Making better access to healthcare services

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October 2005
Preface

1) The present ITU-D Study Group 2, Question 14-1/2 (Application of telecommunication in health care) report is not intended to be a textbook on e-health/telemedicine, in general, or on its telecommunications requirements, in particular. These subjects are covered in many existing publications.

2) This report is not an overview of e-health/telemedicine achievements worldwide. Our goal is much more modest. It is to provide some practical information on successful projects and activities, at various stages of implementation, that have been realized with the direct or indirect participation and support (financial, moral, scientific or other) of ITU’s Telecommunication Development Bureau. The common feature of many of the projects presented here is a maximum of achievement with a minimum of funding. The lessons learnt are therefore particularly valuable, especially for countries with limited resources available.

The report represents the collective experience of experts from different continents and different cultures. It is an eclectic collection of essays.

The aim of this report is to enable those planning to introduce e-health projects in their regions or countries to benefit from the experience of others in order to facilitate such an introduction.

This report consists of two parts:

• Part 1 provides an introduction to the subject, and deals with background matters — a definition of e-health/telemedicine, and who needs it, telemedicine applications, economic analyses, etc. It also highlights ITU’s efforts in the development of standards for e-health applications. Brief instructions are included for preparing projects for application, and an example is given on how to estimate the feasibility of a project proposal.

• Part 2 discusses a number of telemedicine projects in Africa, Asia, Australia, Europe and Latin America.

While this report is under translation, the experts from Japan have introduced additional items in chapters 3 and 4 of the present text. These include “Successful usage of Communications Satellite for supporting Medical Treatment in the aftermath of disasters, A decade History of PARTNERS Project, Experiments on secure satellite communications for long distance image transmission, Telemedicine and Biometrics, as well as Metadata Standardization for Telemedicine”. Additional case studies from the following countries and regions have been added: Japan, Latvia, Lithuania, Tanzania, the Pacific and Zambia.

Although the report is intended primarily for experts in developing countries, we hope that it will be a useful source of information for anyone involved in e-health.
Foreword

The Government of Japan has been promoting “Ubiquitous Network Society” which enables connection anytime, anywhere, anything and anyone in the world.

By premising the rapid evolution of ubiquitous related network technology, applications will play an important role in the area of telemedicine in the world; in particular it will bring many opportunities and solutions to developing countries. The National Institute of Information and Communications Technology (NICT) was established to carry out research and development in the field of information and communications technology in an integrated manner from basic science to application, with the aim of supporting the high information and communication society of the 21st century, as well as providing a comprehensive assistance to public and private organizations working in this field.

The work of ITU-D Study Group 2 in the field of application of telecommunication in health care is a useful tool for the countries that would like to embark in the marvellous adventure of e-health. It is our pleasure, therefore, to contribute to the publication of this excellent output. We are proud that some experts from Japan have participated in this excellent work.

Moreover, NICT appreciates and recognizes the activities of ITU/BDT in developing countries. It is our strong ambition to continue to work closely and jointly with ITU/BDT by sharing our knowledge and expertise, not only in exchanging technical advice and assistance, but also in analyzing the progress and impact of the ICTs on health care, at both the local and the global levels.

The report covers the entire process of telemedicine, from its definition to technology applications and successful practices.

This joint publication is a good opportunity to promote the partnership and work towards more joint activities between ITU/BDT and NICT.

It is our hope that it contributes to developing e-health all over the world.

NAGAO Makoto, Ph.D
President
National Institute of Information and Communications Technology (NICT)
Japan, October 2005
Foreword

Today, it is well known that e-health solutions and applications can play a crucial role in health care delivery, particularly in developing countries where the acute shortage of doctors, nurses and paramedics is constantly increasing to the enormous unsatisfied demand for health services. E-health can not be achieved without using telecommunications facilities. The use of telecommunication and information and communication technologies (ICTs) for supporting health-care and a healthy life is, therefore, a real challenge that all countries are facing, particularly developing countries.

This report has been prepared by the Rapporteurs’ Group on ITU-D Question 14-1/2 relating to the application of telecommunications in health care and it was approved by ITU-D Study Group 2 during its September 2005 meeting. At this meeting, the Japanese delegation offered to publish the English version of the report for dissemination during the World Summit on the Information Society (WSIS) in Tunis from 16 to 18 November 2005.

It is my sincere hope that this report will contribute to taking up this challenge and will promote and facilitate the development of e-health solutions to the benefit of many developing countries.

ITU is very grateful to NICT Japan for the support provided in making the results of this ITU-D Study Group 2 Question 14-1/2 into a publication that will be beneficial to developing countries worldwide.

I look forward to further collaboration between the ITU and NICT Japan in our collective effort to assist developing countries in the use of ICTs in the health and other sectors.

Hamadoun I. Touré
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International Telecommunication Union
Geneva, October 2005
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The text was prepared by a group of experts, led by Mr Leonid Androuchko (Rapporteur, Telemedicine Group, ITU-D Study Group 2 Question 14) and Prof. Isao Nakajima (Vice-Rapporteur, Telemedicine Group, ITU-D Study Group 2 Question 14) assisted by Dr. Jordanova Malina of the Institute of Psychology, Bulgarian Academy of Sciences. Valuable guidance was received from Mr Nabil Kisrawi, Chairman of ITU-D Study Group 2. Special thanks to ITU/BDT staff, in particular to Ms Fidelia Akpo (Coordinator ITU-D Study Groups) and Mr Alexander Ntoko (BDT Focal Point) for their active involvement and tremendous help in the process of preparation of this document.

In addition, the report has benefited from the inputs and comments of many experts from all over the world, to whom we owe our special thanks.

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# Table of Contents

Preface ................................................................................................................................. 1  
Foreword ............................................................................................................................... 2  
Acknowledgements ............................................................................................................... 4  
List of Contributors ............................................................................................................. 4  

## PART 1: Background

1 Terminology and Scope: brief overview ................................................................. 11  
   1.1 Definition .................................................................................................................. 11  
   1.2 Terminology ........................................................................................................... 12  
   1.3 Scope ..................................................................................................................... 13  
   1.4 Telemedicine-charity or business ......................................................................... 16  
   1.5 Some issues on e-health/telemedicine policy for developing countries ............... 19  
   1.6 From Theory to Practice ....................................................................................... 23  
   1.7 ITU e-health expert training course at Tokai University ...................................... 25  

2 Common e-health applications ...................................................................................... 28  
   2.1 Why is telemedicine expanding at this time? ......................................................... 28  
   2.2 Developments in telemedicine ............................................................................. 28  
   2.3 Digital imaging in pathology .............................................................................. 33  
   2.4 Teledermatology .................................................................................................. 40  

3 Telecommunication Infrastructure ................................................................................ 50  
   3.1 Overview of telecommunication infrastructure for telemedicine ....................... 50  
   3.2 Satellite-based telemedicine practices ................................................................ 52  
   3.3 Successful usage of Communications Satellite for Supporting Medical Treatment  
      in the Aftermath of Disasters .................................................................................. 56  
   3.4 A Decade History of PARTNERS Project ........................................................... 64  
   3.5 Experiments on secure satellite communications for long distance image  
      transmission ............................................................................................................ 68  

4 Standardization in e-health and interoperability problems ........................................... 71  
   4.1 Integrating Telemedicine Systems for e-health ................................................... 71  
   4.2 Interoperability considerations for e-health in developing countries ................... 83  
   4.3 Standardization activities ..................................................................................... 90  
       4.3.1 Current situation in e-health standardization ................................................. 90  
       4.3.2 ITU standardization activities in telemedicine ............................................. 96  
       4.3.3 TELEMEDICINE AND BIOMETRICS ................................................... 99  
       4.3.4 Metadata Standardization for Telemedicine .............................................. 104  

5 Project Design for e-health .......................................................................................... 108  

6 How to make a telemedicine/e-health project sustainable: ........................................... 112  

## PART 2: CASE REPORT

1 Bangladesh ....................................................................................................................... 122  
2 Bhutan ............................................................................................................................ 131  
3 Bulgaria ......................................................................................................................... 139  
4 Cambodia ...................................................................................................................... 148  
5 Ethiopia ......................................................................................................................... 152  
6 Georgia ......................................................................................................................... 156
ANNEX 1: RESOLUTION 41 OF WTDC, ISTANBUL, 2002
PART 1

Background

1 Terminology and scope: brief overview

1.1 Definition

Telemedicine has been practiced for a long time. It first came about with the introduction of telephone and telegraph in the early 1900s. At the beginning of the 1920s, medical advice was being sent in Morse code to naval and commercial vessels at sea. Today telephones, faxes, e-mail and the Internet are all in wide use for transmitting information between medical schools, hospitals and physicians, improving the processes of consultation, diagnostics, treatment and distance learning.

Among early uses of the term “telemedicine”, in the 1970s Thomas Bird used it to describe the process of using telecommunications technologies to examine patients remotely. The word “telemedicine” is formed from the Greek word τελε (tele), meaning “at a distance”, and medicina or ars medicina to denote “healing”.

The exact definition of the term has varied over the years. Usually telemedicine is defined as “a delivery of e-health and exchange of health care information across distance” [1]. More elaborate definitions have included the following:

—Rapid access to shared and remote medical expertise by means of telecommunications and information technologies, no matter where the patient or relevant information is located. This is the definition used in the European Commission’s health care telematics programme.

—Investigation, monitoring and management of patients and staff using systems which allow ready access to expert advice and patient information no matter where the patient or relevant information is located. This official explanation of telemedicine is a basic concept of the action “Advanced Informatics in Medicine” of the European Communities for the period 1989–1994.

—The World Health Organization (WHO) applied a more sophisticated definition in its Health Telematics Policy in Support of WHO’s Health-For-All Strategy For Global Health Development. Telemedicine is defined as “the delivery of e-health services, where distance is a critical factor, by all e-health professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.”

The list could be continued, but it would be futile. All these definitions are valid, but they represent the result of political consensus. How do the specialists working in everyday telemedicine/e-health practice describe it? In early 2005, a survey to investigate this question was conducted among 66 telemedicine experts from Africa, Asia, Europe and North and South

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America. Participants were asked to fill in a questionnaire listing the main characteristics of telemedicine. The following definition emerged: “Telemedicine/e-health is a digitalized health service supporting medical staff in routine work ensuring easiness of data transfer and on time, cost effective, time saving, 24 hours a day patient care without physical presence of patient and doctor at the same location”. Perhaps the simplest definition of telemedicine is “medicine at a distance” [2].

As we see, all of these definitions are sufficiently broad to include every aspect of e-health services and e-health education.

References


1.2 Terminology²

What is telemedicine?

Telemedicine combines state-of-the-art electronics and telecommunications technology and applications to deliver health care and education to patients and providers at a distance. The electronic tools used in telemedicine include

—low-tech tools, which includes telephones, facsimile machines, video cameras and monitors; and

—high-tech tools, which includes computers, digital imagery and Internet.

Using any one or a combination of these tools to facilitate improved health care (relative to existing norms), or to deliver health care more efficiently, constitutes telemedicine.

Why we use the term telemedicine

While the term telemedicine was widely used and accepted until the middle of the 1990s, authors have since started to distinguish between different concepts such as telemedicine, e-health and telehealth. Positions differ. For many authors telemedicine and e-health are one and the same thing. Others consider that e-health is a broader term and includes telemedicine. Still others consider them separate concepts, with telemedicine including telecardiology, teleradiology, telepathology, teleophthalmology, teledermatology, telesurgery, telenursing etc., while e-health covers the use of information and communication technologies in health care (ICT-health), health communication services, picture archiving and communication systems (PACS), hospital information systems, e-education, e-prescription etc. Readers with an interest in discussions of the terminology issue may refer to the TM Alliance Final Report from 2004, entitled “Telemedicine 2010: Visions for a Personal Medical Network”.

The authors of the present report have used the terms telemedicine and e-health interchangeably, reflecting both the world-wide acceptance and recognition of the former term (in wide use for more than three decades) and the increasing popularity of the latter (despite its tenuous hold in developing countries, rural areas and other administrative units). One consideration has been that at the time when most of the projects described in Part 2 were initiated, telemedicine was the only accepted term.

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In the final analysis, disagreements over terminology must not be allowed to obscure the underlying issues. Thus, the two terms will be used interchangeably, and the term telemedicine will be used in its broadest sense, encompassing a wide range of activities.

1.3 Scope

Telemedicine/e-health-who needs it?

The answer to this question is part of the definition of telemedicine. As telemedicine is “medicine at a distance”, everyone needs it. Its greatest potential, however, may lie in the promise it holds for developing countries.

Unfortunately, even though telemedicine is not a new concept and has been introduced in most areas of medical specialization, and despite the wide range of telemedicine projects existing in various countries, it is still considered to be outside the mainstream of health care.

Professor J. C. Healy from the European Commission said during the Telemedicine Workshop in Strasbourg in November 1999, “…the bottlenecks of telemedicine activities are no longer the technologies themselves (in term of speed, quality, resolution, access, memory etc.), but the real medical interest itself… Of course, the demands are different in different countries. For European Union countries, where the aim is to have a sophisticated health care delivery system, a key demand is second medical opinions and information for citizens, in order to improve quality of care and comply with economic constraints. For other countries, the demand may be primary care, basic health education and medicine in emergency situations or in remote areas.”

Developing countries face various problems in the provision of medical service and health care, including funds, expertise, resources, and shortage of doctors and other health care professionals. Roads and transportation are inadequate and make it difficult to provide health care in remote and rural areas; problems in properly transporting patients are often encountered. A large number of villages and rural areas lack even basic medical facilities, and as a result the population in these areas has no access to medical care, even in case of emergency. People have to travel long distances, away from home and work, to receive medical help.

The question of telemedicine in developing countries was first addressed in March 1994, at the World Telecommunication Development Conference (WTDC) which ITU’s Telecommunication Development Bureau (BDT) organized in Buenos Aires. That Conference recommended that BDT study the potential of telemedicine to meet some of the needs of developing countries for improved access to the health care services. The Conference approved an official Question on telemedicine, which was assigned to the Study Group 2 of ITU’s Development Sector, and an official Recommendation on the application of telecommunications in health and other social services.

ITU’s Study Groups are set up in such a way that official Questions are studied by a team of volunteers from different countries (Member States) and Sector Members. This allows them to draw on experience from around the world and share the information on best practice among countries. The ITU telemedicine group is unique in dealing with the needs of developing countries; it includes experts from developed and developing countries alike.

In accordance with the decisions of two World Telecommunication Development Conferences

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BDT has undertaken various activities related to the study of the potential benefit of telemedicine applications in the health care sector of developing countries as well as the demonstration of these applications in implemented telemedicine pilot projects in selected countries. During the period 1996–2000 BDT organized several missions of telemedicine experts to developing countries in order to identify their needs and priorities for the introduction of telemedicine projects, taking into account the state of the local telecommunication networks and their development. The following countries were visited: Mozambique (1996), Uganda (1996), Cameroon (1996), Tanzania (1996), Bhutan (1997), Viet Nam (1997), Mongolia (1998), Senegal (1998), Georgia (1998), Uzbekistan (2000), Ethiopia (2000).

Why developing countries are so important

Let us take as an example one of the least developed countries in Africa-Ethiopia. This is not a small country. Ethiopia has an area of about one million square kilometres and a population of approximately 61.7 million, of which more than 52 million (85.3%) live in rural areas. The health care system is underdeveloped and able to provide health services to only about half of the population. There is a lack of doctors and health care infrastructure. The few medical specialists working in the country are concentrated in the capital, Addis Ababa, and other major cities. Much of the rural population has no access to any type of health care, so the health care delivery system cannot respond to their needs.

For such countries, with their limited medical expertise and resources, telemedicine could provide a solution to some of the problems mentioned above. Traditionally, one difficulty in achieving equitable access to health care has been that the doctor and the patient must be physically present in the same place. Recent advances in information and telecommunication technologies, however, have created unprecedented opportunities for overcoming this by increasing the number of ways that health care can be delivered. Thanks to telecommunications, telemedicine offers solutions for long-distance consultation, emergency medical assistance, administration and logistics, supervision and quality assurance, and education and training for health care staff.

Within the limits of the available financial resources, it was recommended in Ethiopia to start the introduction of telemedicine applications with dermatology due to the shortage of specialists in this medical discipline and also because skin diseases are very common in the country. Twelve hospitals were selected to be connected together via the Internet into the telemedicine information network. Following teledermatology, other telemedicine applications could be added later, such as teleradiology, telecardiology, telepathology etc. Of course, telemedicine cannot increase the number of doctors in the country but it helps to use available resources more efficiently.

It was possible to extend the telemedicine information network in Ethiopia to the village level (primary health care units) using Internet transmission platforms. Health care at the village level is relatively simple: it centres on performing vaccinations, dispensing common medicines and providing maternal/child health advice, including family planning. These services do not require the use of sophisticated forms of telemedicine equipment. A computer and modem would allow the exchange of electronic messages (e-mail) and it would also permit distance education.

This example showed clearly that developing countries can benefit from the introduction of telemedicine services, and that it is useful for their health care system. It could be an economical means of achieving national health policy objectives with regard to the improvement and/or extension of medical and health care. Telemedicine also promises to
enhance the continued medical education of doctors, nurses and other healthcare practitioners in rural areas. This is a wide area of application, and one that is extremely useful for all developing countries.

