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Prepared for Ohio Association of Career/Technical Superintendents

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Definition of Health Informatics

The term information science, first used in 1960, is "the collection, classification, storage, retrieval, and dissemination of recorded knowledge treated both as a pure and as an applied science" (Merriam-Webster, 2011, ¶ 1). The invention and availability of technology has exponentially increased the quantity of information and accessibility in various disciplines. The field of health informatics evolved from the sphere of information science. The term informatics appears in a variety of career fields, chemical informatics, business informatics, archival informatics, ecoinformatics, to name a few. In *Information Nation*, Stanton, Guzman, and Stam (2010) identify informatics as a "combination of technology, information science, computer science, and information management" (p.22).

There is some disagreement about the adjective preceding informatics in the health field, as the researcher finds the terms medical, biomedical, or health used interchangeably in many educational programs. According to the American Medical Informatics Association (2011b), professionals in the field no longer use the term medical informatics. Health informatics refers to applied research and practice in clinical and public health fields (AMIA, 2011b). Stanton, Guzman, and Stam (2010), use the term bioinformatics as "the use of information technology along with molecular biology to detect, catalog, store, and analyze the characteristics of the building blocks of life" (p. 21). Specific disciplines within the health and biomedical informatics fields include computer science, information science, cognition, social sciences, engineering, clinical care Professionals in biomedical informatics utilize the knowledge and

skills of mathematics, sciences, mental modeling, synthesis of information, and evaluation of systems (Mantas, et al, 2010; Kampov-Polevoi, & Hemminger, 2010).

The AMIA (2011b) defines biomedical informatics (BMI) as the "core scientific discipline" (¶ 5) and the term health informatics as "applied research and practice in clinical and public health informatics" (¶ 5). AMIA defines BMI as "the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving, and decision making, motivated by efforts to improve human health (AMIA, 2011a). Ohio State University (2011) defines biomedical informatics as "the study and process of efficiently gathering, storing, managing, retrieving, analyzing, communicating, sharing, and applying biomedical information to improve the detection, prevention, and treatment of disease" (¶ 1).

The University of Illinois at Chicago (2009) describes health informatics as "the science that underlies the fusion of health care, information technology, and business administration, and guides its integration into all aspects of the patient health experience, including clinical care, nursing, pharmacy and public health. Not only does health informatics focus on the implementation and optimization of the information systems that support clinical practice, it creates the infrastructure that connects and enables the flow of critical information to and from each of the stakeholders in a patient's care. This has spurred a demand for professionals in health informatics, as well as the sub-disciplines that comprise it: medical informatics, nursing informatics, pharmacy informatics, clinical informatics, public health informatics, health IT and health information management" (¶ 1).

Health Informatics Domains

Individual universities, community colleges, technical schools, and various fields within medicine an information technology (IT) categorize health informatics in various ways. The AMIA developed five categories of health informatics. These include translational bioinformatics, clinical research informatics, clinical informatics, consumer health informatics, and public health informatics. The following are descriptions from each area or domain identified on the AMI website (2011).

Translational Bioinformatics

> Translational Bioinformatics is the development of storage, analytic, and interpretive methods to optimize the transformation of increasingly voluminous biomedical data, and genomic data, into proactive, predictive, preventive, and participatory health. Translational bioinformatics includes research on the development of novel techniques for the integration of biological and clinical data and the evolution of clinical informatics methodology to encompass biological observations. The product of translational bioinformatics is newly found knowledge from these integrative efforts that can be disseminated to a variety of stakeholders, including biomedical scientists, clinicians, and patients (AMIA, 2011).

Clinical Research Informatics

> Clinical Research Informatics involves the use of informatics in the discovery and management of new knowledge relating to health and disease. It includes management of information related to clinical trials and also involves informatics related to secondary research use of clinical data. Clinical research informatics and translational bioinformatics are the primary domains related to informatics activities to support translational research (AMIA, 2011).

Clinical Informatics

> Clinical Informatics is the application of informatics and information technology to deliver healthcare services. At times, this has also been referred to as applied clinical informatics. Despite some acknowledged variations, AMIA considers informatics when used for healthcare delivery to be essentially the same regardless of the health professional group involved (whether dentist, pharmacist, physician, nurse, or other health professional). Clinical Informatics is concerned with information use in health care by clinicians. Clinical informatics includes a wide range of topics ranging from clinical decision support to visual images (e.g.

> radiological, pathological, dermatological, ophthalmological, etc); from clinical documentation to provider order entry systems; and from system design to system implementation and adoption issues (AMIA, 2011).

