

A Conceptual Framework for Education in Health Informatics: guidance for the Libyan context

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Abstract. Health informatics (HI) is a newly developed branch of knowledge that is concerned with how to realize Information and Communication Technology (ICT) potentials in increasing the efficiency and safety of healthcare process. Health informatics as a discipline has not matured yet and its definition, scope and purpose are still not well articulated. Meanwhile, healthcare reforms, advocated by many governments and health authorities, stress the importance of ICT implementation in healthcare. Universities and educational institutes develop programs and course tracks to train and graduate qualified individuals in the field of health informatics. Major aim of such educational programs is to qualify individuals with various level of knowledge about ICT potentials and capable of harnessing these potentials in healthcare context. Another aim is to graduate new breed of professionals, namely health informaticians, who understand the concepts and methods of HI and lead the cause of improving the way healthcare is conducted. Most of the published work in HI literature discusses the discipline and educational efforts in the developed countries and few on developing countries. This paper attempts to synthesize a conceptual framework for education in HI and draw some guidelines for developing a HI educational program in a Libyan University.

Keywords. Health informatics, Health Informatics education, Health Informatician, Competencies of health informatics, Libyan health informatics education

1. Introduction

Healthcare is faced by many challenges which affect its safety and efficiency. Process of delivering healthcare is costly and complex and requires collective efforts of many individuals and institutes such as clinicians, nurses, pharmacists, administrative staff, insurance companies and government agencies. To effectively organize and coordinate efforts among these individuals and institutes, seamless flow of data and information is required. Computer-based Health Information Systems (HIS) have pivotal role to play with respect to effective data and information management. This role is well known and articulated in healthcare literature [1, 2] and healthcare governing bodies and institutes in many countries recommend its activation. However, the implementation of HIS to support healthcare process is still lagging behind due to many reasons including

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lack of professionals acquainted with both healthcare and information and communication technologies to guide HIS implementation process. Education in HI is corner stone in preparing individuals with such knowledge and skills to undertake the endeavor of implementing HIS [3].

Faculty of Public Health at University of Benghazi is looking at developing a HI educational program to graduate students majored in HI. This effort was challenged by many factors including lack of expertise in the field of HI education in Libyan context. This is evident in the lack of universities in Libya and even in the Arab world offering this program. Reviewing some of the published work in HI, education in HI, and HI programs offered by many universities in the world we understand that shortage in HI educational programs, particularly in graduate level, is universal [4].

To shed the light on HI as a discipline in general, what sort of knowledge and skills are required in HI, and what challenge education in HI, this paper attempt analyzing important work published in the field of HI and synthesize a conceptual framework to guide the work of developing an educational program for HI in faculty of Public Health at University of Benghazi.

2. Health informatics as a discipline

Health informatics is an evolving discipline that emerged recently to be concerned with understanding how health data and information are collected, stored, distributed and used utilizing information and communication technology (ICT). This definition provides a general view of the field; other definitions are also used to define HI with slightly different perspectives. Georgiou, A and Whetton S [5] mention that the prime focus of HI is the application of computers in all fields of medicine – medical care, medical education and medical research. Gardner, R et al [6] used the term clinical informatics and define it as the discipline that qualifies clinical informaticians who have the ability to transform healthcare by analyzing, implementing, and evaluating information and communication systems. Hersh et al [7] note that HI requires understanding healthcare, information and communication technology, and elements of people and organization involved.

Huang[8] discussed three terms: health informatics, medical informatics, and biomedical informatics. He defined HI as a scientific discipline that deals with the collection, storage, retrieval, communication, and optimal use of health related data, information and knowledge. And that medical informatics is concerned with the systematic processing of data, information and knowledge in medicine and healthcare. These two definitions probably mean the same, although the term technology was not used with the later. He further comments that the two disciplines are “very similar”. Huang defined biomedical informatics as “the union of basic informational and computing science, with biomedicine as an application domain”[8]. Even with this definition the distinction is not clear. Thus it is reasonable to estimate that the three terms means the same. Although the terms used to define HI can vary, the basics are similar [9] and the variations are on the fields of application of these basics within healthcare.