What are the common and most urgent problems in developing countries which could be alleviated by using telemedicine?

These countries suffer from a severe shortage of health care professionals. Competent medical specialists using state-of-the-art medical technology such as scanners and other sophisticated diagnostic equipment are very rare, generally working in the university hospitals of large cities. The lack of medical specialists, and the limited opportunities for consultations between doctors in regional and remote small hospitals with their colleagues in the referral hospitals results in a large number of unnecessary referrals. Telemedicine links between hospitals and other medical institutions could lead to an overall improvement of health care services through the centralization and coordination of resources (specialists, hardware and software packages).

The population living in rural and remote areas suffers from lack or even absence of health care.

As a first priority, there is a need to improve maternal and child care, in particular when it comes to early detection of high-risk pregnancies. The deployment of fixed or mobile telecommunication telecentres, which are now considered to be one of the possible ways of bringing telecommunication services to rural areas, could be useful for telemedicine as well. A small bus with appropriate medical diagnostic equipment and a doctor visiting rural areas on a regular basis, could be a good solution. The bus should have a mobile satellite phone for consultation with the hospital. This mobile medical service could also play a very important role in disease prevention and health promotion. It could also be useful to provide a connection via Internet between a health centre staffed by a nurse (where available) and the nearest hospital. Nurse practitioners can provide primary care but they frequently need consultation and advice from doctors. The level of need varies from reassurance as to the correctness of a diagnosis to uncertainty about a diagnosis and a plan for management, particularly medical evacuation.

High maternal and prenatal mortality rate. One of the major factors contributing to this situation is the inadequacy of trained staff and the very late identification of pathological pregnancies. Local maternity units could be connected by telemedicine link to the maternity service in a regional or referral hospital. This will allow remote monitoring of the health of pregnant women, especially those with pathological problems.

Very few doctors (particularly in rural and remote areas) have access to medical journals after graduation. As a result, they are unable to keep their professional skills up to date. There is a need to make continued medical education accessible to as many health professionals as possible. E-mail and Internet access for regional and rural medical centres and hospitals could be extremely useful. The benefits from connecting as many hospitals and medical centres as possible to a medical information system would be:

- Improved standard of medical practices
- Improved epidemiological and other reporting
- Educational benefits for doctors and medical staff outside the capital, continuous medical education
- Access to several of the available worldwide medical databases

Most hospitals have a poor internal telephone system. The modernization of internal
telecommunication in the hospitals could considerably improve the efficiency of health care. It will form the basis for the introduction of telemedicine applications.

The introduction of telemedicine applications is a multidisciplinary undertaking, which — at least in developing countries — requires extensive cooperation between telecommunications operators and health care authorities. Pilot projects implemented by BDT, such as those presented in Part 2, are a good basis for elaborating practical recommendations on how to benefit from the introduction of telemedicine applications in developing countries. They show that telecommunication is also a very important tool in improving both the quality of and access to health care, regardless of geography, particularly in areas where the medical infrastructure is inadequate or non-existent.

It is expected that the expertise achieved through these projects, and the lessons learnt, will provide information that will guide the introduction of telemedicine applications in other countries, and help build realistic expectations of how telemedicine may improve health care applications in developing countries.

To many people, telemedicine has become synonymous with videoconferencing, so that broadband is seen to be a basic prerequisite. Of course, it is good to have as much bandwidth as possible available. But for most practical applications, telemedicine applications do not require videoconference telecommunication facilities, so actual bandwidth requirements are much more modest. A simple telephone network may be quite adequate. As things stand at the moment, the Internet is an increasingly important transmission medium for telemedicine.

The successful introduction of telemedicine applications requires more than just the delivery of the right hardware and software to the users. Much more important is to find the right way in each case of incorporating telemedicine applications in medical practice and in routine clinical consultations. This is relevant to organizational and administrative matters, as well as to efficient training.

References


1.4 Telemedicine-charity or business4,5

Billions have been invested in telemedicine in the past few decades. Clearly, telemedicine is a viable and efficient tool for dealing with pressing issues in contemporary healthcare. Telemedicine provides solutions that help healthcare providers to deal with problems arising from ongoing technological, demographic, social and cultural changes in an era of globalization. However, for many of the key players, its implications remain murky. Among the more important questions that need to be addressed are the economic implications of telemedicine. Should it be considered as an area of humanitarian work? Does it fall within the domain of private enterprise properly speaking? The answers are important, as they will determine the nature of the interaction between research, science and humanitarian work on the one hand and private enterprise on the other, i.e. insurance companies, providers of

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telemedicine equipment etc.

The issue can be approached from another angle: are telemedicine and private business in contradiction? At a first glance, their objectives differ. Telemedicine aims to increase the quality and efficiency of e-health in order to achieve optimal service for everyone, regardless of time and place; to reduce the pressure of e-health on national budgets; and to create a new working environment for medical staff. The strategic goal for business is profitability. Accordingly, telemedicine is more often considered as a tool for achieving social objectives, rather than for successful business activities.

But this does not mean that there is any incompatibility between telemedicine and business. Telemedicine is an emerging new branch of the health market, which has been business-driven for decades. Telemedicine clearly has a legitimate place in the economics of traditional healthcare services. However, compared to that older market, the telemedicine market has some specific characteristics.

Some of the problems have their roots in the historic development of telemedicine. Due to the high cost of information technology, in the beginning most projects were funded under national or international programmes. This tendency continues even now. For the first e-health call alone, under European Commission 6FP IST, had a €70 million budget for telemedicine. Over the years, all of this funding was used as an economic measure to stimulate growth on the telemedicine market. This is not a sound approach.

In the late 1990s, telemedicine began to expand in many directions. The development of digital diagnostic peripherals, store-and-forward devices for biological data, and the worldwide distribution of low-cost mobile telephones and the Internet dramatically increased the number of ways that patients and physicians can interact. Many surveys have been performed to understand the market, but telemedicine grows faster than our ability to measure it as a business sector. Most surveys have been based on relatively small samples in one or two countries (http://www.hon.ch/Mednet2003/abstracts/314641657.html). These surveys are welcome, although they cannot capture the full size of the market. One solution might be to develop an all-inclusive measurement system for telemedicine, but this is not realistic. Thus, we have to accept that it is not possible at present to have a precise picture of the telemedicine market. We have to concentrate on what is already known.

The telemedicine market

To understand the market, it is essential to identify its main driving forces. These forces are: competition within the health care industry; the advent of affordable IT solutions, especially the Internet, with its user friendliness, insensitivity to distance and increasing functionality; and 21st-century health care consumers, embodying "the three Cs" (cash, college, computers) and bringing their expectations of free choice and high level of e-health application (Mittman, Cain 2001).

These driving forces are not restricted by national boundaries, continents, religion, culture or social status; they are closely connected with telemedicine market segmentation. The market has four segments-citizens, patients, professionals and employees. Boundaries between these segments become blurred as members of society participate in different segments during different periods of their lives (http://www.esewa.org.lb/wsis/conference/documents/07-e-health.pdf). Each segment has its own needs and expectations, which very often overlap.

The next step in understanding the market is to compile a list of current telemedicine applications. These can be broken down into (1) health-related commercial activities, i.e. medical equipment and supplies, health insurance, medications, clinical applications and (2)
telemedicine web sites that have enjoyed a rate of growth outpacing general Web growth. The sites may be non-interactive, i.e. aiming at the distribution of health-related information, or interactive, acting as specialized online support groups offering post-treatment care, consultations etc.

**Forecasts**

Numerous analyses have been published trying to estimate the market value of telemedicine and make predictions for its development. An example is the CHIC market forecast (http://www.chic.org.au). Irrespective of forecasts, one has to remember that “the true measure of telemedicine should also include the value of expenditures on telecommunications, human capital, and other resources consumed in the process of delivering health care over… time and distance. […] Almost any estimate of the size of the telemedicine business should be interpreted with a big grain of salt.” (http://www.himss.org/ASP/ContentRedirector.asp?ContentId=15722)

Last but not least, it is necessary to recognise that at the moment telemedicine market is facing serious barriers, such as:

- Funding
- Staffing (staff with IT skills and experience in the health environment)
- The pace of technological change
- Reimbursement. This is one of the greatest barriers, as online health providers cannot compete with traditional e-health paid for by insurance companies.
- Legal issues and the need for globally-recognized safety standards
- Lack of regulations on the global development and distribution of telemedicine. These are extremely important in the age of globalization. The first steps were taken by the EU policy in setting up specific action plans (eEurope 2002 and 2005) to contribute to the development of e-health across EU, because only telemedicine can help to meet the challenges faced by European e-health systems (http://www.jrc.es/home/report/english/articles/vol81/ICT4E816.htm).

To sum up, the telemedicine market is obviously growing. The signs are numerous. We are witnessing growth in the demand for e-health applications. In fact, demand is growing ahead of supply. Other indicators of market growth include the increasing number of trade show exhibitors every year, the growth in published telemedicine applications, a significant increase in the number of websites offering telecare, and a move towards reimbursement for telemedicine, despite the fact that it is not yet government policy and people have to pay out of their own pocket. These are signs of growth, not of stagnation.

At the same time, it must be recognized that the telemedicine market remains unstructured and fractured — while it is very dynamic, it is not well organized. The path from research activities to practical applications is far too long and takes too much time. From an international perspective, the situation varies widely from country to country.

There is no conflict between telemedicine and business. On the contrary, telemedicine is a promising for business development. The market exists and is steadily growing. The active participation of business in the distribution of telemedicine services in developing countries may thus turn out to be a very promising and rewarding activity. However, the most powerful factor may yet turn out to be the passage of time. Time, after all, is the only thing one cannot buy or sell.
References


1.5 Some issues on e-health/telemedicine policy for developing countries

Introduction

The World Telecommunication Development Conference (Buenos Aires, 1994) noted that “the widespread use of telemedicine services could allow universal health access and consequently facilitate the solution of the principal health problems connected with infectious diseases, pediatrics, cardiology etc., particularly in areas where medical structures are inadequate or non-existing”. Even in the area of health information there is still a great unmet demand.

Studies conducted by the Rapporteur’s Group for this Question, and published reports with the discussions and recommendations of the African Regional Telecommunication Development Conference (Abidjan, 1996), the Regional Telecommunication Development Conference for the Arab States (Beirut, 1997) and later the two World Telemedicine Symposiums for Developing Countries (Lisbon, 1997 and Buenos Aires, 1998), as well as reports from missions by telemedicine experts to developing countries, have shown that there is an overwhelming need for the provision of medical and health care applications in developing countries, especially in rural areas. They also show that telemedicine services can be an economic means of achieving national health policy objectives with regard to improvement and/or extension of medical and health care, especially in rural areas.

The 2002 World Telecommunication Development Conference (held in Istanbul, Turkey) examined a new report on telemedicine, along with contributions on the issue submitted to the Conference by France, Japan, Mexico, Russia and Egypt. The importance of telemedicine was again broadly discussed and received support from the majority of countries participating in this Conference. The Conference proposed to change name of telemedicine for e-health given in this way to these applications much broader definition. The Conference approved a new Resolution on e-health and telemedicine (Res. 41) that was included in the BDT Programme on E-Strategies and Applications.

Resolution 41 on e-health (including telehealth/telemedicine) recommended that ITU:

- continue its efforts to raise the awareness of decision-makers, health professionals, partners, beneficiaries and other key players about the benefits of telecommunications for the e-health applications;
- continue to support e-health projects in collaborations with government, public, private, national and international partners-in particular with the World Health Organization (WHO);
- encourage collaboration on e-health projects on the national and regional level;

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• set up, within existing budgetary resources, a fund for telecommunication facilities for e-health, and introduce e-health training in the centres of excellence;
• promote, facilitate and provide technical support and training in information and communication technologies for e-health;
• work with the health sector to identify models for sustainability of e-health applications, particularly in remote and rural areas of developing countries, exploring possibilities for sharing infrastructure with other services and applications.

The Resolution also asked the ITU Member States to consider the establishment of a national committee/task force comprising representatives from the telecommunication and health sectors in order to assist with awareness-raising at the national level, and with the formulation of feasible telemedicine projects.

The main goal now is to convert this Resolution into practical actions; the role of the ITU-D Study Group will be extremely important here.

**Potential benefit**

Telemedicine is no longer a technology awaiting applications. This is a powerful tool, which has been successfully implemented in many pilot cases in various countries. Despite the growth of ICT equipment and tools in the health sector, their impact depends largely on whether or not they are used, and how, when and where they are used; this in turn depends heavily on the organization of provider systems and the behaviour of care givers, and the behaviour of telecommunication infrastructure in all these cases.

The World Health Organization will conduct a comprehensive evaluation of telemedicine applications that have already been introduced in developing countries, in order to prepare a recommendation dealing with medical aspects of e-health for health care professionals. Decision-makers in the health sector who wish to take into account telemedicine applications in the framework of the national health policy need to consider at least five aspects of health-care where telemedicine could play a significant role:

1) quality and efficiency of health care services;
2) medical education for both medical staff and citizens;
3) enhancement of national e-health structures;
4) e-health administration;
5) the role of the telecommunication infrastructure in the above four aspects.

To improve access to medical knowledge; to provide consultation remotely to small hospitals located in rural areas; to reduce the unnecessary transfer of patients to regional hospitals and provide the correct, remotely supervised treatment on the spot; these are some of the telemedicine applications that are particularly relevant to developing countries.

Tele-education (or e-education) in health is another of the significant uses cited for multimedia technology in e-health. The simplest and most common example is the delivery via Internet of a remote lecture by an e-health expert, disseminated to any number of students sharing a common workstation or scattered over a campus, a city or the world. The number of Web sites offering virtual education in health and health-related areas is growing. Distance learning through telecommunication tools can bring crucial knowledge to the participants, particularly information-starved hospitals and medical schools in developing countries. The course material has to be redesigned for online use and the professors need to be trained in online lecturing.

Since telemedicine relies heavily on telecommunication technologies, including the Internet, it is necessary to promote e-literacy. Consumers need to learn not only how to navigate the
World Wide Web, but also how to critically evaluate the reliability, accuracy and the source of information and services offered online.

Effective governance in telemedicine requires codes, regulations and standards to ensure consumer satisfaction. Issues in governance include legal liability, ethical standards, privacy protection and cultural and social standards. Medical culture and practice vary greatly between countries and this has to be taken into consideration too.

Increasingly, medical professionals unfamiliar with (or having limited access to) ICTs and e-health decision support and telecommunication tools are unable to function effectively either in private or public hospitals. They are unlikely to take full advantage of technology that is available or contribute innovative ideas for using the information infrastructure for the benefit of public health.

**Implementation steps**

Introduction of e-health applications requires multidisciplinary collaboration, with the active participation of telecommunication operators and health care professionals. Therefore it is recommended that ITU Member States consider establishing a national committees/task forces comprising representatives from the telecommunication and health sectors. This committee/task force should be open to other interested parties, the aim being to coordinate all telemedicine activities at a national level by rationalizing the available resources for both sectors and assuring the interoperability of different telemedicine systems.

The creation of national committees, associations, task forces and the like, with a multidisciplinary composition, is necessary to bring together telecommunication and health professionals, law professionals, industry and others to assist with the preparation of a national e-health master plan.

The national e-health master plan has to be based on a modest, step-by-step approach, allowing telemedicine applications to be introduced in parallel with the training of doctors and nurses on how to use them. The choice of a first pilot project in telemedicine is crucial, as it will play a dual role as a new tool for the delivery of health care and also as part of a promotion campaign to raise the awareness of decision-makers, health professionals, beneficiaries and other key players about the importance of ICTs for the health care sector.

In developing countries, even hospitals located in the capitals are not all equally well staffed with medical specialists, and they have to cooperate. This provides an ideal opportunity for setting them up with a telemedicine connection using the telecommunication infrastructure, and allowing them to exchange patient information electronically. Doctors and other users will see immediate benefits in terms of saved time and improved treatment. This will smooth the integration of e-health services into routine medical practice, something that is important at this early stage.

Hospital information systems (HIS) are becoming an important and useful part of any modern hospital system. An HIS is a platform for telemedicine applications today and in the future. While few developing countries can afford to put an HIS in every hospital, but the process of hospital “informatization” is gaining momentum around the world. However, the lack of uniform, international, multipurpose standards for the structure, content, and transmission of medical data seriously impairs administrative efficiencies of the health care sector as a whole.

**Role of telecommunications**

The role of telecommunication facilities cannot be overestimated. They form the platform for any kind of e-health application. Most of the communication and information technologies
that can be applied to the health sector are common with other sectors, or share common elements and solutions, having been developed in other sectors prior to being adapted to solve problems in the health sector.

Part of the attraction of some e-health services is that they can be set up with only the most simple telecommunication facilities. For example, ordinary telephone lines can be used to transmit electrocardiograms, and this information is playing an important role in cardiology. Nonetheless, analogue modem technology is gradually being phased out in favour of high-speed (broadband) digital transmission technologies.

Any of the existing transmission telecommunication technologies can be used to deliver medical information, as long as the transmission speed/bandwidth is sufficient for the quality required. In practice, e-health data can be transferred in different forms, ranging from a high-quality, two-way, full-motion video link to sound and still images. Optical fibre links are an ideal medium for broadband communications, but satellite technology is useful for reaching remote locations and rural areas. The widespread use of mobile communications has made this technology accessible for e-health as well.