Consumer Health Informatics

> Consumer Health Informatics is the field devoted to informatics from multiple consumer or patient views. These include patient-focused informatics, health literacy and consumer education. The focus is on information structures and processes that empower consumers to manage their own health--for example health information literacy, consumer-friendly language, personal health records, and Internet-based strategies and resources. The shift in this view of informatics analyses consumers' needs for information; studies and implements methods for making information accessible to consumers; and models and integrates consumers' preferences into health information systems. Consumer informatics stands at the crossroads of other disciplines, such as nursing informatics, public health, health promotion, health education, library science, and communication science (AMIA, 2011).

Public Health Informatics

> Public Health Informatics is the application of informatics in areas of public health, including surveillance, reporting, and health promotion. Public health informatics, and its corollary, population informatics, are concerned with groups rather than individuals. Public health is extremely broad and might even reflect an interest in information technology with regard to ecology, architecture, climate, agriculture, and such. Generally, AMIA focuses on those aspects of public health that enable the development and use of interoperable information systems for public health functions such as biosurveillance, outbreak response, and electronic laboratory reporting (AMIA, 2011).

Educational Programs

Professionals in the field of biomedicine or health care informatics have not clearly defined competencies and curricula. A search of programs reveals the term informatics used in programs, but the scope of the programs vary greatly. There are a variety of educational options ranging from post high-school certificate programs to advanced degrees and post-graduate certifications. Instructional delivery methods vary from online certifications, face-to-face courses and a hybrid of internet based and traditional classroom work. Researchers, Kampov-Polevoi and Hemminger (2010) surveyed 177 postsecondary informatics programs and

concluded the field is evolving with discontinuation of some programs and emergence of others. Some subfields, such as dentistry- or chemistry-specific fields require stronger emphasis in chemistry and pharmacology. More traditional sub-disciplines, such as health, medical, and bioinformatics, evolved to include non-research degree options.

The International Medical Informatics Association (IMIA) recommends educational institutions focus on healthcare professionals, specialization ns (i.e. IT users, biomedical health informatics specialists), and career progression through bachelors, masters, and doctoral programs (Mantas, et al., 2010). IMIA advocates educational programs for medicine, nursing, health care management, dentistry, pharmacy, public health, health record administration, and informatics/computer science. A detailed list of recommendations is in the article, *Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics.* See references for more information.

The AMIA (2011) recognizes the following tenets for all levels of professionals, *informaticians*, within the academic, research, or applied informatics fields:

> Scope and Breadth of Biomedical Informatics: investigates and supports reasoning, modeling, simulation, experimentation and translation across the spectrum from molecules to individuals to populations, from biological to social systems, bridging basic and clinical research and practice, and the healthcare enterprise.
>
> Theory and Methodology: develops, studies, and applies theories, methods, and processes for the generation, storage, retrieval, use, management, and sharing of biomedical data, information, and knowledge.
>
> Technological Approach: builds on and contributes to computer, telecommunication, and information sciences and technologies, emphasizing their application in biomedicine.
>
> Human and Social Context: recognizes that people are the ultimate users of biomedical information, and so draws upon the social and behavioral sciences to inform the design and evaluation of technical solutions, policies, and the

> evolution of economic, ethical, social, educational, and organizational systems (AMIA, 2011).

Postsecondary Institutions Offering Health Informatics

The researcher reviewed Ohio postsecondary institutions offering health informatics and located the following programs.

Table 1.

Four Year Colleges and Universities in Ohio Area offering Health Informatics

Institution	Degree	Contact
Ohio State	Bachelor's with possible certifications in Registered Health Information Administrator (RHIA), Clinical Coding, and Healthcare Privacy and Security	Kynthia Droesch, Director of Student Affairs School of Allied Medical Professions 127 Atwell Hall 453 West 105h Avenue Columbus, OH 43210 614-292-1706 Droesch.4@osu.edu
Ohio State University of Toledo	Master of Science Bachelor of Science Bachelor of Science in Health Information Administration	Melanei Brodnik, PhD Marie Janes, Program Coordinator College of Health Science and Human Service Mail Stop 119 The University of Toledo Toledo, OH 43606-3390

		419-530-4523 Utoledo.edu/hshs
University of Toledo	Post Baccalaureate Certificate in Health Information Administration	
University of Cincinnati – Online	Bachelor of Science Degree in Health Information Management Administration w certification Registered Health Information Technician (RHIT)	College of Allied Health Sciences http://cahs.uc.edu 800-499-6813

Table 2.

