Telecommunications
& *Health*

I N THIS SECTION of *Telecommunications in Action*, telemedicine services are proposed as a means of supplying health care in developing countries where infrastructure may be rudimentary or non-existent. The costs of providing telemedicine can be considerable, but initial spending need not be excessive. A cautious approach is proposed, using pilot projects as a useful first step, perhaps in collaboration with other sectors of the economy which face similar problems of service delivery and may wish to become partners. Various national and international means of financing are explored and potential issues in telemedicine delivery are discussed. Costs and benefits are described and a number of case studies illustrate possible applications. This section shows how information and communication technologies can bring health care and medical services to populations to whom (because of geography, economics or other reasons) they had previously been denied. Such services can be simple, at minimal cost, or sophisticated, at considerable cost, but there is no doubt that, if delivered by traditional means, their costs would be prohibitive. Telemedicine therefore provides health authorities with a potent means to help meet their health care responsibilities, improve the well-being of their people and so accelerate development.

telecommunications
in Action

THE TERM *telemedicine* means, literally, "medicine at a distance" and was coined in the 1970s. A number of other terms such as *telehealth* and *telecare* have evolved around the original idea of telemedicine. Various definitions exist, but what is generally meant is the use of information and communication technologies to facilitate the provision of health care and medical information and services. These services can range from educating people in basic hygiene to the direction or control of a surgical operation from a distance. Telemedicine is especially helpful in diagnosing illnesses, in responding quickly to emergency situations, and in a number of educational applications.

The Deputy Director General of the World Health Organization (WHO) has made the following distinction "…if telehealth is understood to mean the integration of telecommunications systems into the practice of protecting and promoting health, while telemedicine is the incorporation of these systems into curative medicine, then it must be acknowledged that telehealth

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CORPORATE VIEW | Connecting hospitals

A TELEMEDICINE project in eastern Quebec has become a showcase in which different partners collaborate to provide the very best communication technologies.

Cifra Medical used advanced communication links supplied by Quebec Telephone and Telesat Canada to provide a network connecting 13 medical centres together. The links use signals operating to standards at the leading edge of communication technology, and allow combinations of various types of signals – for example, voice, computer file transfer, moving video pictures and fax – into a single signal that transfers information rapidly to a number of distant sites. Using this kind of network, specialists at the Laval University Medical Centre can, on request, provide real-time diagnosis of ultrasound images coming from a patient in hospital many miles away.

The project has been so successful that 25 hospitals are now connected to the network, and the number is continuing to increase. One key to its success was that Cifra Medical recognized the diversity of needs and used the various communication links to develop telemedicine technology that caters for either slow or very fast transfer of data, for small packets of information or large files respectively.

The company is also involved in the Montreal Hôtel Dieu Hospital project, which is developing applications for teleconsultation networking. This will enable specialists to discuss and consult with each other on clinical cases simultaneously, although long distances apart. This also opens the door to the possibility of on-line training, where specialists in one country would be able to join an operation in another and receive instruction on the medical procedures being used.

The kind of technology used in the project demonstrates how remote towns could be equipped with a "clinic" linked to telemedicine centres at specialist hospitals. Distance becomes irrelevant once a digital telephone call is established, and a doctor or specialist anywhere in the world can diagnose a patient. Real-time monitoring and diagnosis would be possible through otoscopes, stethoscopes, microscopes and other equipment connected at the remote site. People living far from main centres would be spared long journeys and, more importantly, quality medical advice would be given quickly, reducing the risk to the patient.

Thanks to remote surgeries, where health experts in a particular field of medicine can support remote nurses who may have only received basic training, the quality of primary care can be significantly improved, and health care brought within the reach of many who previously had no access to it.

Cifra Medical
E-mail: jfmeunier@ciframedical.com
Website: http://www.ciframedical.com
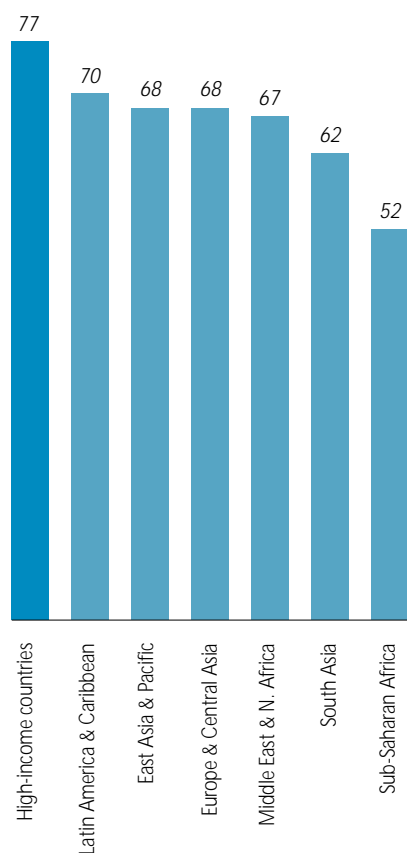*For further information see Annex B*

corresponds more closely to the international activities of WHO in the field of public health. It covers education for health, public and community health, health systems' development and epidemiology, whereas telemedicine is oriented more towards the clinical aspect." Telecare is a newly emerging area of distance nursing and community support. _Telematics for health_, as used by the European Commission, has a broad scope which covers not only tele-medicine and telehealth but also the application of information technology to improve health care systems. (_Telematics_ itself refers to the technology which has resulted from combining information and communication technologies.)

WHAT TELECOMS CAN DO

ITU and telemedicine for the developing world

The International Telecommunication Union (ITU) became involved in tele-medicine through a recommendation of the 1994 ITU World Telecommuni-cation Development Conference in Buenos Aires to study the potential of the technology to meet some of the health care needs of developing countries. A study group was set up which recognized the limited experience with tele-medicine in developing countries and the need for field trials to evaluate its impact properly. Regional telecom development conferences in Africa and the Arab States in 1996 approved directives for the ITU Telecommunication Development Bureau (BDT) to organize trials of telemedicine which would serve as test beds and models for successful implementation. The momentum of ITU work was maintained when the BDT convened the first World Tele-medicine Symposium for Developing Countries in Lisbon in July 1997. A report on the work to date within BDT, reflecting the conclusions and recom-mendations from the Symposium has been published[1] and BDT also published a more extensive report entitled _Impact of Telecommunications in Health-care and Other Social Services_ at the end of 1998.

Health telematics policies

Health for All in the 21st Century is the title of WHO's strategy for universal health care, and it specifically includes a Health Telematics Policy, formally adopted in December 1997. Eighteen recommendations were agreed, encour-aging member states to explore how telemedicine techniques can help in delivering health care. The ITU, at the World Telecommunication Development Conference in Valletta in 1998, approved a recommendation which, among other things, encourages national ministries of health and telecommunications (particularly in developing countries) to work towards the introduction of a telemedicine policy. It also encourages telecommunication operators to take an active interest in telemedicine and to work together with equipment and service providers and telemedicine experts.

Telecommunication components of telemedicine services

Local telephony circuits (between the telephone and the exchange) normally use a physical medium, such as wires, with limited transmission capabilities. These are, nevertheless, quite adequate for the exchange of information by telephone or relatively low-speed analogue data transmission (e.g. fax). When equipped with a modem, however, the same telephone line can carry digital

LIFE EXPECTANCY AT BIRTH _(years)_

High-income countries	77
Latin America & Caribbean	70
East Asia & Pacific	68
Europe & Central Asia	68
Middle East & N. Africa	67
South Asia	62
Sub-Saharan Africa	52

Source: _World Development Indicators 1998/99,_ World Bank

data and exchange audio data or video information between computers. Telephony combined with radio makes it possible to displace the receivers (telephones) and use them without requiring a wire or other physical connection. This makes it the most practical approach in many developing countries where no physical infrastructure exists. Mobile services include cellular telephones (at first analogue, but now increasingly digital), radio pagers, satellite mobile telephones and mobile Earth stations. The transmission capacities of these mobile services vary, for example from voice transmission for telephony to high-speed data transmission for video conferencing.

Telecommunication transmission techniques used in telemedicine

The following techniques are not mutually exclusive and a telemedicine application or service may use a single technique or any combination.

Audio transmission

Audio transmission is a well-known, everyday application used, for example, in medical consultations between patients and their doctors, or case discussions between two doctors. A successful, low-tech telemedicine service in the United Kingdom involves a helpline staffed by nurses which permits customers to consult a professional by telephone for advice on straightforward problems.[2] This is a simple but effective idea that could be adopted anywhere where there is reasonable access to telephones.

Data transmission

Data transmission permits the movement of medical data either in the form of static information (e.g. medical records or teaching materials) or as dynamic information such as vital signs (e.g. heart rate, blood pressure). Typical applications of static data transfer are access by a doctor to patients' records stored in a computer in a distant specialized clinic, fax transfer of documents and access by family doctors to specialized computer medical databases or libraries to update their knowledge. An example of dynamic data transfer occurs when a hospital monitors the vital signs of a patient who is in an ambulance. In a recent development, such medical telemetering systems are being offered commercially for use on passenger aircraft.

Image transmission

Image transmission may involve still images, such as X-rays, or moving images, such as video, for the purposes of consultation, diagnostic interpretation or video conferencing. Radiology images are the most commonly transmitted in current telemedicine practice and cover the following types of images: conventional X-ray, CT (computed tomography), magnetic resonance, ultrasound, nuclear (gamma ray), thermography, fluoroscopy, angiography and digital subtraction angiography. In some of these techniques an analogue image is produced which, for efficient transmission, must then be digitized. Other techniques directly produce digital images or digital data records (without any visual image) before transmission to the distant terminal where images are reconstituted. Telepathology and teledermatology use diagnostic

Topham

Once an X-ray has been scanned the images can be transmitted and interpreted anywhere in the world.

techniques where either still or, preferably, moving images can be transmitted for interpretation by a remote specialist.

Image transmission in still-image radiology, or in telesurgery, where real-time, moving images are required, is one of the more sophisticated and complicated processes used in telemedicine and may not always be practical, depending on the telecommunication links and/or compression techniques available. For example, to transmit two thorax digitized still-image X-rays by a digital cellular mobile phone would take four and a half hours. Using a much faster ATM (asynchronous transfer mode) circuit it would take two seconds. Transferring these X-ray images using slow-speed techniques is obviously not practical.

Some other medical imaging techniques – such as CT scans and EEG (electro-encephalogram or brain scan) images – may require the transfer of even greater quantities of data. In these cases, high-speed facilities or image compression techniques (which can reduce data transfer time by factors of 10 to 100 depending on the acceptability of image quality) are indispensable.

CORPORATE VIEW	Increasing productivity

TELEMEDICINE technologies continue to develop and one company, Medweb, has produced an e-mail plug-in which turns any typical desktop personal computer into a medical imaging workstation in minutes.

