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Challenges of the Health Informatics Education in the Kingdom of Saudi Arabia: What Stands in Our Way?

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Abstract. Over the years, health informatics (HI) education has evolved in different patterns around the world. This evolution was accompanied by challenges that impede its ideal progress. Accordingly, there is a set of general challenges that face the education and training of the discipline and there are, as well, challenges that hinder its progression in every country in particular. This paper attempts to explore the challenges that face health informatics education and training in the Kingdom of Saudi Arabia (KSA) by examining the current state of health information technology education in general in the country with an emphasis on the HI education. An overview of the global challenges that face the field along with some suggestions to relieve this situation are also presented in this paper.

Keywords. Health informatics Education, Training, Challenges, Saudi Arabia.

Introduction

With the massive expenditures the Saudi government spends on the transformation of the paper-based hospital environment into an electronic one, the responsibilities on the health informatics (HI) education sector is increasing. Such investment has been contributed to many reasons such as increased quality, improved safety, enhanced outcomes, reduced medical errors and unnecessary cost elimination.[1] As a result, highly- efficient personnel in health informatics are required now more than ever in order to deliver expected benefits to patients. For this reason, the required skills to handle electronic hospital environment along with "cultural change, the relevant principles, concepts and methods of health Informatics need to be integrated into the curriculum of all clinicians and healthcare managers".[2,3] In this regard, Health informatics refers to "applied research and practice of informatics across the clinical and public health domains"[4] while education is being defined as "the act or process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and generally of preparing oneself or others intellectually for mature life"[5] or as " the act or process of imparting or acquiring particular knowledge or skills, as for a profession".[5] The paper at hand aims to explore the challenges that face health informatics education in the kingdom of Saudi Arabia by viewing the current state of the education of health informatics in particular and health information technology in general in various programs across the country to come to a conclusion of the main obstacles that face the development of this discipline and suggest some solution to relieve this situation in this

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area of the world. An overview of the global challenges that face the education of health informatics in the world is also presented in this paper.

2. Health information technology (HIT) education in the KSA

The e-health movement that the kingdom witnessed in the last few years has contributed to the increased demand of highly-qualified professionals in health information technology (HIT). The government looks forward to be an international player in HIT arena and had taken many steps to achieve this goal. For example, a meeting took place in 2002 by a group of professionals to discuss the notion of developing a national e-health framework for the entire country. A set of objectives was decided in order to help this initiative see the light. These objectives included establishing a health informatics society, forming a college that teaches health informtaics and other HIT specialties, establishing a health inforamtics center of excellence, promoting the current state of medical health records, and expanding the tele-health usage.[6] Furthermore, in 2005 and under the supervision of King Saud bin Abdulaziz University for health science (KSAU-HS), a Saudi Association for Health Informatics was established.[1] Nevertheless and regardless of these initiatives, until now, there is still no unified national body that coordinates these efforts either in terms of communication and health information systems deployment in hospital settings or in HIT education and training.

Accordingly, the decision makers decided to establish a number of programs which are targeted at educating students in the various areas that deals with health and biomedical information technological handling and management. These programs included health informatics, health information management (and technology), Health Information Systems, and medical record keeping. Nevertheless, there are limited data available about those who study and work in the health information technology settings. As a result, the entire spectrum of those involved in these areas of specialization will not be covered in this paper. Instead, the paper attempts to have an overall view of the most distinguished programs of these specialties in the kingdom. Medical record keeping was excluded from this review because of its sporadic, disseminated and widespread nature across the country.

Starting with the health informatics, the authorities formed a master program in health informatics at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) that targets clinicians from different fields of health care such as physicians, nurses, pharmacist, and so on. Nevertheless, a total of additional ten programs that offer Health Informatics, Health Information Management and Health Information Systems certificates in different level of education do exist in the country, yet, none of these programs offer a PhD degree.

Overall, there are four programs provided in health informatics, three bachelors and one Master, while four Health Information Management and technology programs are available in which four of them are for Bachelor but one of them is under the name of (health information management). Health information systems have two bachelor programs with one of them under the name of health informatics/health information system. When it comes to the medical record keeping, a numerous number of diplomas are provided nationwide. So to sum up, in the country, how health information is technologically handled, organized and managed is governed by the graduates of these disciplines.

