Telemedicine in women’s health care

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Telemedicine is the electronic transmission of health information for the delivery of clinical care from a distance. Today it is increasingly used to provide efficiencies in the delivery of women’s health care.

In 1975 Park and Bashshur[1] published a listing of 15 telemedicine projects that were underway at the time, two of which were sponsored by the National Aeronautics and Space Administration (NASA) in the United States. In addition to their astronaut programme, in 1972 NASA developed a system to deliver general medical care to Papago Native Americans, consisting of a van with medical workers and a microwave connection to a hospital and specialists[2]. Even as early as 1964 the Nebraska Psychiatric Institute used a closed circuit television system for teleconsultations[3], and in 1967 Massachusetts General Hospital was providing occupational services remotely to airport employees and travellers[4]. A true pioneer in the field, Memorial University of Newfoundland in Canada began to utilise satellite technology in the 1960s to provide distance education via teleconferencing to Nairobi, Kenya; and later to Kampala and the Caribbean[5, 6]. While nearly all of these early attempts at telemedicine were incredibly costly and yet equivocally effective, their developers were unquestionably the pioneers in a field which seems now to finally have come of age.

Telemammography
As the technologies for telemedicine have become better developed, they have become more fully integrated into the delivery of women’s health care. Probably the most publicised example of the use of telemedicine in women’s health care was in the diagnosis of breast cancer and initiation of chemotherapy in a who was stationed in Antarctica and later evacuated from the Pole[7]. Mammograms are a hallmark of health care, and by far the most developed and advanced technology in telemedicine is that of teleradiology. In a remarkable example of international cooperation, from 1990 to 1996 multiple organisations in Europe, America and Japan collaborated in the development of the Digital Imaging and Communications in Medicine (DICOM) standards for the transmission of radiographic images[8]. These DICOM standards were adopted in Europe under the name MEDICON and this standardisation paved the way for all teleradiography and specifically telemammography for women. As early as 1995 Goldberg and Dwyer[9] discussed the more demanding spatial resolution requirements for telemammography as a factor in its implementation, but accurately predicted that telemammography systems and their widespread use were not far away. At that time film screen mammography was the most common and effective technique used for the radiographic detection of breast cancer, but in 1997 Lou et al.[10] presented preliminary results of direct digital mammography. This technique increased the ability of radiographers to detect breast cancer via the distant transmission of mammographic images. In 2000 Bick[11] described other digital alternatives to conventional screen mammography, the same year that Mendez et al.[12] presented a project jointly sponsored by the European Union and the Spanish government. This project utilised computer-aided diagnosis to assist radiologists in the detection of
breast cancer in screening mammograms. Today, telemammography is widely used all over the world and still more advanced technologies and programmes continue to be designed. Drescher et al.[13] recently described the transmission of mammogram images over a POTS line (Plain Old Telephone System), and Carrol et al.[14] are looking at the realtime evaluation of mammogram images. This allows women on the Navajo Nation in the western United States to immediately obtain their results before they travel back into the remote areas of their lands, most of which are devoid of any communication capabilities. Telemammography for women is rapidly becoming a standard in today’s world.

**Telescopscopy**

Telescopscopy is another field in which technology is contributing to women’s care. In 2003 Ferris et al.[15] first described the technical feasibility of colposcopy, and in 2002 Etherington et al.[16] in Australia and Ferris et al.[17] in the United States both provided data that supported the reliability of telescoposcopic diagnoses. Others have also reported on the feasibility of telescopscopy in the evaluation of abnormal cervical cytology[18, 19].

**Telepsychiatry**

Telepsychiatry is also used specifically in women’s health care: in 2000 Morris and Hayward[20] described counselling for prenatal diagnoses, and in 2003 Thomas described its use for counselling in domestic violence[21]. While the experience in these areas is relatively limited, clear advantages for women in medically underserved areas are beginning to emerge.

**Telemedicine in pregnancy**

One area of women’s health care where telemedicine has offered some of the greatest opportunities is in pregnancy and prenatal care. There are many examples of the use of telemedicine in pregnancy, one being the remote and distant monitoring of blood glucose in diabetic pregnancies[22]. The monitoring of blood glucose in non-pregnant patients has become widespread in medical practices all over the world, and now the technology has been applied to the monitoring of diabetic pregnancies. Both Wojcicki et al.[23] and De Lieto et al.[24] reported on the improved glycaemic control in pregnant diabetic patients, suggesting improved fetal and maternal outcomes secondary to the use of telemedicine.

**Telemedicine in fetal monitoring**

One of the earliest examples of the use of telemedicine for fetal evaluation was provided by Boehm and Haire in 1979[25] when they reported 4 years’ experience of transmitting fetal monitoring data via a Xerox telexcopier to tertiary care centres. Home monitoring for preterm labour has now become widespread throughout Asia, Europe and America, and in 1999 Torok et al.[26] presented 10 years of data on home monitoring demonstrating improved perinatal results. In 2001 Morrison et al. showed significant cost savings as well as improved outcomes with home monitoring for preterm labour et al.[27]. And while monitoring for preterm labour is now considered routine in high-risk obstetrical patients in many centres, other programmes have moved on to remote active monitoring of the fetus itself in these high-risk patients. Numerous studies from several continents have confirmed the efficacy of these monitoring techniques[28–30]. More recent reports from China have reported on pregnant women who were able to transfer their pregnancy non-stress tests over normal phone lines for remote fetal evaluation[31], improving still further the ability to remotely monitor fetal well-being at home.

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With remote radiological imaging a reality, it was logical that the remote evaluation of fetal ultrasounds would soon follow. In 1996 Fisk et al.[32] reported a 6-month pilot of real-time ultrasound and video consultations between London and the Isle of Wight, establishing technical and clinical feasibility of the process. In 1997 Malone et al.[33] published a comparison of real-time evaluation of fetal ultrasounds with interpretation via recorded videotapes and concluded that there was a significant improvement in results with the use of telemedicine. Other studies have since documented the feasibility of even more advanced fetal ultrasound capabilities such as a virtual cardiological examination via telemedicine[34]. Fetal ultrasound continues to be a useful application of telemedicine and undoubtedly will become increasingly commonplace in the future.

**Fetoscopy**

One of the most impressive examples to date of the use of telemedicine in fetal care was reported in 2002 by Quintero et al.[35]. Telesurgical and ultrasound consultation from the United States was used to assist in performing an operative fetoscopy in Santiago, Chile, for the correction of birth defects in a pregnancy involving an acardiac twin. Examples such as this demonstrate that telemedicine does indeed offer substantial value and benefits in the provision of health care to women and will undoubtedly continue to expand and defy the limits of our imagination.

**References**


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