CHAPTER – II

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

In this chapter, an attempt has been made to present the review of related literature pertaining to Continuing Medical Education (CME).

Factors interfere with access to both formal programs, such as distance from a clinical teaching centre, and informal learning; e.g., limited availability of current medical information. (Hirsch, 1999) In fact, working in isolated environments where access to peers, education and information is limited, is one of the highest risk factors for physicians’ loss of medical competence. (Lewkonia, 2001)

Similar to telemedicine’s influence on health care access, advances in information and communications technologies (ICTs) have increased opportunities for Continuing Medical Education. (Hjelm, 2005)

This study provides a descriptive overview of the use of ICTs in Continuing Medical Education from an educational perspective. Its purposes are to:
1. Suggest a conceptual model as a framework for reviewing ICT use in Continuing Medical Education.
2. Describe the use of specific technologies and integrated technology systems in Continuing Medical Education.
3. Consider opportunities and challenges the technology offers for Continuing Medical Education, especially in Iran.

The literature review was conducted using Pub Med-Medline, Pub Med-Central and ERIC databases, 1996-2005, for research studies and pertinent theoretical publications including journals and texts. Key search words included general terms such as: “telehealth,” “telecommunication,” “distance learning,” “Continuing Medical Education”; and specific terms such as: “videoconference,” “audio conference,” “computer-aided instruction,” “Web-based learning,” “handheld technology,” “learning repositories; levels of Continuing Medical Education: “undergraduate,” “graduate,” “post-graduate,” “continuing”; and “professional health,” and “international approaches.” Theoretical approaches were included to place the review within an educational and social context, and selected studies to demonstrate use of ICTs within diverse elements of Continuing Medical Education.

2.2 A CONCEPTUAL MODEL FOR REVIEWING ICT USE IN CONTINUING MEDICAL EDUCATION

Guidance for the appropriate use of ICTs for distance and distributed learning comes from research and theory in general education. (Perraton H., 2000; Howard C., Schenk K., Discenza R., 2004) As in traditional face to face education, a number of learning theories (e.g. behavioral, cognitive, social) provide information about educational strategies and effective education takes place within
an educational system. This system is composed, very simply, of the following interactive components: (Mayer R.E., 2003)

1. Learner/s
2. Educational materials and information resources
3. Instructor/s
4. Connections among the above and is influenced by the:
   a. educational environment, and
   b. social environment (in Continuing Medical Education, this specifically includes the healthcare environment)

These components and environments are presented schematically in suggesting a conceptual, yet practical model for considering the roles which ICTs play a role in Continuing Medical Education. In traditional education, learners, learning materials (both specific course materials and general information resources) and instructors are temporally and physically connected. In distributed learning, ICTs connect learners, instructors and materials. When using ICTs for education, the temptation is often to focus more on the technology and less on the learners and instructors, often to the detriment of the educational quality. (Eva KW, MacDonald RD, Rodenburg D, Regehr G., 2000) And, education does not take place in a vacuum and environments moderate learning and educational outcomes. These include the educational environment, influenced by factors such as available support systems and learners’ prior experiences, and social and health
care environments; e.g., local support and access to relevant health care resources. Each component deserves attention. (Johnson SD, Aragon SR, 2003).

Using this model, individual ICTs and functions each serves in distributed learning will be briefly discussed, followed by a more detailed description of the uses of specific ICT within medial education.

ICTs in Continuing Medical Education, similar to the ones used in telemedicine and general education, range from simple to complex and fall into four general groupings:

1. The telephone is the earliest, simplest and sometimes the most overlooked technology.

2. Video-conferencing incorporates computer technology to provide interactive, “real-time” transmission of audio and video, and transmission of files, graphics, etc.

3. Computer technology and software enable computer-aided instruction and with the Internet, support Web-based learning, computer conferencing, and access and transmission of large databases, files and images.

4. Handheld technologies can be used alone or linked to the Internet to provide “just in time” information.
The conceptual model depicts the general functions which these ICTs serve in Continuing Medical Education. They connect learners, instructors and educational materials in different ways:

1. **Connecting learners and instructors in “real-time” or synchronously**: Simple ICTs, like the telephone and audio-conferencing, and more advanced ones like video-conferencing connect learners and instructor for “live” educational sessions. Internet “chat” or conferencing programs also provide synchronous communication.