The e-mail plug-in is given free to any hospital which buys a server. It is small enough for doctors to include a copy in their e-mails. People receiving e-mailed case notes can then open up the software and study images at the same time as they read the notes. This means that consultants can annotate selected cases, include dictated impressions linked to graphic annotation and e-mail the results back with their comments.

The server offers considerable cost savings of up to US$50,000 per machine, compared with other workstations. Instead of using an expensive work-station to send images, technicians can display and transmit them simply using an Internet browser, the plug-in and a personal computer. When used with Net-scape Navigator, Microsoft Explorer or Lotus Notes, the plug-in allows users to download, display, manipul-ate and send annotated radiology studies via e-mail.

Medweb was established in 1993 to challenge many of the customs of image transfer, and to provide solutions for radiology groups to dramatically increase productivity, greatly reduce costs and assist in restruc-turing their professional services completely.

Medweb members bring closer the concept of a cost-effective nationwide medical imaging network that, in the future, could even change the way medical images are transferred worldwide. Inexpensive but intuitive personal activity centres – desktop computers with multitasking ability – are linked to servers that offer faster services and better patient file management to ensure quicker and more accurate diagnosis and follow-up.

The company provides affordable but sophisticated technology by using the established telecommunication network, which integrates the digital packet services of multiple regional and long-distance telecommunication providers. The network offers low-cost services to medical imaging users even in rural and remote areas.

They and all other users can access images and studies over local and/or wide area networks and the Internet using the unique browser plug-in. Encryption ensures confidentiality, and multi-level password control allows worldwide transmission.

Medweb
E-mail: pete@medweb.net
Website: http://www.mednet.net
For further information see Annex B

Telemedicine use: the pattern worldwide

The use of telemedicine, after several years of being a rather exceptional, experimental practice, has increased in the last few years. This rapid growth has largely taken place in the industrialized world, while the developing world is at the stage of conducting field trials and pilot projects. A number of case

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CASE STUDY | **Helping rural areas**

OBJECTIVES
■ To help users quickly find the best, most up-to-date and validated information for implementing health telematics, including access to educational multimedia software.
■ To identify and to give access to websites expected to be of interest to health care professionals in developing countries.
■ To provide information about selected telemedicine pilot projects in developing countries, which will serve as case studies.
■ To help disseminate the results of research projects.
■ To help producers disseminate data on their biomedical equipment and services to the right audience, including developing countries.

BACKGROUND A key problem for those interested in finding out about telemedicine is the fragmentation of information. The innovative concept of the European Health Telematics Observatory (EHTO) and its network of national language affiliated sites (NLAS) is to overcome that problem and enable a fine tuning of information to the different structures of health care, at national and regional levels.

DESCRIPTION The EHTO website <http://www.ehto.org> is a unique entry point for access to qualified, classified and categorized information on health telematics (including telemedicine) in Europe. EHTO disseminates the latest information on European Commission initiatives, programmes and projects, and calls for proposals. Information about existing European expertise and research results in health telematics can be accessed through the diverse projects on the EHTO website. EHTO can be used to search for information on specific domains and key areas using telematics applications or solutions, just by clicking on their key words.

EHTO also acts as an electronic market place, displaying information which can be exchanged by health professionals, industries and service providers. The EHTO website offers space for discussion groups and for electronic workshops.

The EHTO-NLAS Network is fully interactive, and each affiliated site can act as a link to websites in other countries speaking the same language (e.g. the existing affiliated sites in France, Portugal and Spain are establishing links with other countries in the developing world speaking French, Portuguese or Spanish, respectively). Affiliated sites have been installed in Greece and Finland. New affiliated sites were due to be created in 1998 in South Africa, eastern Europe (Romania, Czech Republic, Bulgaria and Ukraine), Germany, Canada and Australia.

COSTS For the first three years, EHTO costs were 100 per cent covered by the European Commission (US$220,000 per annum). EHTO-affiliated site costs are fully supported by each of the national telecom operators and the ministries of health (approximate cost per annum for developing countries is US$95,000; for developed countries, the cost of becoming an affiliated site is about US$220,000).

RESULTS The EHTO project has been in full operation for almost three years and has enjoyed a major success through the creation and implementation of its EHTO-NLAS Network which involves both health ministries and telecom operators.

Helping rural areas is one of the key objectives of EHTO. Access through the Internet to EHTO (or to one of its affiliated websites) gives new opportunities to distant areas. EHTO integrates images and voice and facilitates access to health care information and contacts. Access can be achieved by terrestrial or satellite means. EHTO facilitates participation in practical medical events (remote video conferences can be watched through EHTO), and remote areas can also benefit from educational tools (video, CD-ROM, distant symposia or conferences). The possibility of accessing the European Telemedicine Directory is another helpful tool for health professionals and decision makers in remote areas, to keep them informed on updated products and help them to choose the most appropriate one.

CONTACT
Maria Laires, European Health Telematics Observatory (EHTO)
Portugal Telecom
Praça Marquês de Pombal
15 – s/loja
1250 Lisbon, Portugal
Tel: +351 1 319 32 12
Fax: +351 1 315 94 30
E-mail: maria.laires@ehto.org

studies of such projects are highlighted later in this section. In Europe and North America, the results of earlier field trials of telemedicine have been encouraging. The technologies, both on the medicine and on the information and communication side, have evolved, and government bodies have given the green light, encouraging its expansion. In addition, the costs of providing systems have fallen as more parties, particularly from the private sector, have become involved in the competitive provision of systems and services. A recent report[3] estimates that US$500 million was spent in 1996 on telemedicine and that, by 2001, Europe and the Pacific Rim alone will be spending US$1.4 billion. The vast majority of expenditure is still in the industrialized world.

## Telemedicine and the Internet

One of the reasons for the North-South disparity in the distribution of telemedicine usage is the availability of adequate information and communication infrastructure, which includes the Internet and its most popular application the World Wide Web (the Web). Although Internet access is available in a number of developing countries, it is not universal because in many places the supporting telecommunication networks do not exist. In North America and Europe, many major medical centres and teaching institutions are connected to the Web and provide access to their electronically stored medical databases. Community hospitals and clinics have been less enthusiastic; the United States National Library of Medicine indicated that only 25 per cent of them had Web access during 1995. Estimates in March 1996 suggested that fewer than 1 per cent of all hospitals worldwide had a Web server. To encourage hospital usage of the Internet, the Health On the Net Foundation,[4] based in Geneva, maintains a list of hospitals worldwide that offer Internet consultation access, and outlines the services/specializations they provide together with Internet address information.

The growth of Internet usage is now providing opportunities for individuals, medical professionals and health care providers to obtain information, communicate with specialists, deliver first-line support and promote preventative medicine programmes. The Internet provides a low-cost communication tool with ever-widening availability (200 countries had Internet access at the end of 1998). The quality and low cost of new video conferencing and audio tools on the Internet are also providing a valuable resource for remote consultation and diagnosis.

The Internet and telemedicine in developing countries

There is no doubt that the Internet can play an important role in improving communications and information sharing in the developing world, but its presence is dependent on the availability of a suitable telecommunication infrastructure, i.e. a telephone network. Whether the Internet becomes a positive force will depend on how much it costs to access and how well people are trained in its use. If its potential is harnessed in locally appropriate ways, at a cost that is affordable to ordinary people, it will be a force for good. For some in the health sector in Africa, direct real-time access to Internet lines is obtainable through a growing number of commercial providers, especially

ACCESS TO HEALTH CARE IN SELECTED COUNTRIES, 1990-1995 *(% of population)*
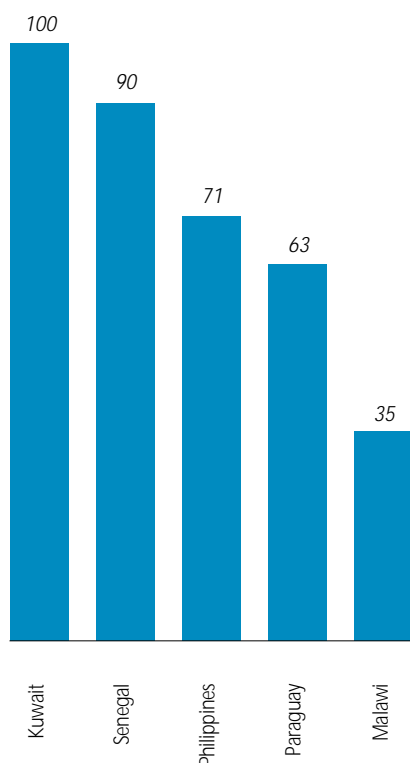
Source: *Human Development Indicators, 1997,* United Nations Development Programme

in the major cities. However, access fees and training costs put it financially out of reach of the majority of health professionals, let alone the ordinary citizen. In Zimbabwe, for example, Internet access costs around US\$5 a month, plus the cost of the calls, while the average monthly wage of those working in the medical and related sector is just US\$8.[5]

One particular problem of real-time Internet access for those in the developing world is the costly combination of usage fees and the extraordinary breadth of information on the Internet. Searching a particular subject can be time consuming because the vast quantity of information available is not organized coherently. For a health worker, trying to locate a specific piece of information can be the proverbial hunt for a needle in a haystack. This problem is exacerbated by the scarcity of useful information for health care practitioners in the developing world. While there are hundreds of websites containing information on cancer or heart diseases, very few sources of information exist on diseases such as leprosy, malaria or cholera that have major consequences outside industrialized countries. Even sites that deal with tropical diseases often lack detail and are unhelpful to clinicians dealing with the disease in hospitals and clinics in the field.

Telemedicine technology requirements

Hardware

Health care professionals need devices that can capture and manipulate data so that they can be transmitted over a telecommunication channel (which in developing countries is most likely to be a telephone line). General peripheral equipment (i.e. attached or connected to a modem or telephone) used in telemedicine can include the following:

- personal computer (PC) with software;
- teleconferencing and video conferencing equipment;
- digital camera;
- microphone;
- digital scanner and image processing software – once a digitized image has been captured in a computer, it can be manipulated and discussed by physicians far apart.

Medical equipment might include the following:

- for radiology (X-rays, CT, ultrasound): high performance ultrasound systems using digital technology and satellite links allow patients to be examined anywhere in the world while a doctor in another location receives the image and provides diagnosis and treatment consultation by telephone;
- for dermatology: video camera;
- for cardiology: digital sphygmomanometer (blood pressure); ECG (electrocardiogram); electronic stethoscope; microscope/endoscope adapter; EEG; portable monitoring unit – such units could be used by doctors or paramedics travelling in remote and rural areas.

On-line databases such as MEDLINE make medical resources available to anyone with Internet access.

