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Health Informatics Domain Knowledge Analysis: An Information Technology Perspective

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Abstract: Health Informatics is an intersection of information technology, several disciplines of medicine and health care. It sits at the common frontiers of health care services including patient centric, processes driven and procedural centric care. From the information technology perspective it can be viewed as computer application in medical and/or health processes for delivering better health care solutions. In spite of the exaggerated hype, this field is having a major impact in health care solutions, in particular health care deliveries, decision making, medical devices and allied health care industries. It also affords enormous research opportunities for new methodological development. Despite the obvious connections between Medical Informatics, Nursing Informatics and Health Informatics, most of the methodologies and approaches used in Health Informatics have so far originated from health system management, care aspects and medical diagnostic. This paper explores reasoning for domain knowledge analysis that would establish Health Informatics as a domain and recognised as an intellectual discipline in its own right.

Keywords: Health Informatics, Domain Analysis, Information Technology, Healthcare, Education

1. Introduction

Health Informatics is the intersection of Information Technology (IT), medicine, nursing and health care. The specialisation is unique because it brings together the key areas of IT, medical sciences, nursing, health sciences, computer sciences and biomedical engineering. This is particularly important for electronic health record management, utilising advanced network capabilities and clinical decision support to improve health care safety and quality using Point-Of-Care Information Technology (POC-IT), Health Care Information Technology (HCIT) and allied protocols.

The successful use of IT in health care and medicine is a challenging and rewarding endeavour. However, the use of IT also raises a number of serious issues including data interoperability, data security and privacy concerns. The privacy concerns are significant in the health informatics domain and must address initial stages of the process. The security concerns are critical and must be addressed during real time embedding into Operating System level (Franco *et al.*, 2008). Augmentation of IT to the point-of-care has produced better and more efficient medical decision making processes and resulted in a variety of applications development from the field of health informatics in recent years. The specialisation of Health Informatics provides a critical understanding of the ways in which IT has reshaped thinking and practices regarding organisational solutions and strategies in particular when delivering better and quality health care services. It is a worthwhile exercise to explore the ways in which IT has altered the production and enhancement of health care knowledge, health informatics, increased emphasis on ensuring patient safety, information accountability, information assurance, privacy concerns and preventing medical error, as well as development of new protocols such as ubiquitous access (UA), (Abraham *et al.*, 2008) and embracing open and trusted health information systems (OTHIS) and their services (Liu *et al.*, 2008) when improving health care safety and quality. This paper focuses on analysis of the health informatics domain from an IT perspective with recent development consequently proving requirements for evidence based education and knowledge driven practices.

Back to Contents

What are the domain connections?

The term Health Informatics and Medical Informatics require a dissection in order to highlight the central factors. It does not matter whether you call the domain 'health informatics' and/or 'medical informatics'. It does matter what is in it and how it operates in order to deliver efficient, timely and economically feasible health care solutions to improve patients care and safety. Europeans have simply opted to call all of this "**e-Health**". For instance, very recent technological advancement has increased the use of hand-held medical devices. When patient information is shared using hand-held medical devices, it is possible that significant errors will occur due to the poor quality of data being transmitted. Caring for a patient's information is an important aspect of caring for the patient because poor patient data, records and their quality of presentation can impact on treatment and could possibly lead to a fatality (Abraham *et al.*, 2008). The U.S. Institute of Medicine has reported that nearly 98,000 people die each year due to medical errors, such as incorrect medication dosages due to poor legibility in manual records, or delay in consolidating needed information to discern the proper intervention (Institute of Medicine, 2000).

In Australia, there are no valid statistics to constitute and demonstrate that the numbers of death in hospitals are due to poor quality medical data and/or records. This information itself is not accurately validated and recorded for many reasons. One of the reasons is that there is no efficient, accurate and appropriate reporting mechanism. The so called "**Clinical Incidences**" (in medical terms it is defined as "*unexpected outcomes or care*" but not medical mistakes and/or negligence) for the last financial year in Queensland are 47,000 cases (which is around 4000 per month). Out of these incidences around 1~2% occurrences are fatal. There are thousands of incidences such as near-misses which are not accounted for and not recorded (QLD Health Publications, 2008).

