COMMENTARY

Information Communication Technology: New Approach for Rural Cancer Care Improvement

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Abstract

Cancer control aims to reduce the incidence, morbidity, and mortality of cancer and to improve the quality of life of cancer patients. For rural populations this presents particular problems. This article covers challenges of oncology care in rural areas and solutions via applying information communication technology with specialty telemedicine for overcoming problems in prevention, early diagnosis, treatment, and palliative care. In addition, telecommunications infrastructures and frameworks for implementation of telemedicine are decribed.

Key Words: Cancer control - rural communities - communication technology - telemedicine

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Introduction

Mortality rates for road traffic accidents, asthma, and cancer are worse in rural areas. Cancer is diagnosed at a later stage and intervention rates for coronary artery disease (key government targets for health improvement) are lower (Baird et al., 2006). Telemedicine can be cost-effective for different entities of care. For example, teleoncology is obviously cost-effective for the patients themselves. It's also cost-effective for the receiving rural facility, because they can keep their pharmacy, x-ray, and other patient charges locally. Telemedicine is cost-effective to the extent that our oncologists don't have to travel to those distant facilities (Cancer Care & Economics, 2007). Generally aim of this systematic review is to survey impacts of modern communication and computer technology on the delivery of cancer preventive services in remote locations.

Rural Locations and Cancer Care Challenges

The rural population is generally older, poorer, and less well educated than their urban counterparts. Rural areas have fewer physicians and hospitals per capita compared with urban regions. This disparity often results in a lower level of patient-reported health status, less confidence in being able to obtain needed care, fewer physician visits, and the need to travel farther to obtain care (Lipsky, et al., 2008). Cancer was most frequently rated as a priority by rural hospitals (Gosschalk, 2003). The inability to deliver cancer prevention and treatment to the rural population poses a significant barrier in the national effort to reduce cancer mortality (Desch, et al, .1992).

Teleoncology in Remote Areas

Developments in information and communication technologies (ICTs) during the last quarter of the 20th century heralded an information age in which economic and social activity has been widened, deepened and transformed. Telemedicine/telehealth uses IC to improve access to quality healthcare (Patoli et al., 2005). In 1998, the World Health Organisation (WHO) defined telemedicine as "… the delivery of healthcare services, where distance is the critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interest of advancing the health of individuals and their communities." (Ricke, et al,.2000). Telemedicine and the electronic health record are rapidly emerging technologies in contemporary health care (Carroll,). clinical telemedicine relates to the patient care and includes the processes such as teleconferencing, teleconsultation, telediagnosis, and telemonitoring, as well as specialty applications including teleradiology, telecardiology, telepsychiatry, teledermatology, and teleoncology. Being a complex diagnostic and therapeutic discipline, oncology is destined to practice a variety of telemedical applications (Malbasa, 2001). Teleoncology has been defined as delivering clinical oncology services at a distance and has come to encompass the use of electronic devices to aid clinical diagnosis, treatment and follow-up based on the transfer of video, images of clinicians and patients and data including pathology and radiology images, graphics and text (Olver,2003). Teleoncology is another

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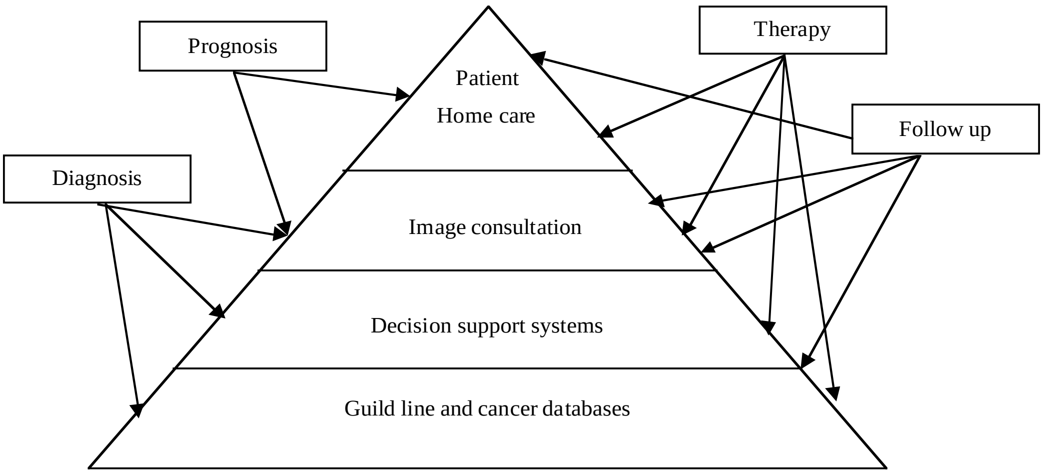

Figure 1. Pyramid Structure of Tele-oncology Applications According to the Patient Management Flow

aspect of telemedicine that is becoming increasingly popular. GTU (The Georgian Telemedicine Union)is implementing a teleoncology pilot program, through on-line consultations, via e-mail or web-page technologies (The Georgian Telemedicine Union, 2005). Telematics facilities can aid the cancer patient management in all its phases:

1. Four strictly related classes of aids can be used in tele-oncology
2. Information resources consultation (i.e. cancer guidelines and databases) generally via internet in hypertext format.
3. Access to decision support systems
4. Second opinions or specialist consultation
5. Patient homecare

The pyramid structure of the tele-oncology applications according to the patient managing flow is illustrated in Figure 1.