Hurley, K. et al [10] present an interesting analogy to define HI, describing health information as “lifeblood” of today’s healthcare with health information technology serving as its “circulatory system”. They elaborate that HI is the scientific discipline behind this system

One reason for the inexistence of one definition for HI is probably because it means different thing to individuals concerned with HI. Furthermore, HI is not a generic science but rather an amalgamation of several other sciences and knowledge fields. Basically HI body of knowledge is composed of health science, ICT, and management science. In addition to other topics which might be considered as HI topics such as medical terminology, epidemiology, biostatics, health information systems and other topics that dealt with data and information in healthcare. Besides being multidisciplinary, HI applies to various healthcare subspecialties, which introduced many terms associated with HI [9] . These terms might be considered as branches of HI which include: medical informatics, biomedical informatics, clinical informatics, nursing informatics, dentistry informatics, and public health informatics.

Coiera [11] used a comprehensive perspective to emphasize the importance of HI, defining it as the study of how clinical knowledge is created, shaped, shared, and applied. Coiera anticipates that in the future the study of informatics will become fundamental to the practice of medicine. Putting the field in a historical perspective, Coiera mentions that health informatics is as old as healthcare itself. It started the day the clinicians took their first notes about patient’s illness and used these notes to learn how to treat their next patient. This historical perspective stresses the informatics skills which healthcare professionals practice in their routine work without neither have formal training to gain them nor, in many cases, using computers to support and perform them. These skills include: structuring, recording, searching and communicating clinical data, information and knowledge. The recent growth of health informatics as a discipline is partly fuelled by the advances in computer technology.

In general, health informatics focus on understanding information and communication systems, developing interventions that improve existing systems, and evaluating the impact these systems have on the way individuals or organizations work [11]. This makes the scope of health informatics includes the design of clinical decision support systems for practitioners, the development of computer tools for research, and the study of ways to distribute medical knowledge to all practitioners.

3. Education in health informatics

One reason for justifying the purpose and the importance of HI is its aim to realize the potential benefits of ICT to healthcare. It is consensus that ICT has positive impact on healthcare. However, the successful rate of ICT implementation projects in healthcare context is low and this can be attributed to many challenges [1, 3]. These challenges are characterized as sociotechnical and require a holistic view to be able to reduce their effects[12]. Sociotechnical challenges are composite of interrelated social, organizational, and technical issues. Individuals with proper knowledge and training in

all these aspects of ICT implementations in healthcare are rare [13]. Hence, the need to have individuals with adequate qualifications and skills to address these and other issues related to application of ICT in healthcare [9, 14].

Studying HI qualifies individuals capable of performing the following tasks:

- Participate in healthcare reforms, which are advocated by many governments, by setting strategic plans for ICT implementations in healthcare.
- Lead HIS implementation projects and guide a change process in the social network of healthcare institutions.
- Understand the data and information requirements of the healthcare professionals targeted by the ICT intervention.
- Develop HIS specifications and perform the duties of system analyst.
- Be active member of HIS development team.

Health informatics is comprehensive discipline that emphasizes that implementation of HIS is not merely a technical rollout rather a sociotechnical process.

Lack of understanding the role that health informatician can play in healthcare, lead to lack of characterization of these professionals. There are also calls for health informatics to be a professional discipline, which require among others to have a qualification as a proof of these professionals fitness to practice [9]. Education programs for graduating individuals with HI qualifications are considered to be one of the central initiatives towards achieving high quality healthcare delivery services[15].

Healthcare services are considered to be information intense industry as there is a vast amount of data and information to be properly managed. Thus, it is imminent that ICT will become a corner stone of health sector. Consequently to be able to recognize and realize the potentials of ICT, HI education programs are needed to qualify healthcare professionals who have sound understanding about ICT and its applications in healthcare. Many countries endeavor to develop strategic plans for the application of information technology in healthcare. The most common IT strategic plan focuses on the implementation of electronic health record which requires having qualified individuals to take responsibility in rolling out such initiatives. It is also required that physicians should have the necessary skills to use these systems effectively, thus medical school curriculum should include courses to train them in using these technological tools effectively [16]. There are also a pressing demand on healthcare professional and physicians in particular to be information literate [16], which requires being up-to-date with the medical research literature. This is an informatics skill that should be taught, as well as knowing what ICT tools support it.

