

Data, Information, Knowledge: The Emerging Field of Health Informatics

by Prudence W. Dalrymple

EDITOR'S SUMMARY

The area of health informatics applies information science methods to analyze and understand health care information, to progress from raw data to knowledge, for improved problem solving, decision-making and care delivery. With the field still relatively young and subspecialties already branching off, the terminology and scope continue to evolve. The fundamental model is shifting from treatment of an illness to wellness and disease prevention and viewing an individual's daily life in the broad context of factors that influence health. As the field takes shape, professional education is typically originating in health education for the informatician or in information science and technology for the health informaticist, with complementary coursework to expand understanding of and competency in the interdisciplinary field. The rapid growth and high demand for health informatics is stimulating an expansion of educational opportunities with degrees at all levels both in the United States and at international institutions. Conferences, professional publications and online resources on the topic multiply, serving those interested in making health informatics a career.

KEYWORDS

medical informatics	interdisciplinarity
emerging disciplines	trends
biomedical information	education

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Harnessing the power of information technology to improve health status both of individuals and of populations is claiming unprecedented attention nationally and internationally as society deals with the effects of recent economic, environmental and policy change. Health informatics is the relatively new, interdisciplinary field that has evolved to bring expertise in information science and technology to the medical and biological knowledge base. The recent, rapid growth of health informatics, along with its natural connection to information science, increases its relevance to readers of the *Bulletin of the American Society for Information Science and Technology*, as well as to prospective students who are considering health informatics as a career choice. This brief article will define and describe the field, identify educational pathways and provide some resources regarding career options, professional associations and other resources that readers may find useful.

What Is Informatics?

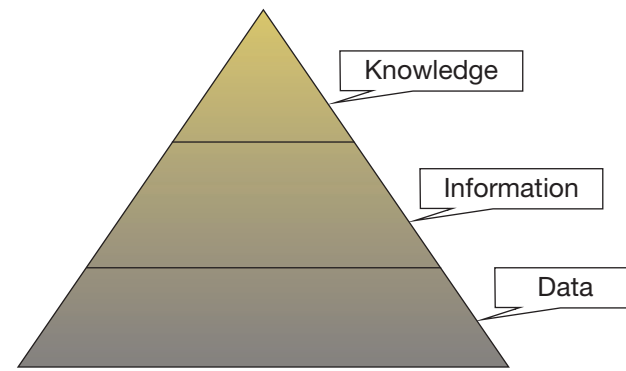
Any discussion of the field must begin by clarifying what is meant by *informatics*, and in particular, *health informatics*. Although the literature of health informatics can be traced as far back as the 1970s, interest increased during the 1980s [1]. It has been international in scope from its outset, with programs in Europe recognized as early leaders. Also, in Europe, the term *informatics* has not been so tightly tied to a specific domain as it has in North America. Here, informatics is generally used in conjunction with a specific domain such as health or biomedicine – or to other fields such as law, resulting in terms such as *health informatics*, *biomedical informatics* or *legal informatics*. (An allied field known as *social informatics* is not domain specific and refers to the socio-technical aspects of information and communications technologies.)

Health informatics – sometimes called *healthcare informatics* – is complemented by related fields that have overlapping areas of focus. For instance, *biomedical informatics* is the term preferred by AMIA, one of the leading associations founded primarily by physicians (www.amia.org). The authors of a well-known text use this term to refer to “the scientific field that deals with biomedical information, data and knowledge – their storage, retrieval and optimal use for problem solving and decision-making.” [2] They situate biomedical informatics as it relates to biological science and medical practice. Others, such as HIMSS, the Healthcare Information Management and Systems Society (www.himss.org) use the term *health informatics* to situate the field as it relates to health care, going beyond the practice of medicine to include public health, nursing and consumer health. Yet another related term is *bioinformatics*, which refers to the application of computer technology to the biological sciences to acquire, organize, store, analyze and visualize biological data to expand their use [3]. *Clinical informatics* has emerged as a term to describe the application of informatics to problems in clinical care, usually by physicians. Finally, the term *health information management* usually refers to the management of health data and information that is captured in medical or health records. Now that such records are increasingly electronic, the field of health information management overlaps some aspects of health informatics. The leading society for health information management is AHIMA (www.ahima.org).

Despite the differences in terminology and scope, all of these fields refer to the informatics pyramid [Figure 1] where the relationship among data, information and knowledge is displayed. The informatics pyramid illustrates the relationship between data and information and how they can be transformed into the creation of knowledge that is applied to make decisions and solve problems. Informatics thus encompasses the principles and processes through which data is transformed and applied to problems in a domain of interest.

In addition to the varying definitions of the field, the terminology used to describe the professional worker differs, too. The term *informatician* has been the term of choice for practitioners who come from the biomedical domain, while *informaticist* is most often used by those whose roots are in nursing

FIGURE 1. Informatics pyramid



or other health professions. Whether they are called informaticians or informaticists, those who study and practice informatics are quick to point out that their expertise extends well beyond that of

information technology to encompass both knowledge of and appreciation for the domain in which they practice and for the needs of their constituents.

A Rapidly Evolving Environment

The environment surrounding health and biomedicine is evolving at a rapid pace. The medical model in which patients who have diseases are treated in episodic encounters with physicians is no longer the dominant one; rather, the term *health* implies an approach in which the goal is as much disease prevention as it is disease treatment. In the health model, activities and decisions are embedded in the context of daily living; thus, informatics problems are not solely those arising from healthcare practice, but also those that arise from the needs of individuals in their social environments. This shift suggests greater opportunities for those who are interested in topics such as eHealth and health information literacy that draw upon the intellectual traditions of information science, computer science and public health.