Table 1. Benefits of Teleoncology Processes (after Brigden et al., 2008)

Category of user	Potential benefits
Patient	- improved access to a physician - less travel time with decreased stress - decreased costs for meals and accommodation - less time lost from work - easier system access and improved scheduling - more family involvement and social support
Telehealth team including physicians and nurses	- decreased need for travel; increased safety - optimized professional time; potential for increased productivity - educational, peer review and collaborative opportunities
Other healthcare providers and stakeholders	- speed up medical processes and provide - more efficient service to patients - reduce unnecessary referrals - more needed referrals possible - reduce unnecessary tests and procedures - expanded networking opportunities for all participants

Tele oncology applications should cover the four basic steps in management: diagnosis, prognosis, therapy and follow up (Ferrer-Roca, 1999).

Benefits of teleoncology illustrated in Table 1. There is an increasing interest in assessing telemedicine as alternative method of delivering high quality cancer treatment to patients living in rural areas (Larcher, 2003). For example, a teleoncology project in Kansas, USA, provides rural areas with oncology services such as patient evaluation, second opinion consults, and comprehensive supportive care of cancer patients including follow-up visits, pain management, interactive support groups, and patient education also A cancer center in Scotland is linked with rural district general hospitals for the purpose of complementing the outpatient services, providing oncological advices, and teleconsultations (Malbasa, 2001). A common model for teleoncology is real-time videoconferencing. Even within this model there are several possibilities. The opinions of a multidisciplinary cancer team can be provided to rural and remote centers that may only be served by generalists. Here the teleoncology link is between clinicians. The patient's case is presented and the interaction is enhanced if the patient's radiology and pathology can be presented and discussed. This provides a second opinion for the remote clinician. A second model is clinicians videoconferencing with remote patients and their referring clinician or nurse who provides details of the physical examination, which cannot be done by telemedicine. These interactions can occur hospital to remote hospital, hospital to community center, or to a home or community to home. Once in place, the link can be used for any patient support measure or educational activity. It enhances peer review and is part of quality assurance (Olver, 2003).

However, the primary reasons for introducing telemedicine into health services are to deliver high-quality medical care to rural areas or distant clinics to improve clinical results (Olsen, et al, 2000).

Data and technology Infrastructures of Telemedicine

Infrastructure includes the hardware, software, communication, data storage and integration and foundation computer system capacity (Abdelhak et al., 2001). The communication infrastructure is used to transfer the patient data, reports, adiographs, and pathology images (Malbasa, 2001).

Network section

Managed clinical network improve outcomes in applying tele-ncology. Benefits of managed clinical network are:

Bringing together specialists
Using commonly agreed protocols
Multi-disciplinary team management
Developing data bases
Auditing process
Outcome evaluation

Components of managed clinical network are audio-visual tele conference, imaging transfer and data transfer. In addition, information to be collected in managed clinical network consists clinical information, (minimal) data sets, histo-pathology, imaging studies, laboratory data,recording of decision process (Reed, et al, 2008). Rapid advances in wireless and network technologies, such as IEEE 802.16 WiMAX and other broadband wireless access (BWA) systems, will open new opportunities for health care/telemedicine delivery and deployment. The convergence of these BWA around mobile health and systems will also enable the use of these new broadband technologies for efficient healthcare/ telemedicine and cost effective access anytime and anywhere. These new wireless telemedical scenarios will have a powerful impact on the way different healthcare organizations and medical doctors deliver healthcare to their patients(Guizani, 2008).

In addition, for security, data may be supplied in either Integrated Service Digital Network (ISDN) format using an advanced encrypted national standard, or via other formats that may be accessible from any location and also may supply high levels of encryption (Brigden et al., 2008). Finally framework in defining the guidelines and standards including:

- Interoperability: Develop telemedicine networks that interface together and create an open environment sharing the application on different participating systems in real-time or seamless interface between several applications
- Compatibility: Equipment/systems of different vendors and different versions of the same system, to be able to be interconnected
- Scalability: Equipment/systems inducted for telemedicine to be able to be augmented with additional features and functions as modular add-on options.
- Portability: The data generated by an application that runs on one system to be able to be ported to different platforms with a minimum effort.
- Reliability: Telemedicine systems to follow relevant reliability standards of equipment/systems to ensure availability of service with minimum system downtime.