The Internet is becoming a popular tool allowing doctors to read clinical journals and communicate with other doctors, although doctor-patient e-mail is not catching on as rapidly, even in developed countries, where the density of computers is much higher compared with developing countries. With the general trend for the next generation of telecommunication networks to move from circuit-switched technology to packet-switched technology, e-health networks will be used in data communication networks.

The role of telecommunication operators in the introduction of telemedicine services is much more important in developing than in developed countries. The main interest of telecommunication operators is not the addition of a new telecommunication service for the ministry of health and a new revenue stream; rather, it is the contribution of the telecommunication companies to the well being of the population, by helping to improve and extend access to medical services. For this reason, as far as the introduction of telemedicine applications is concerned, telecommunication operators in developing countries are the natural partners of doctors.

There is a need to bridge the gap between the telecommunication and health care communities at all levels. National ministries of health and of telecommunications also need to work together to introduce a telemedicine policy and provide universal service where emergency services, health and social information systems are concerned.

The medical profession should take the lead in determining what the needs are and how telecommunication and business might help. Of course, the implementation of such an ambitious program should be done in several stages, according to the available resources. The first step, particularly for developing countries, is to elaborate a national vision and understanding of the problem. This will make it possible to optimize the use of limited resources and avoid unnecessary duplication of effort.

It is clear that the introduction of telemedicine has to be based on the existing telecommunication infrastructure. Nevertheless, for many hospitals in developing countries, their connection to the nearest telephone exchange is of a poor quality, and they often need assistance on improving it for high-speed communication.

In order to facilitate the wide deployment of e-health services and applications for the benefit of the public in developing countries, in particular, it is important to achieve interoperability among systems and to reduce the cost of devices through economies of scale. Consequently,
the development of global international standards with the involvement of major players (governments, inter-governmental organizations, non-governmental organizations, medical institutions, doctors etc.) is a key factor in achieving these objectives.

1.6 From Theory to Practice

As mentioned in the previous section, nothing is possible without a global strategy, as the extensive use of telemedicine requires specific general conditions and a telecommunications infrastructure. The scientific, practical and business side of telemedicine are in need of a meeting place to review the status of telemedicine and telecare, explore new ways to improve the efficiency of health care services using state-of-the-art technology, and define a roadmap for its further development. One such meeting place is the trade event Med-e-Tel (billed as “the international trade event and conference for e-health telemedicine and health ICT”, see www.medetel.lu). With a firm belief in the importance of telemedicine, ITU is actively supporting the Med-e-Tel organization.

Med-e-Tel

Where does the name Med-e-Tel come from? The “Med” in Med-e-Tel stands for healthcare services (institutional and home based care, prevention and education) and for medical products and equipment (medical imaging equipment, monitoring devices, electronic health records etc.). The “e” stands for the electronic and IT industry and services (hardware and software, Internet, e-mail etc.). The “Tel” stands for telecommunications (whether it is PSTN, ISDN, wireless, satellite, videoconferencing, VoIP, or other).

The role of Med-e-Tel is to:

—organize a global specialized telemedicine exhibition, enhanced by a high-quality scientific program;

—bring together suppliers of specific equipment and services with buyers, e-health professionals, institutions, decision makers and policy makers from around the globe;

—provide them with hands-on experience and knowledge about currently available products, technology and applications;

—facilitate international dissemination of knowledge and experience in telemedicine, and provide access to recognized experts in the field worldwide;

—be a forum where state-of-the-art products, ideas, projects etc. can be presented and discussed; and

—act as an incubator for cooperation and partnerships between scientific groups/

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institutions, small, medium and large size enterprises etc.

This is an annual event held at the Luxexpo venue (www.luxexpo.lu) in Luxembourg, in cooperation with the International Society for Telemedicine (ISIT).

At Med-e-Tel 2005 (the latest such exhibition, held 6–8 April 2005) suppliers and users of telemedicine products, technology and services exchanged information, established new business relationships or reinforced existing ones, identified solutions, looked for partners and new markets, and viewed a wide range of telemedicine solutions currently available on the market. With 32 exhibitors from 23 countries and with over 400 industry and medical participants coming from 50 countries around the world, Med-e-Tel was an outstandingly successful event.

In parallel to the exhibition, an extensive educational programme was conducted. With 77 presentations from 29 countries in Africa, Asia, Europe and North America, participants were able to get in-depth information on newly developed telemedicine technologies and applications. Exhibitor presentations covered commercial products; research units presented the results of their work on leading-edge products and technologies and outlined future directions for the further development of telemedicine; and e-health centres discussed telemedicine applications for patient monitoring and the cost efficiency of telemedicine applications.

At Med-e-Tel 2004, ITU organized two satellite symposia on the following subjects:
1) Standardization in e-health (in cooperation with WHO and the European Space Agency, ESA)
2) Telemedicine for developing countries (in partnership with WHO).

Also at that event, the e-Health Standardization Coordination Group (eHSCG) held its inaugural meeting, and participated in the ITU/WHO session on standardization in e-health. Details have been posted at the website www.medetel.lu.

“Telemedicine & eHealth Directory”

The Telemedicine & eHealth Directory, a “who’s who” of the telemedicine and e-health world, was also unveiled at Med-e-Tel. This annually updated directory is part of a project initiated by ITU in cooperation with Med-e-Tel and ISfT. It is another example of ITU’s efforts for the global implementation of telemedicine.

The directory focuses on telemedicine applications worldwide, and is intended to provide a central list of telemedicine equipment vendors and e-health users. Listing in the telemedicine directory offers great opportunities for worldwide publicity among people who are looking for telemedicine products, technologies and services. The 132-page directory is broken down into four sections, as follows:

— manufacturers and suppliers of telemedicine/e-health products and services;
— institutions and organizations involved in telemedicine/e-health activities and development;
— media, publications and online information services covering telemedicine/e-health topics;
— telemedicine/e-health projects and initiatives.

The Telemedicine & eHealth Directory is now in its third
1.7 ITU e-health expert training course at Tokai University

Background

Despite recent improvements in hardware and some positive additional experiences, telemedicine is facing major difficulties in developing countries. The lack of expertise and training opportunities on telemedicine has become one of the major obstacles for the deployment of telemedicine in those countries. At the ITU/BDT Study Group 2 meeting in Caracas, Venezuela (September 2001), the vice-rapporteur for telemedicine, Dr Isao Nakajima (professor at Tokai University) proposed an e-health expert training course, to be hosted by the Tokai University Institute of Medical Sciences. This proposal was adopted unanimously. It was the first attempt to offer specialized telemedicine/e-health training courses for e-health workers from developing countries. It has already attracted attention not only in Japan but also from a number of other countries.

Programme outline

Tokai University extended invitations to participants from developing countries, including Indonesia, Bhutan, Haiti and Pakistan, for e-health/telemedicine application training.

The program gave participants knowledge about current trends in telemedicine, and about research and application methodology in the telemedicine field.

Course activities consisted of four parts:

1) Telemedicine research and project implementation.
2) Advances in telemedicine equipment.
3) Research possibilities in telemedicine. Research items included:
   • telemedicine via PSTN in rural areas
   • WiFi and IP-based satellite communications
   • wavelet analysis for biomedical data
   • independent component analysis
   • UWB radar to detect victims
   • super high definition TV
   • Web radio for disaster application
   • ambulance communications
   • telesurgery
   • teleradiology
   • telecardiology
   • telepresence and virtual reality
4) Enhanced administration and management in the introduction of telemedicine applications.

“I am a citizen of the Islamic Republic of Pakistan. I graduated in computer science with a specialization in e-commerce. I studied Japanese language and culture in Tokai University, and after finish my one-and-one-half year Japanese-language training program, I started my career as a researcher at the Nakajima Research Lab in the Tokai University School of Medicine.

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8 Dr. Hiroshi Juzoji, Tokai University School of Medicine, Kanagawa, Japan, e-mail : juzoji@ets8.jp
Participants in this course in 2000 included representatives of countries from all over the world: Dr Yongguo Zhao from China, Dr Hendri Priyadi, Mr Agus Subekti, Mr Asep Najmurrokhman and Mr Koredianto Usman from Indonesia, Mr Gregory Domond from Haiti, Mr Kinlay Penjor from Bhutan, Mr Muhammad N. Nawaz and Dr Muhammad A. Sadiq from Pakistan, and Ms Kiyoko Nagami from Paraguay.

This training course has been designated as an official WHO telemedicine training course for the Asia Pacific region.

One participant’s remarks

Participants were highly satisfied by ITU-D training course, as seen from their feedback.

Upon returning to my country, I shall try to teach e-health to my people, to make this kind of medicine technology better known.”

Conclusion

The course has been of benefit to participants from developing countries, giving them an understanding of the different aspects of e-health/telemedicine systems up to current and future trends.

From 2001 to 2004, ten researchers from Indonesia, Pakistan, Bhutan, China, and Haiti graduated from the ITU e-health expert training course hosted at Tokai University. Upon completing the training, they returned to their countries, where they are contributing to the development of e-health projects in their respective countries.

Reference


2 Common e-health applications

2.1 Why is telemedicine expanding at this time?

At the beginning of the new millennium all countries face two serious problems:

1) the need to increase the quality and efficiency of the health care system, providing optimal health service for the entire population independently of time and place, and

2) the need to trim health care budgets.

The combination of these new needs and the rapid development of an electronics and telecommunication infrastructure capable of meeting these needs has created the right conditions for the design and development of telemedicine to extend to all parts of classical medicine.

Currently there are two main directions in the development of telemedicine.

• Telemedicine is incorporated in all areas of medical specialization, leading to the development of new branches or areas of specialization such as telecardiology, telepathology, teledermatology etc. This is the result of networking, with specialists in different areas of medical practice being connected and cooperating.

• Homecare as a way to deliver e-health services at the actual point of need.

2.2 Developments in telemedicine

The following paragraphs provide an outline of the direction that telemedicine developments are taking, as illustrated in the projects presented in Part 2 of this report. Before examining each area of medical specialization in detail, it is important to emphasize what they all have in common.

1) All telemedicine applications use the same basic components, i.e.

   a) a means to capture the necessary information
   b) a means to communicate the information remotely
   c) a means to display this information
   d) a means to receive feedback.

2) They can be practiced anywhere the necessary equipment is available. Contrary to popular belief, telemedicine does not rely on satellite communications, despite the latter’s usefulness in providing access to the more remote regions on Earth. E-health services are commonly provided using ordinary telephone lines, integrated services digital networks (ISDN), local area networks (LANs), wireless local area networks (WLANs), mobile communications systems (GSM), optical fibre cables, the Internet and intranets.

3) There are two communication modes — online and offline.

4) The aim in each case is to improve the quality of e-health services with:

   • faster diagnosis
   • improved treatment and reduced delays in administering medication and performing scheduled treatment
   • improved consultation and follow-up

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9 Dr Malina Jordanova, Institute of Psychology, Bulgarian Academy of Sciences, Bulgaria, Tel/Fax: +359 2 979 70 80, e-mail: mjordan@bas.bg
• shorter-duration hospitalization
• reduction of waiting lists, travel and loss of time
• reduction of stress and time pressure
• improved psychological comfort for patients and medical staff.

5) An important objective is to achieve economies and lower costs for health services. Some 90% of hospital costs are covered by health insurance schemes, so cost savings from the application of telemedicine in different areas of medical specialization translate to savings for society as a whole and for taxpayers, with attendant financial and social benefits.

Potentially, many different fields of medicine stand to benefit from e-health. Given the need to limit the scope of the present report, and in view of the great interest that developing countries have shown in the implementation and development of telepathology and teledermatology, these two fields have been selected for examination in greater detail in separate sections further below.

Telecardiology

This is the practice of cardiology using state-of-the-art information and communication technologies (Beolchi 2003). The aim is to provide chronically ill patients with access to specialized e-health services and increase their quality of life by reducing the cost of treatment and minimizing the inconvenience caused by the need to travel and by prolonged absences from home and the working environment.

Telecardiology originated almost 35 years ago in response to the need to monitor the cardiovascular parameters of the first patients fitted with implanted pacemakers. This led to the development of early single-lead trans-telephonic electrocardiograms. Currently, individuals with pacemakers form the largest group of patients receiving telecardiological consultation and continuous monitoring.

Further developments in all aspects of telecardiology, and its worldwide dissemination, are in progress. This is because the main beneficiaries of telecardiology are patients with cardiovascular diseases (CVD), although it is also used in cases of kidney diseases, pulmonary diseases, abnormal pregnancies etc. CVD afflicts more than 60 million people in Europe and almost the same number in the USA. CVDs are the main cause of death in Europe and North America. CVDs are not only the most common chronic diseases, but they are the most expensive diseases for e-health providers.

Teledermatology

This is one of the most useful and rewarding telemedicine applications, as skin diseases are extremely common. One quarter of all patients seeking medical help is doing this because of skin disease. What is more, almost all skin problems are associated with a high degree of psychological discomfort.

Teledermatology involves remote dermatologist consultation for patients and/or their primary health providers, for purposes of diagnosis and management advice (Wootton, Oakley, 2002). An important part of teledermatology is the transfer of images. This is not unexpected, as dermatologists have relied on images as diagnostic tools for decades.

In general dermatologists are more skillful in the diagnosis of skin problems that are general practitioners or non-dermatologists. Like many other highly qualified specialists, they generally reside and practice in major urban hospitals or university centres. Teledermatology
allows the dermatologist to examine an image of the problematic skin without losing time, and to provide consultation and/or treatment.

The section below dedicated to Teledermatology, entitled “Example of a network for underserved areas of South Africa”, provides additional information on telepathology. It was included for its relevance, as the problems discussed there are the same for all e-health disciplines relying on image transferring.

**Telepathology**

This is pathology in which the specimen is digitally transmitted and examined by a pathologist at a distance. As in the case of teledermatology, the pathologist relies on high-quality images to diagnose the disease. As in the case of other telemedicine disciplines, telepathology is used when a second opinion is needed, where diagnosis is particularly difficult or complex, or when a pathologist is not available at the medical facility treating the patient.

The main difficulty in telepathology is how to transmit high-quality colour images, as colours provide critical clues for pathological-anatomical diagnosis. High-resolution cameras are now available, making it possible to capture the microscopic image and record it in digital form with a very high spatial resolution. However, imaging quality, and in particular the need to address the issue of degradation of colour data, are crucial to the accuracy of a diagnosis. Increasingly sophisticated solutions are being developed (YUV encoding, dithering, median cut colour quantization), but much remains to be done.

In the section entitled “Digital imaging in pathology”, a sub-section entitled “Telepathology for developing countries” provides additional information on telepathology. It was included for its relevance, as the problems discussed there are the same for all e-health disciplines relying on image transmission.

**Teleradiology**

The aim of teleradiology is the electronic transmission of radiological images in order to receive assistance in their interpretation. Like all telemedicine, it allows more precise diagnosis, access to a second opinion and improved continuous education.

Milestones in teleradiology are image size, transmission standards and display quality. Image size is significant as it determines the transmission time. Different types of images vary in size, as the size is a function of image modality. Mammography images are among the largest, exceeding hundreds of megabytes each. Currently, various transmission standards are used: Dicom protocol (DICOM); Tagged Image File Format (TIFF), which is less complex than DICOM but does not allow patient information to be bundled with the image data, so that the latter has to be sent as separate file; JPEG (Joint Picture Expert Group), originally created not for teleradiology but for image transmission via the Internet, where it remains in very wide use. JPEG uses an excellent compression technique and is the most widely used, despite the fact that it creates artificial edges, which are easily detected by the human eye.

The major benefit of teleradiology is that it does not require partners to use the same applications to display images; it is enough for the images to be transmitted in one of the standard formats.

**Teleophthalmology**

This is another discipline based on the transmission of images at a distance. In the past 15 years it has gained in importance. The experience that has been acquired can be readily applied in developing countries.
The diagnostic, social and financial benefits of teleophthalmology have been thoroughly assessed in numerous pilot projects all over the world. The UK, the USA, Australia and Israel are among the countries making extensive use of teleophthalmology. Highly successful projects have included specialist consultations as part of primary care (Shanit et al, 1998) emergency services in rural areas (Rosengren et al. 1998; Blackwell et al. 1997), continuous monitoring second opinions for patients suffering from diabetic retinopathy (Lithuania—Med-e-Tel 2004), specialist assistance for eye surgery, and consultations for prisoners (Barry et al. 2001).

**Telenursing**

This is the use of information and communication techniques for nursing care. It involves the use of electromagnetic channels (e.g. wire, radio and optical) to transmit voice, data and video communications signals. Telenursing is not new. For decades, nurses have been providing health information and nursing advice by telephone in certain cases. It is a quickly expanding service. Remote delivery of health promotion and disease prevention services, as well as nursing diagnostics, treatment and education are developing rapidly. While Western countries have seen the greatest expansion to date, developing countries are also benefiting from tele-technologies. Telenursing can be used in homecare, hospital and hospice care situations. It can also be provided through telenursing centres or mobile units. Telephone triage and home care are the fastest growing applications today.

This is clearly an extremely effective application of ICT. The country where telenursing is best developed is the USA. It has been estimated that almost 46% of the on-site nursing visits in that country could reasonably be replaced by telenursing http://www.icn.ch/matters_telenursing.htm.