In another perspective bodies and associations that are overlooking the practices and setting standards for healthcare activities are recommending an informatics agenda for their sub-disciplines. Public health sub-discipline, for instance, is targeted by a set of recommendations aiming for integrating informatics into public health practice. American Medical Informatics Association (AMIA) stated a set of suggestions for public health informatics (PHI) in a conference held on 2011 [17]. The recommendations took a holistic perspective where multiple aspects were covered. The

aspects included technical infrastructure, research agenda to establish a scientific ground for PHI, ethics concerning confidentiality and privacy of data, informatics education and work force development. Generally, the recommendations point at some challenges to public health informatics such as interoperability and lack of standardization, and suggest that articulating public health business process and use cases, developing technical and semantic system interoperability and having qualified public health informaticians could contribute to tackling of these challenges. They emphasize the need to have trained professionals who can manage the rapidly evolving electronic systems that manage and distribute public health information[17]. The AMIA 2011 conference recommendations also indicated to the importance of having all levels of public health work force trained on the concepts, principles and methods of PHI through continuous education programs. They warn that ignoring this recommendation will lead to poor judgments about system investments and creating poor quality data for decision making [17]. They add that challenges to the recognition of PHI careers is in part due to lack of clear job description and the inexistence of clear definition of PHI and also to not recognizing PHI credentials in acquisition and employers' demand when hiring.

4. What sort of knowledge and skills are required?

HI is multidisciplinary were various topics from sciences of health, computer, management and health informatics amalgamated to form its body of knowledge. Furthermore, there are variations on the percentage of constituent sciences depending on many factors including:

- The schools offering the program
- The learning objectives of the program
- Level of interaction with the computer
- Background of the intended students
- HI sub-specialty targeted by the education program

In terms of constituent knowledge of health informatics there is a variation on the percentage of each core discipline that should make up a health informatics education program [18]. This variation is often devised by the school offering the educational program and the background of the students being taught. With medical schools there is tendency to focus on the medical science and HIS; where at schools of technology there is a tendency to focus more on technology and computer science.

The content percentage also varies depending on the learning objectives. The learning outcomes range from qualifying competent users to becoming developers of health information system, through gaining knowledge to be managers of implementation projects of such systems. Education in health informatics can range from courses, course tracks, to complete program qualifying graduates with degrees in health informatics[9]. HI education can be included within the curricula of health and medical schools, as well as, having special programs to graduate health informaticians.

The International Medical Informatics Association recommends that healthcare professionals should have the opportunity to acquire accredited qualification in HI as part of their career development.

A US government report articulates that the informatics knowledge and skills required by public health practitioner and public health informatician are different [19]. They mention that all public health practitioners should have competencies in use of information in public health, use of IT to increase personal effectiveness and management of IT projects. On the other side public health informatician should have knowledge in both public health programs and information systems. This type of expertise is needed by public health agencies to help design, implement, and manage computer applications that support public health goals [19].

In a study about health informatics programs in Canada, the researchers classify these programs as health informatics and health information management programs. Health information management programs graduate individuals with qualifications in health records. They also noted that many programs provide their qualifications in “base discipline” such as clinical epidemiology and biostatistics rather than health informatics directly [13].

AMIA in their call for integrating PHI into public health practice stress the following competencies: system thinking, evaluation, trans-disciplinary approaches to problem solving, communication and leadership [17].

Triola et al stress the importance of incorporating biomedical informatics education and training within the curricula of medical school [20]. This include knowing and understanding health information systems such as electronic medical records and computerized provider order entry systems; uses and limitations of clinical data in warehouses; system interoperability; and why clinical information systems can fail [20].