2. **Connecting learners and instructor “asynchronously”**: This refers to interpersonal interaction occurring over time, not at the same time, enabled through the Internet via email, list serve and numerous conferencing programs.

3. **Connecting learners, instructors to learning resources (specific course materials)**: Before ICTs and even today, correspondence courses provided paper course materials to learners by mail. (Aoun S, Johnson L, 2002) With computers and the Internet, these are now available electronically; e.g., course outlines, cases, images, simulations, and examinations.

4. **Connecting learners to learning resource (information resources)**: Access to current information is paramount for medical practice and the Internet and computers now offer this; e.g., access to libraries, databases, journals, texts, decision-making tools, and clinical guidelines. These resources are important in formal instruction and also for informal continued learning.
2.3 DESCRIPTIONS OF THE USE OF SPECIFIC ICTs AND INTEGRATED TECHNOLOGY SYSTEMS IN CONTINUING MEDICAL EDUCATION

This section describes uses with examples of the identified ICTs and their educational functions:

1. *Traditional telephone and audio-conferencing*

   Often neglected as learning tools, the telephone and audio conferencing connect learners and instructor for formal and informal Continuing Medical Education. One long-standing program is offered by the Memorial University of Newfoundland, Canada in Continuing Medical Education (CME). Since the 1960s, rural physicians are linked for a 1-hour audio-conference program with clinical experts. The program continues to be well-received and valuable. (Curran V, Kirby F, Allen M, Sargeant J, 2003) A similar program has been used in the UK for undergraduate and postgraduate programs. (Hibbard, BM, Marshall RJ, Hayes TM, 1996) Audio conferencing enables interaction among learners and the instructor and is an affordable and effective means of education.

2. *Interactive videoconferencing*

   Videoconferencing is used extensively for formal Continuing Medical Education. It synchronously connects learners, instructors and course materials. It effectively provides traditional programs for physicians and other health professionals at distributed sites and supports their interaction. (Misra UK., 2004) Videoconferencing connects sites for grand rounds and other sessions traditionally
hosted by a medical centre, and allow peripheral sites to present clinical material during these rounds. (Sclater K, Alagiakrishnan K, Sclater A, 2004) Electronic diagnostic images (e.g. computerized tomography, angiograms) and video-clips or live videoconferencing of the patient can also be transmitted, adding value to the programs. (McCrossin R., 2005) Other CME initiatives using videoconferencing include journal clubs and small-group learning. (Wilson SF, Collins F, 2005)

In undergraduate and residency education, videoconferencing use is increasing and includes students and residents in rural and distributed sites, including family medicine and cardiology residents. (Callas, P, Bertsch TF, Caputo MP, Flynn BS, Doheny-Farina S, Ricci MA, 2004) More recently, videoconferencing is being used in combination with other ICTs to develop distributed campuses for faculties of medicine. (see section 5 below)

Videoconferencing also facilitates skills instruction and assessment at a distance. Examples include teaching surgical procedures through off-site observation, teaching hand assessment techniques for physical therapists, improving pediatric resuscitation skills through observation and participation, assessing neonatal resuscitation skills and assessing surgeons’ informed decision-making skills using a video conferenced standardized patient. (Curran VR, Aziz K, O’Young S, Bessell C, Schulz H., 2005)

3. Computer-assisted instruction and Web-based learning

Computer-assisted instruction (CAI) refers to using computer technology to enhance instructional design and provide instruction, while Web-based learning
incorporates these features with the connectivity of the Internet. (McKimm J, Jollie C, Cantillon P, 2003) CD-ROMs are an example of an accessible yet sophisticated multi-media computer-aided instructional medium. They can be an effective learning tool for knowledge and skills and are easily and cheaply distributed. (Roy D, Sargeant J, Gray J, Hoyt B, Allen M, Fleming M, 2002) The relative accessibility and affordability of digital camera and video technology enable the creation of sophisticated materials; e.g. multi-media texts. (Tegtmeyer K, Ibsen L, Goldstein B, 2001) CD-ROMs link the learner and learning resources.