**Telepsychology**

Also known as telepsychology, e-psychology, virtual psychology or cyber-psychology, this new area uses the convergence of electronic equipment and telecommunication facilities for the exchange of audio, video, and/or text for therapeutic communications. Generally speaking, telepsychology consists of short interventions and is used when face-to-face contact with a licensed psychologist is impossible due to the absence of transport, great distances, extreme situations and so on. Virtual psychological consultations are an alternative for people who cannot afford private consulting, for example, those who are afraid to speak about their difficulties with a counsellor in person, or shy people who want quick answers (Garcia et al. 2004). To put it briefly, thanks to the development of new information and communication technologies, this service now provides the option of rapid psychological counselling while at the same time expanding the group of potential users of psychological help. However, telepsychology has its risks, especially for the psychologist, who lacks the possibility to check user background and must operate without the non-verbal language necessary in any counselling and interviewing process.

Most often e-psychology is realized in the form of e-mail exchanges, chat sessions or chat groups, or videoconferences. On the whole, it is very effective, and patients rate their Internet contacts with psychologists very highly. Surveys revealed that users’ satisfaction varies from 68% (Ainsworth 2004; Wildermuth 2004) to 88% (Lahad 2004). This has given impetus to the growth of e-psychology. Its applications have the potential to advance the fields of psychology in a multitude of ways. Some of the potential e-psychology applications for patient care are assessment, psychotherapy, crisis intervention, patient education etc. It also meets certain needs of the psychology community itself, such as teaching activities, vocational assessment and case management. Another aspect of e-psychology is that in many cases
Internet psychological consultations are free of charge. However, e-psychology is new; technology and strategy alike are far from being mature.

**Homecare**

The simplest definition of homecare is the delivery of medical care to patients who are physically unable to reach e-health providers at the point of need, which may be the patient’s home, a nursing house, a clinic etc.

This concept could have a tremendous impact all over the world, including developing countries as well as the industrialized countries in Europe and North America, with their rapidly aging population.

Homecare not only makes it possible to offer medical services to everyone independently of time or place, but also is cheaper for e-health providers and, clearly, more convenient and cheaper for patients. From the point of view of technology, homecare requires a telematics environment for monitoring the patient’s physiological parameters and equipment for the exchange of information.

**Decision support systems**

Decision support systems (DSS) are in very wide use, with applications in all areas of telemedicine. A DSS is a computer system designed to support decision-making activities such as data analysis, problem identification, decision-making etc. DSS has become essential to organizations and companies providing e-health services, helping to turn mountains of raw data into valuable information that can be used for decision-making.

DSS concepts and technologies are still evolving. Nevertheless, experts agree that decision support systems will revolutionize the delivery of e-health over the next 5–10 years. In the e-health system, telemedicine is the part in which DSS is most widely applied. At the primary e-health level, decision support browsers are already available. Innovative software programs give general practitioners (GP) timely access to relevant, tailored medical information at the point of care and will also assist GPs to remain up-to-date with the latest guidelines and recommendations. The quality of service to patients independently of place and time will continue to improve, thanks to the availability of tools and services such as hospital management systems, decision support systems that improve diagnosis and treatment, real time image transfers and health information through networks.

**References**


2.3 Digital imaging in pathology

Studies have indicated that, in a typical American medical centre, seventy percent of the clinical data in the electronic medical record are from pathology, and seventy percent of requests for data from the electronic medical record are for pathology data (Ferreira R, et al. 1997). Significantly, clinical decision support programs are highly dependent on pathology data. Much of the analysis performed in the pathology lab is visual; therefore pathology imaging has become an important and growing area in the medical imaging environment. However, pathology imaging presents a number of unique challenges. These include the fact that pathology image quality is a function of many processes, such as processing of tissue, cutting and staining of the slide, ability of the microscope to form a clear, in-focus image suitable for capturing etc. These and other challenges have limited the utility and use of pathology imaging and telepathology. Furthermore, the diversity, complexity and scope of pathology and medical microscopy have made it difficult for organizations to agree on standards for pathology imaging. The reasons for the difficulties in standardizing guidelines and standards in pathology imaging are described below. Then, methods are proposed for beginning to move forward on standardization. This process will be complicated and will not be completed any time soon; nonetheless, it needs to be started.

The pathology environment

Those who would attempt to define standards or guidelines for pathology imaging need to have a clear understanding of the wide scope of image “quality” or “resolution” necessary for imaging to be useful in pathology. One of the best ways of describing these requirements is to examine the way a typical surgical pathologist uses his/her microscope. In examining some cases, the pathologist will not use the microscope at all, making a diagnosis instead on the gross visual examination. In other cases, the pathologist will use a 4x objective lens (with an optical resolution of ~5 microns), while in other cases a 20x lens (optical resolution of ~1 micron) or 40x lens (optical resolution of ~0.5 micron) is used. As a further option, there are very powerful oil-immersion lenses and, beyond that, electron microscopy. The choice of optics is up to the pathologist, and his or her judgment as to what is required for the case at hand. The same argument can be applied to other factors that have an effect on image quality, such as contrast, tissue staining and tissue processing. Imaging guidelines in pathology need to take into account the fact that it is up to the pathologist to determine if the specimen or image is of sufficient quality to render a diagnosis.

Microscopy imaging

The difficulty of image standardization in telepathology is that so many factors can influence image quality. The following system components are required for a general pathology imaging station. 1) Microscope: these vary widely according to type of microscope, magnification, type of objective lens, condenser, aperture, filters and light voltage. Each user can change or chose each item every time he/she uses it. 2) Optical coupler: this connects the

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microscope and camera, and it is an art to choose the right one. 3) Camera: there are analog and digital types, with a variety of parameters such as CCD size, sampling interval, dynamic range, and colour characteristics. 4) Computer and software: sizes of RAM and VRAM and CPU speed change the speed of controlling these huge images and the number of colours to display. Image acquisition and manipulation software directly influence image quality. 5) Display: Each display has different characteristics (e.g. spatial resolution, maximum luminance) and the user can change the brightness and contrast, affecting perceived image quality. It is also important to properly calibrate the displays. 6) Compression/image format: since the images are so large, it is often necessary to compress the images. With respect to image quality and diagnostic accuracy, issues such as acceptable compression ratio and whether the compression should be lossless or lossy are important.

Compression/image format: since the images are so large, it is often necessary to compress the images. With respect to image quality and diagnostic accuracy, issues such as acceptable compression ratio and whether the compression should be lossless or lossy are important. There are so many pathology imaging systems that can be built with many possible combinations because there are many choices for each component of the system. Each component presents a variety of options to the user; and each user can pick any version of each component. Furthermore, the same system with the same components, when operated by users of different levels of skill and knowledge, can result in different image quality levels. Colour differentiations between systems are shown in Figure 1.

**Limitations of current telepathology**

Telepathology is a useful tool for remote diagnosis in pathology, for education and for obtaining a second opinion. It is especially useful in the support of isolated pathologists and non-speciality pathologists. However, telepathology, in general, has seen limited use for the following reasons.

1) It is an expensive and time consuming process.

2) The limited field of view of telepathology images, unlike glass slides directly viewed on a microscope, often makes pathologists feel uncomfortable.
3) There is no widely accepted method to measure the image quality and accuracy of image parameters such as colour.

In general, the uses of telepathology are for 1) primary diagnosis, 2) second opinion, 3) education/QA. Each may require a unique telepathology system design.

There are several general types of telepathology systems.

1) In static mode (store and forward or live), images (typically only a few) are captured and transmitted for sequential viewing.

2) In dynamic mode, live video images are transmitted and viewed dynamically in real time.

3) Dynamic systems with a robotic microscope allow the remote viewer to control the microscope at the originating site for a more interactive experience.

4) Combining static and dynamic systems produce hybrid systems with even more flexibility.

5) Whole-slide imaging (virtual slide imaging) is the newest development in which the entire slide is digitized, obviating the need to select individual or sequential images for viewing.

Depending on the requirements and budget, different types of telepathology systems — with different levels of image quality — can be used. Furthermore, as in the more general field of pathology imaging, a variety of human factors, such as the ability to cut and stain a good tissue section, set up the microscope and optimize contrast and focus, tissue area selection etc. are very important for the effectiveness of the system. This makes telepathology systems even more complex to evaluate and standardize. For example, under-staining or over-staining may hide or fail to reveal important structures in the final image. It may also result in colour variation, based not on tissue variation but rather on variations in the cutting, processing or staining process. Colour differences of the same stain by institution or technicians often occur, as shown in Figure 3. Usually pathologists are familiar with the colour of stains at their own
institution, and sometimes each pathologist has a favourite colour. For instance, the colour of blood cells in one slide is not always the same as in another slide. This can create confusion even when pathologists correspond by means of a conventional postal consultation, so the problem can be even worse with telepathology.

Every type of imaging system has its own limitations.

**Static image telepathology** depends on the ability of the referring pathologist or staff to both form an appropriate image with the microscope and capture a clear image with the camera. Equally important, static systems rely on the operator to capture the appropriate area of the slide in question. Using a 20x objective lens and a standard 3/4-inch (8.8 x 6.6 mm) CCD, a single field of view is about 0.44 x 0.33 mm or 0.145 square mm. As a typical cover slip has about 12.5 square centimetres of area, a static system samples only a very small proportion of the potential area of a tissue section. It is up to the referring pathologist to select several areas of interest and capture images with the appropriate magnification. When the pathologist has specific questions for the consultant, or merely wants to confirm the diagnosis using the telepathology system, static image telepathology works very well. However, when the referring pathologist does not have enough confidence in his/her own diagnosis or needs a primary diagnosis to be rendered, the static image telepathology system can be risky, because the consultant pathologist has to make a diagnosis based entirely on the transmitted images, which were chosen by the referring clinician. The image quality of static images depends on the person who captured them, potentially limiting the ability of the consultant to render an accurate and confident decision. It is important to understand that a “high resolution” image is not necessarily a good quality image, especially if the optical image from the microscope is out of focus or otherwise imperfect. Most images captured by people who are not experienced in telepathology or digital imaging show problems that are related to the use of the microscope, such as problems with focus and colour fidelity.

**Dynamic image telepathology** is limited by many of the factors already listed for static telepathology, in addition to the fact that the dynamic image quality at the receiver site depends on the bandwidth of network used (and the amount of compression required). In practice, most systems using H323 or H320 for dynamic images cannot provide image quality as good as static systems. For this reason, one often uses both static image and dynamic imaging in one system. This works well. However, when robotic microscopes are used, with motorized stages for remote control, the system needs specialized equipment that is not common in pathology practices, and is unfamiliar to pathologists. Consulting pathologists can use non-robotic microscopes for dynamic telepathology, and let the referring site control them so as to focus on areas of interest, but the same problems with static image of area selection remain.

Another factor in both static and dynamic telepathology systems is that current systems are significantly slower than the manual use of a glass slide on a microscope. No matter what kind of system we use, it takes longer for the pathologist to make a diagnosis using telepathology images. However, if the pathologist uses the system as part of a pathology information system, it might in the future reduce the specialist’s total time to diagnose and report.

Automated whole-slide imaging (WSI) is a new technology that has brought the possibility of standardization in pathology nearer. WSI involves digitizing of entire slides (so there is no issue of sub-sampling), the imaging process being automated (eliminating the need to force specific parameters and eliminating human factors in image capture). However, since the technology is still developing, it will take another few years before it becomes clinically
available and a useful system. Figure 2 shows an image obtained with a WSI system.

**Methods for standardization in pathology**

When we think about medical image standards, this commonly includes the required image resolution, the number of colours, monitor resolution, compression ratio, format etc. As mentioned above, pathology imaging has a wide range of requirements, and is subject to significant human factors and non-imaging-related parameters that make a single standard for pathology imaging problematic. Defining a required “pixel resolution” is meaningless if the optical focus or staining quality is not defined, and even if these parameters could be defined, the image type and quality required for some aspects of pathology is radically different from that required for others. One could decide on a file format for file transfer, but this would not address some of the more basic issues in pathology imaging.

The important concepts for pathology imaging standards to consider are:

1) Systems should be able to share image files.

2) The standards should allow the transmission of information on baseline colours and recommended display parameters.

3) The images should be useful to the pathologist, not necessarily better or worse than direct examination of a slide under the microscope.

4) A mechanism to evaluate image quality objectively should be present.

5) A mechanism to adjust and correct minor errors of tissue processing should be developed.

6) A public organization should support pathologists in the development of standards.

To move pathology imaging into a space where standards can be effectively applied there are two main areas of attack. One involves formal training of pathologists in imaging and image-related activities. This may take the form of a web-based formal training process in diagnostic imaging (e.g. continuing education courses). The second area, more directly applicable to this paper, is the development of technical mechanisms to remove human factor issues in the image capture process. The goals are to correct (or at least identify) differences between systems and materials, to develop technical protocols for evaluating and/or grading image quality objectively, and finally, to deploy colour standardization technology.
To avoid human factors, automated, whole-slide imaging robots and/or imaging microscopes may provide a solution (Ferreira R, et al. 1997; Gu J, Ogilvie R in press). However, these systems have not yet achieved clinical product status, and are limited to groups that are able to afford them. Also, it takes time and training for pathologists to interpret WSI in an optimal way. However, it is clear that such systems will become more widespread in the next several years. Imaging microscopes (robotic microscopes with built-in cameras and robotic stages) can potentially remove problems related to the human factor, such as variations between users in terms of microscope focus, filter and brightness settings. By having these parameters software-controlled, these systems can help achieve areas of image quality standardization. Automated whole-slide imaging robots capture a complete glass slide (preferably fast enough to be useful for remote diagnosis for frozen sections) without human intervention. With the addition of automated slide loaders and barcodes, along with control slides to monitor resolution and colour parameters, these systems can automate the entire image process. Systems to support these QA functions are being evaluated at Pittsburgh, Arizona and other centres. This should lead to a major improvement in telepathology imaging, and open the door for extensive quality control and image quality standardization techniques.

Image quality evaluation is another important factor. Currently, the methods used to evaluate image quality are very subjective and vary between individuals and institutions. This subjectivity does not necessarily affect diagnosis by telepathology and/or the imaging system. However, as telepathology systems become more popular and more ubiquitous, it will become necessary to develop more objective image quality assessment methods. Even something as new and untested as the whole-slide imager is making rapid inroads into telepathology, and several commercial systems are available on the market. Each system gives a different visual impression of the images, and different models of the same system give different impressions and image quality. We do not know what level of quality of image we really need for clinical uses, for education or for research purposes, complicating the problem of standardization. At the University of Pittsburgh Medical Centre, we have just started in this line of research.
developing a system to evaluate image quality objectively and define the level of quality for each purpose. The approach can be applied to any kind of imaging system for pathology. Figure 4 illustrates the prototype application.

**Telepathology for developing countries**

The key functionality of a telepathology system is the ability to allow a local physician to send microscope images of a tissue section, along with text to describe the clinical context, to the remote pathology expert. In the USA and Europe, pathology imaging and telepathology are moving to the use of WSI, and pathologists are able to look at the virtual slide through the Internet from anywhere in the world. However, in the case of developing nations, popular telepathology is still based on e-mail (sender captures static images and sends them as e-mail attachments, with a brief case description) due to limited network bandwidth and technical support.

In some cases, there is not even a histology lab to provide histology slides for microscope examination by a pathologist. Now, as current telepathology practice depends on slide-mounted, stained tissue samples, this absence makes it difficult to set up and run a telepathology service. The University of Basel in Switzerland has installed a small histology lab at the national referral hospital of Honiara, Solomon Islands. Specimens are now prepared locally, and the histology images are sent to the server in Basel, where pathologists from Europe and the US can review the cases and provide a diagnosis. Currently there are no pathologists practicing in the Solomons (Brauchli K et al. 2004).

At the University of Pittsburgh Medical Centre, a web-based telepathology system (store and forward) and an e-mail based system are being used to provide assistance to a number of countries, including Egypt and India. The assistance consists of limited technical support by help desk staff and imaging software tools and medical support by pathologists. The scope of the web-based telepathology system was reduced to make the system simpler. In addition, access has been provided to the websites offering archived educational conference videos, and to the WSI site containing educational cases (http://telepathology.upmc.edu).

In providing telepathology support to developing countries, a total services approach should be considered; this includes setting up the laboratory, training lab technicians and pathologists, providing remote system support and training, diagnosis, and case maintenance. Existing infrastructure and new technologies can dovetail to provide needed diagnostic services, with training benefits for the medical professionals involved. In this way, people in developing countries will have an opportunity to benefit from the more advanced technologies now available.

**References**


2.4 Teledermatology

Example of a network for underserved areas of South Africa

The problem

Sub-Saharan Africa has long suffered from a huge burden of disease and limited resources to deal with it. Great deficiencies exist in health care, with poor access to basic care, let alone specialty care, in many areas. In the 1980s, the AIDS pandemic brought a bewildering twist to overburdened health care providers. At the end of 2002, 25% of adults aged 15–49 in South Africa, for example, were HIV-infected. Skin disease, already a cause of significant morbidity and mortality before AIDS, has become more prevalent, complex and stigmatizing in the HIV era. Because of the skin’s role in immunologic protection, it is no surprise that studies have shown that at least 90% of HIV-infected patients will develop skin disease during the course of their infection. A skin condition is commonly the first sign of HIV infection. Once HIV infection is established, the number and nature of cutaneous diseases is a gauge to the stage of infection. Cutaneous conditions are often multiple in a single patient, resisting therapy. As a result, a significant proportion of primary care providers in one US study were unable to recognize skin signs associated with HIV infection.

