VIDEOCONFERENCES. SYSTEMATIZATION AND EXPERIMENTS IN TELEMEDICINE*

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Abstract **Telemedicine refers to the delivery of health care services over a distance. Videoconference is one of the different modalities of telemedicine, allowing real-time interaction. The present study is aimed at describing videoconference systems in a simplified way, focusing on their application in telemedicine. Videoconference involves the necessity of equipment for audio and video capture and reproduction, besides a communication link for connection with similar equipment through ISDN (integrated services digital network) or IP (internet protocol). Video and audio quality is essential for the success of a videoconference. Experiments using videoconferencing equipment in radiology and other fields of medicine are a reality at international level. In Brazil, reports account for some isolated initiatives in this field, most of them involving universities networks. Besides its remarkable impact on costs of medical care delivery for the population, videoconference represents an invaluable tool for physicians in their education and knowledge updating.**

Keywords: Videoconference; Telemedicine; Teleassistance; Second opinion; Distance learning.

Resumo *Videoconferências. Sistematização e experiências em telemedicina.*

A telemedicina é definida como a troca de informações utilizando tecnologia de informação e de comunicação em saúde e a distância. Entre as diversas modalidades da telemedicina incluem-se as videoconferências, que permitem a integração em tempo real, recebendo e enviando áudio e vídeo de alta qualidade entre pontos distantes geograficamente. O objetivo deste trabalho é descrever, de maneira simplificada, os sistemas de videoconferências, destacando-se suas aplicações no contexto da telemedicina. Para a realização de videoconferências são necessários equipamentos que façam captura e reprodução de áudio e vídeo, e que tenham possibilidade de conexão com equipamentos similares, como microcomputadores e equipamentos dedicados. Os tipos de conexão para uma videoconferência são: via ISDN (*integrated services digital network*) ou via IP (*internet protocol*). A qualidade do áudio e do vídeo e a velocidade são críticas para o sucesso da videoconferência. Experiências internacionais na utilização de equipamentos de videoconferência, inclusive na radiologia e diagnóstico por imagem, já são uma realidade. No Brasil, relatos mostram iniciativas isoladas de telemedicina, em sua maioria incluindo redes universitárias. A videoconferência representa uma excelente ferramenta para a capacitação e atualização do profissional médico, além de proporcionar grande impacto nos custos do atendimento à população.

Unitermos: Videoconferência; Telemedicina; Teleassistência; Segunda opinião; Educação a distância.

INTRODUCTION

With the arrival of new technologies, the medical practice has undergone significant changes. One of the most impressive innovations is the application of information and communications technologies to the medical practice, generically called telemedicine or telehealth, aiming at medical information exchange using communications and information technologies for the delivery of clinical care at a distance[1].

Telemedicine dates from the sixties, during the space race, when the vital bodily functions of astronauts in the space were remotely monitored from the Earth by doctors of the National Aeronautics and Space Administration (NASA)[2–4]. From that time on, the application of this technology in medicine has been disseminated worldwide. In some countries such as Italy and United Kingdom, data transmission for diagnostic purposes is already in use since the seventies, and currently constitutes complex networks, connecting remote locations with renowned study centers and universities[2].

In Brazil, considering the territory size and the poor resources distribution, the potential telemedicine advantages may be considerable. Amongst these advantages, easier access to systematized protocols, distance education, collaborative research between teaching centers, second opinion sessions, besides a better assistance for the population, can be mentioned, especially in remote or deficient locations with difficult access to health care. The gap between di-

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agnosis and treatment is minimized, increasing the efficiency of the medical assistance, so justifying the investment in technology[2].

Videoconference is one of the several modalities of telemedicine, allowing real-time (synchronous) interaction, with transmission and capture of high quality audio, video/images files between geographically distant locations.

The present study is aimed at describing, in a simplified manner, the videoconference systems, focusing on its applications in telemedicine.

DISCUSSION

Videoconference systems

International Telecommunication Union (ITU-T) defines videoconference as "an audiovisual interactive conversation service providing a bidirectional and real-time exchange of audio and video signs between users groups locates in two or more different sites"[5].

The videoconference systems have been developed in parallel with the progress in the communication means. In the middle of 1964, the system inventors could associate phone conversations (voice) and static interlocutors' images. From that time on, communication systems and particularly communications means have developed significantly, allowing the synchronous transmission and reception of audio and video signs between two or more physically distant sites[5,6].

Presently, and under appropriate transmission conditions, videoconferences may be performed among several locations, with transmission and reception of high quality audio and video signs from and to any site through a network. Furthermore, several devices may be connected to these systems, expanding potential applications and improving communications[5].

Videoconference involves the necessity of equipment (hardware) like dedicated computers and peripheral devices for audio and video/images capture and reproduction, besides a communication link for connection with similar equipment. Hardware solutions may be divided into two categories: microcomputer accessories and dedicated hardware[5].

Distance conferences may be performed between microcomputers with a microphone and a camera (webcam), provided they are appropriately installed and configured. Any standard PC currently in the market includes a microphone input. Also, low expensive webcams are available[5]. However, there are limitations like poor images quality, bandwidth (depending on the type of connection) and the frames per second (the number of pictures the software can grab and transfer per second, depending on the type o camera), and also the impossibility of a multipoint connection provided by the equipment dedicated to videoconferences[7,8].