Multi-media CAI combined with the Internet for formal courses connects learners to sophisticated learning resources. Examples include an undergraduate program teaching examination of the eye and ear using computer-assisted interactive learning and virtual reality. (Grundman JA, Wigton RS, Nickol D, 2000) Other multi-media programs include assessment of the learner; e.g., the “interactive patient” program evaluates performance in history taking, physical examination, diagnosis and treatment. (Hayes KA, Lehmann CU, 1996) In radiology, a sophisticated Internet-based program assesses knowledge and skill matched to the learner’s level. (Grunewald M, Heckermann RA, Wagner M, Bautz WA, Greess H. ELERA, 2004) In pathology, a web-based tutorial hosted on a US web site improved grading of images by 643 practicing pathologists from across the United States (72%) and outside the US (28%), emphasizing the broad population the Web serves. (Kronz JD, Silberman MA, Allsbrook WC, Epstein JI, 2000)
Web-based programs enable interpersonal interaction and collaborative learning among learners or learners and instructors, either synchronously or asynchronously, especially important for rural and isolated medical and health professionals. An example is an interactive electronic notice board developed as a forum for discussion of clinical problems for medical students in rural settings and their clinical preceptors. (Walker J, Thomson A, Smith P, 1998) Other multimedia programs on the Internet link learners, resources and instructors for formal instruction. One such CME program included a didactic multi-media component, interactive cases with feedback and enabling tools and resources, supplemented with Web-conferencing. (Fordis M, King JE, Ballantyne CM, Jones PH, Schneider KH, Spann SJ et al., 2005) WebCT is an educational course management software supporting both synchronous and asynchronous communication, used for undergraduate, post-graduate and continuing education. (webCT.com [homepage on the Internet] Vancouver, British Columbia: WebCT Canada [cited 2005 September 22]) Evaluation of formal CME programs using this courseware showed that physicians valued access to relevant programs and interactions with instructors and learners, but interpersonal interaction required appropriate facilitation. (Curran VR, Lockyer J, Kirby F, Sargeant J, Fleet L, Wright D, 2005) Another intervention for Web-based learning is a journal club, including links to pertinent articles and a discussion board for interaction. (Jacobs JL, Thomas S, 2004)
In addition to facilitating formal learning, the Internet provides access to medical information, journals, libraries and databases for all levels of Continuing Medical Education and lifelong learning. These resources are traditionally easily accessed by learners at modern medical schools, but are often less accessible to learners and practitioners outside these facilities. (O’Brien B, Sargeant J, Ryan K, 2000) The negative impact of not having access to current medical information is serious for learners at all levels and especially for practitioners. (Lewkonia R, 2001)

Rabin A et al., 2004) These findings have implication for designing Continuing Medical Education curricula.

To summarize, computer-mediated multi-media instruction and the Internet can effectively link learners to learning materials and information resources, to each other, and to instructors.

4. Hand-held computers in continuing medical education

Since their introduction in the early 1990s, the use of hand-held computers or personal digital assistants (PDAs) has increased. Generally, they link the learner/practitioner directly to the information resource. They are most frequently used to access clinical and evidence-based information at the point of care, providing immediate access to journals, databases and calculators for clinical procedures. (Recommendations for Handheld Hardware and Software, Dalhousie University Faculty of Medicine - Spring 2005, 6th edition [on the Internet]. Halifax, Nova Scotia: Dalhousie University; [updated 2005 April 18; cited 2005 Sep 15]. Dalhousie University, Faculty of Medicine; [about 2 screens]. Available from: http://handheld.medicine.dal.ca/index.htm) They are used in undergraduate and postgraduate education for recording and monitoring learners’ clinical experiences, data collection, log books and evaluation. More recently, cellular telephone technology provides hand-held capacity to perform many electronic and communications activities: capture and transmit digital images, access email, search the Internet, and store information, (Cellphones.etc [homepage on the Internet]. Edmonton: WCS Cellphones Online Inc. c2005 [cited 2005 Nov 28].
Available from: http://www.cellphones.ca/.) but few if any formal studies of its use in Continuing Medical Education have been reported.

