
University of Illinois at Chicago	3	1	14	11	29
University of Wisconsin–Milwaukee	2	2		31	35
Grand Total	**13**	**11**	**32**	**64**	**120**



IV. Conclusions

This pilot study to define the multi-disciplinary nature of Healthcare Informatics has provided fertile ground for future research. Future research should expand the sample size to include more institutions and also investigate if courses in other disciplines are included in Healthcare Informatics graduate programs. Although not a research question for this pilot study, there appears to be a relationship between the students enrollment in a University and the number of courses offered in the program.

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