Equipment dedicated to videoconferences constitute integrated solutions specifically developed for this purpose. A dedicated system includes at least its own camera, microphone and network interface. More complete systems include auxiliary inputs for audio and video, alternative network interfaces, hardware CODECS (to improve the transmission performance and the audio and video quality), besides providing integration with peripheral devices[5].

Dedicated solutions do not require a computer to run, because they include their own managing system, are directly connected to audio and video devices and to the network, so the setup is easy. But they are more expensive than the solutions for PCs[5].

Most frequently, videoconference connections are made via ISDN or IP (Internet Protocol).

ISDN is the acronym for Integrated Services Digital Network. It is a circuit-switched telephone network available worldwide, a digital network supporting, for example, the transmission of a great amount of data, voice and images. As in the conventional telephone network, this service can be requested to the local carrier as a subscription[5].

ISDN allows transmission of voice, images and data over an ordinary digital telephone line called channel, in a single copper wire. Each of these channels can operate independently or in conjunction[9].

ISDN provides voice, data and image digital transmission at up to 128 kbps. It may be a dial-up internet connection service that, as compared to the traditional dial-up access, offers numberless advantages:

Quality: high quality ISDN digital line;

Connection: connection is completed in a short time (up to three seconds);

Baseline applications: ISDN duplicates the telephone line and allows the simultaneous utilization of voice over both lines, data transmission over both lines, or voice and data each over each line;

Data rate: Faster connection (connections at 64 kbps or 128 kbps). The lines can be utilized to access the internet, reaching an access speed up to 128 kbps. Furthermore phone usage can occur simultaneously with internet usage at up to 64 kbps;

Videoconference: With a videoconference system, presentations and meetings with participants in different remote locations can be performed.

Because of constant connection problems, and high cost as compared to broadband internet providers, ISDN is not appropriate for conferences requiring, for example, a continuous connection[9].

Connecting via IP means utilizing the Internet to complete a connection. It is the most common and less expensive connection type; however, the connection quality will be highly dependent on the bandwidth available between the ends [5].

The audio and video quality constitutes a critical issue for a successful distance participation, to allow participants to mimic as closely as possible a face-to-face environment. In videoconference meetings, although this may seem a little intuitive, audio is more likely to affect and interrupt a transmission than video. Little "hiccups" in the image (pixelization, freezing, etc.) are, most of times, tolerated by users. However, similar audio "hiccups" make a meeting unsuccessful. The effort and investment for improving the global audio quality in a videoconference will certainly result in the user satisfaction[10].

Another factor influencing the videoconference quality is the connection speed. Frequently, the higher the speed, the higher the videoconference quality: 384 kbps is, in fact, the minimum speed required for many videoconferences, particularly in static meeting. However, if a videocon-

ference involves participants´ movement or the capture of a live event (a demonstration, for example), a higher connection speed is justifiable. Limiting factors are the bandwidth available at each location involved, and the capacity of each endstation. In multipoint meetings requiring a multipoint conference unit (MCU), the participants may connect with different bandwidths. Depending on the MCU capacity, the participants will connect at the rate of the slowest site, or each site will connect at their call speed[10].

Endstations may include from systems based on large scale conference rooms with multiple displays and cameras to ultra-portable plug-in units to be utilized like a laptop. Different types of endstations may be utilized for connection to a same videoconference, provided they adopt the same standards. Also, the same audio&video systems may be utilized to access a range of different videoconference products[11].

Experiments with videoconference in telemedicine

Videoconference systems have been widely utilized as a tool in telemedicine. A study developed by and between Satakunta Central Hospital (Pori, Finland) and Noormarkkku Health Center (Noormarkkku, Finland), with a 15 km-distance between each other, was aimed at evaluating the technical feasibility of achieving a surgical diagnosis in 50 female patients. The methodology involved a general clinician in a remote location and without the assistance of a surgeon, and with a videoconference system connecting both medical centers. The distant surgical team had as an objective to perform the corresponding examination in the traditional way for confirming the results. The general clinician performed the physical examinations under the surgeon guidance through videoconference. This system presented interobserver agreement in 48 of 50 cases. The patients were saved from the physical discomfort of traveling to a distant reference center, and the interobserver agreement was sufficient for the system clinical application[12].

Another study developed in the Acute Critical Medicine Osaka at Medical School (Osaka, Japan), has described a telecommunications system for telemedicine purposes and evaluated its clinical utility as a support in diagnoses based on radiological and endoscopic images. The system has been evaluated for 53 times in Japan and five times in transoceanic procedures. The study concludes that the system has shown to be efficient as a support to the diagnosis remotely performed by a specialist[12].