3. Health informatics and Health information systems programs in KSA

3.1 University of Haiel (UoH):

This health informatics Baccalaureate degree program was founded in 2010. The program uses a trilogy of research, practice and education to prepare its student to handle their future responsibilities in a more effective fashion. The department describes its mission as "to reform Health management systems and make social contribution, by applying information technology to healthcare sector, and to improve health services through information systems in both the private and public sectors of the healthcare and public health systems".[7]

3.2 Al Qassim University:

The public health and health informatics college at Al Qassim University was founded in 2005. The department gives a bachelor degree in health informatics. The students have to take a preparatory year followed by four years of specialization in the discipline and ends with a full year internship. The program aims at graduating well prepared professionals in this area who are able to comprehend and adapt to the ever-changing health care environment.[8]

3.3 Saudi Electronic University (SEU):

The SEU is the first of its kind in the country i.e. electronic university. The SEU college of health sciences (CHS), which was founded 2011, offers a bachelor degree in Health Informatics / Health Information Systems using an e-learning method. The program works to fill in the marketplace with personnel with supreme technical and communication skills.[9]

3.4 College of Public Health and Health Informatics in King Saud bin Abdul-Aziz University of Health Sciences (KSAU-HS):

The KSAU-HS was established in 2005. KSAU-HS has a main campus in Riyadh with two additional campuses in Jeddah and Al-Ahsa. It has several colleges including the College of Public Health and Health Informatics that contain the department of health informatics which supervise three programs; one postgraduate and two undergraduate programs. The postgraduate program is in health informatics and it was formed in 2005. The program design is based on both national and international standards of accreditation as it has been approved by the Saudi commission for health specialties. The students are required to finish 42 credits to obtain the degree. Additionally, even though this is a non theses track, students have to complete a graduation project that is supervised by a faculty member upon graduation.

In 2011, two undergraduate programs in KSAU-HS were established as well; Health Information Management and Health Information Systems. These Baccalaureate degree programs were mainly developed to support the development of mHelath and eHealth movements in the country. The graduates of these disciplines are expected to cover important functions in various informatics fields. They also are expected to excel in different areas such as administrative, managerial, planning, and implementation of health care systems. [10]

4. Health Information Management & Technology (HIMT) programs in KSA

4.1 Umm-alQura University:

It was originally established in 2005 but was reformed in 2011. It contains the department of Management and Health Information Technology that was established in 2011. The department provides a Baccalaureate degree in Management and Health Information Technology. Additional information couldn't be obtained from the website. [11]

4.2 Jazan University:

Jazan University provides a program in Health Information Management & Technology (HIMT). This Baccalaureate degree program was formed in 2010. It's described as a science that combines four components; health science, information technology, health services administration, and last but not least, quantitative methods and information management. The program consists of two phases; general phase (which forms the fresh year) and specialized phase (which lasts for three years). After spending a total of 134 credit hours, the student has to finish a one year internship in one of the accredited hospitals before she/he fully graduate. [12]

4.3 King Faisal University:

King Faisal University was established in 1975 and includes 16 colleges. It provides a 5-year Baccalaureate degree program in Health Information Management and Technology that result in a totaling of 118 credit units. General education requirements are covered in the first three semesters while core health information management and technology courses are provided in the remaining five courses. A one year internship should be completed at certain hospitals as well. The program focuses on graduating a technical and executive expert in the field of Health Information Technology. [13]

5. National and international challenges of Health informatics education

5.1 General challenges that face the Saudi and the international Health informatics education:

Many reasons have contributed to the challenges that face the discipline of health informatics. For example, less information is available about health informaticians, which might be due to the fact that "These individuals do have a highly diverse array of job backgrounds, titles, and descriptions".[14,15] These backgrounds include for example physicians, nurses, computer and information scientists, and medical librarians. One of the obstacles as well is that a health informatician role is not yet well-defined.[16] The current numbers of informaticians can't possibly cover the increasing demands of the industry, which can be considered as another challenging fact for the field.

In particular, the educational sector of health informatics faces many obstacles and challenges around the world. As Hersh (2008) indicated in his paper "Health and Biomedical Informatics: Opportunities and Challenges for a Twenty-First Century Profession and its Education", several problems do exist in the education of health

information technology such as unclear criteria of ideal education, unknown educational needs of the informaticians, the status that their profession should evolve to, and "a lack of known best practices for their optimal deployment".[14] Hersh also mentions the absence of "a clear view of the ideal levels of education and most important competencies to teach such individuals". The fact that "competences of individual informatics educational programs are less well developed, but were recently analyzed and determined to be quite diverse"[14,17] May explains these challenges.

