Education Issues in Health Informatics

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Health informatics is a growing science concerned with the techniques and methods applied in the management of information within the health sector. Its scope and objectives include the collection, storage, analysis, dissemination and use of medical knowledge in an economic and effective manner. Therefore, health informatics or medical information science deals with fundamental and applied issues in the use of computerised systems in all facets of the health care field including administration and management of hospitals, clinics and community care centres, biomedical research, public health, on-line medical libraries, pharmacies, patient-oriented applications, education and training.[1]

Medical and health care knowledge, data and information continue to grow exponentially. The health care system has been for the last few years submitted to external and internal factors which are influencing the generation, capture, processing, storage and use of information for both health care management and for clinical practice. There is a contemporary demand for higher quality, patient-centred health care in an environment characterised by formidable challenges, economic, social and political pressures. On the other hand, technology and, in particular Information Technology, is advancing so rapidly that it affects the curricular structure, learning theory and education outcomes of health administrators and professionals.

Currently, there is a shift in the way medical education has been delivered, from the traditional system of disease-oriented to a problem-oriented approach. At the same time Information Technology is revolutionising education and training. The need for adequate strategies integrating both aspects and new trends in hospital information systems is becoming a necessity for the efficient and effective delivery of health care services.

This paper will address the main economic, organisational and technological issues affecting and influencing health informatics education and training. Particular emphasis will be given to the development of models and programs of co-operation and international exchange in the context of the Asia-Pacific Region and the applications of technologies such as Multimedia, Virtual Reality and simulation, Artificial Intelligence and Computer Based Training (CBT), Integrating Databases, CD-ROM, CD-I and Digital Video Interactive, Intelligent Tutoring Systems, On-line Databases and authoring to address the educational needs of medicine students, clinicians, administrative and clerical, technical and auxiliary staff at all levels.

1. INTRODUCTION

Rapid advances in computers and communication technologies are now capable of transforming education and training around the world from one field of traditionally low level of creativity and use of modern technology into one of the most innovative and high-tech. This applies not only to the education sector, in general, but also to specific areas or segments of the economy. A particular case is the education in health care and principally the advances in health informatics education. The health care sector is a complex system characterised by a wide mixed range of services, markets and professionals. Currently, there is a growing demand for higher quality outcomes in health care which are to be achieved within a framework of tight economic and financial constraints. In addition, there are interesting but difficult challenges and choices for the future systems of health care delivery facing enormous social, political and organisational pressures. This scenario raises special concerns related to curriculum evolution, skills and needs of health care professionals to cope with an increasingly computerised medical environment.

2. FACTORS INFLUENCING HEALTH INFORMATICS EDUCATION

Technology-based education and training is already

playing an important role for the advancement of health informatics education. Some extraordinary breakthroughs have been achieved in the field of Telemedicine to perform surgery by remote control in a remote location [2]. These experiments can be successfully applied in health education, for example, to train surgeons in remote sites. Advances in technology and specially in Information Technology are driving the emergence of integrated frameworks for the development of curricula. These new models of educational response cover the areas of health information systems technologies and applications, theories and methodologies, administration and impacts and can be used in undergraduate, graduate and master's level education programs [3].

There is an increasing demand for extensive use of computers in health education and integration of informatics in curricula in response to external and internal factors affecting the efficiency, effectiveness and quality of health care services. First, the health care market is rapidly being transformed into a highly complex, ever-changing and competitive environment. The need for immediate access to quality information for planning and decision-making is a high priority for health care administrators, policy makers and governments. Second, skills can be taught through computer mediation to deal effectively with an increasing complexity of knowledge and information in health care as well as an increasing clinical complexity. Third, in the study of medicine there is a huge need for visual representations and creation of models. This constitutes a promising area for extensive graphical representations through multimedia and computer simulation in computer-assisted learning. Fourth, on-line databases and interactive videodisc as well as hypertext and systems capable of analysing the users own responses are becoming important tools for continuing health care education and professional development. Fifth, the trend for the widespread use of computers and networks in health care seems to be inevitable with continuous advances in hospital information systems, technological approaches to diagnosis and treatment of diseases, computerised medical research and developments in large community health information networks. This scenario affects and demands a greater emphasis on the development of computer literacy skills in all phases of medical education [4]. Sixth, trends in learning theory, content and orientation of training shifting from disease-oriented to a problem-oriented approach. Modern health care education programs place a greater emphasis on building student technical competency, cognition, valuation and behaviour change. Computers will facilitate the wide introduction of the scientific method, offering rigor and capacity, problem solving and problem-based learning capabilities, interaction with other professionals via networks and effective transfer of learning to other training activities and needed medical applications. Finally, computer learning strategies and outcomes are becoming a necessity to pursue efficiency in health care informatics education in the current environment of economic, organisational and policy constraints.