5. Conceptual framework

Health informatics as a discipline and education can be mystifying due to characterizations of: multidisciplinary; concerning various healthcare sub-specialties; immaturity; and diversity on the level of acquaintance. Education on HI depends on the skills targeted by the educational program and the background of the school offering the program. In this respect, percentage of constituent knowledge can vary from one program to another. Some programs stress computing skills, others informatics skills (epidemiology, medical terminology, and biostatistics), many stress the managerial skills and some stress the health information management aspect of health records. Furthermore, HI education programs can be offered on certificate, undergraduate, Masters, and PhD levels. Medical specialties boards also qualify physicians in health informatics sub-specialty via fellowship education. The background of students studying HI could be medical or information technology, consequently introducing variant curriculum for each students group. Many of these programs aim at qualifying health informatician – individuals who understand both

healthcare process (in general) and informatics to take responsibility of introducing changes into healthcare delivery process and the development and implementation of HIS. Others are training programs which aim for qualifying competent users of HIS by delivering a course or track of courses within medical and health school curricula.

6. Case of developing a health informatics educational program

Faculty of Public Health at University of Benghazi already includes a track of three IT courses within its curriculum to qualify their graduates as competent users of ICT. This initiative probably unprecedented in the Libyan medical faculties and complies with the recommendations and directives of international health informatics agenda [16]. This track of courses educates the faculty students about the basics of information technology, health informatics, database technology, and management IS.

The faculty is now looking at activating a health informatics department to start graduating students with Bachelor of Science in public health majoring in health informatics. It is envisioned that the graduates of this program to be health informaticians with adequate skills and knowledge to lead ICT implementations in the Libyan healthcare sector.

Developing a health informatics educational program that fit the Libyan context started from scratch, as there are no similar programs offered by other Libyan universities, no work was published discussing this before, and there are no individuals and academics specialized in this topic. The conceptual framework discussed in the previous section was used to guide the establishment of a draft health informatics program.

The faculty currently graduates students with B.Sc. in public health majored in three area: health environment, health administration, and nutrition. The study period is five years divided in general in three phases. Phase I: that is a one year of preliminary study. Phase II: composed of two years where all students study general topics of public health and health science. This includes: anatomy, physiology, pathology, pharmacology, epidemiology, statistics and introductory course in information technology. Phase III: is composed of two years, and it is where students' studies concentrate on topics of their major. During phase III, the draft health informatics program suggests topics related to computer science, management, and health informatics, these will include: computer programming, software development process, database management, project management, change management, quality management in healthcare, research methodology, health information systems, and electronic health records. Student would also study topics introducing concepts of health informatics skills, health terminology and standards, and HIS implementation process.

7. Conclusion

Gaining skills and competencies in health informatics is becoming essential to enhance and achieve better healthcare outcomes. This is due to many reasons including: the break through achievements in ICT and potential applications in healthcare, recommendations of governing bodies and associations in the healthcare, expectation that healthcare professionals are competent users of HIS to manage vast amounts of medical data and information, and to be able to mitigate the risks associated with the implementation of what is considered to be technically sound HIS.

Education in HI, particularly degrees at the undergraduate level, has not been widely offered by universities around the world. We believe that the reason behind that is attributed to the characteristics of HI discipline (immaturity, multidisciplinary, and diversity of infancy specialties). The conceptual framework presented in this paper characterizes HI discipline and illustrates aspects of education in HI including: constituent knowledge, levels of education and aims of the educational program

Although the recommendations and concepts underpinning the conceptual framework were derived from a non-Libyan context, it is general enough to be used to guide the development of HI educational programs in Libyan universities. Additionally, despite the lack of concern about education in HI in Libya (which is the case in many countries), this should not invalidate the effort to establish an education program for developing the core competencies of Libyan health informaticians. In the short term the outcomes from any HI educational program at Libyan universities should aim at developing the general skills of health informatician. It is assumed that graduates with basic HI skills would play a major role in developing the ICT infrastructure and initiate and lead HIS implementation projects in the Libyan healthcare system.

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