Equally important, Hersh pointed out some of the recommendations of both the American Medical Informatics Association (AMIA), and American Health Information Management Association (AHIMA) in his paper. These recommendations included "establishing industry-wide advocacy for workforce training and development, utilizing innovative learning environments to train the workforce, developing formal educational programs and promoting their value, disseminating tools and best practices for these new professionals to succeed".[14]

Moreover, in a 2010 discussion paper, Rainhold Haux reflects on Health and biomedical informatics as a discipline. He also makes suggestions and discusses future research trends or directions within the field of HI.[18] One of his recommendations regarding HI education is that "research, education and practice may shift more and more from local, to global activities".[19] It seems that Brillinger and Kagolovsky agree with him. In their conference paper "Intercultural Communication: A 'Foundation' Competency In Health Informatics", the authors suggest that "health informatics education itself is becoming increasingly internationalized, requiring professors with cross-cultural teaching skills".[20] The authors also indicate that intercultural communication is one important challenge that faces the discipline of HI. They suggest some solutions such as providing courses, as the ones they already provide in their program, in "Intercultural Communication Skills" and "Cultural Diversity in the Workplace".

Furthermore, In the UK between 2000 and 2002, an educational provider national survey was carried out to investigate the level of "education, training, and development (ETD) being provided in health informatics" and to which degree the "provision confirms to the standards specified"[3] in a national consensus document of the gold standards of HI education called "*Learning to Manage Health Information*".[3] The survey targeted three groups; physicians, nurses and NHS managers.

The results showed that several factors impeded the progress of health informatics ETD in the UK with the factor of lack of staff with the proper knowledge and skills to stand as academic leadership as the most important factor. These factors also included " lack of understanding of HI among health science educators; lack of champions within clinical schools (an absence of trained qualified staff to promote HI and to teach it); crowded curricula which makes it difficult to find time to innovate or experiment; a focus on IT skills to the neglect of HI (the prevailing attitude in many sectors is that IT skills need to be addressed before able to deal with HI); too many competing directives, checklists and gold standards which leads to 'let us wait and see what happens' attitude; lack of 'buy-in' from senior managers, school administrators, educational groups to the importance of integrating HI into curriculum; insufficient liaison and coordination between educational providers and employers; confusion and uncertainty as to who is ultimately responsible for overseeing HI education and lack of an overview as how the different sectors and stages fit together;

students on placement denied access to clinical systems; and lack of guidance and support from HI research and development groups (center of excellence)".[3]

When it comes to the case of Saudi Arabia, different matters represent some serious problems in this sector. To begin with, there is a lack of communication, cooperation and coordination between the health information technology colleges across the country. Also, there is no coordination between the workplace needs and the numbers of graduates every year. In addition, the low number of workforce in each discipline does not go well with the demands of the market needs. Furthermore, the health informatics, health information management and technology and health information systems specialties are only covered in a bachelor and a master degrees. The different levels of the available health informatics programs, i.e., bachelor and master, do not cover all requirements and needs of the education sector such as the need for specialists on a PhD level. The lack of training found among these colleges is another issue that needs careful consideration. In a nutshell, current health information technology education fails to support an interdisciplinary and synchronous work and communication between all the HIT colleges in the country.

5.2 Health informatics program's curriculum development challenges:

Little is known about the curriculum development process in the Saudi colleges of health informatics. Yet, in order to have some form of consistency among them, the Pakistani experience, as a developing country, in this regard could be useful. In health informatics, curricula development should combine courses from computer science and health sciences. The question that always pops in is; should health informatics curricula be comprised primarily of more health science or computer science? Many programs try to find some sort of harmony between these two disciplines.