Community College and Technical Schools in Ohio Area offering Health Informatics

Institution	Types of Degree
Stark State College of Technology	Associate of Applied Science, Biotechnology
Stark State College of Technology	Health Information Management Technology
Cincinnati State Technical and Community College	Health Information Management Technology
Cincinnati State Technical and Community College	Medical Coding Certificate
Cincinnati State Technical and Community College	Medical Coding Certificate
Cincinnati State Technical and Community College	Health IT Certificate
Cincinnati State Technical and Community College	Clinician Practitioner
Cincinnati State Technical and Community College	Implementation Support Specialist
Cincinnati State Technical and Community College	Technical Software Support Specialist

Owens Community College	AAS - Health Informatics Technology
Owens Community College	Cancer Information Management Certificate
Owens Community College	Medical Coding Certificate
Owens Community College	Medical Reimbursement Specialist Certificate
Owens Community College	Medical Transcription Certificate
Brown Mackie College	Healthcare Administration
Brown Mackie College	Medical Coding and Billing
Lakeland Community College	Health Information Management Technician
Lakeland Community College	Coding Certificate
Lakeland Community College	Biotechnology Science
Cuyahoga Community College	Health Information Management
Cuyahoga Community College	Health Unit Coordinator
Cuyahoga Community College	Medical Billing Specialist

Other Educational Opportunities

The Center for Disease Control offers informatics training for various fields including public health advisors. The AMIA offers courses in cooperation with the several professional medical organizations and universities including:

- American Diabetic Association
- University of Alabama Birmingham
- Kansas University
- University of Texas Health Science Center at Houston
- Nova Southeastern University
- Oregon Health and Science University
- Ohio State University
- Stanford University
- University of Illinois at Chicago

- University of Minnesota School of Nursing
- University of Utah

AMIA lists the following postsecondary institutions as offering degrees and/or certifications.

- American Society of Health Information Managers
- Catholic University of America
- Canyon College
- Centers for Disease Control and Prevention
- Claremont Graduate University
- Columbia University
- Emory University
- Excelsior College
- George Mason University
- Harvard-MIT Program in Biomedical Informatics
- Indiana University School of Nursing
- Johns Hopkins
- Kent State University
- Marine Biology Laboratory - National Library of Medicine
- Marshall University Joan C. Edwards School of Medicine
- Medical College of Georgia
- Montana Tech
- Milwaukee School of Engineering
- NOVA Southeastern University
- Ohio State University
- Oregon Health and Science University
- Rasmussen Health Informatics Management
- Rasmussen Health Informatics Technician
- San Diego State University
- Stanford Biomedical Informatics
- Stanford Center for Biomedical Informatics Research
- SUNY Downstate
- Tufts University
- University of Alabama

- University of Arizona
- University of Buffalo
- University of California Davis
- University of California, San Francisco
- University of California LA Medical Imaging Informatics
- University of Central Florida
- University of Chicago
- University of Colorado
- University of Kansas
- University of Illinois at Chicago
- University of Iowa
- University of Maryland
- University of Milwaukee
- University of Minnesota
- University of Missouri
- University of North Texas
- University of Pennsylvania
- University of Utah
- University of Virginia
- University of Washington
- University of Washington School of Nursing
- University of West Florida
- University of Texas Health Science Center, Houston
- Vanderbilt University

The University of Texas Health Science Center at Houston offers a non-degree certificate program, a Master of Science in Health Informatics, Master of Science in Applied Health Informatics, and a Doctor of Philosophy in Health Informatics program (University of Texas Health Science Center at Houston, 2008).

Cost Benefits of Health Informatics

Available literature regarding cost benefits includes a variety of fields, such as cancer research, networking systems, architectural strategies, information exchange, information technology, hospital administration, pediatrics, imaging, and others. The purpose of this review

of literature is to synthesis information from a variety of fields to determine cost benefits of health informatics under two broad categories, human and financial benefits.

Human Benefits

The exchange of information has the potential for linking a patchwork of systems, such as handwritten notes in paper file folders to automated health record information systems. Patients benefit by having access to lifelong health information as needed in order to make better health care decisions including decisions made during emergencies (Hinman & Davidson, 2009) or natural disasters (Public Health Informatics Institute, 2006). In public health, information systems help track immunizations, infectious disease trends and can focus efforts on education and prevention. Health Informatics can reduce medical errors, adverse drug events, and warn physicians and pharmacists regarding interactions with the patients' other drug. (Hillstead, et al, 2005, United States Department of Human Services, 2010).