Software for telemedicine

On the software market there are products ranging from CD-ROM family medical guides to on-line medical databases such as MEDLINE.[6] On-line

databases can be used by anyone, anywhere in the world, as long as they have Internet access. With such a range, equipment or service suppliers should be consulted for the software appropriate for the application. In some countries, software has been purpose built, designed by the service providers, and could be of interest to other countries facing similar situations. National or regional health services may wish to devise or engineer their own telemedicine service and while this is more complicated it may possibly be more economical. For such purposes there are numerous commercial, off-the-shelf software packages available, designed for telemedicine applications.

New software packages on the market are lowering the cost of teleconferencing and permit conference participants to collaborate over computer images or documents. New software also allows greater data compression than ever before, so that digital images with high data content can be transmitted over lower capacity networks. These Internet protocols are providing a real alternative to the high-cost bandwidth requirements otherwise needed.

CORPORATE VIEW | Patient monitoring

TELEMEDIC Systems has developed a new remote vital signs monitor (VitalLink™) that will bring a new dimension to telemedicine applications.

The device is designed to transmit, in real time, vital signs information from patients in isolated locations to a doctor who may be some distance away. It can also be used as a platform for any more conventional "store and forward" telemedicine applications. It has already been tested in a number of difficult environments, including aircraft in flight. The biggest potential benefit, however, is in the improvement of health care globally.

The unit is easy to use. It can be operated under remote guidance and the person using it needs neither medical training nor experience. It can monitor, among other vital signs, a patient's heart, pulse rate, blood pressure and a number of respiratory parameters. And this range is set to increase as other manufacturers develop different devices to integrate with the VitalLink system.

At the heart of the unit is a powerful IBM ThinkPad touch-screen portable computer "tablet" which has been especially adapted to encompass the medical monitoring electronics. The monitor is lightweight and comes, ready to use, in an easy-to-carry, fold-out case no bigger than a child's schoolbag. All the medical equipment is powered from the main computer system, which gives a continuous read-out of how much charge is left in hours and minutes. Additional batteries can be "hot swapped" if it is necessary to prolong the patient's monitoring, and the whole unit can be recharged from an external electricity supply.

The unit can connect directly with any available telecom/telephone system, including the public service telephone network, ISDN (integrated services digital network) lines, and cellular and Inmarsat mini-M satellite telephone systems, so that anyone using the device can connect to a doctor or other medical professional anywhere in the world. On an aircraft, the unit plugs directly into the existing in-flight telephone system.

The unit can also be used as an electronic "black bag" to enable doctors and others to gather medical data from many consultations and then store the data as part of their patients' electronic medical records.

By providing doctors with the ability to carry out on-line telemedical consultations with patients some distance away, as well as offering the facility to store and forward the data to a clinic or laboratory, the remote vital signs monitor can be used in virtually any out-of-hospital situation.

Telemedic Systems
E-mail: alasdair@telemedics.com
Website: http://www.telemedics.com
For further information see Annex B

telecommunications
in Action

TELECOM APPLICATIONS

Costs

Typical costs for the above equipment and software are in the range of US$20,000-50,000, depending on the particular software and equipment configuration.

As discussed earlier, most of the expansion of telecoms into health has so far taken place in the industrialized world, and most of the examples that follow are from there. They show what can be done in a number of different applications that could be replicated in developing country settings.

Teleconsultation

This service can be used in real time, for example direct telephone discussions between two doctors or video conferencing between a university hospital and

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CASE STUDY — Showing the benefits

OBJECTIVES

■ To improve access to health care for people in the region of Beira, Mozambique.
■ To show the possibilities and benefits of telemedicine applications such as teleradiology, ultrasound and laboratory information to doctors, specialists, government, the Ministry of Health and Empresa Nacional de Telecomunicações de Moçambique, the country's main telecom operator.

BACKGROUND Mozambique, with a population of close to 18 million, suffers from a severe shortage of health care professionals, especially in rural areas where 75 per cent of the population lives. Improved communications are needed to link clinics and hospitals with the University Hospital in Maputo.

The project was identified jointly by the Telecommunication Development Bureau (BDT) of the International Telecommunication Union (ITU) and the health and telecommunication authorities of Mozambique. It is taking place between the regional hospital in Beira, a city of some 350,000 people, and Maputo, the capital, with 1.1 million inhabitants.

DESCRIPTION The hospital in Beira makes approximately 30,000 X-ray films per year; in the past the more complicated cases have involved transportation of patients to Maputo for diagnosis and treatment. With the new set-up, the patient visits the X-ray clinic, where the doctor or the nurse prepares an X-ray image. The image is converted into digital form using a digitizer and stored in a PC. The image can then be sent via a dial-up telephone connection to a specialist in the Maputo University hospital. The new link uses digital microwave transmission between Maputo and Boane where the signal is picked up by satellite for transmission from Boane to Beira. In Beira the specialist examines the image, stores it and sends the results and recommendations back to the doctor in the Beira clinic. Having examined the X-ray in advance, the Maputo hospital specialist can advise on the necessity of transporting the patient and perhaps provide treatment advice and so avoid unnecessary transportation.

TELECOMMUNICATION EQUIPMENT One telephone dial-up connection between Beira and Maputo – a leased (dedicated) connection that will be replaced by a faster and larger capacity ISDN connection when this service becomes available in Beira.

TELEMEDICINE EQUIPMENT

■ 1 film digitizer.
■ 1 diagnostic workstation.
■ 2 PCs, each equipped with modem.
■ 2 teleradiology packages.

RESULTS The project became operational in January 1998. It is estimated that several hundred patients a year are saved the time, inconvenience and expense of travel to Maputo. But a further intangible advantage is the possibility for collaboration between the two hospitals and the learning opportunities presented.

This project is one of a series of case studies involving the BDT and other partners which can serve as models for telemedicine initiatives. Following a favourable evaluation, it has been decided to extend the service to the regional hospital in Nampala.

CONTACT
Telecommunication Development Bureau (BDT)
International Telecommunication Union
Place des Nations
CH-1211 Geneva 20
Switzerland
Tel: +41 22 730 54 33
Fax: +41 22 730 54 84
Website: http://www.itu.int

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one or more regional clinics. It is also possible to have off-line teleconsultation using e-mail when response delays are acceptable.

■ The University Hospital of Tromsø, Norway, provides ISDN (integrated services digital network, able to handle a large quantity of data very quickly) video conferencing facilities for rural doctors in the fields of dermatology, otorhinolaryngology and psychiatry. Results obtained early in the programme were checked on site, providing confirmation of accuracy. Rural physicians are happy with the system which also provides learning opportunities.[7]

■ An initiative set up under the leadership of the Telecommunication Development Bureau of the ITU in 1998 is enabling doctors in Georgia to obtain second opinions from specialists in Switzerland. X-ray files are transmitted over the Internet from the Research Institute of Radiology and Interventional Diagnostics in Tbilisi to the Centre of Diagnostic Imaging in Lausanne, and recommendations for treatment are returned within 48 hours. A number of difficult cases have been dealt with in this way, and the cooperation between the two institutions may be extended to other areas.[8]

■ In a demonstration project at the Sahel Hospital of Beirut, technically difficult coronary surgery was carried out for the first time by Lebanese surgeons with remote assistance from senior cardiologists in Toulouse, France, over a video conference link. This project was carried out during the ITU Regional Telecommunications Development Conference for the Arab States in 1996.[9]

Tele-education for health

Efficient and effective health care infrastructures require not only access to appropriate expertise but also continuing education and training for health care workers and the public. Specialized databases with the latest information and techniques are available to professionals who can thus update their knowledge, permitting them to detect diseases and take appropriate action more quickly. General health care information diffused electronically could help create a more enlightened public, which may then make fewer demands on the health care system by focusing on prevention (e.g. diet and hygiene). Tele-education in general is dealt with in a separate section of *Telecommunications in Action*.

■ The East Carolina University School of Medicine[10] in the United States maintains a network of contacts with trainee doctors in rural areas that permits them to consult medical information bases, increase their knowledge and deal with problems which they might not otherwise be able to address.

■ To give surgery students in the United Kingdom broader experience than that which a single hospital could provide, a high-speed video network – called superJANET[11] – links six major universities and gives access to both real-time teaching from operating theatres and multimedia information sources.

Medical emergencies and disaster relief

International and non-governmental organizations have used telemedicine applications for many years when dealing with emergency or disaster

situations. Virtual teams of medical experts around the world can be quickly assembled electronically to support teams working in epidemic areas and/or remote locations. Field personnel can utilize satellite communications for electronic mail and access to existing resource centres on the Internet. Local relief workers can also benefit from the support of distant medical professionals or can provide hospitals with details about emergency cases they will be receiving.

- A Swedish telemedicine systems company in Gothenburg provides mobile emergency care through consultations and transmission of ECG signals from a fleet of some 75 specially equipped ambulances to hospital cardiology intensive care units.[12]
- Medical Emergency Aid Through Telematics (MERMAID) is a European pilot project providing 24-hour multilingual telemedicine surveillance and emergency services in the maritime sector. The start-up MERMAID service is aimed at about 100 ships equipped with telemedicine stations.[13]

CORPORATE VIEW	Improving quality

THROUGH its new digital camera technology, Eastman Kodak is playing a vital role in innovative telemedicine programmes which are revolutionizing the way in which medicine is both practised and taught today.

In a bid to gain market share, cut costs and improve quality of care, Partners Healthcare, based in Boston in the United States, is integrating telemedicine into its large urban delivery system. The key objectives of this scheme are to decrease hospital admissions and reduce unnecessary clinic visits. One of the highlights of this project includes a wound management programme in which digital images are transmitted between a patient's home and the hospital. Post-surgical complications can lead to high health care costs and this method of monitoring patients once they have left hospital can avert serious problems.

Home care nurses take close-up images of patients' wounds using a Kodak DC50 digital camera which is connected to a laptop computer. The images can then be sent immediately by using a dial-up line to the local area network, where they are kept in a storage bank or transmitted directly to the relevant physician's desktop. Alternatively, the data can be stored locally and uploaded into the network at the end of the day.

Being used initially in the treatment of vascular surgical wounds, this system is expected to extend to cover general surgery wounds, diabetic wounds and ulcers, with the potential to change the way in which wound management is carried out worldwide. Cost savings incurred by this change in practice could be significant as managed care programmes are aiming towards shorter periods in hospital for vascular procedures. Patients need frequent visits to the clinic as well as home visits for up to 16 weeks after they have been discharged.

The medical school at the University of Maryland in the United States has been using the Kodak Professional DCS 420 digital camera system to capture and digitize radiology images to prepare a single-disc teaching programme aimed at radiology residents. The radiologists compiling the disc found that it was quicker and easier to photograph a film image using the Kodak digital camera than to wait for cases to come through on the monitor. In addition, it is often difficult to transfer digital data from medical scanners, as the images are stored in formats which are not easily understood by standard image processing applications. For specialist applications like radiology, the digital camera provides the desired superior image quality while the computer provides highly efficient access to information.