The aforementioned Pakistanis experience reviewed in 2007 the curricula of an already offered health informatics programs in twelve UK and New Zealand universities in order to help develop a curriculum for a training master degree program in health informatics at COMSATS Institute of Information Technology in Islamabad, Pakistan.[21] A couple of national HI training guidelines were used to assess the curriculum outline comprehensiveness; the Australian Health Informatics Educational Framework that (was developed by Garde and Hovenga in 2006)[22] and the New Zealand Health Informatics Capability Development. [23]

The review showed that, in the examined twelve universities, health informatics program curricula were dominated by the health science courses as compared with computer science. Such finding is consistent with the International Medical Informatics Association's (IMIA) recommendations on education (2000) which indicate that out of 60 credits, 40 should be dedicated to "the processing of data, information and knowledge in medicine and healthcare" while 15 credits should focus on the knowledge and skills in computer science.[21] Additionally, Malik and Khan (2007) paper elaborate more on the required portions of health science and computer science in a dedicated health informatics masters program according to the suggestions of Garde and Hovenga (2006).[22] Such division of credits in both curricula and training programs does not mean that the subjects of computer science are less important since they are indispensable for the discipline, but rather a mere reflection of the qualities that a health informaticin needs in his/her practice.

Nevertheless, the review identifies some limitations in the courses of HI such as the disagreement in the core modules across these twelve programs as well as the courses' scope variations that would inevitably result in a form of discrepancy in some of the particular skills and knowledge competencies that students would acquire throughout their educational journey. To better prepare students for their future profession, Malik and Khan (2007) suggest that the core competencies of HI courses should be identified and employed by "monitoring bodies and institutions involved in the field". [21] Also, according to them, "the development of a concurrent set of core courses that health informatics training should cover"[21] should also accompany this approach.

Another way of educating HI could be based on a problem based, project organized approach such as the one used in the Master's program in Denmark at Aalborg University that was initiated in 1994. Corresponding to 60 ECTS, the program equals a 2 years part time study. The goal of this program is to equip students with capabilities to help them bridge the existing gap between IT professionals and healthcare professionals. Two basic types of activities are required from the students: project work and courses. Every year, the students take three courses with two projects in the first year and one master's thesis in the second year. However, different mandatory perspectives of projects are designated for the students; these are "Health Informatics from an analytical perspective" for the first year projects and "Health informatics from a design and/or implementation perspective" for the second year project.[19]

Additionally, since 1994, the content, size and organization of the program have been revised several times. In the revision of the content of the courses, a series of interviews were conducted with important HI stakeholders such as "decisions makers from municipalities and regions, clinical experts, representatives from doctors and nurses' trade union, patient organizations etc". These interviews aimed to gather these people's conceptions regarding health informatics, and what kind of skills, knowledge, and competencies students of HI should poses.[19] The program developers are now considering a more module-based structure that allows a room for individual needs and requirements as well as flexibility in cooperation with other HI programs.[19]

6. What can we do to fix this?

On an international level, health informatics education was over the years a subject of interest for the International Medical Informatics Association (IMIA), which was originally established in 1967. The association initiated numerous activities to support it's pursue to promote the education of health informatics. Establishing a working group (WG) on the education of Medical and health informatics is an example of IMIA's effort to develop an efficient HI education and training around the world. This working group primarily aims to raise the quality and scope of HI education. This is achieved by disseminating and exchanging information about health and biomedical programs and courses which is done through organized conferences in HI education that reached to nine conferences, release of special issues on education of an international Journal of Medical informatics, and by promoting an IMIA established database on HI courses and programs.[24, 25] Such attention to the issues the education of HI faces led IMIA to develop recommendations on HI education that originally came in 2000 and was revised ten years after. Now, IMIA is creating and testing a procedure for accrediting HI programs around the world.[26]

On the other hand, In the developing countries in general and particularly in the middle east, such challenges, either educational or non educational, are augmented by the obstacles the health informatics discipline is currently facing such as socio-technical issues that include for instance insufficient managerial support and commitment, infrastructural resources, and adequate and qualified manpower. [27] Having larger unifying organizations for the developing or the middle eastern countries under the supervision of IMIA, as other parts of the world do, have the potential to help relieve the current state and provide the necessary support for these countries to build an efficient HI educational system. The Middle East Association for Medical Informatics (MEAHI), which was approved at the IMIA Assembly meeting in 2009, the African, and the regional federation of health informatics for Latin America and the Caribbean, can serve this cause well. These organizations should be engaged with the local HI bodies such as SAHI in the improvement process to produce at least a unified HI curricula for these countries under their supervision in terms of education and training, at least as it applies for the core modules, with a room left for each country to adjust such curricula according to their local needs and requirements. Furthermore, when it comes to the Middle East, MEAHI in specific has committed itself to play a major role in promoting health and biomedical informatics training and education at all levels as well as connecting industry and governments with academia, and assisting in the international institutions' and organizations' HI activities. Its 2012 vision of "Better Health Through the Better Information" clearly reflect its strategy to raise the bars for the standards it longs to achieve in the field of HI. Additionally, local HI associations should cooperate and coordinate their efforts with IMIA's regional bodies to help achieve such strategy and improve the level of HI in their developing countries.