Health care services are fundamental requirements and necessary for every country around the world for economic and social development. Health systems are complex, costly, and can create unrest in any part of the community. Furthermore, it does not matter whether the country is developed, developing and/or under developed, a considerable amount of funding from the Gross Domestic Product (**GDP**) must be allocated to make the country move forward. In this connection, Information and Communication Technology (**ICT**) plays a vital role in delivering efficient and timely health care services and health system solutions. The term "**e-Health**" is becoming more familiar as the use of technology to support healthcare practices is increasing. However, while the term is becoming broader, the common concern regarding the quality of patient care still remains unanswered. In this context, the health informatics domain connections are integrating the patient with the health care delivery process through the means of ICT to deliver better outcomes (e.g., Electronic Medical Record integration). This may not necessarily be the case and acceptable scenario for some professionals' expectations. However this is the way we are moving in the 21st century. The subsequent sections summarise published quotes on the terms health informatics and medical informatics which will provide better understanding of the footprint of IT and its applications.

What is Medical Informatics?

In general, medical informatics encompasses development and assessment methods of systems for acquisition, processing and interpretation of patient data with the help of knowledge that is obtained in scientific research (van Bemmel and Musen, 1997). Medical informatics is at best a more widely defined field and its definition largely depends on the people, processes and the technology used. Furthermore, the term medical informatics encompasses the background of the definer and the context in which it is being used. A few definitions taken from the medical informatics literature below drive the domain overlaps and connections with health informatics significantly.

> *"Medical information science is the science of using system-analytic tools ... to develop procedures (algorithms) for management, process control, decision making and scientific analysis of medical knowledge"* (Shortliffe, 1984).

> *"Medical Informatics comprises the theoretical and practical aspects of information processing and communication, based on knowledge and experience derived from processes in medicine and health care"* (Van Bemmel, 1984).

From the analytical perspective, the above two definitions emphasise processes and technology. It will be significant to review the journey of the last 30 years of the medical informatics domain and their evolution. Despite these developments, it is timely to review the modern development of both medical informatics and health informatics in the 21st century. They are emphasising and leading to system development centred on people, processes and technology. This is a promising move when the aims of both the medical and health informatics domains are concerns. In this connection, it is worthwhile to highlight a recent definition of the term 'medical informatics':

> *"The integrative discipline that arises from the synergistic application of computational, informational, cognitive, organisational, and other sciences whose primary focus is the storage, and use of information in the health/biomedical domain"* (Hersh 2002).

Back to Contents

What is Health Informatics?

Based on the above definition it is the term medical informatics that is moving towards providing people centric solutions. In contrast, reviewing the evolution of health informatics and its perception and development in the modern era are important.

> *"Health informatics or medical informatics is the intersection of information science, computer science, and health care. It deals with the resources, devices, and methods required optimizing the acquisition, storage, retrieval, and use of information in health and biomedicine. Health informatics tools include not only computers but also clinical guidelines, formal medical terminologies, and information and communication systems"* (Wikipedia 2008).

> *"Medical informatics has to do with all aspects of understanding and promoting the effective organisation, analysis, management, and use of information in health care. While the field of medical informatics shares the general scope of these interests with some other health care specialties and disciplines, medical informatics has developed its own areas of emphasis and approaches that have set it apart from other disciplines and specialties [….,]. For one, a common thread through medical informatics has been the emphasis on technology as an integral tool to help organize, analyse, manage, and use information. In addition, as professionals involved at the intersection of information and technology and health care, those in medical informatics have historically tended to be engaged in the research, development, and evaluation side of things, and in studying and teaching the theoretical and methodological underpinnings of data applications in health care. However, today medical informatics also counts among its profession many whose activities are focused on dimensions that include the administration and everyday collection and use of information in health care"* (AMIA 2008).

The UK Health Informatics Society (BMIS) is a national association for people concerned with health informatics in both of these senses, and is based on the recognition that practical and scientific concerns in this domain are interdependent and inseparable. Twenty years ago medical informatics was seen largely in terms of the computerisation of healthcare. Today, with computers much more a part of routine daily life, there is a tendency to reduce the specific emphasis on computers and technology in health informatics, and to stress the meanings of information in the everyday work of healthcare professionals, in communication, shared knowledge and decision-making, and in the complex social and functional needs of healthcare organisations and services. There is more scepticism (notably from the professions themselves) about guaranteed benefits from computerisation for the delivery of healthcare, and more emphasis (notably by politicians and managers) on technology and organisation as a single agenda and on `culture change' as a key item in that agenda. The strategy Information for Health which the UK government announced in 1998 is the most ambitious considered and widely supported agenda for health informatics ever officially adopted on a national basis. The scope, challenges and problems it offers for health informatics, intellectual and practical, technological and cultural, are daunting and exciting" (BMIS 2008).