Eastman Kodak
E-mail: mgiglio@kodak.com
Website: http://www.kodak.com
For further information see Annex B

<http://www.pain.com> is a virtual support group, information source and contact point for pain sufferers.

Telesurgery

The objective of telesurgery is to perform surgery at a distance. This is very complex and has only reached the experimental stage. Trials of robotic tools capable of removing tumours or drilling holes in bones, directed from a distance, have taken place. The one important factor missing from tele-surgery up till now is the ability to transmit the surgeon's sense of touch, but work on this important aspect is under way. Telesurgery remains for the moment at the forefront of telemedicine techniques. Before such practices become routine and accepted, the question of legal liability for any errors will need to be resolved.

- A gall bladder operation in Hawaii was performed by a surgeon while another surgeon in the Netherlands gave advice via a video screen. The same Netherlands surgeon has also been conducting experiments with a robotic arm to operate an endoscope in laparoscopic or keyhole surgery. The next step is to control the robotic arm over a telecommunication connection.
- A surgeon at the Polytechnic of Milan carried out a prostate biopsy on a patient in a clinic several kilometres away. From a computer, he performed the biopsy using robotics with only an assistant present in the clinic.[14]

Keeping it simple – virtual support communities

The growth in Internet access is prompting new initiatives that enable health care providers to deliver better services at lower cost. An example of such an initiative is the growth of virtual support communities, where group members are geographically separated but linked electronically through the Internet into a "virtual" community. Groups of patients, and/or people caring for them, participate in newsgroups providing or exchanging information on their specific medical conditions. The quality of information provided to participants is generally of a high level, often supported by contributions from medical professionals. Possibly of greater significance, however, is the social or community support provided among participants. While neither sophisticated nor costly, this social support has proved to be a powerful tool in assisting patient recovery and in reducing visits to physicians and clinics. There is a wonderful opportunity for health care providers to contribute to these groups and encourage their patients to use them for complementary support. The Internet is an ideal communication facility for such support communities, particularly in regions with low or scattered populations and limited health care. A regularly updated listing of virtual support groups is maintained at the Health On the Net webserver <http://www.hon.ch>. This same server includes examples of benefits generated by such groups.

COST CONSIDERATIONS

The need for cost-benefit assessment

There is normally a need to justify spending on telemedicine against expected benefits or possible revenues generated. Various standard techniques for project analysis can be used, for instance a net present value analysis, which may enable a comparison with the costs of the existing situation and other options. The overall objectives of telemedicine should be kept in mind when conducting any economic feasibility study; they may

include specific national policy objectives such as the provision of universal health care, or those aimed at reducing the costs of health care provision among a specific target population or in a specific target region.

An important factor to keep in mind when preparing a cost-benefit assessment is that telemedicine is conducted in a complex and ever-changing technological, medical and political environment. Costs and priorities can alter rapidly, and cost-benefit assumptions that were well grounded a few years ago, or even one year ago, may no longer be valid. Many countries have found that, over a number of years, cost-benefit ratios improve significantly: projects that could not have been funded in the past have subsequently become feasible and were approved.

While a fully fledged cost-benefit analysis for assessment (or a feasibility study) could itself be expensive and time consuming, an outline of both the costs and benefits at least is required to enable the planners, politicians and health care administrators to seriously address a proposal for a

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CORPORATE VIEW | Specialist counselling

BASED IN Ancona in Italy, Aethra is developing and installing multimedia conferencing networks in emerging economies throughout Africa, Asia, eastern Europe and Latin America. As a result, distance barriers are being broken, people are learning new skills and new jobs are being created. With extensive global experience gained working in developing countries, the company is playing a major role in assisting these markets to develop their economies through multimedia workstations.

Access to information and knowledge sharing is pivotal to success in today's global business arena. Multimedia conferencing involving the simultaneous transmission of real-time video and audio communications and interactive graphics combined with collaborative computing has recently revolutionized business practices. More than just a business tool, multimedia conferencing is enabling the delivery of new opportunities in the fields of education and health care in developing countries, crucial to successful economic growth.

Distance learning, particularly in countries where educational resources may be limited, is key. Aethra's multimedia conferencing systems are having a positive impact on education services worldwide by bringing specialized teachers to a larger audience.

In South Africa, where recent socio-economic changes have made enormous demands on the education system, Technikon Witwatersrand is using the company's equipment to overcome the limitations of campuses in different locations. Lectures are being delivered using multimedia conferencing stations, allowing interactive sessions among students and lecturers across the country. In Guinea, a project is being launched to create a distance learning network in a drive to deliver education to the most remote parts of the country. Similarly, the Universidad Andina Simón Bolivar in Bolivia has started a video conferencing programme using Aethra's expertise to reach more people.

Telemedicine, which allows interaction between doctors in different locations as well as between doctors and patients, is playing an increasingly important role in ensuring quality health care for people in scattered regions where specialist medical care is in short supply and where there are few modern facilities. In Romania, Aethra equipment has been installed in a hospital in Singureni, where children with HIV infection are nursed. Using a satellite link, doctors at the hospital are able to obtain specialist counselling and advice whenever they need it from the San Raffaele hospital in Rome, as well as other centres. In Peru, hospitals in Arequipa, Lima and Piura share their knowledge and expertise in ophthalmology through video conferencing while in Côte d'Ivoire, telemedicine workstations supplied by Aethra will be used to link a small hospital in Ayamé to centres in Italy.

Aethra
E-mail: flaiani@aethra.com
Website: http://www.aethra.com
For further information see Annex B

telemedicine project. Cost-benefit studies should be conducted professionally and include all known benefits, both direct and indirect, as well as the economic and social benefits. Texts on these topics are widely available, so a review of only the most important elements for analysis and assessment is presented.

Simple framework for assessment

Cost-benefit analysis and economic and financial assessments should permit a good understanding of all cost and benefit elements as well as their expected evolution in time. Such analyses will satisfy the requirements of government decision makers, policy planners and health care administrators. Among the key considerations are:

■ the overall feasibility in a country or regional setting;

■ annual schedule of savings resulting from telemedicine applications;

■ annual operating costs for the health centre responsible for running the programme.

It is important that the apparently large set-up costs of any telemedicine

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CASE STUDY | Training opportunities

OBJECTIVES
■ To provide medical support to rural hospitals and populations.
■ To develop undergraduate and postgraduate medical distance learning programmes.
■ To lower the costs of services in remote regions while optimizing their quality.

BACKGROUND
Argentina is a large country with a population that is 87 per cent urban (with over 30 per cent living in the urban belt around the capital Buenos Aires). Distribution of the medical profession follows the same pattern, and rural areas have insufficient doctors and almost no specialists. Thanks to widespread cable television in the urban areas, a health and medicine channel Teleciencia was launched in 1989 and has since extended postgraduate courses, free of charge, to medical professionals in some 200 hospitals, clinics and societies. The current project will bring the services of specialists to a remote hospital in Salta (northern Argentina) and thus reduce the need for travel for local patients. The system will provide training opportunities to rural professionals that were previously available only in urban areas.

DESCRIPTION
A link has been established between a hospital in the Salta area and the city-run Santojanni hospital in Buenos Aires, which is affiliated to the Faculty of Medicine of the University of Buenos Aires.

The link will enable doctors at the Salta hospital to consult their colleagues in Buenos Aires on specific clinical cases. Sociedad Iberoamericana de Telemedicina S.A. (SITEM), as the company responsible for services in the telemedicine field, will coordinate the activity and provide the link required for transmission.

TELEMEDICINE AND OTHER EQUIPMENT REQUIRED
■ Salta hospital: video conferencing station and equipment for monitoring vital signs.
■ Santojanni hospital (Buenos Aires): video conferencing station.
■ ISDN line linking the Salta and Santojanni hospitals.

COSTS
The cost of the equipment is in the region of US$50,000, financed by Telecom Argentina and Telintar.

Other costs (travel by representatives and technicians to the locations involved, transmission costs) are estimated at approximately US$20,000.

PROGRESS
This pilot project is the first extension of telemedicine into the rural areas of Argentina. The system became operational in the first half of 1998 and plans are in hand to expand similar services to other rural regions of the country by extending links from Buenos Aires.

CONTACT
Guillermo Schor-Landman
Director
Sociedad Iberoamericana de Telemedicina S.A. (SITEM)
Bartolome Mitre 777 – piso 2
Buenos Aires 1036, Argentina
Tel: +54 1 328 7797
Fax: +54 1 328 8408
Mobile: +54 1 478 9704
E-mail: wschor@webar.com

programme be set against all categories of benefits over a suitable period of time, say five or ten years. All benefits can be annualized and used for constructing a series of cost-benefit ratios.

In performing net present value analysis, discounting should be done using appropriate social discount rates as opposed to commercial rates, to better reflect the value of a telemedicine programme to the community. It should be noted that not all categories of either benefits or costs are applicable in a particular programme or a country setting. In fact, most cost-benefit analyses can be relatively straightforward.

Criteria for selecting and assessing telemedicine projects

Telemedicine should be implemented on a scale commensurate with the requirements of any health care policy and the resources available. It is best to start with small-scale and simple projects or pilots and gradually expand as experience is gained. Care should be taken that the complexity of the

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CORPORATE VIEW | Home health care

WITH THE DEMAND for health care at home continuing to grow steadily – in the United States alone there are over 17,500 home care agencies – so the demand increases for computing systems which improve professional efficiency and patient care.

Telemedical.com has developed an intranet (a virtual private network) solution for home health care agencies, which includes application gateways for patients, nurses, physicians, administrators and other health care professionals. Qualified users can access medical records, notes, medication profiles and care plans. The data entry and display forms contain the patient's entire clinical record. Additionally, the website system allows instant access to medical and drug databases, agency policy, procedure manuals and training guides. Video conferencing modules enable the home health nurse to communicate with other health professionals directly from patients' homes. The video and telemedical monitors can also be used by a nurse to conduct patient education sessions, routine physical observation and vital signs monitoring from a central office location.

As the first Web-based home health care information system to combine the relevant infrastructure with low-cost telemedical features, the system provides the opportunity for home care agencies to deliver electronic health care at a fraction of the cost of typical provider visits or network solutions. The system can either run on the home care agencies' own intranet, or Telemedical.com can provide the agency with secure and encrypted Web-hosting services. Using this new technology means that a nurse can have instant access to electronic medical records and other information to help meet a patient's needs.

The advantages of providing remote patient access to these facilities are that patients and carers can take more responsibility for their care while the costs of data entry and documentation by health care professionals can be cut. Travel costs are reduced, with electronic rather than physical visits, as are in-person emergency visits, hospitalizations, office visits and nursing home placements, all of which significantly reduce the overall cost of providing health care.