On a local level, a good remedy for the problems that face HI education could be brought by the movement by all HI Saudi colleges to be all united under a unified umbrella or unified body such as the Saudi Association for Health Informatics (SAHI). SAHI on the other hand, need to cooperate more with MEAHI to boost its efforts in this regard. Furthermore, on an individual level, Saudi informaticians should focus on specialization in the different area of informatics such as bioinformatics, public health informatics, and clinical research informatics. On a global level, there are numerous opportunities in the horizon, as Hersh indicated that "informatics educational programs are growing in size and stature".[14] The professional and students of health informatics in the kingdom should be introduced for instance to AMIA's 10X10 courses that offer suitable educational opportunities. These programs are part of an initiative that aimed to, and still do, educate 10,000 health care professionals by 2010 and provide them with "an in-depth introductory course in biomedical informatics".[14] Such programs are carried out in collaboration with various American universities. Students can use distance/online education to attend classes. Similar programs in coding, clinical documentation, and privacy and security are offered by AHIMA for health information management personnel as well.

7. Conclusion

Many obstacles face the HI education on a national and international level. These challenges include for instance intercultural communication, lack of staff with the proper knowledge and skills to stand as academic leadership, the absence of "a clear view of the ideal levels of education and most important competencies to teach such individuals" [14],

crowded curricula and the disagreement in the core modules that should exist in a HI curriculum, and the lack of 'buy-in' and cooperation from senior managers, and educational schools heads. Different approaches can help fix this situation such as the calls which demands that health informatics "become a professional discipline" [14, 28] and also to have the qualities of a real profession such as "well-defined set of competencies, certification of fitness to practice, shared professional identity, lifelong commitment, and a code of ethics".[14, 29] Unifying the HI colleges in the kingdom under a well-known body such as SAHI and allowing it to decide what core modules should be involved in the curricula and employed them afterwards, and encouraging the HI individual to specialized in different areas of the discipline could improve the situation locally. Finally, according to Hersh (2008), further research is, indeed, needed to better inform health informatics decision makers and leaders about the optimal level of required competencies and proper education and training of the workforce. Other areas of informatics such as bioinformatics, public health informatics, and clinical research informatics should be, at the same time, taken care of.[14].

References

[1] Altuwaijri M. M. (2008). Electronic-health in Saudi Arabia: Just around the corner? *Saudi Med J*; **29** (2): 1296-1303.

[2] Haux, R. (2002). Health Care in the Information Society: What Should Be the Role of Medical Informatics? *Methods of Information In Medicine* **41**:31-35.

[3] Murphy, J., Stramer, K., Clamp, S., Grubb, P., Gosland, J., and Davis, S. (2004). Health Informatics Education – What's holding up progress?. *PubMed*. **73**(2):205-13.

[4] American Medical Informatics Association. (n.d). Retrieved 5th of December from http://www.amia.org/about-amia/science-informatics

[5] English dictionary. Education definition. (n.d). Retrieved 5th of December from http://dictionary.reference.com/browse/education

[6] Househ, M., Al-Tuwaijri, M., and Al-Dosari, B. (2010). Establishing an Electronic Health Center of Research Excellence (E-CoRE) within the Kingdom of Saudi Arabia. *Journal of Health Informatics in Developing Countries*, **4***(1)*, 42-46.

[7] University of Haiel. The Faculty Of Health Informatics website. (2011). Retrieved 5th of December 2013 from http://www.uoh.edu.sa/sites/en/Pages/default.aspx

[8] Al Qassim University. The Faculty Of Public Health & Health Informatics website. (2013). Retrieved 5th of December 2013 from http://www.qu.edu.sa/en/Pages/Home.aspx.

[9] Saudi Electronic University (SEU). The Faculty Of Health Sciences website. (2013). Retrieved 5th of December 2013 from http://old.seu.edu.sa/en/index.php/pages/view/19/

[10] College of Public Health and Health Informatics in King Saud bin Abdul-Aziz University of Health Sciences (KSAU-HS). The Faculty Of Health Informatics website. (2013). Retrieved 5th of December 2013 from http://www.ksau-hs.edu.sa/English/Pages/default.aspx.