In contrast to the USA, where specialty care is widely available, medical care from specialists, including dermatologists, is scarce in sub-Saharan Africa. In the South African public health care system, which serves the majority of patients in this country, there is on average one dermatologist serving 3–4 million people. When a basic health provider needs help treating a patient with skin disease, referral to a dermatologist is frequently ruled owing to distance and a lack of funds for travelling. The problem, then is how to deliver consultation for dermatological care to African health care providers by an alternative means.

Telemedicine is the delivery of health care across a distance. In the 1990s, telemedicine made great leaps with the rise of information and communication technology (ICT), satellite communication, and high-resolution audiovisual equipment. The application of teledermatology is especially useful in the visually oriented specialties, particularly radiology, pathology, and dermatology. The addition of images to clinical histories is a significant help for the diagnosis and management of skin diseases. Teledermatology, utilizing convenient and inexpensive store-and-forward (SAF) technology, involves capturing patient images and electronically transmitting them asynchronously to a specialist, who can then render an opinion. As most dermatological consultation is not of an emergency nature, a delay of 24–48 hours for a consultant’s opinion is entirely acceptable for the referring provider and the patient, particularly given the savings in travel costs and time to referral.

The real test of teledermatology will be in the developing world. Despite the lack of specialty health care, ICT continues to grow and reach more people, including those in sub-Saharan Africa. Thus, in 2002 South Africa ranked 18th in the world in Internet use. Even basic health centres have the ability to upload and transmit images, accompanied by clinical data, via the Internet. It is in these areas that provision of teledermatology services could have its greatest impact.

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Research in progress

The project under consideration was established to study the feasibility of and satisfaction with a telemedicine network that aims to enhance delivery of dermatological care in relatively remote areas of South Africa using a simple telemedicine system. An assessment is made of the quality of a teledermatology network linking the University of Cape Town with outlying primary-care clinics to provide critically needed consultation for underserved skin-diseased patients in South Africa. The objectives of this study are to:

- Establish a collaborative and sustainable network of teledermatology consultation, based at the University of Cape Town (UCT) and supporting selected underserved areas of South Africa.

- Determine whether referring primary health care providers believe the system has a significant effect on patient outcomes.

- Collect quality assurance data regarding patient and provider satisfaction with the network.

- Explore the feasibility of extending this network to other underserved regions or populations in South Africa.

- Become a model for a similar system for other countries in sub-Saharan Africa.

- Establish sister-institution ties between UCT and the University of Washington (UW) via a virtual exchange of instructional patient cases and interactive distance learning. Eventually, exchange rotations will be established to enable UCT and UW dermatology residents to learn directly from the sister institutions.

The procedure for implementing this network and assessing its quality involves setting up digital equipment at health centres or hospitals where in-person dermatological consultation is unavailable. Health care providers receive training in taking and uploading digital images. Patients and providers are asked to give their informed consent, and the providers can then transmit dermatological patient images via a secure email system, along with a medical history and specific referring questions. A dermatologist experienced in teledermatological interpretation reviews these images and renders an opinion, with feedback and references, to the primary provider within 48 to 72 hours. Assessment of quality measures will focus on the patients’ and providers’ satisfaction with the system, and the providers’ assessment of outcome improvement and cost savings. Network sustainability will occur as a result of the PI training South African dermatology registrars in teledermatological consultation and system management. This study involves human subjects and has been approved by the University of Washington Human Subjects and the University of Cape Town Ethics Committees. Site selection commenced on September 1, 2004, with the first referral sent in late October 2004.

The main questions being addressed in this study are:

1) Is a network to provide virtual dermatological consultation in South Africa feasible at the present time, with the current state of technology and IT infrastructure?

2) Will such a system be sustainable?

3) Will outcomes according to the referring health care provider be improved?

4) Will patients and referring providers be satisfied with the system?

Significance of the study

This project will enhance the delivery of dermatological care in underserved areas of South
Africa, using simple and inexpensive technology. In the past, the cost of computers and
digital cameras, as well as limited Internet access in this region, have made the prospects of
initiating a sustainable teledermatology network in sub-Saharan Africa less hopeful. The
results of this study will provide other countries having similar specialty health care
deficiencies with valuable information on the satisfaction with and feasibility of this IT-based
solution. The results of this study will also have a demonstrable impact in the following
areas.

1) A decrease in morbidity and mortality from skin disease through delivery of dermatological
care to underserved South African patients who would not have received such care
otherwise.

2) A perpetuated teledermatology network, eventually managed by trained South African
dermatologists.

3) Clinical education in skin disease recognition for referring health providers, through
consultant feedback and provision of resources for learning.

4) The potential for expanding a simple technological network to similarly underserved areas
in sub-Saharan Africa.

**Results to date**

Since October 2004, 53 patients and 9 providers from 4 underserved sites in South Africa have
been part of the programme. The sites are located in Hermanus and George in the Western
Cape; Umtata, Eastern Cape; and Polokwane, Limpopo Province (see the site map at Fig.1).

![Map of South Africa showing site locations](image)

**Fig.1**

The number of referrals by site is shown below.
The referring providers work in the local provincial hospitals, treating patients within the public health systems serving these regions. The providers consist of six doctors and two nurses. The patients are 80% adults, and almost evenly divided male and female. Most (88%) had more darkly pigmented skin (Fitzpatrick types IV or higher). The conditions in question were mostly inflammatory or infectious rashes (95%), the remainder being solitary skin growths. Most of the images sent (90%) were rated by the teledermatologist as being of very good or excellent quality, while in two cases (5%), the images were not interpretable. Insufficient histories were given in 43% of referrals, despite the use of an electronic form providing a template of the required information. Sites staffed solely by a nurse consistently used this template, whereas doctors continued to use a more informal history reporting style.

A small sample of patient and provider satisfaction questionnaires has been reviewed. This reveals that patient comfort with the teleconsultation process was rated as very good to excellent. Patient and provider satisfaction overall were rated as excellent. It is too early to report on follow-up and the providers’ perception of disease outcome.

Example of a SAF Teledermatology Consultation

A. Patient data (sent in text of email):

   Hi Roy,

   Please comment on this XX year old Xhosa man, painter for 10 years, completed TB treatment 1 year ago, who presents with these widespread itching ulcerating skin lesions for about 1 year. I'm thinking of severe impetigo/secondary bacterial infection, upon some underlying condition such as scabies, eczema or secondary syphilis, or ?? SLE.
   I tested him today for HIV and VDRL, awaiting results.
   I’ve put him on Flucloxacillin, Phenergan, and aqueous cream, to see him next Friday.
   I’ll send you 3 e-mails, with 2 photos per e-mail, not to jam the server.
   Would it be ok to make the pictures smaller in future-re loss of detail?
   Regards
Fig. 3

B. Patient images attached to e-mail (Fig. 3–5)

Fig. 4
Response from teledermatologist

Dermatology Consultant Response

Date: 2 April, 2005
Date referral received: 1 April, 2005
Teledermatology Site: George

Patient code: 7 Outpatient
Consultant Name: Roy Colven, MD

Provider code: 1
Institution: UCT
Number of Images: 6
Total file size: 8.2 MB

Case Summary
XX year old male with one year history of itchy, eroded skin. History of TB, treatment completed 1 year ago. Works as a painter. No history of atopy mentioned. HIV status not yet known.

Teledermatological exam
6 images show the extremities, buttocks, and face of an African adult male. The images show hyperpigmented plaques, papules and nodules, most eroded, and some, especially on the legs with heavy crusting. Most lesions appear chronic. His face shows a symmetrical pattern of hyperpigmented and erythematous plaques over the cheeks. He has some edema of his lower eyelids, but his conjunctivae look spared.

Assessment
This looks best for secondarily infected prurigo nodules. I will stick my neck out and predict that his HIV test will be positive. His arms, legs and buttocks have the appearance of “pruritic papular eruption” commonly seen in relatively advanced HIV. Staph carriage is likewise prevalent in HIV patients, making secondary infection a likely event. This is not to say that he couldn’t have atopic eczema, or another systemic cause of itching with secondary lesions from scratching that have become infected. Secondary syphilis usually doesn’t erode, and the one year history would make this unlikely. Easy to rule out, though.

Recommendations
I completely agree with your management thus far. In addition to the flucloxacillin and phenergan, I would also give him a topical steroid to help reduce the symptoms from these chronic lesions. Either Lenovate or 10% Dovate ointment would suffice, which ever you can give him in reasonable quantity. Ultimately, if his

Please let me know the results of his HIV test.

(Footnote: HIV seropositive subsequently)

Feedback for Referring Provider
Image quality: Excellent
Historical data: Sufficient
Comments: None
Educational value: High

Review during next site visit? Yes

References
(Assuming this patient ends up being HIV+) Full PDF of this article is attached separately.

Etiology of pruritic papular eruption with HIV infection in Uganda.
Resneck JS Jr, Van Beek M, Furmanski L, Oyugi J, LeBoit PE, Katabira E, Kambugu F, Maurer T, Berger T, Pletcher MJ, Machtinger EL.

Department of Dermatology and Institute for Health Policy Studies, University of California,
CONTENTS: A frequent cause of human immunodeficiency virus (HIV)-related morbidity in sub-Saharan Africa is a commonly occurring, intensely pruritic skin rash. The resulting scars are disfiguring and stigmatizing. Despite the substantial prevalence of pruritic papular eruption (PPE) among HIV-infected Africans, the cause has been elusive. OBJECTIVE: To determine the etiology of PPE occurring in HIV-infected individuals. DESIGN, SETTING, AND PATIENTS: Cross-sectional study of HIV-infected patients with active PPE from clinics in Uganda conducted from May 19 through June 6, 2003. Enrollment occurred in the month preceding May 19. Each participant was clinically examined by 2 dermatologists, had laboratory studies performed, was administered an epidemiologic questionnaire, and had a skin biopsy of a new lesion evaluated by a dermatopathologist. MAIN OUTCOME MEASURES: Histological characteristics of new pruritic lesions. Other assessments included CD4 cell count, eosinophil count, and physician-assessed rash severity. RESULTS: Of 109 patients meeting inclusion criteria, 102 (93.6%) completed the study. The CD4 cell counts in this study population were generally low (median, 46/microL) and inversely related to increasing rash severity (median CD4 cell counts: 122 for mild, 41 for moderate, and 9 for severe; P<001 for trend). Eighty-six patients (84%; 95% confidence interval, 77%-91%) had biopsy findings characteristic of arthropod bites. Patients with arthropod bites on biopsy had significantly higher peripheral eosinophil counts (median, 330 vs 180/microL; P = .02) and had a trend toward lower CD4 cell counts (median, 40 vs 99/microL; P = .07) than those without histological evidence of arthropod bites. CONCLUSIONS: Pruritic papular eruption occurring in HIV-infected individuals may be a reaction to arthropod bites. We hypothesize that this condition reflects an altered and exaggerated immune response to arthropod antigens in a subset of susceptible HIV-infected patients.

Thank you for referring this patient!

Immediate benefits

Immediate benefits of the network thus far have been enhancement of triage, diagnostic support, and skin disease management guidance from a dermatologist. The teledermatologist’s response was 100% and timely, usually within 3-5 days (response times range from less than one hour to seven days). The response, with the referral images, were available to go into the patient’s medical record for future reference. The referring provider also benefited from learning about skin disease management and, when referrals were provided, more general reading on the referred patient’s condition. A further educational benefit was gleaned when the PI revisited the sites to review the cases with the providers. This was most apparent in George, W. C., where the PI revisited to give a professional development lecture on dermatology for the general practitioner and was able to review cases directly with the referring providers. This visit also served in troubleshooting for any difficulties with the system. The PI furthermore established a weekly review of the teledermatology referrals with the staff, including trainees, in the dermatology division at UCT. This weekly teledermatology review session has become a routine part of the training curriculum. Lastly, the network has provided an intercontinental dermatology education exchange between UCT and the Division of Dermatology at the University of Washington in Seattle, USA. Challenging dermatology cases from UCT and UW have been exchanged for trainee and consultant education. A live interactive video “grand rounds” has also been held between the two faculties.

Pitfalls

The system has not been without pitfalls. Image utility, though usually very good to excellent, can vary, in terms of image quality and body site. Uploading images and history takes time
out of a busy primary provider’s schedule. Obtaining informed consent and answering questionnaires is likewise burdensome for a busy healthcare provider. Camera failure at one site (Hermanus) imposed a delay of 6–8 weeks in referrals, and the threat of theft of equipment is always present. Securing equipment generally comes at the expense of efficiency.

**Future objectives (year two)**

Objectives for the second year of this project include:

a) Extension of the network to include other underserved areas/populations. The PI has had discussions with the South African Armed Forces regarding support for the military and primary providers. Similar discussions have occurred with NGOs aiding the antiretroviral roll-out in South Africa and we have received approval to equip and train two sites involved with this. Two other South African nations, Kenya and Zambia, have been in contact with us to provide both patient/provider support and system support. Lastly, inspired by a recent event where four people were shot and a prison guard killed in an attempt to break a prisoner out while he was in the Groote Schuur Hospital Outpatient Department waiting area, we are planning to approach Pollsmoor Prison regarding a possible teledermatology link to reduce the risks and the cost of transporting prisoners to hospital for a personal dermatological consultation.

b) Though password-protected email for referrals and responses is working thus far, a web-based, password-protected interface offers definite advantages for both provider and consultant. We intend to look at other web-based platforms and assess our specific needs before implementing this.

c) Extend our network of dermatologists willing to take on telereerrals.

d) Establish a mechanism for reimbursement for the teleconsultants’ time.

e) Explore further research looking at innovative questions. Examples include the use of cell phone cameras as a more mobile option for providers to transmit images. Also, a study looking at the formal assessment of teledermatology diagnostic accuracy in diagnosing inflammatory skin rashes in darkly pigmented patients is being offered as a medical undergraduate research module at UCT.

**Grant Support**


Further grant support is being pursued by the PI to allow attention to the above future objectives. The aim is to enrol approximately 100 patients and provide data to the agencies responsible for health care financing in the individual provinces. If support is obtained, a formal business plan and reimbursement scheme can be devised to sustain the system for the long term. Sustainability of this network will depend on compensation for this effort, as well as its usefulness and effectiveness for patients and providers. Without further support, this project is at risk of failing before it has had a chance to reach its full potential.

**References**


[14] CIA World Fact Book Online
3 Telecommunication infrastructure

This section consists of two segments:
1) an overview of telecommunication infrastructure
2) an example of a working application of satellite-based communication for telemedicine purposes

3.1 Overview of telecommunication infrastructure for telemedicine

The use of telecommunications in support of health care services, particularly in telemedicine applications, often requires a highly sophisticated multimedia infrastructure.

Healthcare-related information in the form of text, data, audio or video (or a combination of these) demands different, and usually quite stringent, signal requirements, together with session properties varying with the application. One of the first steps to be taken in any remote health care delivery is a clear definition of these requirements and a choice of the telecommunication techniques to meet them.

In this part, an overview of the techniques is given. The choice of these techniques needs careful planning, since the special quality of service demanded by the health care will typically require significant investment.

Traditional infrastructure

The public switched telephone network (PSTN) is ubiquitous around the world. The transmission medium is typically a copper pair, but other media (optical fibre cable, radio communication etc.) may also be used.

Though designed for voice calls (expected duration of a few minutes), this basic system can also provide low-data rate communications through dial-up modems connections to the terminal points. The highest rate achievable for data transmission is 56 kbit/s (usually closer to 48 kbit/s).

Not only point-to-point, but also point-to-multipoint and multipoint-to-multipoint connections are available with PSTN; however, the connections are restricted to voice (e.g. teleconference) and low datarate transmission services such as file transfer (see ITU-TV-series recommendations). Other services, such as videoconferencing, are possible with some compression techniques; however, in general they fail to satisfy the demanding conditions of e-health.

A major improvement over the voice-oriented infrastructure is the Integrated Services Digital Network, ISDN. As its name implies, ISDN’s objective is to provide voice (in digitized form) and data communication on a single infrastructure. ISDN presents full-duplex access on an on-demand basis through two interfaces: BRI (Basic Rate Interface) and PRI (Primary Rate Interface).

BRI consists of three independent channels: two B (bearer) channels of 64 kbit/s each, and one D (data) channel of 16 kbit/s. The B channels can be aggregated to a single 128 kbit/s data channel. The D channel is used for control signals and call data. PRI has 30 B channels. ISDN has a number of advantages associated with its being an end-to-end digital system.

A similar system, sharing some design principles with ISDN, is known generically as time-division multiplexing (TDM). TDM systems constitute a digital hierarchy beginning with

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E1 (2,048 Mbit/s) ; a channelized version is employed with n x 64 kbit/s.

Though both ISDN and TDM networks are effective at transmitting synchronous data, they are less well suited to responding to the varying character of multimedia applications and meeting the need for a guaranteed level of QoS while preserving economy of networking.

Asynchronous transfer mode

Asynchronous transfer mode (ATM) is an integrated solution to the restrictions that apply to any synchronous flow of fixed-length time slots of data. Sizing down the packet structure to a cell of 53 bytes and a firm system of signalling to adapt dynamically to various characteristics of multimedia flow, the ATM network overcomes the main problems that the traditional synchronous approach faces.