Telemedical.com is pioneering on-line telemedical services, such as second-opinion medical consultations, preventative medical services and on-line semi-urgent care. Patients first complete on-line consultation interviews concerning their medical problems. Decision support and workflow software is then used to prioritize the patient's problems, transmit electronic reports and schedule a conference with appropriate online physician specialists. Web-based telemedicine is still in its evolutionary stage, but this technology will have significant effects on current medical practice.

Telemedical.com
E-mail: drcarr@telemedical.com
Website: http://www.telemedical.com
For further information see Annex B

technology and specific applications are appropriate for the objectives selected. Some typical criteria and factors which should be considered for project selection include the following.

Health care criteria:
- types of patients and symptoms to be addressed by telemedicine;
- skills needed by telemedicine practitioners;
- health care protocols which need to be established or modified;
- methods of evaluating the success of telemedicine.

Management criteria:
- operational support needed;
- administrative skills required;
- training needs to be arranged for practitioners at either end of the telemedicine link;
- technical requirements and skills necessary to implement telemedicine;
- requirements for integrating telemedicine into the overall health care system.

Technology criteria:
- equipment required for the initial set-up to achieve at least the minimum set of objectives;
- requirements on the telecommunication side to operate telemedicine applications reliably;
- type of training needed (this is of vital importance when new ways of working are introduced, and must be included every time a project is set up).

Technology assessment in the field of telemedicine has addressed questions such as technical feasibility, image quality, diagnostic accuracy, medical need, investments and running costs. But more emphasis is required in the fields of diagnostic impact, therapeutic impact, patient outcome, organizational impact of this type of health care, and new possibilities in the delivery and structure of health care. Technology assessment should take place continuously as telemedicine evolves, and work in the field of telemedicine should be a guide to further development, setting of priorities and implementation strategies.

Costs of telemedicine

Costs are usually quite easy to identify, although care must be taken to avoid including costs that national or private health service providers would incur in any case, or the cost of equipment that has already been purchased for a different reason. Similarly, costs of vehicles, telecommunication equipment and operators should be shared in appropriate proportions if these items are not only used for telemedicine. The costs fall roughly into three categories: capital expenditure, recurring operating costs and indirect costs. The cost of evaluating projects must also be taken into account. (As a guide, the United States army is reported to allocate some 30 per cent of investment in telemedicine for evaluation of systems.) It should be kept in mind that costs of telecommunications are decreasing every year, and the same can be said of the

British Telecom

Telecom applications like paging have an important role to play in making sure health professionals are accessible.

This CT scan can be transmitted to a specialist hospital many miles away for diagnosis or second opinion.

costs of computers, interfaces and software. On the other hand, personnel costs may be rising.

Capital expenditure costs:

■ telecommunication equipment specifically used for telemedicine (or a proportion, if it is also used for other purposes);

■ vehicles, boats, aircraft for mobile units (unless already available);

■ necessary hardware, software, interfaces and peripherals;

■ special diagnostic apparatus or modifications to the existing stock;

■ import duties, one-time licence fees and similar;

■ modifications to remote clinics, if necessary;

■ preliminary studies;

■ re-engineering of hospital services;

■ project management;

■ project assessment.

Operating costs:

■ telecommunication expenses;

■ maintenance of computers and specialized telemedicine apparatus;

■ vehicle running expenses and maintenance;

■ cost of telemedicine specialists and operators (only the relevant portion should be counted if these people also have non-telemedicine duties);

■ administrative costs;

■ insurance costs;

■ training and skills maintenance costs.

Indirect costs:

■ impact of competition for available funds in times of scarcity;

■ impact on the balance of payments if funds need to be obtained externally.

HOW IT CAN BE FINANCED

Optimized spending

Health ministries in developing countries, wrestling with widespread health problems and inadequate budgets, need to find the most cost-effective way to place their resources. This implies optimal use of their financial, physical and human resources to attain strategic national health goals. Despite infrastructural and other barriers to providing health care (e.g. geographical), their strategy will aim to improve the health of the largest possible number of people. Telemedicine, using modern technologies, can help meet this challenge.

Cost efficiencies – sharing the load

There are factors which can lessen the financial impact of providing tele-medicine services and thus favour their deployment in developing countries.

■ By their nature, these services are provided in conjunction with tele-communication services – whose operator can share the costs.

■ There is a possibility of providing other needed services in the domains of education, agriculture or commerce, whose providers, including other ministries, could share the costs.

OBJECTIVES

■ To improve the treatment of patients by linking three hospitals and using distance telemedicine consultation to access medical expertise and knowledge. For example, a radiologist is available in the hospital of Dakar Fann but not in the two other cities. The telemedicine network connecting the three hospitals will enable distance consultation and avoid specialists and patients having to travel.

■ To facilitate the ongoing remote training of health professionals.

DESCRIPTION

As a result of this project three hospitals in three different cities, Dakar Fann, Djourbel and St. Louis, will be connected to each other by telemedicine links, allowing transmission of medical images and other medical information. The "store and forward" method will be used for transmission of patient data. Equipment should be available in all three locations for video conferencing. The project will be implemented in phases according to the availability of financial resources. The present condition of the telecommunication network in Senegal will allow all three hospitals to be connected by ISDN network lines.

PARTNERS AND TASKS

Telecommunication Development Bureau of the International Telecommunication Union (ITU):
■ coordination with all partners and relevant local authorities;
■ telemedicine expert service for identification of the configuration of the telemedicine network;
■ partial financial support (in cash or in kind);
■ participation in the evaluation and monitoring of the work of the telemedicine network during the pilot period (six months).

SONATEL (Société Nationale des Télécommunications du Sénégal):
■ coordination with local partners;
■ participation in project engineering;
■ partial financial support (in cash or in kind);
■ participation in project implementation;
■ provision of the digital network transmission line between the three hospitals;
■ provision of maintenance support to all three hospitals for the telemedicine network and telemedicine terminal equipment;
■ participation in evaluation and monitoring of the network.

Ministry of Health of Senegal:
■ selection of hospitals for the telemedicine network;
■ selection of telemedicine application according to needs;

■ participation in evaluation and monitoring;
■ future financial support to the network after the first phase.

University Hospital in Dakar Fann:
■ coordination of all medical aspects of the project;
■ participation in the selection of telemedicine applications;
■ financial support (in kind);
■ participation in the implementation of the project;
■ participation in evaluation and monitoring;
■ based on the results achieved, make a proposal, together with SONATEL, for a further extension of the telemedicine network in Senegal.

COSTS

Phase 1		Amount (US$)
Partners	cash	in kind
BDT	30,000	15,000
SONATEL	30,000	35,000
University Hospital in Dakar Fann		25,000
Total	**60,000**	**75,000**

Phase 2 (provisional figures)		Amount (US$)
Partners	cash	in kind
BDT	70,000	
SONATEL		35,000
Ministry of Health		
Other potential partners	150,000	
Total	**220,000**	**35,000**

SCHEDULE

Transmission testing and design has been completed, and procurement of equipment, installation and testing is under way.

SONATEL CONTACT

Matar Seck
06 rue Wagane Diouf
BP69, Dakar
Senegal
Tel: +221 839 22 21
Fax: +221 821 40 06
E-mail: seck@sonatel.senet.net

CONTACT

Telecommunication Development Bureau (BDT)
International Telecommunication Union
Place des Nations
CH-1211 Geneva 20
Switzerland
Tel: +41 22 730 54 33
Fax: +41 22 730 54 84
Website: http://www.itu.int

■ The efficiencies of multiple use can be attractive to funding agencies which may provide financial aid.

The first goal – the pilot project

Before turning to external aid, cost efficiencies can be realized at national level if the ministries concerned and the national telecom provider work together. Expert advice is available from international and other agencies (e.g. ITU, WHO and the European Union (EU)) and neighbouring nations with telemedicine experience may also be able to contribute. After discussions among the partners, agreement on objectives and pooling of resources, it is possible that funding, at least for one or more pilot projects, can be found. Pilot projects allow the accumulation of indispensable first-hand experience and can indicate, under the particular local conditions, whether the service is cost-effective. This may lead to further steps such as a percentage of the national health budget being devoted to expanding the service or the introduction of other services.

CORPORATE VIEW | Nurses and midwives

MATERCARE International, an association of health care professionals dedicated to improving the lives and health of mothers and their unborn children throughout the world, has embarked on a three-year health improvement programme in Ghana with the assistance of Atlantic Communications Enterprises.

It is estimated that 600,000 women die during pregnancy and labour each year. In Africa the risk ratio is one in 13. By focusing on improved training for traditional birth attendants, nurses and midwives through distance learning initiatives, the tragedies of these unnecessary deaths and the problems of fistula tissue damage caused during childbirth can be avoided. Atlantic Communications Enterprises is providing the missing communication channels to the areas targeted by MaterCare in Ghana.

Initially, landlines are being linked via high-frequency radio to remote village clinics, and higher quality service with wider coverage will be introduced when personal communication systems, wireless local loop and access to low Earth orbit satellites are in place. These advanced systems will enable MaterCare to access its global network, providing essential tele-communication links and facilitating a constant flow of information between its offices. Video conferencing is another target requirement for the project, which will facilitate the compilation of a patient database to enable consultation and interactive debate between centres around the world.

With this infrastructure in place, MaterCare will focus on its training programme in rural areas, which is fundamental to the success of the whole project. Traditional birth attendants, who care for the majority of pregnant women in rural areas, are being trained to use a pictorial antenatal card to recognize and refer high-risk mothers to the district hospital at an early stage.

Nurses and midwives in rural maternity homes are learning how to use the labour partograph, a graphic method of tracking progress during labour developed by the World Health Organization, which will help them to identify complications early on. A new fistula centre is being established where physicians and nurses are being trained in obstetric fistula rehabilitation and treatment, as there are currently insufficient physicians in the region with these skills. The professional expertise provided by MaterCare International's network, in conjunction with distance learning materials and the extensive amount of data available on the system, will have a long-term effect on the well-being of women in West Africa.

Atlantic Communications Enterprises
E-mail: ace@acelgroup.ca
Website: http://www.acelgroup.ca
For further information see Annex B

Sources of funding

Given the dimensions of supplying health care, financial help is likely to be necessary. With the experience of a pilot project behind them, health authorities will be able to deal more confidently with funding agencies or experiment more knowledgeably with other funding sources. It should be kept in mind that help and advice will vary according to the provider. International organizations are motivated by open and wide objectives while those of the private sector, with normal commercial constraints, may be more narrow and self-interested. In all cases, it is suggested that contact is made to find out the best way to present an application for funding as this will vary between organizations, and according to the type of funding sought. Some of the possibilities are detailed below. (An extensive list of funding agencies and contacts is provided in Annex A.)