3. NEW TECHNOLOGIES IN HEALTH INFORMATICS EDUCATION

The study of modern medicine requires appropriate responses taking into account recent interdisciplinary developments including biomedical sciences, education and organisational behaviour, and information technology. Modern medicine is fundamentally an applied science requiring substantial training and experimentation. The emergence of new technologies and the convergence of computing, telecommunications, broadcasting and publishing constitute, indeed, an enabling technology for the advancement of medical informatics education.

3.1 TELEMEDICINE AND EDUCATION

Telemedicine has been described as the transmission and exchange of voice, video and data between remote sites by using advanced network technologies such as the integrated services digital network (ISDN). It has been considered a mature technology [5] and its applications in medicine include diagnostic medical imaging systems, accessing patient and administration records and remote surgery. Telemedicine constitutes one of the most promising applications of Information Technology to health care with important repercussions in training and education. When combined with Virtual Reality, robotics, interactive media communication, databases and high-speed data communications, Telemedicine can be used to perform three-dimensional images from scans and X-rays as well as rapid mapping of the patient's body for visualisation before surgery at a remote location. The advantages for training and education are enormous. For example, highly trained specialists can advise and train less experienced

doctors on how best to operate on any particular individual. A surgeon's expertise can be carried across the globe to living patients and health care professionals via satellite and fibre-optic cable. Remote hospitals and rural medical centres can be connected to teaching hospitals and other health care experts in large metropolitan areas. The benefits include a dramatic reduction in training costs and less invasive and more accurate interventions.

3.2 THE VIRTUAL HOSPITAL AND MULTI-MEDIA

The Virtual Hospital has been described as an online multimedia resource used to connect teaching hospitals to medical practitioners over the Internet [6]. The Virtual Hospital provides a wide range of educational information including simulations, diagnostic algorithms, medical dictionaries and multimedia textbooks. Multimedia has the ability to manipulate digital forms of audio and video information through computer technology and integration of storage, communication and presentation mechanisms for diverse data types in a single technology. The Virtual Hospital combined with multimedia offers an integrating instructional model suitable for the high-quality demands of learning environments today. Other advantages include the potential to reduce the learning curve and accelerate the learning process; to reach health care professionals with different learning styles and skill levels as well as placed in different geographic locations (e.g. Telemedicine).

3.3 DISTANCE AND OPEN LEARNING

Developments in telecommunications and high-speed data and voice networks provide opportunities for distance learning in health informatics. Satellites and fibre-optic cable provide reliable communications covering and connecting remote areas to urban areas. Sophisticated services such as electronic mail provide message transfer confirmation, forwarding, annotation and distribution lists. They also provide special features for recording messages, saving messages, checking incoming messages and so forth. The growth of large electronic networks for education and research and the accessibility offered by portable computing will have a significant impact on education and training of health care professionals placed in distant locations. Students can access and search library resources, communicate with other

professionals and researchers and have on-line access to instructional software as well as administrative procedures.

3.4 ELECTRONIC MEDICAL LIBRARIES

The electronic management of documents including books and journals represents a challenge to traditional medical librarianship with important repercussions in the ways instructional material will be accessed and delivered in the future. Advances in desktop publishing and progress in optical storage technologies (CD-ROM and more recently CD-I) permit the compilation of huge amounts of medical information including text, graphics and images in full-text databases available at the desktop and online. Hospitals, universities, general practitioners and other health care professionals, in particular those in remote areas, have now access to a large volume of library resources available on CD-ROM or via national and global networks. The CD-ROMs offer text search functions, dictionaries and even audio-features. Dramatic advances in CD-I permit students interactively interrogate the database.

3.5 KNOWLEDGE-BASED SYSTEMS

Recent developments in Artificial Intelligence and Knowledge-based systems (KBS)[7] promise to make important contributions for the collection and interpretation of expert medical information and subsequent provision of health care education and training. The development of KBS requires a capacity to translate knowledge into a form that can be executed on a computer [8]. KBS can perform advanced functions and suggest solutions to specific problems such as, for example, low health care coverage rates and disease outbreaks. This can be valuable in programs of public health including immunisation services and disease surveillance. KBS and Expert Systems offer great potential for the health care and health informatics education. Health care services are information intensive activities and there is a need for constant training and support in data analysis.