In Germany, a pilot telemedicine project called Telemedic Pilot Project for Integrative Stroke Care (TEMPiS), promoted the integration between 12 hospitals in rural locations in the West-Bavaria and stroke centers in Munich-Harlaching and Regensburg. Discussions on clinical cases, computed tomography (CT) and magnetic resonance imaging (MRI) images occurred during videoconferences. A total of 106 systemic thrombolyses were indicated via teleconsultations in the period between February 2003 and April 2004. The mean door-to-needle time was 76 minutes, including 15 minutes for the teleconsultation[13].

Videoconference systems also can aid in the prenatal diagnosis of cardiac malformations. In a study aiming at selecting pregnant women requiring follow-up in tertiary hospitals in remote Chilean areas, sonographists and gynecologists submitted 50 pregnant women to 4D ultrasound. All cases suggestive of fetal cardiac malformations were discussed through videoconference with specialists at Clinica Sanatorio Aleman, in Concepción. This study has shown three post-natally confirmed cases of fetal cardiac malformation, two cases of extracardiac anomalies, and one non-confirmed case of cardiac malformation[14].

Application of videoconference for delivering clinical care to the population was described in the NASA's Telemedicine Space Bridge to Armenia demonstration project aimed at providing medical assistance in response to a huge earthquake in Armenia in 1988. Utilizing a live satellite or bidirectional communication system, medical teams of hospitals in Salt Lake City, Houston, Texas and Maryland, in association with doctors in Armenia, performed a range of medical consultations[3].

A pioneer and widely recognized study regarding the application of telemedicine may be found at the East Carolina University Telemedicine Center (ECUTC). A telemedicine program utilizes an interactive data bank of audio and video technology to deliver clinical care and education to the rural population in the East of North Carolina. Since 1992, the Center has performed more than 7,500 telemedicine consultations in more than 35 different medical specialties, and more than 10,000 activities of continued medical education and distance education. The O ECUTC includes a center of operational communications connecting the necessary ends with the global medical resources by means of ISDN, T1 links, microwave links, satellite links and IP technologies [3].

The NORTH Network in Ontario, the major videoconference-based telemedicine network in Canada, manages an extensive telehealth service for remote hospitals and clinics in the North of the Province. A private IP network (dedicated to health care applications) was implemented to link more than 60 Northern locations with large urban teaching hospitals. Specialists utilize state-of-the-art telediagnosis equipment for patients´ assessment. Presently, they allow more than 1,000 monthly consultations through videoconference, as well as the transmission of educational lectures utilizing the same technologies[3,15]. Furthermore, the IMPAX system was implemented for storage of image files from several PACS (pictures archiving and communications system) throughout the Ontario Province, allowing a fast and safe access to images required during the consultation. One of the most significant aspects of this system was the integration of more than 100 medical centers in Ontario, not all of them equipped with PACS, by means of NORTH's Multi-Organizational Membership. In the near future, NORTH Network plans to utilize the IMPAX system for the TeleStroke purposes, to allow a faster and safer access to the patient's CT images[25].

A new emergent application in telemedicine, is the distance monitoring, or even assistance of patients, either at home (telecare) or in centers of medical support and assistance, utilizing dedicated videoconference equipment, as necessary, or a computer with a webcam to connect them with a hospital or medical center via ISDN,

DSL (digital subscriber line) or cable connection. Frequently, such systems combine medical diagnosis devices such as stethoscope, electrocardiograph, otoscope, etc.[3].

In Brazil, some regional experiments of teleassistance including videoconference equipment and webcams, are currently in development, such as the "Telesaúde uma nova visão da Amazônia" project (Telehealth – a new vision of Amazonia)(http://www.sivam.gov.br/TECNO/ORG12.htm), connecting remote sites in the Amazonia with the most progressive hospitals in the country, transmitting digital radiological images and other studies requiring the analyses by specialists from the different areas of medicine. In the area of the Programa de Saúde da Família (PSF) (Family Health Program), some impact strategies have already been implemented in the field of telemedicine, such as Rede de Núcleos de Telesaúde (Nutes) (System of Telehealth Centers) in the state of Pernambuco (http://nutes.ufpe.br/), and the Programa BH-Telesaúde (BH – Telehealth Program) (http://www.ufmg.br/online/arquivos/006446.shtml), among others (http://telemedicina.ufsc.br), (http://estacaodigitalmedica.locaweb.com.br/). In the academic environment, and supported by the Ministério de Ciência e Tecnologia (MCT) (Brazilian Ministry of Sciences and Technology) and Rede Nacional de Pesquisas (RNP)(National Research Network), dedicated high speed networks (remavs) have been implemented all over the country, including telecommunications carriers, research institutes and universities with the support of private companies. So, projects like Rede Ipê, Projeto GIGA (http://www.projetogiga.org.br/) and, most recently the Projeto Rute – Redes Universitárias em Telemedicina (RUTE Project – Universitary Networks in Telemedicine)(http://www.rute.rnp.br/), have been interconnecting excellence centers, including in the areas of radiology and imaging diagnosis (http://www.rnp.br/noticias/2006/no-061218a.html)[16].

CONCLUSION

Experiments with videoconference systems are already a reality, including in the field of radiology and imaging diagnosis. Besides its remarkable impact on costs of medical care delivery for the population, videoconference represents an invaluable tool for physicians in their professional education and knowledge updating.

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