While much of the current focus of health informatics is on clinical issues such as the design and implementation of electronic health records and decision support, the field includes medical ontology construction as well as information organization, storage and retrieval, artificial intelligence, text mining, data exchange, data standards and natural language processing in addition to security and privacy. The related field of bioinformatics also includes data curation and modeling.

Education for Informatics

Formal education in informatics occurs at multiple levels – baccalaureate, master’s and doctoral; however, there are also some training programs at the community college level aimed at preparing workers to perform technical duties under the supervision of a professional. A typical academic program consists of coursework in information science plus at least one health or biomedical domain. A strong computational emphasis is present throughout the curriculum, and most programs require either a practicum or a research project or both. Programs are usually structured to accommodate two types of prospective students: those coming from a health or medical profession seeking knowledge and skills in information science and technology or those who possess knowledge and skills in information science and technology but whose background does not include preparation in the health sciences.

Students are expected to select courses so they can acquire sufficient understanding to work effectively in multidisciplinary teams and to function as boundary spanners or translators between biomedical and health domains and IT. Indeed, one of the benefits of an education in health informatics is the opportunity to interact with professionals from diverse backgrounds, thereby gaining an appreciation for the varied perspectives, vocabularies and values of each domain which, if not addressed, can be a barrier to arriving at a solution to a problem. One example of divergent vocabularies emerged in a course in which one of the students, a nurse, contacted the professor about three weeks into the course. She commented, “I suddenly recognized the challenges inherent in health informatics when I realized that “HIT” refers to “health information technology,” not “hemolytic idiopathic thrombocytopenia!”

The Challenge of an Interdisciplinary Field

Finding solutions to today’s health problems – ranging from drug development to consumer health – requires insight and talent from multiple fields. Addressing these needs requires deliberate consideration of the ways in which domain knowledge or “context” is best acquired through the educational process. Interdisciplinary programs administered across academic departments bring diverse perspectives together to determine course content, admissions standards and degree requirements. Despite the fact that interdepartmental

academic programs can be fraught with administrative barriers, almost a third (30%) of medical and health informatics programs in the United States are interdepartmental [4]. The interdisciplinary nature of informatics is also reflected in recent statements by organizations ranging from the ACM (Association for Computing Machinery) to the American Nurses Association (ANA), each of which emphasizes the necessity of a broad-based approach to contemporary issues [5, 6].

The interdisciplinary character of health informatics may explain why a recent review of the literature identified more than two dozen published lists of competencies [7]. Though these competencies vary widely in their level of specificity, clearly some have been developed with the expectation that they will be used to credential practitioners. For example, clinical informatics is likely to become recognized as a sub-specialty by the American Board of Medical Specialties in the near future, while a certification exam is offered to nurses through the American Nurses’ Credentialing Center (www.nursecredentialing.org/) [8]. Program accreditation at multiple levels is available through CAHIIM (Commission on Accreditation for Health Informatics and Information Management Education), but uptake among master’s level programs has been relatively slow (www.cahiim.org/).

Informatics education has recently undergone a growth spurt in the United States, and according to a 2008 survey, courses of study leading to degrees at several levels are offered by over 175 institutions in the United States [4]. This number has likely increased in the intervening interval because of the perceived need for an increased workforce needed to meet the 2014 electronic health record mandate. When programs outside the United States are included, the number likely approaches 200. Informatics education occurs throughout the world, although most programs are located in North America and Western Europe. There are several lists where prospective students can identify informatics programs of study. Programs located in institutions that are members of AMIA’s Academic Forum are listed at www.amia.org/inside/initiatives/acadforum/members.asp; a list of medical informatics programs worldwide that is current through the end of 2010 is at www.hiww.org/se.html. The International Medical Informatics Association is the “association of associations” and provides additional

listings and resources both inside and outside of North America (www.imia-medinfo.org/new2/).

Is Informatics for You?

U.S. News and World Report named health informatics as among the top 10 “ahead of the curve” careers in 2007 [9]. Given the pressure on the healthcare sector to adopt information technology to reduce errors and become more efficient and effective, it is likely that prospects for employment in health informatics will continue to be favorable. Because informatics is an emerging field, most informaticians have migrated from other careers; the field comprises physicians, computer scientists, librarians, systems analysts, information professionals, pharmacists and nurses. Successful informaticians integrate their previous experience with their new knowledge and skills while being willing to move beyond their comfort zone and take on new challenges. Informaticians must be flexible and innovative broad thinkers who are able to analyze problems from multiple perspectives. Those who enter health informatics from the library and information sciences will find that their knowledge of information organization and database structures will serve them well, as will their grounding in user-centered information systems and the construction and use of information standards. Learning more about how health care is organized and delivered, the barriers and facilitators for acquiring and applying data, information and knowledge in medical decision-making and the sources of data from the molecular to the population level provide the student of informatics plenty of opportunity to engage their intellectual energy.

To begin exploring this field, it is wise to attend one or more professional conferences to network and become acquainted with the field. There are numerous professional societies that hold conferences. Some of them have been mentioned already, including AMIA, AHIMA, HIMSS and IMIA. ASIS&T has an active health informatics group. ACM’s SIGHIT has recently launched an annual symposium that is beginning to attract attention in health informatics (www.sighit.org/).

There are other ways to acquire additional knowledge about health informatics as a career. A quick search of PubMed will identify well over 50 scholarly journals in health informatics. While there are many good quality

health informatics blogs and twitter feeds, the Office of the National Coordinator for Health Information Technology is a primary site for remaining abreast of the current drivers in health informatics (http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov_home/1204). As technology continues to make inroads into health care at all levels, an abundance of interesting problems await solutions. The number and variety of these opportunities, as well as the knowledge that your work is helping people lead healthier lives, makes health informatics a very rewarding career. ■

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