5. Distributed and integrated learning systems

Beyond using technologies individually, educational programs and systems are being developed which integrate various ICTs and/or integrate ICTs with traditional education approaches, connecting learners, instructors and resources in various ways. A European integrated web-based system for distance learning in mammography digital imaging processing includes network-delivered interactive multimedia courses and tutoring via collaborative browsing and “white boarding” or editing of the content, supported by video, audio and text communication and transfer of data files. In Taiwan, programs using video-conferencing and web-based CME network with a virtual classroom are available to satisfy the needs of physician-education in rural areas. (Chen HS, Guo FR, Ching-Yu C, Chen JH, Kuo TS, 2001)

Highly sophisticated and integrated learning systems are in use for teaching surgical and other skills. Virtual environments combining robotics, video-conferencing and internet transmission provide real-time consultation, education and mentoring during surgery for remote surgical residents and students and learners in other countries. (Lavrentyev V, Rafiq A, Merrell RC, 2004). Asynchronous learning in surgery can be aided by high-quality optical capture using a laparoscope and robotic arm to create video clips which are then validated
by an expert review panel, for collaborative learning of surgical procedures. (Pearson AM, Gallagher AG, Rosser JC, Satava RM, 2002)

An innovative system for continuing surgical education incorporates both ICTs and traditional approaches. This is a model for training rural surgeons in India, where long distances and few specialists cause particular challenges. (Rafiq A, Moore JA, Doarn CR, Merrell RC, 2003) Using principles for surgical training, the authors propose integration of self-instructional materials, observations of operative procedures through live video transmissions or recorded videos and CDs, and hands-on experience in local hospitals under supervision.

The Internet also supports international collaboration in Continuing Medical Education through creation of and access to large databases and resources, or learning repositories. These store electronic educational materials referred to as “reusable learning objects”; e.g., single diagrams, images, course overviews. Educators and learners can use these to create a course or learning module. (Jena TK, Agarwal AK, 2003) This is an exciting opportunity as collaborating educational institutions can customize and re-use learning materials, and share and refine high quality educational strategies. One such collaboration is the International Virtual Medical School (IVIMEDS), a collaboration of 37 institutions. (Geueke M, Stausberg J, 2003) Another is the Hong Kong International Consortium for Sharing Medical Student Assessment Questions, a partnership of 12 medical schools sharing their pools of assessment questions, and
collaborating to increase access to rigorous and affordable assessments. (Harden RM; Hart IR, 2002)

Medical schools, currently challenged to serve rural populations and educates medical students distributed over large geographic areas, are responding in creative ways using ICTs and traditional educational methods. Australia, for example, is implementing rural clinical and medical schools to reduce health differentials between rural and non-rural communities and indigenous and non-Indigenous people. (Hkwebmed. Org [homepage on the internet]. Hong Kong: International Consortium for Sharing Medical Student Assessment Banks. [Updated 2005 Jul 8; cited 2005 Nov 25]: Available from: http://www2.hkwebmed.org/webmed) One system has a satellite link, four videoconferencing units, computer lab, communications links for videoconferencing, and high-speed Internet links. Other studies report the need for ICTs for education at undergraduate and practitioner levels and to support physicians. (Sturmberg JP, Reid AL, Thacker JL, Chamberlain C, 2005) In Canada, one medical school is collaborating with other non-medical campuses to prepare students for rural practice using synchronous education and web-based support in undergraduate education. (Booth B, Lawrance R, 2001)
2.4 OPPORTUNITIES AND CHALLENGES RELATED TO THE EFFECTIVE USE OF ICTs, ESPECIALLY IN DEVELOPING AREAS

To return to the educational model, ICTs and integrated systems using them connect learners, instructors and experts, formal learning materials and information resources in various ways, with the potential to realize a more equitable distribution of high quality Continuing Medical Education. While benefiting all learners and teachers, the opportunities are greatest for rural areas with limited access to the resources of academic medical centers. Summarized briefly, opportunities are in three general categories: interpersonal connection, connections with resources, and collaborative systems for international partnerships:

1. Interpersonal connections: Through ICTs, individual learners can interact with and learn from fellow students, colleagues, experts and instructors, previously inaccessible.