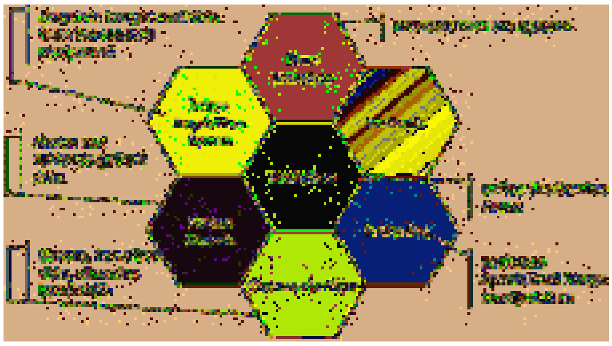

Figure 2. Application Software Architecture in Telemedicine (after Guizani, 2008)

Soft ware section

Software is the set of instructions required to operate computers and their applications, including programs that direct actual computer functions, and others to accomplish various types of business processes, known as application software (Abdelhak et al., 2001). More and more specifically designed software applications can be used to assess the medical workflow of an oncological patient and determine a life-long oncological electronic patient record (Mohr, 2008). Application software architecture in telemedicine is illustrated in Figure 2 (Guizani, 2008). Software written to process laboratory orders is application software. UNIX and flavors of UNIX as operating system can run on mainframes as well as workstations. UNIX is cable of running a number of powerful utility programs to support internet applications while allowing multi-user access and file-sharing capabilities (Abdelhak et al., 2001).

Standards for image sharing

New standards and data formats such as the 'digital imaging and communications in medicine' (DICOM), have significantly improved image transfer and exchange between different data systems (Olsen, et al, 2000). The DICOM standard represents the evolution of the historical ACR-NEMA (The American College of Radiology—National Electrical Manufacturers Association) sets of recommendations. DICOM version 3.0 protocol architecture illustrated in Figure 3 (web site LEAD

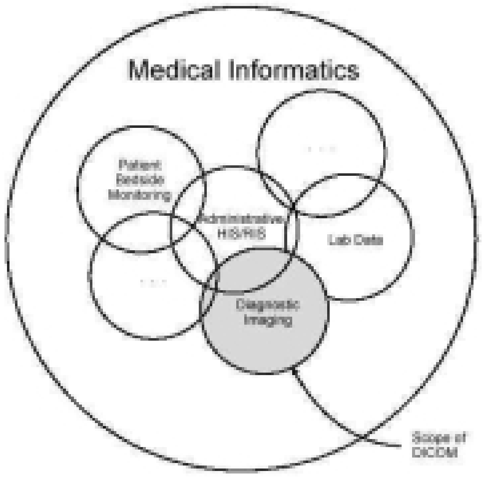

Figure 3. DICOM Version 3.0 Protocol Architecture (after web site LEAD Technologies)

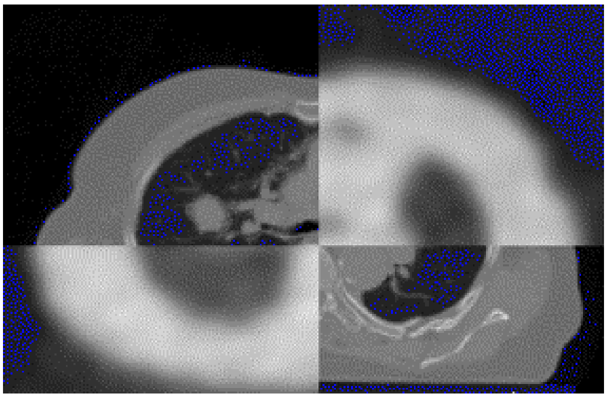

Figure 4. Matching of CT images with PET Scan and Tumour Delineation Facility (after Olver, 2003)

Technologies, 2008). It is designed to ensure the interoperability of systems used to produce, store, display, send, retrieve, query, or print medical images such as computed tomography (CT) scans, Magnetic Resonance Imaging (MRI), and ultrasound. DICOM Standard has also been developed to meet the needs of manufacturers and users of medical imaging equipment for interconnection of devices on standard networks (Lim et al., 2006). For on-line review and teleconsultation the 3-D image viewer and image registration module with DICOM access has been developed (Figure 4).

Conclusion

The disability to present cancer prevention and treatment services to the rural population is an important barrier in effort to reduce cancer mortality. Teleoncology is a new technology for providing comprehensive care for the cancer patient. It can have a key impact on the public health and cancer care in very remote communities. However, Teleoncology can overcome the obstacle of access to expert consultation and transfer pathology and laboratory data for them to aim best cancer diagnosis and early detection in remote locations.

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