3.6 VIDEOCONFERENCING AND ELECTRONIC BULLETIN BOARDS

Videoconferencing combined with other technologies specially advanced network communications provides a complete medical networks and allows

simultaneous document, computer and multimedia conferencing. Videoconferencing involves groups of people at different locations holding a conference by means of communication links. The group see each other on TV screens, discuss relevant issues and exchange information such as visuals and it can include high-resolution group video and audio overlayed with spreadsheets, drawings and so forth. This opens immense opportunities for health care informatics education and training. For example, remote hospitals can hold conferences and presentations with teaching hospitals. Educational programs and relevant topics can be discussed interactively at the same time that the group share information and transmit medical imagery. Videoconferencing can be used for clinical education, infection control, clinical consultation and development of competencies.

On the other hand, an electronic bulletin board can be used for teaching students on technologies while providing the means for conferencing on various topics. Electronic bulletin boards can be useful in assessing communications needs and they seem to improve the accessibility to information [9].

3.7 THE HIGH-TECH MEDICAL SCHOOL

Technology is revolutionising training and education. As different media and communications merge and converge, a new form of school emerge - the high-tech school. Innovative and creative processes of delivering education and training can be tested, simulated and integrated in future curricula. The high-tech school or electronic classroom emphasise the use of computer-controlled multimedia systems for presentation. Computer technology including interactive videodisc, high-resolution graphics and stereo sound projection systems, CD-ROM, Computer Assisted Learning (CAL), Computer Based Training (CBT) and Virtual Reality offer significant opportunities for a shifting in the instructional process from a lecture-based approach to an environment of understanding of concepts, creative and critical thinking, discovery and interactive discussion among students and professionals [10]. This scenario can be extremely important for the advancement of health informatics education and the introduction of innovation so necessary to increase efficiency and quality of outcomes in health care services delivery.

4. MODELS AND PROGRAMS IN HEALTH INFORMATICS EDUCATION FOR THE ASIA-PACIFIC REGION

The Asia-Pacific Region has long been one of the fastest growing economic regions in the world, identified as an area with tremendous growth potential and, therefore, of significant interest and emerging opportunities for new ventures and alliances. Opportunities for electronic networking are rapidly becoming a reality specially in health care informatics education and training. Telecommunications developments in the Region including the increasing coverage of larger areas by satellite communications, optic fibre undersea cable networks and multimedia superhighways will allow access to a wide range of services and rapid exchange of data and video images. The opportunities for health care informatics will depend on the building of a seamless voice and data communications infrastructure in order to facilitate the implementation of educational global networks for the sharing of knowledge and experiences. Current possibilities include the use of the International Telecommunications Satellite Organisation (INTELSAT), the new low earth orbiting (LEO) satellite systems, VSAT-based data and private line-type services, the Indonesian Palapa satellite, AsiaSat, TongaSat and other satellite systems around the Pacific. On the other hand, the Internet offers a number of tools for biomedical information access. The emerging opportunities for the creation of common interests, models and programs in health care informatics education incorporate structures available in other sectors of the economy such as trade and commerce. They can be summarised as follows:

- **Electronic networking**
- **Scientific and Technological Collaboration**
- **Cross-border Alliances and Joint-Ventures**
- **Distance and Open Learning**
- **Cross-border regulatory and standardisation processes**
- **Creation of knowledge and skills intensive areas**

Other forms of cooperation and programs include:
- Programs aimed at reinforcing technological co-operation (hardware, software and telecommunications systems applied to health informatics education)
- Co-operation between universities and indus-

- try regarding training in the field of technology
- Development of learning technologies through computer mediation
- Transfer of know-how and technology
- Development of programs which aim is to draw the full potential from human resources and investments in research, development, innovation and technology transfer policies
- Programs designed to increase cross-border student mobility
- Vocational programs designed to promote foreign language competency
- Massive commitment and increasing financial investment in transnational initiatives devoted to the development of technology and vocational training in health care informatics through computer mediation
- Cross-border reviews and standardisation of policies of higher education in health care informatics
- Intergovernmental informatics programs.

5. CONCLUSION

Health care informatics education and training is increasingly becoming a necessity for health professionals and practitioners in order to cope with the widespread use of computer systems and network technologies. Rapid advances in technology and shifts in curriculum structure and content are driving the emergence of new ways of dealing with the analysis and complexities of knowledge and clinical information in health care. On the other hand, organisational and cultural attitudes, economic, social and political pressures impose significant barriers to the advancement of innovation and in particular health informatics. However, significant breakthroughs and successful case studies in the application of the new technologies constitute real predictors and landmarks shaping the future for a better education and consequently better outcomes in health care services delivery.

6. REFERENCES

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