2. Connections with resources: As well as increasing access to formal course materials, ICTs also provide novel and important learning experiences; e.g. Virtual patients and environments provide risk-free settings for practicing skills ranging from history-taking to complex surgical procedures. New cellular phone technology can provide access to these resources anywhere, anytime, emphasizing that one of the most significant contributions of ICTs is the potential for universal access to timely and accurate clinical information.
3. Collaborative systems for international partnerships: In addition to benefiting individual learners and institutions, international collaborations using learning repositories and Internet communications, are working to improve Continuing Medical Education globally through shared resources and expertise.

While these benefits may now be realities for some learners, practitioners and medical schools, they are not universal and rural areas in particular may have more difficulty realizing them. Benefits result from a sophisticated combination of technology, applied educational theory, and environmental factors, held together by a high degree of organization. (McCormack C, Jones D, 1997) Challenges identified in studies cited above and by reviews of Continuing Medical Education interventions using ICTs, (Lau F, Bates J, 2004; Curran VR, Fleet L, 2005) arise in three main categories: 1) technology, 2) educational environment and 3) health care and social environments.

1. Technological challenges

These relate to using the appropriate ICT and having appropriate support for its use. The appropriate technology means the one that will meet the educational objectives in a feasible and sustainable manner. As noted above, using relatively simple ICTs combined with traditional approaches can be effective, and for rural areas, may overcome technological barriers. Challenges include limited access to communications capability (e.g. access to broadband Internet, cellular phone networks), cost, maintenance, learners’ and instructors’ training in the ICT
and support for remote sites. Each requires planning and monitoring for the ICT to effectively contribute to education or collaboration.

2. Educational challenges

Incorporating ICTs into educational interventions is often a challenge. Their use in education is often limited by inadequate attention to educational principles and evidence for effective learning (Chumley-Jones HS, Dobbie A, Alford CL, 2002). For example, educational outcomes are strengthened by instructor and learner preparation for ICT teaching environments, consideration of learners’ prior experience and knowledge base, matching learning goals with the specific technology and administrative support. Additionally, learners and instructors need new skills; e.g., information search, management and critical appraisal skills for using information resources such as websites, electronic journals, and databases, and instructors able to teach these skills.

3. Challenges created by local health care and social environments

Synergy between the goals of the education program and those of the local health care community facilitate learning. On a practical level, this also means having the appropriate health care resources at remote sites so that learners can put into practice the skills and knowledge newly acquired via ICT-enabled education, usually from urban sites with greater resources. (Davies D., 2005) More broadly, educational programs offered by ICTs have the capacity to cross demographic, social, economic and national boundaries. Hence, they need to be culturally sensitive, relevant to local health care priorities and supportive of local resources.
Continuing Medical Education has the potential to “bridge the digital divide”, to enhance health care of underserved populations and education of remote physicians and other healthcare providers. (Hovenga EJS, Hovel J, Klotz J, Robins P, 1998)

On a related note, many rural areas suffer from a shortage of physicians. While recent studies have identified many factors influencing physician recruitment and retention, several medical schools have designed specific rural undergraduate programs which appear to be positively influencing recruitment and retention. (Rabinowitz HK, Diamond JJ, Markham F, Rabinowitz C, 2005) One small CME study found limited evidence that providing distance education positively influenced recruitment and retention and further research is needed. (Curran V, Rourke J, 2004)

This study proposed a conceptual model as a framework for reviewing ICT uses in Continuing Medical Education (i.e., linking learners with instructors, specific course materials and/or information resources). Using the model, it described specific technologies and their uses as educational tools, and identified opportunities and challenges presented by ICT use in Continuing Medical Education. While there is a great opportunity to improve access to Continuing Medical Education, to improve the quality of education and to facilitate collaboration amongst individual learners and institutions; challenges do exist, especially for remote areas. These includes technological (e.g., overcoming barriers like cost, maintenance, access to telecommunications infrastructure),
educational (using ICTs to best meet learners’ educational priorities) and social (sensitivity to remote needs, resources, cultures). Finally, there is a need for more rigorous research to more clearly identify advantages and disadvantages of specific use of ICTs in Continuing Medical Education, to determine the specific conditions under which they are effective, and to understand the use of complex educational systems using multiple ICTs in Continuing Medical Education especially in Iran.