Digital subscriber lines

Digital subscriber lines (DSL) present an outstanding solution satisfying the broadband access needs of small and medium-size businesses and home users alike. The underlying idea is to make full bandwidth capacity of a regular copper pair (telephone subscriber line) available by deploying DSLAM (Digital Subscriber Line Access Multiplexer) in the central office of the telephony company, in place of the traditional voice equipment which uses only its 4 kHz band. With a DSL modem at the customer premises, a high bandwidth at reasonable distances is achievable. The bandwidth obtained depends on the quality of the line and the distance from the central office hosting the DSLAM.

There is a variety of DSL technologies, collectively known as xDSL. Two of them are particularly useful in e-health applications:

- SDSL (Symmetric Digital Subscriber Line)
  SDSL provides data rates up to 2.3 Mbit/s in both directions within a range of 3 km over a single copper pair. As the name implies, this technology is suitable for applications with the downstream traffic load close to the upstream, such as teleconsultation.

- ADSL (Asymmetric Digital Subscriber Line)
  ADSL is designed to meet the need for a downstream rate greater than the upstream. 9 Mbit/s downstream and 768 kbit/s upstream is achievable within a few hundred meters from the central office. The operating range is typically 5.5 km. As the transport method, ADSL uses ATM.
  ADSL handles PSTN calls concurrently with data communication by making use of the low frequencies of the line spectrum for voice and the higher frequencies for data. However, this adds to the complexity on the customer side, requiring the installation of a signal splitter and a microfilter at the user side.
  A version of ADSL known as G. Lite dispenses with the splitter, and is designed to be more user-friendly. G. Lite provides a data rate from 128 kbit/s to 1,544 Mbit/s downstream, and from 128 kbit/s to 384 kbit/s upstream. Other versions of ADSL include the recently deployed ADSL2 and ADSL2+.

The other major DSL types are:

- HDSL (High-bit-rate Digital Subscriber Line)
  Basically, HDSL provides the same service as an E1 connection.

- VDSL (Very High Datarate Digital Subscriber Line)
  VDSL delivers 52 Mbit/s downstream and 2.3 Mbit/s upstream at distances of a few hundred meters.

Radio communication

Cellular radio networks are mostly frequency or code-division multiple access systems (FDMA
or CDMA) and composed of cells (generally of hexagonal shape) defined by base stations that enable frequency or code reuse. The terminals communicate through base stations connected to a central switching unit.

Cellular networks can support many data services, although voice calls and short messaging remain the main drivers.

There is a large number of digital cellular technologies: GSM, GPRS (General Packet Radio Service), CDMA (Code Division Multiple Access), EDGE (Enhanced Data for GSM Evolution), 3GSM and DECT, to name but a few.

The backbone of radio communication is implemented by satellites. Satellite communication has two main advantages:
1) very large bandwidth
2) inherent point-to-multipoint transmission over a very large area.
This makes it an attractive solution in the absence of a terrestrial infrastructure, whether due to the remoteness of a region or to a disaster of some kind.

There are very effective and efficient radio communication technologies that enable both mobility and high QoS, such as Wi-Fi. Unfortunately, a discussion of the details would go beyond the scope of this report.

**Summary**

There is a very wide range of telecommunication techniques ready to serve e-health under any conditions. Through the strong connection between information and communication technologies, a very powerful example is the Internet, new possibilities for e-health applications emerge while bringing new problems such as security along.

### 3.2 Satellite-based telemedicine practices

**A success story from India**

**Background**

India is faced with the enormous task of providing health care to a vast rural population, spread in inaccessible and remote areas, including distant island. 80% of the population live in some 627,000 villages; by contrast, 80% of the medical specialists reside in the major cities. The country is served by approximately 27,000 hospitals and health centres, broken down as follows:

- district hospitals — 670;
- community health centres — 3,000;
- primary health centres — 23,000;
- medical colleges and super-speciality hospitals — 250.

India faces other challenges as well, including the difficult terrain, long distances, poor transportation, poor literacy, low income and limited access to media. Assuring access to healthcare at the super-speciality level for the entire rural population is almost impossible, a situation that might be characterized as a “health divide”. Telemedicine is the only option that promises to bridge this divide.

As part of the utilization of space technology for the development of the country’s remote

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regions, the Indian Space Research Organization, ISRO, has initiated a number of programmes. One of the major programmes is telemedicine. ISRO has taken the initiative to provide satcom-based telehealth and telemedicine facilities, in the framework of a social programme. Telemedicine promises to improve access, reduce travel costs for patients and healthcare staff alike, lower expenditure on staff/equipment cost, provide support to people in their own environment, and overcome rural isolation.

The applications of telemedicine are:
• teleconsultation
• telediagnosis
• radiology
• pathology
• cardiology
• ophthalmology
• tele-education
• CME (continued medical education)

Telemedicine systems consist essentially of (a) a patient-end terminal, (b) a specialist-end terminal and (c) a server.

**Patient-end terminals include:**
• A PC with telemedicine software and interfaces for diagnostic instruments
• A videoconferencing system
• Diagnostics instruments
• A 12-lead ECG unit
• A high-resolution X-ray scanner
• A digital imaging-capable microscope for pathology.

**Specialist-end terminals include:**
• A PC with telemedicine software
• Processing and display of the diagnostic data
• A videoconferencing system.

**The rationale for a satellite-based infrastructure**

Videoconferencing is one of the main components of any telemedicine system. This requires a data exchange rate of at least 384 kbit/s. In densely populated areas, terrestrial telecommunication systems (ISDN or optical fibre) offer high capacity at a low cost; however, they are less cost-effective in remote areas, where the population density is lower. Furthermore, the construction of such an infrastructure is time-intensive.

Satellite-based communication is the most effective way of providing the necessary communication links. Compared to a terrestrial link, it allows ubiquitous access anywhere within the satellite’s footprint, at a much lower cost and with a reduced lead-time.

Satcom-based links are thus more suitable for the telemedicine network. The configuration of a typical ISRO telemedicine satcom network is shown on Figure 1. Around 100 terminals are already operational, connecting 20 super-speciality hospitals, 80 district/rural hospitals, and others located in remote places like the Andaman and Nicobar islands, Lakshadweep, and poorly accessible areas of Ladakh and the northeast. Many more are in the process of installation (Fig.2).

Three types of connectivity are provided:
• Point-to-point
• Point-to-multipoint
• Multipoint-to-multipoint

The terminals use VSATs with a 3.8m antenna.

An ISRO hub at Bangalore is used for network control. Its technical characteristics are as follows: data rate 384 kbit/s, link on demand (SCPC-DAMA), LAN-TCP/IP interface.

Two types of terminals are used:
1) standalone—each node requires the full software suite
2) server-based—the full software suite resides at the server node only, the other nodes being browser-based with minimal software requirements

Patient-end terminals are provided with:
• a PC with telemedicine software
• a PC-based videoconferencing system
• a 12-lead ECG unit
• an A3-size X-ray scanner or X-ray view box with digital camera and stand and a pathology microscope with digital camera (at some locations)
• a VoIP phone
• a printer.

Doctor-end terminals have:
• a PC with telemedicine software
• a PC-based or standalone videoconferencing system with PTZ (pan, tilt, zoom) camera
• a VoIP phone
• a printer.

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![Satcom based Telemedicine System](image)

**Fig.1**
ISRO has taken the lead to standardize e-health data interchange:
- DICOM-Digital Imaging and Communication in Medicine
- HL7-Health Level Seven
- Videoconferencing standards
- H.323 with H.261 and H.263 video coding.

The satcom solution relies on the use of transportable telemedicine terminals that can be moved from village to village by van. This is done to avoid the prohibitive costs of fitting terminals in every single village. The mobile units are assigned to cover a cluster of villages, visiting each village at regular intervals and also on call, when required. The mobile unit consists of a small bus chassis with a roof-mounted 1.8 m antenna and VSAT electronics for satellite connectivity. The vans are self-contained; in addition to the VSAT terminal they have a videoconferencing system and a PC-based telemedicine system, as well as diagnostic instruments. They are also fully air-conditioned, and fitted with an uninterruptible power supply and petrol generator. ISRO has supplied ophthalmic telemedicine vans to:
- Sanker Nethralaya, Chennai
- Aravind Eye Hospital, Madurai.

Vans are being extensively used by both the hospitals to provide eye care services to large number of villages. Two more telemedicine vans for general medicine are in the pipeline.

Utilization

A user meeting was organized in November 2003 to review the utilization of the telemedicine systems installed by ISRO. Doctors from super-specialty hospitals, social research scientists
and telemedicine system vendors participated in the meeting. Social research scientists solicited feedback from doctors and patients at some of the telemedicine nodes regarding the utilization and acceptance of telemedicine by the doctors and patients. It was found that telemedicine is well accepted and increasingly being adopted by doctors and patients. It has definitely improved the quality of e-health at remote locations.

**Satcom systems in disasters**

The satcom-based telemedicine terminals installed in the Andaman and Nicobar Islands have shown their usefulness during the tsunami disaster that struck the islands following the 26 December 2004 earthquake off the coast of Indonesia. The terminals saw extensive use in organizing medical support from the mainland super-specialty hospitals.

**The future**

The present telemedicine network, working in the extended C-band with the Insat spacecraft, has nodes requiring 3.8 m/1.8 m antennas. This size of antenna is not suitable for a portable telemedicine terminal, being too large to be easily carried by a healthcare worker travelling in an isolated area with a small vehicle. Future satellites will have high-power S-band and Ku-band transponders.

This will make it possible to use portable satcom terminals, roughly the shape and size of a briefcase, with a small dish or a flat array of patch antennas mounted on the lid, and electronics in the base. The telemedicine system requires a laptop or tablet PC with a built-in camera and a small number of diagnostic instruments that can be fitted easily inside a small suitcase. The emphasis in the future will be on wireless connectivity between the satellite communication terminal, telemedicine system and diagnostic instruments, along with the following features:

- a mobile telemedicine van
- a small steerable antenna.
- mobile connectivity to a super-specialty hospital
- a telehealth kiosk in every village
- standardization of telemedicine systems
- interoperability of different telemedicine systems
- the use of new video coding standards such as H.264 and MPEG-4
- HealthSat.

### 3.3 Successful usage of Communications Satellite for Supporting Medical Treatment in the Aftermath of Disasters¹⁴

**Introduction**

When disaster occurs, telemedicine plays an imperative role in saving lives. According to the American Red Cross, disaster is defined as an occurrence such as hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, earthquake, drought, blizzard, pestilence, famine, fire, explosion, volcanic eruption, building collapse, transportation wreck, or other situation that causes human suffering or creates human needs that the victims cannot alleviate without assistance. Telemedicine is the practice of medicine over distance with the use of telecommunications equipments¹ and it was first applied in disasters during the mid-1980s¹¹.

At the beginning, inconveniences such as bulky, uncooperative systems had reported causing

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technical difficulties. Subsequent learning through trials and tribulations brought the improved technologic systems of today. Using data from the past earthquakes in Japan will simulate mobile phones relying on the public network for medical communications during disasters. Subsequently, number of Satellite Telecommunications channels necessary for telemedicine in disasters will be addressed. Finally, the development of telemedicine package under the initiatives of Tokai University Nakajima Laboratory will be introduced for consideration.

1 Communications Satellite for Telemedicine in disasters

NASA (The National Aeronautics and Space Administration) first began to conduct research on telemedicine in coordination with the startup of the Gemini project\textsuperscript{131}. The usage of telecommunication technology to furnish disaster aid by NASA began following the devastating 1985 earthquake in Mexico City. The Advanced Technology-3 (ATS-3) communications satellite provided critical voice communication support within 24 hours of the disaster.

ACTS (Advanced Communication Technology Satellite) was launched in 1994 to be used to

<table>
<thead>
<tr>
<th>Year</th>
<th>Area or Project</th>
<th>Infrastructure</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>Earthquake in Mexico (civilian)</td>
<td>ATS-3</td>
<td>Voice communication support</td>
</tr>
<tr>
<td>1990</td>
<td>Hurricane Hugo (military)</td>
<td>INMARSAT, land lines</td>
<td>CT</td>
</tr>
<tr>
<td>1991</td>
<td>Gulf War (military)</td>
<td>INMARSAT, land lines</td>
<td>CT</td>
</tr>
<tr>
<td>1992</td>
<td>Somalia (military)</td>
<td>INMARSAT, land lines</td>
<td>CT, still image</td>
</tr>
<tr>
<td>1993</td>
<td>Primetime I, Macedonia and Croatia (military)</td>
<td>Orion satellite</td>
<td>CT, still image</td>
</tr>
<tr>
<td></td>
<td>Space Bridge, Moscow (civilian)</td>
<td>GTE Spacenet, G-Star II, WSDRN satellite (Russian)</td>
<td>2-way video, audio, telepathy</td>
</tr>
<tr>
<td>1994</td>
<td>Eruption of a volcano, Rabaul (Papua New Guinea)</td>
<td>ETS-V</td>
<td>Voice communication between disaster sites and hospitals</td>
</tr>
<tr>
<td>1994</td>
<td>Haiti (military)</td>
<td>INMARSAT, ACTS satellite</td>
<td>CT, video, still image, digital acquisition devices</td>
</tr>
<tr>
<td>1995</td>
<td>Primetime II, Croatia (military)</td>
<td>Orion satellite, ATM technology</td>
<td>CT, still image, ultrasound, color Doppler</td>
</tr>
<tr>
<td>1996</td>
<td>Primetime III, Bosnia (military)</td>
<td>Orion satellite, ISDN</td>
<td>CT, still image, ultrasound, color Doppler, store-and-forward</td>
</tr>
<tr>
<td></td>
<td>ACTS Montana Demonstration (civilian)</td>
<td>ACTS satellite</td>
<td>On-site acquisition devices (audio, video, data)</td>
</tr>
<tr>
<td>2004</td>
<td>Tsunami, India (ESA, DISCARE)</td>
<td>GPS, Globarstar, Inmarstar, Eutelsat</td>
<td>To connect mobile teams of rescue workers with hospitals via satellite</td>
</tr>
<tr>
<td>2004</td>
<td>Tsunami, India (ISRO)</td>
<td>VSAT, INMARSAT</td>
<td>Has brought 3 hospitals in Andaman and Nicobar islands into ISRO telemedicine network. Connected to medical facilities on the subcontinent and received specialist services.</td>
</tr>
</tbody>
</table>

transmit medical records, images, and live video at up to T-1 (1.544 Mbps) data rates.

In 1994, the U.S. military gained additional experience by sending a telemedicine team to support U.S. troops in Haiti. Telemedicine capabilities included video teleconferencing and transmission of high-resolution still digital images (including digitized radiographic films)\textsuperscript{iv,v}. The ESA (European Space Agency) began actively pursuing activities in telemedicine back in 1996\textsuperscript{vi} in the former Yugoslavia to provide support in setting up a satellite-based pilot communication system between hospitals in Italy and the field hospital in Sarajevo. It has also taken initiatives in several telemedicine related projects such as DELTASS and I-DISCARE, under the framework of ARTES programme-Advanced Research in Telecommunications Systems. DELTASS (Disaster Emergency Logistic Telemedicine Advanced Satellite System) is a space-based system designed to improve the benefits and efficiency of the management of the rescue, first medical aid and emergency operations in disaster situations like earthquakes or explosions. The follow-up of the project DELTASS is called I-DISCARE where satellites systems have been proved to be both cost effective and adaptable to disaster. I-DISCARE has been put into action during tragic tsunami disaster in the Indian Ocean in 2004 by connecting mobile teams of rescue workers with hospitals via satellite.

Tokai University School of Medicine and the Telemedicine Society of Japan developed a medical network spanning the Asia Pacific region using the ETS-V Satellite during 1992 to 1996 called Project “AMINE”. In 1994, the eruption of a volcano crashed public lines in Rabaul (Papua New Guinea). AMINE project team provided satellite services by communicating medical school at UPNG in Port Moresby and helped supplying first aid kits and water.

Several telemedicine efforts using communications satellite has been performed in the immediate aftermath of the December 26, 2004 tsunami in Indian Ocean. It has been reported that the Indian Space Research Organization (ISRO) has brought satellite facilities to local doctors to communicate with hospitals in the ISRO telemedicine network. For Summary of military and civilian disaster related telemedicine deployments see Table 1.

2 Simulations

We have observed several cases of successful satellite telecommunication usage in Disasters. Disasters, whether natural or man-made can strike any time, any place, and without any warning. Whether it’s a natural disaster, such as an earthquake, hurricane or tornado, or a terrorist attack as in the aftermath of the attacks of September 11, 2001 and more recently the bombings in London. See Table 2 for classification of various disaster cases.

Japan is known as volcanic country. A country that has experienced many tragic disasters in its history. Are we prepared?

We have picked up two disasters occurred in Japan. One is the most recent Fukuoka Prefecture Western Offshore Earthquake occurred in March 2005 and the other one is the biggest South Hyogo Prefecture Earthquake in 1995. In short, from telemedicine point of view the effectiveness of mobile telephone as a tool for supporting medical treatment in the aftermath of disasters and the number of satellite telecommunication channels necessary for telemedicine during major disasters will be discussed.