Financial Benefits

The cost of investing in health information systems is sometimes a barrier to implementation. However, multiple studies indicate the benefits outweigh the initial costs of creating health informatics structures. The cost benefit estimates vary widely due to differences in methodology to calculate expenditures and savings; however many studies concur there is a cost savings for consumers, health providers, and the U.S. Government for the implementation of health informatics systems. One study by Hillestad, et al. (2005) estimates electronic medical records could yield $81 billion annually. This estimate includes the costs of adoption, savings through efficient use of resources and improved safety. The costs may be greater if one considers malpractice costs, research savings, public health savings, and transaction costs. If one examines the productivity gained by many industries over the past 25 years, such as

telecommunications, wholesale and retail distribution and sales, and securities exchanges in the form of bar-code checkouts, automated teller machines, and online shopping, the annual average spending may decrease between 346 billion to $813 billion.

Employment Outlook

Since the *American Recovery and Reinvestment Act (ARRA) of 2009,* health informatics has gained attention of politicians and policy makers in health care (Hersh, 2009). The ARRA legislation provided stimulus funds to improve Health Information Technology (Health IT or HIT). Thus, the employment outlook with those who have appropriate skills is strong.

Professions

The lack of clear language for health and biomedical informatics leads to some confusion regarding the categorization of careers blurring the lines between the IT, health, public health, and research fields. Bernstam et al. (2009) distinguish between complimentary roles within the profession including IT professionals, computer scientist, and biomedical informatics.

IT professionals in the health informatics fields include operational IT support ranging from careers with on-the-job training to PhD-level computer scientists. Entry-level job duties may include working with email servers, helping users with office software, or maintaining networks and security. Research-support IT job duties involve designing or utilizing research databases, supporting software, maintaining super-computers. IT professionals are not required to have advanced scientific background. Research IT and operational IT specialists typically collect data using specialty software and or write software to analyze data (Berstam et al., 2009).

Computer science careers in biomedicine include those focusing on technology (hardware, software, and algorithms). While many academic (PhD-level) computer scientists use research skills to generate new knowledge. Some computer scientists use their expertise to

develop or improve software, rather than generate knowledge. Job duties may include computer architecture, designing software and hardware systems, and designing networks (Berstam et al., 2009).

Bioinformaticians develop ways to store, retrieve and use data to solve problems and make decisions in the field of biomedicine. This may or may not be computer based. There is a continuum similar to IT jobs from on-the-job training to PhD level positions. Entry-level informatician jobs may include working with clinicians and/or researchers to design data warehouses. More advanced informaticians design systems that interface multiple software programs. Those with advanced degrees develop new ways of managing information and knowledge (Berstam et al., 2009).

Labor Projections

The United States Department of Labor does not recognize health informatics as a specific industry. Therefore, the researcher reviewed workforce data through the lens of possible health informatics-related industries and occupations. Many of the fastest growing occupations in the health field may require workers to use skills related to health informatics. Health information management (HIM) professionals historically worked with medical records but the field has evolved to include informatics (Hersh, 2009). The computer science or IT fields include individuals with business, computer science, architectural, engineering backgrounds (Hersh, 2009). Nurses and physicians may collect and report data for clinical information systems. The researcher did not report occupations in the health care or information technology industry that may perform these duties as tertiary assignments. The researcher conservatively outlines findings in Tables 3 through seven below. Of the top 50 fastest-growing industries, the

health informatics fields have a possibility of at least four has at least four industries with three in the top 10 fastest-growing industries.

Table 3.

Top 50 Fastest-Growing Industries

#	Industry	Employment		Percent Change
		2008	2018	
1	Management, scientific, and technical consulting services	1,008,900	1,844,100	83%
4	Data processing, hosting, and related services	261,600	399,400	53%
7	Computer systems design and related services	1,450,300	2,106,700	45%
18	Other information services	133,600	174,700	31%

Note: Adapted from U.S. Department of Labor, Office of Occupational Statistics and Employment Projections

Table 4 contains information on the fastest-growing occupations related to health informatics, employment outlook, and potential earnings in all educational categories.

Table 4.

Top 50 Fastest-Growing Occupations

#	Occupation	Employment		Percent Change	Earnings	Training Needed
		2008	2018			
23	Computer software engineers, systems software	394,800	515,000	30%	Very high (Greater than $51,580)	Bachelor's degree

24	Survey researchers	23,400	30,500	30%	High $32,930 to $51,450	Bachelor's degree
34	Market research analysts	249,800	319,900	28%	Very high (Greater than $51,580)	Bachelor's degree
41	Medical secretaries	471,100	596,600	27%	Low ($21,790 and $32,380)	Moderate-term on-the job training

Note: Adapted from U.S. Department of Labor, Office of Occupational Statistics and Employment Projections

Tables five through seven (below) contain information on the occupations by educational level with the most openings. .