Development and aid agencies

Regional development banks and national aid agencies may be willing to support pilot projects. The European Commission has also supported pilot projects.

Budget matching

Ministries which have devoted a fixed percentage of their health care budget to telemedicine could solicit matching funds from an international funding institution.

ITU funds

The ITU has policies committing it to facilitating the provision of tele-communication services, such as telemedicine, in developing countries, and could possibly help finance some pilot project proposals. In the Mozambique case study presented earlier in this section, the ITU supplied a visit by a teleradiology expert and funding of US$70,000 for medical equipment.

World Bank

The World Bank and its agencies provide aid for both health and telecom initiatives in developing countries. The Bank administers numerous programmes, including Health, Nutrition and Population which, in 1998, boasted 157 active and 100 completed projects with a total value of US$14 billion. Both loans and special grants are available. The Bank also manages the Information for Development Program (infoDev) – a global, multilateral donor programme aimed at helping developing countries benefit from information technology. Its objectives include "improving health" and it encourages applications for funding for pilot projects.

International organizations

United Nations organizations which have supported pilot projects and acted as catalysts in bringing other partners together include the following: the United Nations Development Programme (UNDP); the United Nations Regional Commissions: the Economic Commission for Europe (ECE), the Economic Commission for Africa (ECA), the Economic Commission for Latin

A patient can now be monitored at a distance, even while travelling in an aeroplane.

Topham Picturepoint

America and the Caribbean (ECLAC), the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Economic and Social Commission for Western Asia (ESCWA); and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Support and advice is provided by the Association of Telemedicine Service Providers at <http://www.atsp.org>.

Preferential tariffs and USOs

Telecommunication operators could provide preferential tariffs for the telecommunication part of telemedicine services. Developing countries could form regional groups in order to obtain better prices for telecommunication services provided by foreign operators. For example, RASCOM (founded in 1992), a consortium of 43 African countries which got together with the aim of using and managing telecommunication technologies, especially by satellite, was successful in negotiating more attractive tariffs from INTELSAT. With appropriate regulations, telemedicine could also be part of a tele-communication operator's universal service obligations (USOs), such as provided for in the new Telecommunications Act adopted by the United States in 1996.

Joint ventures

Developing countries could consider establishing joint ventures in the field of telemedicine, by inviting local or foreign partners to participate and to take equity stakes in the delivery of telemedicine services.

Private sector sharing

Suppliers of telemedicine equipment or pharmaceuticals might be willing to contribute to setting up a pilot project.

Other innovative financing mechanisms

Countries seeking to implement telemedicine services could consider innovative funding sources, e.g. by negotiating debt conversion through the Paris Club.[15] Ministries of finance could be encouraged to negotiate some portion of debt conversion for telemedicine as a desirable social good.

Possible revenues

Users of the telemedicine services could be asked to pay a reasonable fee for usage. This money could go towards defraying operating and other costs. The policy proposed for multi-purpose community telecentres during the start-up project period is to find user payments and other revenues that will make them self-supporting after this period.

PLAN OF ACTION

Determining needs and priorities

The following guidelines could be used by developing countries, perhaps through a multi-disciplinary task force, to evaluate their needs and the potential benefits of telemedicine. It comprises task force objectives and a list of open questions to help identify and prioritize areas of potential use of information and communication technologies to improve the delivery of health care services.

telecommunications & *Health*

The mandate of the multi-disciplinary task force could be:

■ to identify health problems and specific areas of health care delivery which could potentially benefit from the use of information and communication technologies;

■ to assign each area a degree of priority at each health care level;

■ to make an inventory of all relevant resources (physical, human and financial, in health and in information and communication infrastructures and technologies) and their geographical distribution;

■ to identify constraints, potential obstacles, socio-cultural factors and legal considerations to take into account before introducing new information and communication technologies;

■ to coordinate a cost-benefit study of various technological options;

■ to make a certain number of recommendations based on the findings of this study.

CORPORATE VIEW | Diagnosis from a distance

MEDICAL imaging as a primary diagnostic tool is accepted as the norm in most industrialized countries. However, the technology needed to produce these images is dependent on expensive equipment and film, as well as water and chemicals. X-ray, which is widely used in most medical situations as the first step in diagnosing a patient's problem and evaluating treatment, is one of the most affordable and user-friendly procedures.

Recent advances in computed radiography have meant that these X-ray images are now available in digital form, overcoming a number of the limitations posed by the use of traditional cassette film. Fuji Medical Systems has been developing and perfecting these systems, which can bring better health care services to under-served areas. Retakes, as a result of poor technique, are virtually eliminated by this new method because of the greater image-capturing capabilities of the storage system.

Having captured the X-ray image digitally, it can be printed on dry printers which do not need water, processing chemicals or drainage systems to operate. If needed, low-cost paper printers can also be used to print locally. All the images can be archived digitally, saving the enormous amounts of storage space taken up by traditional bulky X-ray film jackets. Compatible with all fixed and portable X-ray equipment of any vintage, computed radiography is an efficient and cost-effective technology which can be adapted to suit the needs of any medical environment.

Significant advances in X-ray imaging technology combined with advanced and sophisticated telecommunication systems have revolutionized medical practice worldwide. Digital X-rays can be transmitted from one location to another at speed which means that physicians can have rapid access to data and are able to offer expert diagnostic advice from a distance. As a result, even patients in the most remote and inaccessible areas can have access to expert medical advice and therefore improved health care.

Recent compression technology enables these high-resolution, diagnostic-quality images to travel over telecommunication paths which are less sophisticated than the high-speed networks operating in major hospitals in industrialized countries. In addition new, computer-based image management networks have advanced substantially in recent years and it is now becoming practical to use these revolutionary data-sharing tools for medical teleconsulting, even with large, diagnostic image data files. This new technology has made it practical and affordable to offer quality diagnostic services to those areas with the greatest need.

**Fuji Medical Systems**
E-mail: clayl@fujimed.com
Website: http://www.fujimed.com
For further information see Annex B

Assessment of needs

The task force could use the following questions for assessing needs:

1. Is there a comprehensive long-term health plan, and is it adequate in terms of taking into consideration the new information and communication technologies?

2. What are the most pressing health, nutrition and population problems that need to be addressed in the country, by region and by population group?

3. What is the geographical distribution (and quality) of health resources? This could include:
   - number and quality of types of infrastructure (including pharmacies and laboratories) and medical equipment;
   - all categories of health personnel;
   - all categories of health training infrastructure and personnel;
   - inventory of, and area covered, by mobile teams (medical, health education, vaccination, training).

4. What is the geographical distribution (and quality) of information and communication networks and technologies? Information is required on:
   - the present and projected adequacy of road and transportation systems (in terms of time and cost for individuals to access different levels of health care);
   - the present and projected telecommunication infrastructure and equipment of various types (real-time and delay-time access);
   - computers and peripherals in the health sector (type, capacity); availability of parts and maintenance technicians; training programmes for users; modems and connectivity;
   - the present and projected electrification coverage (all sources used to generate power for medical equipment, computers, lighting);
   - radio and television coverage (including cable and satellite).

5. What is the state, by region, of health-related infrastructure such as access to water and sanitation?

6. Are there any specific geographical, climatic, cultural and political factors to be taken into consideration in integrating information and communication technologies into health care?

7. What are the current uses of information and communication technologies in health?

8. Has there been any evaluation of the use of information and communication technologies for health, and what were the benefits produced and problems encountered?

9. What are the present sources of health care financing (national and foreign), and what is the allocation of these resources?

10. Are financial resources sufficient to cover the present health plan? Would they be sufficient to integrate information and communication technologies into health care? Are there any strategies to generate new sources of financing?

11. Is there a concerted development strategy by different related sectors to share costs and resources at national and community levels?
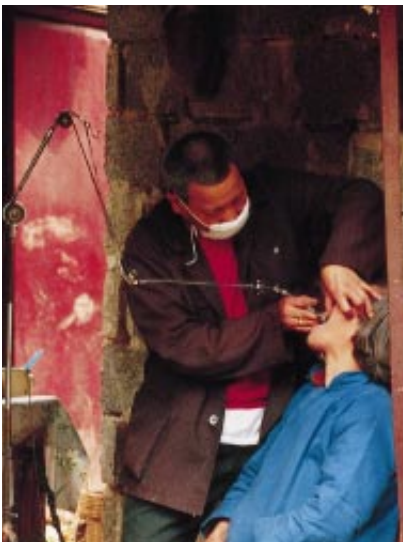
UNEP/Foo Kok Kim/Topham

An inventory of current provision of health care services will be part of an action plan to introduce new technologies.

Service delivery

Final decisions regarding delivery of the telemedicine service will be taken after having determined needs and established priorities; having decided to proceed and having arranged the necessary financing. Delivery of such services to remote areas that were previously unserved may require new approaches by leaders of the medical establishment.

Telehealth care and telemedicine can be delivered in developing countries in at least three ways:

- via a travelling professional such as a paramedic, midwife or doctor, who travels from village to village with satellite phone, ultrasound scanner and a few other pieces of equipment that permit consultation with a distant hospital or service provider;
- via installation of a telehealth care or telemedicine service in a specialized centre such as a new or pre-existing rural clinic or small hospital;
- in a "telecentre" or community centre (which could be a church, school, post office or police station), where the communication needs of several user groups could be aggregated in order to maximize the utility and lower the cost of providing the telecommunication service.

These approaches (and any other that seems viable) need to be validated. The first two methods are under the control – and at the expense – of the national health authorities. In the third method, a shared facility (a multi-purpose community telecentre) is foreseen, where each of the partners has control over its own services but where the costs of the building, the telecom links and certain equipment are shared through a partnership agreement among the service providers and other interested parties. The negotiation and close collaboration required among the local authorities and the different sectors (and, possibly, the national or international private sector) to arrive at a common accord is recompensed by the resulting optimal use of scarce funds and other resources. The telecentre has already been used in many field trials and is discussed in the section of *Telecommunications in Action* on rural development.

Considerations in the delivery of telemedicine services

Successful acceptance and operation of telemedicine services in any developing country will depend upon a number of factors and certain possible difficulties may need to be overcome. For example, physicians and/or patients may resist the use of a new technology that they do not understand. To be successful, telemedicine service providers must therefore answer the needs of the patient and the medical profession, with the patient-health professional relationship as the fundamental focus. Financing may be complex since telemedicine applications can involve different partners in a single venture (e.g. telecommunication operators, education authorities and hospitals). Operation of telemedicine services will require the availability of technicians to maintain and repair equipment, and guardians to oversee the premises. The costs of such personnel should therefore be foreseen. However, in a sharing situation they would be divided among the authorities involved.