[11] Umm-alQura University. The Faculty Of M&HIT website. (2013). Retrieved 5th of December 2013 from http://uqu.edu.sa/english.

[12] Jazan University. The Faculty Of HIMT website. (2013). Retrieved 5th of December 2013 from http://www.jazanu.edu.sa/sites/en/Pages/Default.aspx.

[13] King Faisal University. The Faculty Of HIMT website. (2013). Retrieved 5th of December 2013 from http://www.kfu.edu.sa/EN/Pages/home.aspx

[14] Hersh, W. (2008). Health and Biomedical Informatics: Opportunities and Challenges for a Twenty-First Century Profession and its Education. *IMIA Yearbook of Medical Informatics*. 138-145.

[15] Covvey, HD., Zitner, D., Bernstein, R. (2001). Pointing the Way: Competencies and Curricula in Health Informatics. University of Waterloo: Waterloo, Ontario, Canada. Retrieved 5th of December from http:// www.cs.uwaterloo.ca/health_info/health_docs/ CurriculaMASTERDocumentVersion1Final.zip.

[16] Hersher, B. (2003). The essential skills for the Chief Medical Information Officer. *Journal of Healthcare Information Management*. **17**(1):10-1.

[17] Huang, QR. (2007). Competencies for graduate curricula in health, medical and biomedical informatics: a framework. *Health Informatics J*. **13**:89-103.

[18] The IMIA Strategic Plan 2007: Toward 2015. Retrieved 5th of December http://www.imia-medinfo.org/new2/node/5
[19] Bygholm, A., Hejlesen, O., and Niss, K. (2013). Educating Health Care Professionals Master's Program in Health Informatics at Aalborg University. Scandinavian Conference on Health Informatics 2013, Copenhagen, Denmark, August 20, 2013.
[20] Brillinger, K. and Kagolovsky, Y. (2008). Intercultural communication: a 'foundation' competency in health informatics. *Proceedings of the IMIA Education Working Group Conference, Buenos Aires, Argentina, 27–28 October 2008*. Retrieved 5th of December http://www.hospitalitaliano.org.ar/imiawged
[21] Malik, M. A., & Khan, S. (2007). Health informatics training at the postgraduate level: a curriculum development exercise in Pakistan [Electronic Version]. *Journal of Health Informatics in Developing Countries, 1(1)*, 16-18. Retrieved 5th of March from http://www.jhidc.org/index.php/jhidc/article/view/3.
[22] Garde, S., & Hovenga, E. (2006). Australian Health Informatics Educational Framework [Electronic Version]. *Australian College of Health Informatics*. Retrieved 01 December 2013 fromhttp://www.achi.org.au/documents/publications/Health_Informatics_Educational_Framework_20060326.pdf.
[23] Kerr, K., Cullen, R., Duke, J., Holt, A., Kirk, R., Warren, P. K. J., et al. (2006). Health Informatics Capability Development in New Zealand: A Report to the Tertiary Education Commission [Electronic Version]. *Health Informatics New Zealand*. Retrieved 01 December 2013 from http://www.hsci.canterbury.ac.nz/documents/HI_Curriculum_23-11-06_.pdf.
[24] Haux, R. (1998). Health and medical informatics education: perspectives for the next decade. International Journal of Medical Informatics 50:7-19
[25] Retrieved 01 December 2013 from http://www.imia-medinfo.org/new2/node/139
[26] Hasman, A. (2012). IMIA accreditation of Health Informatics Programs. Yearbook of Medical Informatics 2012. 139143.
[27] Mengiste, S. A. (2010). Analysing the Challenges of IS implementation in public health institutions of a developing country: the need for flexible strategies [Electronic Version]. *Journal of Health Informatics in Developing Countries, 4(1)*, 1-17, from http://www.jhidc.org/index.php/jhidc/issue/view/9
[28] Roberts J. (2006). Developing health informatics as a recognized professional domain supporting clinical and health management activity. *World Hosp Health Serv*. 42(4):38-40.
[29] Joyub R. (2004). The Professionalisation of Health Informatics in the United Kingdom. UK Health Informatics Today. 42:1-2, 4. Retrieved 01 December 2013 http://www.bmis.org/ebmit/2004_42_spring.pdf.