> *"Health informatics is defined as an evolving scientific discipline that deals with the collection, storage, retrieval, communication and optimal use of health related data, information and knowledge. The discipline utilises the methods and technologies of the information sciences for the purpose of problem solving, decision making and assuring highest quality of health care in all basic and applied areas of the biomedical sciences"* (CQU- Handbook 2008).

Given the above definitions and the recent development of health informatics, it is clear that the domain of health informatics is approaching the processes of health care by augmenting advanced technology while keeping the person in the centre. This was the theme of the recently concluded Health Informatics conference in Melbourne. Further details are available in the HISA Web site (HISA, 2008).

Intellectual contribution

All of the above definitions and topics of discussion on medical informatics and health informatics involve learning from such a "discipline" and make it harder for the target group if there is no recognition locally and internationally. It is natural to ask why each of these fields remains so aloof from the other domain. One reason often given is "*that is not a domain*". If use of technology, in particular information technology is about improving the processes and enhancing the decision making paradigm is not sufficient reason for a topic to be considered part of our discipline, then what other qualifications are required? The answer so far seems to be that health informatics is being defined in terms of a set of processes (such as health services, etc), namely those currently being taught in our under-graduate programs. In this context it is a wise move to analyse the domain specific relationship and fill the gap where necessary. Furthermore, introducing and identifying curriculum coverage from university degree courses, or medical colleges' Continuing Professional Education (CPE) programmes and recommendations, would make the Health Informatics domain argument stronger and contribute to be priority position of the health informatics domain.

Back to Contents

It is clear that the idea of learning from available data to extract information has been around for a long time. So, it is reasonable to ask why the interest in Health Informatics has suddenly become so intense. The principal reason is that delivering people-centric solutions in order to provide timely and cost effective health care services from the point-of-care to the point-of-delivery has become urgent. The connections between medical informatics and health informatics basically depend on how the implementation strategies of a solution align with the people, processes and technology. The end result is to reach patient care. So far there is no theoretical improvement as to whether to argue health informatics solely depends on health care process but not using the technology. This is the significant relationship between medical informatics and health informatics which is readily available. However, recent developments in health informatics are connecting people and processes through technological advancement in order to provide better health care solutions and are paramount.

1. The trend on establishing health informatics domain knowledge

The current interest in health informatics raises several issues to be addressed by the academic community. Although health informatics appears to be a viable, challenging academic and research enterprise one can ask whether or not it qualifies as an intellectual discipline. Certainly there exists much important related research in Information Technology.

These include:

- Efficient Decision Support Systems
- Research and Development in data and information accessibility including privacy of the information when it is shared
- Efficient information retrieval
- Workable policy development for health care solutions
- Synergies between academics and researchers providing education and training

In addition, specialised areas (Table 1) like Databases, Advanced Network and Mobile Devices and Security and Privacy are significant to explore. The threats to electronic medical records have been noted in the last few years and have been increasing because of the different usage of these records and the people who have access to them. People with access to the data system and relevant passwords can access medical records instantly. Ethics and the culture of working relationships is a primary concern in a medical institution in which the people who have access to this information must keep it secret and not share it with others with whom it should not be shared. However, this information is accessed by different institutions and persons during hand held devices communication channels and the control of this information could be lost. The "Information Accountability" is a way to implement the policies and procedures into the health sector when such hand held devices are a must. If such policies and procedures are in place, medical record systems could be linked so that patient data can be accessed wherever and whenever. Furthermore, the decision maker can communicate efficiently and effectively to resolve any delay in the processes. Therefore, finding the appropriate means in which the information could be kept secure and only the appropriate people are allowed to access it, is beneficial to keeping this information private with "Information Accountability" without regard of who has access to the data systems. This is a challenge which requires many contributions from the academic community and medical and health practitioners.