PAYPHONES: INCREASING ACCESS TO HEALTH AND EMERGENCY SERVICES
(Community cellular payphones in South Africa)

- Actual
- Projected

29,500

22,100

14,700

9,200

3,700

3/95 3/96 3/97 3/98 3/99
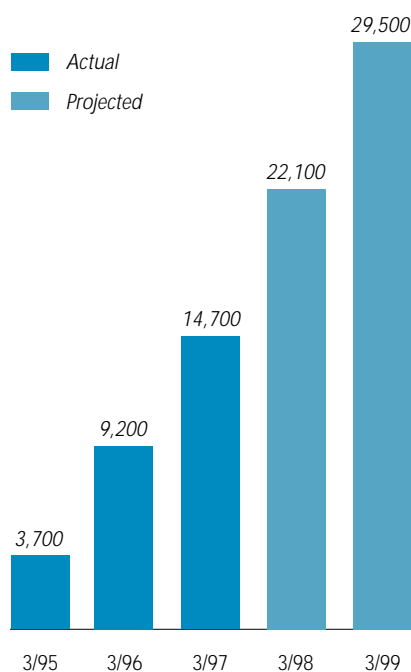
Source: Telkom, M-Cell, in *World Telecommunication Development Report, 1998*, ITU, Geneva

Issues

There are a number of unresolved issues that have emerged from experience in industrialized countries and which are still under debate. These are briefly discussed below because although developing countries may be less directly concerned with many of the situations described they should be aware of them.

Technical standards

Some telemedicine systems and services require that users at both ends of the communication link have compatible hardware. This requirement reduces inter-operability and the benefits of access to different sources of tele-medicine expertise. Similarly, the absence of universal standards in administrative (files, documents) and other aspects of telemedicine can also deter the cost-effective implementation of new telemedicine services.

Diagnosis at a distance

Are doctors willing to make judgements on the basis of transmitted information rather than seeing the patient face to face? The answer seems to be yes. At least one survey of doctors in the United States showed over-whelming support for telemedicine. Similarly, patients seem willing to take advantage of telemedicine services, especially if it means they can avoid costly or difficult travel to see the doctor. General practitioners and paramedics would often like to have a second opinion, or consultation or guidance from a specialist who may be hundreds or thousands of kilometres away. Despite the evidence, however, there is still a difficulty over the willingness of doctors today to make judgements on the basis of transmitted information. There are few insurance providers in developed countries who will cover risks associated with telemedicine consultations.

Legal issues: who is responsible for the patient?

If a local doctor or paramedic treating a patient contacts a telemedicine service and sends digital ultrasound images or X-rays for interpretation, who bears the responsibility toward the patient? Is it the local doctor or the specialist a thousand kilometres away?

Although many telemedicine interactions are already crossing state and national boundaries, legal precedents for remote liability and licensing are not yet established. When a telemedicine consultation crosses borders, does the provider have to be licensed in one state, the other, or both? If the community standard of care is to be upheld, which community standard applies? If telemedicine consultation services are available and an unsatis-factory outcome results when they are not used by a practitioner, does this constitute malpractice?[16]

Medical laws are based on who has a duty to whom. The doctor in direct connection (contract) with the patient is liable. Medical practices without clinical examinations may be contrary to medical ethics, but consultations between specialists who do not require patient contact (e.g. radiologists, pathologists, laboratory specialists) are partly exempt. What is more

Topham

The cost-effective implementation of new telemedicine services would be helped by universal administrative standards.

dangerous for the patient? Is treatment by telemedicine worse than delayed or no treatment?

In summary, the use of the Internet for telemedicine presents particular medico-legal problems. The Internet, by its nature, is not under the control of any identifiable organization. In fact, anyone can establish a website and some of those who may offer "medical" consulting services may not be qualified to do so.

Privacy and confidentiality of information

Remote consultations involve the transfer of information and/or competence. The public health services are generally concerned with protection of privacy, especially when it comes to the introduction of new technology. Sensitive information which can be associated with a patient's identity must not fall into the hands of unauthorized persons. It is also necessary to guard against mix-ups. The medical profession wants information to be stored for later

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CORPORATE VIEW | An interactive kiosk

RURAL North Carolina and the far reaches of Alaska in the United States are worlds apart in many respects, and their people have quite distinctive and different needs, but leaders in both states have discovered innovative ways to meet those needs, using similar advanced communication technologies from Sprint.

For example, parts of North Carolina suffer from high rates of poverty and infant mortality. Diabetes can be difficult to diagnose. Yet, it is difficult to provide comprehensive on-the-spot medical treatment to a population of more than a million living in an area of 36,000 square kilometres. Now, however, the School of Medicine at East Carolina University (ECU) is providing clinical services and professional education through a telemedicine system.

Since 1992, doctors at the ECU have conducted more than 3,000 telemedicine consultations in 34 medical specialities, while also establishing programmes to address specific needs. Working with Sprint, they have developed an interactive "kiosk" to offer information on diseases, treatment and drugs. Patients can also consult with a doctor via video conferencing. The kiosk has diagnostic instruments attached to it so that the doctors can check patients' vital signs and carry out retinal screening – important in diagnosing diabetes early on.

The company's technologies are meeting a different need in the frozen tundra of Arctic Alaska. Some 350 high-school students are scattered in seven villages over 215,000 square kilometres of trackless wilderness. So teachers in the city of Barrow are linked to the students through a combination of interactive video conferencing, a wide area computer network, e-mail and fax. As a result, the students receive a comprehensive high-school education in their own village schools, instead of having to go to boarding school, far from their families and culture. They are taught mathematics, art, health and Alaskan studies.

In both North Carolina and Alaska, full use is being made of Sprint's range of leading-edge technologies. In Carolina, the advanced telecommunication system combines, among other things, ISDN (integrated services digital network), Internet video and ordinary telephones. In Alaska, a fibre-optic network carries voice, video and data to a satellite station which then sends signals to each village school site.

These technologies open up a wealth of similar opportunities around the world. For example, developing countries can provide widespread access to state-of-the-art medical care, education, job training and much more. Well-planned deployment of advanced capabilities makes it possible to address these pressing needs rapidly and cost-effectively.

Sprint
E-mail: dennis.d.lombardi@mail.sprint.com
Website: http://www.sprint.com
For further information see Annex B

consultations, statistics and research, which raises issues about how this information should be managed. The problem of data storage within the health care framework is far from solved, and the process of archiving images electronically has just begun.

It is natural for there to be concerns about the security and confidentiality of health care data, especially when they are transmitted electronically from one location to another. One of the projects sponsored by the European Commission as part of its Third Framework Programme focused on this issue. The project was titled the Secure Environment for Information Systems in Medicine (SEISMED). Within the next few years, all European citizens could choose to have their medical histories stored on a database known as Hermes,[17] currently under development. This would give doctors greater and more complete information on which to base advice.

Security of data has three aspects: confidentiality; integrity (i.e. completeness, correctness and prevention of unauthorized modification); and availability (i.e. accessibility and readiness in a usable form). As information technology becomes increasingly sophisticated and accessible, questions may arise about how much information should be given to insurance companies who can fine-tune their premiums for higher risk groups.

BENEFITS   Socio-economic benefits of telemedicine

There is no doubt that telemedicine has the potential to improve the quality of health care and could evolve as a cost-effective alternative to some forms of delivery. The real economic, organizational, legal and ethical aspects must nevertheless be taken into account. A professional cost-benefit evaluation will thus be of crucial importance for health care policy makers when deciding if telemedicine should be introduced.[18]

Cost savings

Telemedicine could help some countries provide health care to unserved areas at lower cost, or cut existing health care costs. Hospital buildings and other physical infrastructure can be extremely expensive, and a substantial part of the cost of running hospitals is for accommodation and meals, which are essentially hotel services. The more health care can become decentralized and administered efficiently in low-cost settings such as clinics or community centres with telecommunication links, the less dependent patients become on expensive, asset-based sites such as special care hospitals.

Although telemedicine costs today are not low, countries with high health care costs are interested in the prospect of telemedicine as a way to reduce costs and demands upon hospitals. A study made in 1992 in the United States estimated that a total of US$36-$40 billion could be saved if the health care industry were to use more efficient telecom and telemedicine technologies.

Reduced waiting lists

Telemedicine can reduce hospital waiting lists if patients can be "seen" more quickly using telecom systems and can be given treatment immediately.

Reduced travel and stress

The use of telemedicine can reduce the need for patients to visit distant doctors and hospitals, saving them time and money. For example, in the telemedicine service in the Canary Islands, the Centre of Advanced Technologies in Image Analysis[19] receives three or four distant video consultations a week thus eliminating 30 per cent of inter-island patient transfers and 3 per cent of transfers to the mainland. Routine medical visits to the smaller islands by health care workers were reduced by 20 per cent. The yearly savings are estimated at some US$250,000, and families are spared the stress and expense of visiting relatives who have had to go for treatment to a hospital in a distant city.

Improved consultations and second opinions

Telemedicine enables health care professionals to consult quickly with distant specialists, eliminating the cost and risk of transporting an ill or injured patient over long distances and possibly rough terrain. In the future, more people can be treated and diagnosed using telemedicine, especially in smaller hospitals which lack the facilities of the larger ones.

Telemedicine can, theoretically, provide access to centres of excellence in various specialties from anywhere in the world. Telemedicine allows the scarce resources of specialists and expensive equipment to be shared by a greater number of patients. Doctors are no longer restricted by geographical boundaries; international specialists are able to exercise their skills across continents, even on battlefields, without ever leaving their own hospitals.

Public health

Governments in industrialized countries have developed public health networks, as a separate entity from health care networks, in order to follow the major health issues in the population. For example, the Réseau National de Santé Publique in France collects statistical data on births, deaths, diseases, water quality and nutrition and sends alert messages to local and regional centres in case of epidemics or any other significant health problems. Statistics are later published on paper and on the Internet (*sentinelle* service).

Public health telematic services and information centres may well be considered a necessity by governments in the framework of national and international programmes for the improvement of health. In developing countries, such facilities could be managed jointly with telemedicine networks for reasons of cost and efficiency.

Universal access

Telemedicine will help progress toward the WHO goal of Health for All by giving access to large numbers of people who currently have no, or only limited, access to medical care.
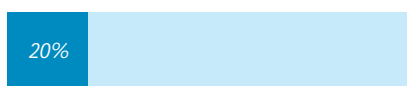
Training and education

For those health care professionals working in rural areas of developing countries, access to remote medical databases on the Internet, for example,

PEOPLE WITHOUT ACCESS TO HEALTH SERVICES, 1990-1995 *(% of population)*

Least developed countries

51%

All developing countries

20%

Source: Human Development Report Office, United Nations Development Programme, 1997

telecommunications
in Action

enables them to keep in touch with events and advances in their field, and to consult or share experiences with other doctors.