2.1 The effectiveness of Mobile phone in disasters

Mobile phones are considered to be an effective communication tool in the aftermath of disaster in general. However, now that the number of mobile phones has increased, both mobile phones and fixed phones are reported creating communication overloads due to
**Table 2** Classification of various disaster cases

<table>
<thead>
<tr>
<th>Disastrous cases</th>
<th>Functions of medical equipment and medicines</th>
<th>Transportation</th>
<th>Communication devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typhoon/hurricane Floods/Tsunami</td>
<td>Relief from drown Prevention for infectious diseases</td>
<td>Boats, helicopters</td>
<td>Telephone, telemedicine equipment</td>
</tr>
<tr>
<td>Earthquakes/fire</td>
<td>Relief from burn</td>
<td>Vehicles, helicopters</td>
<td>Telephone, telemedicine equipment</td>
</tr>
<tr>
<td></td>
<td>Relief from crash syndrome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volcano eruptions</td>
<td>Relief from poisonous gas</td>
<td>Vehicles, helicopters</td>
<td>Telephone, telemedicine equipment</td>
</tr>
<tr>
<td></td>
<td>Relief from burn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air crash/traffic accidents</td>
<td>Relief from crash syndrome</td>
<td>Helicopters, vehicles</td>
<td>Telephone, telemedicine equipment</td>
</tr>
<tr>
<td></td>
<td>Relief from fracture of bones and burn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear power station trouble</td>
<td>On site sampling of HLA type for bone marrow transplant</td>
<td>Vehicles, helicopters</td>
<td>Telephone, telemedicine equipment</td>
</tr>
<tr>
<td>Terrorism by bombing</td>
<td>Burn, Barotrauma, Pulmonary injury</td>
<td>Vehicles, helicopters</td>
<td>Telephone, telemedicine equipment</td>
</tr>
<tr>
<td>Terrorism by poisonous gas</td>
<td>Secured aspiration</td>
<td>Vehicles, helicopters</td>
<td>Telephone, telemedicine equipment</td>
</tr>
</tbody>
</table>

increased calls during earthquakes in Japan\(^{vii}\). The question remains, as to the wisdom of using the existing public phone network for medical communications during disasters. Mobile phones relying on the public network for medical communications during disasters will be simulated using data from the past earthquakes. Figure 1 is the growth of mobile phone subscribers and major natural disasters in Japan.

Communication records and statistical sheets for the Fukuoka Prefecture Western Offshore Earthquake have been used. The earthquake struck Fukuoka prefecture, Japan at 10:53 am on March 20th, 2005 and the maximum magnitude reported 7.0. According to research conducted by a private company, around 70% had reported choosing mobile phone as a tool to communicate after the earthquake. Figure 2 is the type of communication tool used during earthquake occurred in Fukuoka Prefecture.

However, we can see in Table 3 that large amount of people reported communication trouble in communicating via mobile phone.

2.1.1 Methodology

The maximum number of calls from mobile phones has been assumed 147,945 calls/hour (calculated using Statistical data from Ministry of Internal Affairs and Communications, 2004). The channels for mobile phone calls are designed to reduce call loss probability to 5% or less (standard call loss probability for mobile phones in Japan). Since 40% of the national average on call duration for mobile phone is reported 30 seconds (Source : Ministry of Internal Affairs and communication), the Earlang B\(^{viii}\) equation based on this statistical data, indicates that 32 channels per station is required. It was assumed that 15 calls, one call per minutes were made over 15 minutes and the mobile phone transit station installed in the area covers an area of 3.14 km\(^2\). The average duration of calls made immediately after the earthquake is the same as that under normal conditions, i.e., 30 seconds.
Call Loss Probability = \( \frac{a^c e^{-a}}{1 - P(c+1, a)} \)

\[ P(c+1, a) = \sum_{x=c+1}^{\infty} \frac{a^x e^{-a}}{x!} \] [Poisson distribution]

\( c \): Number of channels

By using the Erlang B equation, the call loss probability is 93.3% (probability of successful call is 1/15) and traffic intensity is 456.069 Erlang. The figure implies that the call traffic was 54,728 times/hour in the immediate aftermath of the earthquake. The results of the simulation indicate that the number of mobile phone calls reached about 17.5 times their normal level in the densely populated area of Fukuoka city.
2.1.2 Discussion

A major reason for the high degree of failure of mobile phone calls during disaster is the number of people calling to find out the safety of their friends and family.

According to Saga Newspaper, March 24, 2005, Fukuoka governmental officers including governor of Fukuoka had reported that priority mobile phones for emergency calls were unable to communicate after the Fukuoka Prefecture Western Offshore Earthquake\(\textsuperscript{13}\). The number of medical calls is much smaller during a disaster compared to safety inquiry calls, while the duration of each call is longer than safety calls, due to amount of medical information on the victims exchanged. The typical call duration for real-time teleconsulting using image data is about 30 minutes\(\textsuperscript{3}\). It is impossible to maintain such long call when the mobile network is suffering from traffic congestion. Based on the reports and news articles on this earthquake, a percentage of 70\% reported that have tried to use mobile phone during the earthquake (See Figure 2, 3 and Table 3 in the Annex). 45\% reported being able to contact within 15 minutes after the earthquake\(\textsuperscript{14}\). NTT docomo reported that has controlled the traffic being able to connect once in every 10 calls. Thus, we have assumed it took 15 minutes between the earthquake occurrences till the time to be connected.

Supposed the call was made once in every minutes, then the total would be 15 times and 30 minutes of calling time. The call loss probability would be 93.3\%. See Figure 3 and Figure 4.

Consequently, it can be concluded that under current condition, mobile phones are not a useful tool for medical control during a disaster. Thus, organizations participating in medical control in the aftermath of disasters will require a non-public independent line and/or satellite telecommunication infrastructures.

2.2 Number of Satellite Telecommunications channels necessary for telemedicine in disasters

In the Great Hanshin-Awaji Earthquake, 5488 victims died and according to statistical data as many as 81\% of the victims died in the first seven hours, in the morning on that day. See Table 4 for cause of death and numbers. Figure 5 is the breakdown of 5488 victims during Great Hanshin Awaji Earthquake in Japan.

The Fire Defense Agency of Ministry of Internal Affairs and communications reserves the use of management channels, while the public phone network of Nippon Telegraph and Telephone Corporation (NTT) is generally used for inquiries about safety.

![Fig.3](image1)

![Fig.4](image2)
### Table 4

<table>
<thead>
<tr>
<th>Cause of the Death</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffocation or crushing</td>
<td>4224</td>
</tr>
<tr>
<td>Burn</td>
<td>504</td>
</tr>
<tr>
<td>Crushed or cervical injury</td>
<td>282</td>
</tr>
<tr>
<td>Major organ injury</td>
<td>98</td>
</tr>
<tr>
<td>Traumatic shock</td>
<td>68</td>
</tr>
<tr>
<td>Traumatism</td>
<td>45</td>
</tr>
<tr>
<td>Crush syndrome</td>
<td>15</td>
</tr>
<tr>
<td>Others</td>
<td>128</td>
</tr>
<tr>
<td>Not classifiable</td>
<td>124</td>
</tr>
<tr>
<td>Total</td>
<td>5488</td>
</tr>
</tbody>
</table>


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2.2.1 Methodology

The focus here is only on channels needed for diagnosis in telemedicine in major disaster and the duration of each call has been presumed the same as that needed for video teleconsultation in telemedicine Figure 6 and 7 shows Erlang B Formula.

The transmission of video data used in telemedicine requires a throughput of 2.0 to 6.0 Mbps when NTSC images are compressed by MPEG-2 [5-8]. Assuming a required transmission capability of 3.0 Mbps for each channel, a bandwidth of 87 Mbps (3x29) must be secured for satellite communication channels. Since hospital-to-hospital communication is performed between fixed stations, one of the C, Ku, and Ka transponders of a geostationary satellite can be used for disaster-relief medical treatment.

One study investigated video transmissions from ambulances to an emergency rescue center; the investigation does not represent an example of hospital-to-hospital communications but mobile vehicle to emergency center. The study suggested that 26 channels are necessary for 201 ambulances should be deployed in Tokyo when a major earthquake like the Great Hanshin-Awaji Earthquake strike Tokyo.

In a natural disaster, most of the victims are injured on the first day and there is virtually no chance that two or more areas will be hit by separate natural disasters at the same time. Based on the forgoing two conditions: 29 satellite channels will be sufficient for the realistic operation of a telemedicine system using hospital-to-hospital communications during a major disaster in Japan. The calculated number of channels does not include management channels or channels for inquiries about safety.

The regular use of transponder enables to communicate with satellite communication systems reserved specifically to use in natural disaster prepared programs inquires additional government expenditures. Despite this extra cost, satellite communications systems have already been installed in some fire stations and prefecture city halls where frequently hit by earthquakes in Japan. The transponders aboard the communications satellites are normally switched ON, with operation expenditures paid by the Ministry of Internal Affairs and Communications, as the transponders are a vital element of Japan’s national risk management. In terms of financial feasibility, 29 channels can be allocated to the provision of telemedicine during natural disasters; channels may be utilized if the number of emergency-use transponders is increased.

In addition to domestic requirements, disaster medicine is also the must in overseas. Thus, from a humanitarian perspective, foreign countries should also be included in the crucial medical services provided during times of disaster. Japan needs to send medical rescue teams...
to disaster-stricken areas where JICA (Japan International Cooperation Agency) workers and volunteers are stationed. With possible contributions to rescue activities not only on a domestic level, but also on an international one in mind, the steerable spot beam antenna aboard Superbird-C is suitable for disaster medicine. This steerable spot beam antenna, positioned on the geostationary Superbird-C satellite at 144 degrees east longitude, will enable to provide telemedicine in disaster situations over a large area of the Asia-Pacific. If 29 channels were utilized from four transponders (one with 36 Mbps and three with 27 MHz) aboard Superbird- C on the basis of FDMA-SCPC (Frequency Division Multiple Access-Single Channel Per Carrier), 29 channels with 3.0 Mbps QPSK and one common signaling channel (CSC) will be provided. The feeder link station can be controlled by DAMA (Demand Assigned Multiple Access) for n numbers of VSAT. Considering the mutual modulation product between carrier waves, the Badcock array will be suited for the channel allocation by DAMA. During teleconsultation, most data flow consists of transmission of video images from the disaster site to a remote rescue station through the return link (from VSAT to the feeder link station), an asymmetrical communication. Since feeder link station antennas are sufficiently large in most cases, there are also a sufficiently large number of channels for return link. Thus, even when n (29) waves are transmitted simultaneously from the satellite’s transponders, the transmission power of the transponders is much lower than the saturation level. Namely, the transit signals have a sufficient back off, indicating that there will be no serious operational problems even without mutual modulation product be implemented. Therefore, the availability of transponders is determined not by power capabilities but by frequency and it can secure a significant number of channels in a satellite-borne transponder.

Conclusion

Leasing satellite transponder is one effective option and communication infrastructure can be employed for research purposes using its excess powers. Prompted by events and concern around the threat of anthrax, a research team in the United States, launched the Anthrax Research Project. The project entailed presenting a key protein component of anthrax into the general rotation of the United Devices member community’s virtual screening project, which works with the Grid MP platform over the Internet. This allowed UD Members to lend their computers in the screening of 3.57 billion molecules for suitability as a treatment for advanced-stage Anthrax.

Telemedicine package is also considered an appropriate entity catering for various disastrous cases. Tokai University has started developing a small, light and handy Telemedicine Package using mobile satellite communications to be carried and transported easily by aircraft. This telemedicine package can be used anywhere in the world except in polar zone. The system aims to link disaster-stricken district and non-devastated district in an IP base via ISDN line. Flexible and accessible to PC designed for medical usage and connection to medical terminals are being made via wireless LAN. Nakajima Laboratory team at Tokai University is planning to invent this telemedicine package that can easily be carry on in the aircraft and establish a network in disaster-stricken district. The package will use equipment materials available on the market therefore the initial investments prices are comparatively affordable.

In concluding, telemedicine for major disasters is an important field of application where communications play an important role, and where associated technology, applications and services can quickly be turned into concrete benefits for mankind.

Finally, we propose that in medical control and treatment in the aftermath of disasters will require a non-public, independent and/or satellite telecommunication infrastructures.
Reference

[3] Information regarding Gemini project see following website; http://science.ksc.nasa.gov/history/gemini/gemini.html
[4] The initial telecommunications from Haiti used a 56-Kbps maritime satellite linked to a switched 56-Kbps commercial line at WRAMC. Later, the Army Space Command allocated use of a T-1/VSAT earth station (1.54 Mbps, very small aperture terminal) for telemedicine access to the NASA ACTS satellite system. The satellite provided full T-1 bandwidth connectivity to WRAMC using a commercial line. Using this technology, a high-bandwidth, full-motion video link was established between the combat support hospital and WRAMC. One oral surgery, one neurology, and three dermatology consultations took place over this improved communication link. Interactive remote telepathology and full-motion orthopedic joint examinations were also conducted as concept validation tests using various data rates
[8] Erlang is a unit of traffic measurement and Erlang-B formula allows calculating the probability that a resource request will be denied due to lack of resources. The Erlang B traffic model assumes that calls arrive randomly to phone line group, call durations are either a fixed length or exponentially distributed, and blocked calls are not retried immediately after receiving a busy signal. The Erlang B Calculator is based on the Erlang B traffic model and is used to work out how many lines are required if the traffic and the required grade of service are known.

3.4 A Decade History of PARTNERS Project15

To commemorate the International Space Year, the PARTNERS (PAn-pacific Regional Telecommunications Network Experiments and Research by Satellite) project was launched in 1992. Over the past four years, the project has carried out some experiments using ETS-V (Engineering Test Satellite-V) satellite, promoted by the MPT (the Ministry of Posts and Telecommunications: Present the Ministry of Internal Affairs and Communications) and some corporate organizations. The project was concluded at the end of March 1996, but the participants strongly requested a continuation because of its importance. Therefore, the Post-PARTNERS project (Phase-1) has been started in 1996. Although the Post-PARTNERS project phase-1 was mainly using TV meeting system based on H.261, in the Post-PARTNERS project phase-2 which started in 2003, the IP-v6 (Internet Protocol Version 6) router, PC, and applications for IP communication are added. This paper describes outlines the over ten-year history of the PARTNERS and Post-PARTNERS project, and shows configurations of Post-PARTNERS project (Phase-1 & -2) [1].

15 Kenji Tanaka, Kiyoshi Igarashi, National Institute of Information and Communications Technology (NICT), 4-2-1, Nukuikita-machi, Koganei, Tokyo 184-8795, JAPAN (E-mail : ken@nict.go.jp ; igarashi@nict.go.jp)
1 PARTNETS Project

In 1992, the Ministry of Posts and Telecommunications (Present the Internal Affairs and Communications : MIC), the Communications Research Laboratory (Present National Institute of Information and Communications Technology : NICT) and other corporative organizations was started the PARTNERS (PAn-pacific Regional Telecommunications Network Experiments and Research by Satellite) project for spreading the satellite communication technique to Asia-Pacific region countries using the ETS-V (Engineering Test Satellite-V) satellite as shown in Fig.1.

Next four years, acquisition of the directions of satellite communication equipment, transmission of ionosphere observation data, remote education, etc. have been carried out with CRL, NIME (National Institute of Multimedia Education : Japan), Thailand (KMITL : King Mongkut's Institute of Technology Ladkrabang), Indonesia (ITB : Institute Technology Bandung) and Fiji (USP : University of South Pacific). The Fig.2 shows a configuration of earth station.

2 POST-PARTNERS Project

The Post-PARTNERS (Phase-1) project, which is as next step for the PARTNERS project, started in 1996. This project has conducted tele-education, tele-medicine, multimedia communication experiments, etc. using commercial communication satellites between Asia-Pacific countries such as CRL, NIME (and their domestic higher education satellite network : SCS), Thailand (KMITL and CMU : Chiang Mai University), Indonesia (ITB), Fiji (USP), Philippines (AdMU : Ateneo de Manila University), and Malaysia (USM : University Sains Malaysia) as shown in Fig.3, using up to 2.0 Mbps for communication bandwidth [2]–[7].


Although the phase-1 was mainly using TV meeting system based on H.261, in the phase-2 which started in 2003, the IP-v6 (Internet Protocol Version 6) router, PC, and applications for IP communication are added on the each existing earth stations as shown in Fig.4 and 5. The purpose of the phase-2 project is followings;
Fig.1  Configuration of PARTNERS Network.

Fig.2  Configuration of Earth Station for PARTNERS Network.

Fig.3  Configuration of Post-PARTNERS Network.

- TV conference system based on PC introducing IPv6 as well as IPv4 will be main experimental equipment where the existing satellite network system of the Post-PARTNERS project is fully utilized.
- Usefulness of IPv6 in the case of satellite communications will be examined by experiments of multicast, QoS (Quality of Service), v4/v6 tunneling, unidirectional link routing (UDLR) etc.
- Feasibility study of such a communication infrastructure will be introduced in the case that the fulltime connection environment by the communication satellite is realized several years
Fig. 4 Configuration of Earth Station for Post-PARTNERS Network.

Fig. 5 Snapshots at CMU.

3 ACKNOWLEDGEMENTS

The authors would like to thank the MIC, NEC Corp., TOSHIBA Corp., JSAT Corp., Space Communications Corp., and ARIB (Association of Radio Industries and Businesses), which is a secretariat of this project, for a great deal of their efforts.