Also, most businesses are based on the trust of their users. An example of this is the e-commerce related businesses in which the trust of their users makes possible an increasing demand for different services through the use of the internet. The trust encourages people to be open to new developments. This may result in larger gains in regard to providing different services to customers. This research aims to provide a better way in which medical institutions can provide assurance to their customers about their privacy records and other sensitive information. This will help to build trust that could may encourage the e-health sector to implement different usages of the information without having complaints from their customers.

Table 1: Connection of Information Technology specialist areas with Health Informatics

Databases (Electronic Health Record – EHR)	Advanced Network and Mobile Devices	Security and Privacy
Databases applications Foundation of Information Retrieval Database Design EHR and Data Management Decision Support Systems	Networks Mobile Devices Cryptology and Protocols Data Communication Protocols Ubiquitous Access (UA) Open and Trusted Health Information Systems (OTHIS)	Security Computer Forensics Security Technologies Privacy protocols and practice

Back to Contents

2. Career Progression

Once the health informatics domain is recognised in the Australian Higher Education sector, it will be a promising start to meet the current trend on health care deliveries and may be one alternative to tackle the challenges upon delivering quality health care services. Graduates from the Health Informatics specialisation will find positions in a broad range of health care, medical and allied industries and will be well placed to contribute to medical and health care organisational success. Key positions include: Medical Informatician, Health Informatician, Clinical Informatician, Physician Informatician, Nursing Informatician, Health Information Mangers, Research Officer in Bio-Medicine, Medical Scientist and Several specialised positions in the health sector such as Network, Security and Desktop support etc for the POC-IT and HCIT.

3. Health Informaticians contribution

Suppose we were granted the intellectual viability of health informatics methodological research and development, the issue remains as to whether medical and/or health informatics as a discipline should be concerned with it. The contribution to tackle such issues is strategic rather than political. Health (or Medical) informaticians should be able to:

- publish widely about the relationship between both the medical informatics and health informatics domains
- teach its practices in our undergraduate programs with accessibility including privacy of the information when it is shared
- provide recognition (jobs, tenure, awards) for those who do it well
- be involved in the processes of policy development and country wide health strategic plans
- develop and deliver awareness programs to all levels of education providers to be able to augment future training and development etc.

If we are to achieve intellectual recognition and compete with other fields in the academic (and commercial) marketplace, some of our basic paradigms will have to be modified. Perhaps it is appropriate to highlight the culture of practice. In general, when it is introduced to terms "Medical" and/or "Health" the obvious feeling is that the term "Medical" relates to a profession and the term "Health" is to do with services. It is time to improve this perception and modify the culture. Any "Medical" professional who has worked in other "Health" related fields is struck by their "culture gap" with medical terms and jargon. In these other fields the "currency" tends to be *ideas* rather than process techniques. Heuristically motivated ideas are initially evaluated on the merits of their heuristic arguments. Final value judgments are postponed until a more thorough validation (theoretical or empirical) becomes available.

Discussion

Having understood the above intellectual challenges, in the future the answer is almost surely 'yes' according to all health informaticians that the "Health Informatics" has its own right to be a domain. The enhancement of the technology increases in effectiveness by a factor of ten or more, and one should completely rethink how to apply it. We are facing a deluge of data and relentlessly looking for valid pieces of information that would help to make a better decision. This is the challenge all health informaticians would face in the 21st century. This can be mapped to a historical progression from walking to driving to flying. Each of these processes increases speed by approximately a factor of ten or more. If we think of the future prediction of such processes with the technological advancement, where every time computing power increases by a factor, we should totally rethink how and what we compute in order to make better decisions.

Health informatics is an emerging discipline in a long list of other information and communication related fields that have had their origin outside medical informatics. In many ways, this field represents the closest match to medical informatics in terms of the types of issues and problems it addresses. It is open to debate whether health informatics as a field should embrace medical informatics as a sub-discipline or leave it to the Computer Scientists. The intent of this paper is to stimulate that debate in order to recognise health informatics as an intellectual discipline.

This discussion may come and go for some reasons; however, it is time for us to rethink the starting point. It is a global fact that health care services are complex and costly. The perception and 'culture' drive us to point out that those who are involved may be in jeopardy because the nature of the processes they have to follow and influences they have to make. This is the 'culture' that requires drastic change. It is the general acceptance that the power of technology is one of the solutions for such complex issues. The remainder is people responsibility. In summary, accessing better health care services and contributing to improve such processes is a responsibility for all stakeholders.

Back to Contents

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Back to Contents