Telemedicine can be an important source of case study material from every part of the world. Students in one place can watch a medical procedure being performed by a surgeon or physician in another. It could be possible for students to watch live operations being conducted anywhere in the world and to communicate with the surgeon. Operations could be recorded for future play-back when a lecturer would be able to stop the tape and explain important points further or even replay parts.

Revenues

The provision of telemedicine and telehealth care services could not only optimize the use of tight health care resources but might generate revenues and create employment opportunities. Telemedicine is a high-tech industry where equipment manufacturers and service providers generate revenues

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CORPORATE VIEW | Patient records

A NEW two-way imaging and conferencing system that will permit diagnosis and case management by pathologists, traumatologists and other specialists from home or other remote locations has been produced by InnovaCom and Champlain Turner Enterprises. InnovaCom, based in California in the United States, specializes in communication products, while Champlain Turner consists of two doctors working in Sacramento, California.

The system, known as TransPEG Telepresence, is unique in that it combines the newest video compression technology (MPEG) with state-of-the-art communication networks, which include local area and wide area networks, telephone data lines and small-satellite distribution. The TransPEG family utilizes primary line signalling standards and is compatible with the Internet and modern data transfer processes. The medical information system, created by Champlain and Turner, provides an integrated record for two-way communication between the remote clinic and the specialist. In addition, it has the ability to track a patient's records including X-rays, scans, billing status, insurance information and other data which may be important to the patient, private practitioner, hospital, insurer, billing agency or service provider. The system was developed to reduce the cost and complexity of distance and travel time involved with remote patient access, and increase the specialist's ability to access patient information from a distance.

As broadcasters move closer to the digital television era, many options remain open for transmitting video from one point to another. The retransmission of signals is of primary importance to broadcast facilities worldwide, of which the most common method at present is the use of microwave systems to supply signals to a number of transmitters. However, recent advances in data compression technology and telecommunications have produced fibre- or copper-based systems, which are a significant improvement on microwave distribution systems, offering cheaper solutions, a more efficient and reliable service and one that is totally unaffected by weather conditions. This technology is also capable of compressing good-quality, live audio and video at reasonable data rates using existing networking infrastructure. Fast becoming one of the fundamental building blocks of modern-day transmission systems, compression technology is pushing us closer to a purely digital world. The broadcast benchmark requires full picture resolution and a digital video stream which can be fully edited.

Video compression technology aims to massively reduce the amount of data required to store the digital video file, while retaining as much of the quality of the original video as possible. In all aspects of our daily lives compression technology will have an important role to play.

InnovaCom
E-mail: janek@innovacom.org
Website: http://www.innovacom-mpeg2.com
For further information see Annex B

from the sales of their products and services. Telecommunication operators could augment revenues if their networks were used for the provision of telemedicine and telehealth. Telecommunication operators, equipment manufacturers and specialized service providers already compete for local and global telemedicine markets, and this could provide opportunities of benefit to developing countries.

National development

The delivery of telemedicine services can help in the realization of socio-economic benefits from among established national development objectives such as:

- provision of health education to various segments or to the whole of the population;
- provision of universal care, with a broader reach in rural and remote areas;
- employment opportunities for indigenous technicians and paramedics;
- dissemination of advanced technological knowledge;
- reduction of population migration or repopulation of abandoned areas because of availability of regular or on-demand health care in remote areas;
- necessary personnel recruitment (including but not limited to medical practitioners) for remote and rural areas with a positive impact on the local and national economies;
- improvements in WHO and national government health indicators;
- improvements in the national image (important, for example, for attracting investment).

Summary of benefits of telemedicine

- savings from reduced travel costs of specialists engaged in consultation or teaching sessions;
- savings from reduced travel costs of patients;
- savings on hospital accommodation of patients who can be treated remotely;
- savings on hospital processing costs of patients who can be treated remotely;
- savings following provision of health care in remote clinics or mobile health units as against expansion of urban or regional hospitals (i.e. the difference in construction and running costs of facilities);
- better opportunity for second opinions and consultations, so avoiding delays and costly mistakes;
- reduced waiting time and transfer delays: in some cases, this can prevent serious complications or death;
- reduced loss of income for patients who do not have to travel;
- reduced expenses for family members who might otherwise accompany the patient;
- improved effectiveness of specialists: broader reach, more patients seen;
- improved overall health care management, internally and externally;
- improved availability and reduced cost of training of local specialists;
- increased peer support to medical personnel working in remote and isolated areas, resulting in increased job satisfaction;
- improved teaching and learning possibilities and opportunities.
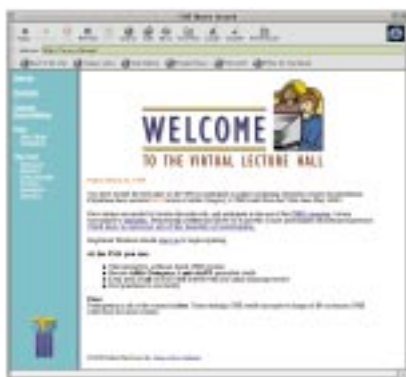
Opportunities for medical education and training are greatly increased by the growing use of the Internet.

Androuchko L. and Wright D. Telemedicine and developing countries, *Journal of Telemedicine and Telecare*, Vol. 2, No. 2, RSM Press Ltd, 1996.

1. *Journal of Telemedicine and Telecare*, Vol. 4, Supplement 2, RSM Press Ltd, 1998.

2. Sequent Computer Systems Ltd.
Sequent House, Unit 3, Weybridge Business Park
Addlestone Road, Weybridge
Surrey KT15 2UF, UK
Tel: +44 1932 851 111
<http://www.sequent.com>
PPP Healthcare and Sequent Computer Systems Ltd provided the patient helpline described in the text.

3. *The World Market for Telemedicine Products and Services*
Feedback Research Services
P.O. Box 1329
Jacksonville, Oregon 97530, USA
Tel: +1 800 927 8071/541 899 8088
Fax: +1 541 899 7344

4. Health On the Net Foundation
Secretariat, Medical Informatics Division
University Hospital of Geneva
1211 Geneva 14 , Switzerland
Tel: +41 22 372 62 73
Fax: +41 22 372 61 98
<http://www.hon.ch>
The Health On the Net Foundation is a non-profit organization, headquartered in Switzerland. Its aim is to build and support the international health and medical community on the Internet and the Web.

5. *ILO Yearbook of Labour Statistics 1997,*
International Labour Organisation.

6. MEDLINE
(also MEDLARS and the NLM National Telemedicine Initiative)
National Library of Medicine (NLM)
8600 Rockville Pike
Bethesda, MD 20894, USA
Tel: +1 888 FINDNLM (+1 888 346 3656)
toll-free (MEDLARS)
Fax: +1 301 402 4080/496 0822
(MEDLARS/MEDLINE)
<http://www.nlm.nih.gov/databases/medline.html>
MEDLINE is an on-line database of references to biomedical information. It contains records that cite articles from about 3,900 biomedical journals worldwide. MEDLINE is one of 40+ databases on the MEDLARS system. The National Library of Medicine (NLM) enters into bilateral agreements with public institutions worldwide to serve as international MEDLARS centres. These centres assist health professionals in accessing MEDLARS databases, offering search training, providing document delivery and performing other functions as biomedical information resource centres.

7. Department of Telemedicine
University Hospital of Tromsø
Norway
<http://www.telemed.rito.no>

8. Telecommunication Development Bureau
International Telecommunication Union
Place des Nations, CH-1211 Geneva 20,
Switzerland

9. Institut Européen de Télémédecine/European Institute of Telemedicine
Toulouse Hospital, Hotel-Dieu Saint Jacques
2 rue Viguerie, F-31052 Toulouse
France
Tel: +33 5 6177 8639
Fax: +33 5 6177 8642
E-mail: lareng@cict.fr

10. East Carolina University School of Medicine
Director
Greenville, NC 27858, USA
Tel: +1 252 816 2466

11. superJANET – ATM (asynchronous transfer mode) video
United Kingdom Education & Research Networking Association (UKERNA)
Atlas Centre, Chilton, Didcot
Oxfordshire OX11 0QS
United Kingdom
Tel: +44 1235 822 200
Fax: +44 1235 822 399
<http://www.ja.net/>

12. Mobimed
Ortivus AB Headquarters
Box 513, Enhagsslingan 5
SE-183 25 Täby, Sweden
Tel: +46 8 446 45 00
Fax: +46 8 446 45 19
Designed for medical professionals who work in the field, the Swedish telemedicine system Mobimed Pegasus is capable of fast transmittal of both data and video pictures. Local and remote diagnoses for a patient can be started immediately, allowing treatment to begin very quickly. The data can be transmitted from the site directly to the relevant hospital.

13. Biotrast S.A.
Dr George Anogianakis (Coordinator)
111 Mitropoleos Str
Thessaloniki 54622, GR12 Greece
Tel: +30 31 27 79 04
Fax: +30 31 27 79 60
<http://www.biotrast.techpath.gr/mermaid>
Biotrast S.A. is responsible for setting up the European pilot project Medical Emergency Aid Through Telematics (MERMAID), an integrated 24-hour multilingual, telematic, around-the-world medical emergency service to transfer medical expertise via satellite and ground-based ISDN networks to marine points of care. Requests for help, broadcast over Inmarsat, will be routed to one or more MERMAID specialist teleconsultants.

14. Polytechnic of Milan
Professor Alberto Rovetta
Department of Mechanics, specializing in robotics and communications
Piazza Leonardo da Vinci
32 I-20133 Milano, Italy
Tel: +39 2 2399 4720 or 4721
Mobile: 0335 463866
Fax: +39 2 706 38377
E-mail: rovetta@axp7000.cdc.polimi.it

15. The Paris Club has become a popular designation for meetings between representatives of a developing country that wishes to renegotiate its official debt (normally excluding debts owed by and to the private sector without official guarantees) and representatives of the relevant creditor governments and international institutions.

16. See also Perodania D.A. and Allen M.D. Legal issues, *Journal of Telemedicine*, 8 February 1995.

17. Hermes
Ken Boddy (Coordinator)
University of Edinburgh
Department of Obstetrics & Gynaecology
37 Chalmers Street
Edinburgh EH3 9EW, UK
Tel: +44 13 15 36 42 09
Fax: +44 13 12 29 74 95

18. Sommer T. Economic aspects of telemedicine, *Health Telematics*, DG XIII/C4, European Commission, April 1994.

19. Centre of Advanced Technologies in Image Analysis
Cátedra Anatómica Patalógica
Faculty of Medicine, University of La Laguna
38071 Tenerife, Canary Islands, Spain
Tel: +34 22 642 015
Fax: +34 22 641 855
E-mail: catai@redkbs.com