Table 5.

Top 50 Occupations with the Most Openings: Educational Requirements - Work Experience or On-the-Job Training

		Employment			
#	Occupation	2008	Job Openings	Salary Range	Training Needed
14	Receptionists and information	1,139,200	48,900	Low ($21,790	Short-term

	clerks			and $32,380)	on-the-job training
44	Medical secretaries	471,100	18,900	Low ($21,790 and $32,380)	Short-term on-the-job training

Note: Adapted from U.S. Department of Labor, Office of Occupational Statistics and Employment Projections

Table 6.

Top 50 Occupations with the Most Openings: Educational Requirements - Postsecondary Training or Associate's Degree

		Employment			
#	Occupation	2008	Job Openings	Salary Range	Training Needed
3	Computer support specialists	565,700	23,460	High $32,930 to $51,450	Associate degree
16	Medical records and health information technicians	172,500	7,030	Low ($21,790 and $32,380)	Associate degree
28	Telecommunications equipment installers and repairers, except line installers	203,100	3,560	Very high (Greater than $51,580)	Postseconda ry Vocational Award
38	Medical transcriptionists	105,200	2,350	High $32,930 to	Postseconda

				$51,450	ry Vocational Award

Note: Adapted from U.S. Department of Labor, Office of Occupational Statistics and Employment Projections

Table 7.

Top 50 Occupations with the Most Openings: Educational Requirements - Bachelor's Degree or Higher

#	Occupation	Employment 2008	Job Openings	Salary Range	Training Needed
6	Management analysis	746,900	30,650q	Very high (Greater than $51,580)	Bachelor's or higher degree, plus work experience
10	Computer systems analysts	532,200	22,280	Very high (Greater than $51,580)	Bachelor's degree
13	Computer software engineers, applications	314,800	21,840	Very high (Greater than $51,580)	Bachelor's degree

17	Network and computer systems administrators	339,500	13.550	Very high (Greater than $51,580)	Bachelor's degree
29	Medical and health services managers	283,500	9,940	Very high (Greater than $51,580)	Bachelor's or higher degree, plus work experience
30	Computer and information systems managers	293,000	9,710	Very high (Greater than $51,580)	Bachelor's or higher degree, plus work experience
37	Computer programmers	426,700	8,030	Very high (Greater than $51,580)	Bachelor's degree

Note: Adapted from U.S. Department of Labor, Office of Occupational Statistics and Employment Projections

Summary

There is not a clear definition used by all in the health informatics industry. The AMIA defines BMI as "the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving, and

decision making, motivated by efforts to improve human health (AMIA, 2011a). AMIA categorized the field to include translational bioinformatics, clinical research informatics, clinical informatics, consumer health informatics, and public health informatics. There are multiple opportunities in health informatics for employment including some of the fastest growing industries and occupations. Additionally, many professions not listed in the workforce data may perform health informatics duties, such as collecting and reporting data, as a component of their job. Students in Ohio and throughout the nation have multiple opportunities to for postsecondary studies ranging from certificate programs to advanced degrees. The advantages of investing in health informatics include human and financial benefits. The exchange of information reduces medical errors, provides patients with lifelong health information, resulting in better medical decisions. In public health, information systems help track immunizations, infectious disease trends and can focus efforts on education and prevention. Multiple studies indicate the benefits outweigh the initial costs of creating health informatics structures for health providers and the U.S. Government through efficient use of resources, improved safety, reduced malpractice costs, research savings, public health savings, and transaction costs.

Websites and Resources

- American Health Information Management Association
- American Medical Informatics Association – www.amia.org
- Centers for Disease Control and Prevention (CDC)
- Computer Programs and Systems, Inc. (CPSI) based in Mobile Alabama - www.dpsinet.com
- Edaptive, develops innovative software - www.edaptivesys.com
- Federal initiative called Direct Project - (www.directproject.org)
- Healthcare IT Leadership, Vision & Strategy - www.healthcare-informatics.com
- Insurance companies
- International Medical Informatics Association – www.imia-medinfo.org/new2/
- Merge Healthcare, healthcare software systems - www.merge.com
- National Association of County and City Health Officials (NACCHO), www.naccho.org, 202-783-5550
- Public Health Informatics Institute, www.phii.org, 866-815-9704, info@phii.org
- U.S. Department of Health & Human Services, Agency for Healthcare Research and Quality – www.hhs.gov
- U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA), www.hrsa.gov
- World Health Organization – several useful sources for projects

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