References

3.5 Experiments on secure satellite communications for long distance image transmission

1 Introduction

Secure transmission technology is needed on the fundamental basis for satellite transmission of medical image data, because any user can access to the satellite communications network and medical image data with private nature should be protected. In this report we introduce our secure communications experiments of image data transmission between Japan and Indonesia. In order to establish secure communications between different countries, we developed common video encryption/decryption modules with the common keys. We choose the VSC (Vector Stream Cipher) algorithm which was developed by NICT (National Institute of Information and Communications Technology) [1, 2] for this purpose. Because the encryption speed of VSC is known to be fast and suitable for real-time image data encryption [2, 5].

2 Portable Encryption Module

For experiments we developed portable encryption/decryption module. Figure 1 shows the

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(a) Whole image encryption of image taken in Japan was observed in Indonesia.

(b) Thick slit image encryption of image taken in Japan was observed in Indonesia.

Fig.3 Experimental results of one-to-one secure communications between Japan (NICT) and Indonesia (ITB). Left images are received encrypted images in Indonesia and right images are decrypted images in Indonesia.

outlook of this developed encryption/decryption module. It has RS-449/422 port which connects to IDU (INDOOR UNIT) and FPGA (Field Programmable Gate Array) chip and was commercialized [4].

3 Secure Communications Experiments of Image Data Transmission

We made transmission experiments between Japan (NICT) and Indonesia (ITB: Institute Technology Bandung) [3]. Figure 2 shows schematic diagrams of our satellite network structure. This satellite network was organized for international cooperated experiments in the Asia-Pacific region in the framework of the New Post Partner Project funded by the Japanese Government. JCSAT-1B of Ku-band was used for our experiments. Figure 3 shows our experimental results. In these figures, left images are encrypted ones of the original images taken in NICT. Those were received in Indonesia before decrypting. Namely, this encrypted data is sent by satellite communication system. Right images are decrypted images taken in ITB. We implemented not only whole image encryption but also some kind of encrypting modes, half image encrypting, thin slit image encrypting and so on. In any encrypting modes, images are recovered completely.

One of the advantages of satellite communication is in multi cast transmission. However, it is not good that any people can receive data on Pay-Par-View broad casting system, etc. Therefore, these systems need a property that the only people who have correct keys can decrypt data. We use the following simple key management for multicast transmission [3]. In NICT, the encryption module encrypts data using “key-1” and then encrypted data is sent to NICT and ITB. The decryption module in NICT has “key-1” and the decryption module in ITB has “key-2”. The difference of key-1 and key-2 is only one bit of 56bit key length. In this experiment, the decryption module in NICT can decrypt completely (like right images in
fig.3) but the decryption module in ITB cannot decrypt (like left images in fig.3). Therefore a specific user who has a correct key can decrypt data but the other user's cannot decrypt data.

4 Conclusions

In this report, we introduce experimental results of our secure communication experiments for image data transmission between NICT (Japan) and ITB (Indonesia). Multi cast experiment was successfully done between NICT and ITB. Such secure image transmission by satellite communications is useful and suitable for long distance medical image transmission because of their private nature.

References

   http://www.us.design-reuse.com/articles/article8264.html
   http://www2.nict.go.jp/kk/e414/shuppan/kihou-journal/journal-vol49no3/05.pdf
   http://www.inkubator.itb.ac.id/filedoc/BusinessResearch.pdf
4 Standardization in e-health and interoperability problems

4.1 Integrating telemedicine systems for e-health\textsuperscript{17}

Introduction

An e-health Hospital Information System (HIS) is the central information system of an e-health environment. It realizes many benefits of networked information systems by integrating information from all telemedicine systems such as teleradiology systems, telecardiology systems, telepathology systems and telesurgery systems \textsuperscript{7}. Typically, different local area networks are installed in different departments. Differences in format and models of information in different departments make interoperability of an HIS difficult. This problem is endemic worldwide in the e-health sector, particularly in developing countries, because the IT equipment used in different parts of an e-health organization may have been provided by different agencies at different times. The need for future integration is often neglected in the rush to rapidly install a range of different biomedical systems. Also, vendors of medical IT equipment may seek to perpetuate their hold over e-health organizations with proprietary technologies. Consequently, it is common to find sophisticated IT systems under-utilized in e-health organizations, due to incompatible technologies and standards.

The problem of interoperability and integration has led to the development of standards such as Health Level Seven (HL7), providing a message-oriented framework for the interoperability of HIS by standardizing and automating hospital information processes, such as admission and discharge (ADT), database query (Query), and pharmacy. This paper is based on a joint project involving the Children’s Hospital in Westmead (CHW), the University of Western Sydney and the University of New South Wales to develop an interoperability framework for HIS that may be of particular interest in the development of telemedicine in developing countries.

This project (completed in 2000) has combined HL7 standards with the latest in distributed object-oriented software technology to illustrate a stable framework for the interoperability of telemedicine systems.

The paper starts with a discussion of the pros and cons of the three major approaches to the implementation of middleware for interoperable telemedicine systems based on HL7 standards, namely platform-dependent (DCOM based), language-dependent (Java based), and platform and language independent (CORBA based). This is followed by a discussion of our case study, which uses Java, CORBA and HL7. This interoperability solution was evaluated through an endocrinology application.

**HIS at CHW**

Children’s Hospital at Westmead (CHW) is one of the most modern hospitals in Australia. This hospital boasts a completely paperless system in its emergency sections. Networked computing has been installed in this hospital since its inception a few years ago. Interoperability is achieved using Cerner\textsuperscript{TM} applications and CloverLeaf\textsuperscript{TM} Interface Engine.

Cerner Systems (from the Cerner Corporation) at CHW are comprised of the following products: Pathnet (pathology laboratory management system), Radnet (Medical Imaging reporting-Radiology, Nuclear Medicine etc.), and OCF (Open Clinical Foundation), which is a clinical data repository for our electronic medical record. OCF contains patient information

\textsuperscript{17} Dr Pradeep Ray, University of New South Wales, Australia, e-mail: p.ray@unsw.edu.au
such as pathology/medical imaging results, discharge referral summaries, emergency department summaries, summaries from various other departmental systems. It also allows electronic ordering of services such as pathology, imaging, allied health etc. OCF is accessed by the clinician using a client application (GUI) called Powerchart.

The sole purpose of the Cloverleaf interface engine is messaging between systems. The messages can be between systems in the format of HL7 to HL7 (same or different versions), HL7 to SQL or batch processing. The interface engine performs the processing of these messages using transaction audit logs that allows the guarantee of delivery and also performs translations between different formats (protocols), e.g. HL7 to SQL.

CHW has spent a substantial amount of funds on the deployment of interoperable systems through HL7. However, they are locked in because of their reliance on proprietary Cerner applications and the Cloverleaf interface engine. The main objective of this project was to develop a more generic open middleware for the interoperability of HIS. This paper discusses the lessons learned in the course of the project, involving the use of Java, CORBA and HL7.

1 Interoperability issues in telemedicine systems

Interoperability can be of various types, ranging from media-level interoperability to semantic interoperability [4].

- Physical-level interoperability deals with hardware level interoperability issues, such as connectors, cables etc., not discussed in this paper.

- Data-level interoperability deals with issues related to data formats for different telemedicine systems. This is not the focus of the paper.

- Specification-level interoperability is concerned with various evolving architectural standards for interconnection, such as the OSI seven-layer communication stack. At this level, the concepts and their meanings are standardized with specified syntactic formulations. Examples are HL7, CORBA and Java, as discussed in this paper.

- Semantic-level interoperability is concerned with the meanings behind terms and syntax. This is a thorny problem, and the semantic Web researchers are developing new concepts and ontologies to solve this problem. This lies outside the scope of this paper. This section presents specification-level interoperability, based on HL7 and distributed object standards.

1.1 HL7 Overview

Health Level Seven (HL7) is one of several Standards Developing Organizations (SDOs) active in the e-health arena. Most SDOs produce standards (sometimes called specifications or protocols) for a particular e-health domain such as pharmacy, medical devices, imaging or insurance (claims processing) transactions. Health Level Seven’s domain is clinical and administrative data. Health Level Seven has developed a messaging standard that enables disparate e-health applications to exchange key sets of clinical and administrative data [6].

The HL7 standards facilitate the exchange of data between heterogeneous computer-based health-care applications. The primary contribution of the HL7 standard is the definition of a set of abstract messages that health-care applications can exchange in order to share data or to notify each other of important clinical events. The application of current distributed computing technology to the HL7 specification would enable the elimination of the HL7 encoding rules and obviate the need for HL7 message parsers and translators, while providing comprehensive open, standard, commercially-available multiplatform communication
capabilities [13].
HL7 also facilitates the exchange of data between independently developed e-health computer applications. Utilization of the HL7 standard eliminates or minimizes the number of custom interfaces required to realize inter-application communication. An additional contribution of HL7 is the specification of encoding rules, which are used to map the abstract messages into a text-based representation that can actually be transmitted using relatively simple communication technologies and protocols [13].

In order to participate as a recipient of HL7 messages, an application must be provided with the appropriate transport mechanism, a parser that maps the HL7 messages of interest into program data structures, and the logic to process HL7 messages. Similarly, to generate HL7 messages, an application must be provided with the appropriate transport mechanism, a translator that produces the text-based messages from program data structures, and the logic to generate HL7 messages.

The advent of open standardized distributed computing infrastructures has now created an opportunity to simplify the HL7 specification and streamline the development of HL7-compliant applications. The application of current distributed computing technology to the HL7 specification would make it possible to dispense with the HL7 encoding rules and message parsers and translators, while providing comprehensive open, standard, commercially-available multi-platform communication capabilities.

The next sections present three approaches to HL7 implementation:

- A platform-dependent approach based on Active X/DCOM (Chameleon)
- A platform-independent, language-dependent approach based on Java toolkit (University of Giessen, Germany)
- A platform-independent and language-independent approach based on OMG CORBA (Openmed/Telemed)

1.2 Platform-dependent Active-X/DCOM-based approach

Microsoft and its allies have implemented a distributed object model called DCOM, with Active X components designed using DCOM [15].

“ActiveX for e-health” is a collaborative project by Microsoft, Andover Working Group [2] and the Health Level Seven (HL7) [6] body. It is designed to provide easy, inexpensive interoperability between e-health applications and systems.

Active X provides a framework involving the DCOM communication environment, and different levels of infrastructure objects defined for ease of implementation of a distributed object-based systems. ActiveX is the key building block for interaction between applications and services — whether on the same machine, on a local network, or over the Internet. ActiveX components can be written in any language and deployed across multiple operating systems.

These freely licensed components and implementation guidelines are based on the work done by the Special Interest Group on Object Brokering Technologies (SIGBOT) of HL7, and specifies the HL7 message profiles and ActiveX-based version of the messaging application programming interface (API) developed by the Andover Working Group [2].

The ActiveX for e-health (AHC) messaging components encapsulate the HL7 2.3 message into objects and make it easy to connect various systems. Applications simply request the
appropriate object (e.g. an admission or a medication order), add the appropriate data elements and transparently send the object to applications that are configured to receive it. A flexible architecture makes possible a migration path from legacy systems and interface engines to networked, component-based applications. Applications can send messages via DCOM to another ActiveX application, or across a TCP/IP connection to an existing HL7-compatible application.

There are now HL7 products available on the market based on ActiveX and DCOM. HL7 Chameleon is one of the popular products that were evaluated as part of this project. The fundamental advantage of Chameleon is that it separates the message interface from the different implementations of HL7, allowing an application written with one interface to support a wide number of different versions of HL7, as shown in Figure 1. Chameleon's design deals with potential problems by shielding the application code from the raw HL7 data structure. It utilizes an intermediate nested data structure that is graphically mapped onto a number of different HL7 message trees [8].

The next level of the engine is the COM (OCX/ActiveX) wrapper layer. This wrapper exposes the entire API of the message engine. The GUI configuration application is written in Delphi and works through the COM interface. The GUI configuration utility is a full-feature, multiple-document interface program. It is used to define messages and mapping, and generate stub code in the native language of the user's application (Visual Basic, Delphi, C, C++ etc.). The generated classes form the interface for the user's application code. At any stage, the GUI configuration tool may be used to reconfigure the type of HL7 messages-without recompiling the user's application [8].

This implementation environment provides a good interoperability mechanism amongst different versions of HL7. Since it is based on COM (supported by Microsoft Windows), it is quite efficient. However, as in any distributed application approach based on operating systems, this approach has the problem of platform-dependence. Also, this approach does not take into account the new HL7 version 3, which is based on an object-oriented approach.

1.3 Platform-independent, language-dependent approach
The Java language, and more importantly the Java Virtual Machine (JVM) from Sun Microsystems and its allies, have provided a powerful, open methodology for the development of distributed applications. It is a platform-independent approach because JVM can convert any platform (OS) to support this architecture. However, the applications have to use a single language, i.e. Java [15]. Various implementations are now available for HL7 middleware based on Java. We had an opportunity to evaluate the HL7 toolkit from the University of Giessen, Germany.

The HL7 message library for Java from the University Hospital of Giessen is based on the
well-known distributed application development paradigm based on a language support (Java). Java virtual machines provide the platform independence in this situation. In this case, the HL7 package is a library written in Java, supporting the programmer writing Java applications that handle HL7 messages.

With the HL7 package, it is possible to build arbitrary HL7 messages. These messages can be converted into text and saved in or retrieved from files. It is also possible to send messages with TCP/IP protocol over the net, as shown in Figure 2 [9].

This language-based, distributed application development approach overcomes the problem of platform dependence, and provides a flexible mechanism for developing HL7 applications in Java that would run on a variety of systems. However, this approach will only provide interoperability of applications written in Java. Many hospital applications have legacy code written in languages other than Java. Hence a complete solution to the interoperability problem can only be provided through a combination of HL7 and CORBA.
1.4 Platform-independent and language-independent approach

The Common Object Request Broker Architecture (CORBA) is the framework and specification for a distributed computing system developed jointly by several hundred computing companies under the management auspices of the Object Management Group (OMG). CORBA provides a standard framework for object-oriented distributed computing that is independent of platforms [15].

The CORBA framework is being used for interoperable application development in many areas, including finance, manufacturing, telecommunications and e-health. Figure 3 shows the various CORBA-based building blocks defined by the OMG e-health (CORBAmed) interest group of OMG for using CORBA in the e-health application domain. The CORBA approach allows applications to be developed in a variety of languages, such as Java, Visual Basic, C++, Small Talk etc. [10].

This is the best approach to interoperability, because it is both platform-independent and language-independent.

It is now possible to map the domain knowledge and experience represented by the HL7 Version 2.2 Specification to CORBA to produce a powerful framework for interfacing distributed medical applications. In this mapping, the HL7 specification would define what the applications communicate about, while the CORBA specification would define how they communicate [13]. The mapping emphasizes HL7 as an e-health domain specification, while CORBA technology provides the basis for an open standard communication platform. The resulting marriage:

* simplifies the overall HL7 specification (e.g. by obviating the need for HL7-specific encoding rules),
* reduces the complexity of developing HL7-based applications (e.g. by making HL7 parsers redundant), and
* enables e-health system developers to employ commercially available, well-supported distributed computing technology [13].

The next section describes our prototype implementation, which uses the CORBA approach with Java language binding.

2 Implementing distributed e-health applications using HL7 and CORBA

In order to participate as a recipient of HL7 messages, an application must be provided with the appropriate transport mechanism, a parser that maps the relevant HL7 messages into program data structures, and the logic to process HL7 messages. Similarly, to generate HL7 messages, an application must be provided with the appropriate transport mechanism, a translator that produces the text-based messages from program data structures, and the logic to generate HL7 messages.

The advent of open standardized distributed computing infrastructures has now created an opportunity to simplify the HL7 specification and streamline the development of HL7-compliant applications. The application of current distributed computing technology to the HL7 specification would make it possible to dispense with the HL7 encoding rules and message parsers and translators, while providing comprehensive open, standard, commercially-available multi-platform communication capabilities.

OMG CORBA provides a distributed object-oriented framework for development applications
that are independent of operating systems (platforms), language for software development and communication protocols. There is an exciting opportunity to map the considerable domain knowledge and experience represented by the HL7 Version 2.2 specification to CORBA so as to produce a powerful framework for interfacing distributed medical applications. The Open E-Med (Telemed) application from Los Alamos Laboratory provides this integration of HL7 and CORBA [11].

The authors chose to adopt an approach used by the University Hospital of Giessen, Germany (as shown in Figure 2), with CORBA services added to enable connection to other distributed systems in the future. The University of Giessen HL7 package is a library written in Java, supporting programmers writing applications dealing with HL7 messages.

The HL7 package allows arbitrary HL7 messages to be constructed. These messages can be converted for saving and retrieval as text files. Furthermore there is a way to send messages with TCP protocol over the net.

3 Implementation strategy

The advantage of adding CORBA services was that mapping HL7 specification to CORBA could produce a powerful framework for interfacing distributed medical applications. Figure 4 shows the scheme.

CORBA helps us achieve the following.

- Eliminate HL7 encoding rules specification
- Eliminate HL7 parser
- Eliminate HL7 translator
- Reduce the amount of application logic
- Standardize the communication services [13]

Figure 5 shows the architectural view of a CORBA-based HL7 application. This section presents a discussion on approaches to implementing HL7-based applications in CORBA.

There are many approaches that could be taken in modelling the HL7 concepts using OMG Interface Definition Language (IDL). These include the following.

- Using CORBA to simply transmit ASCII strings that have been encoded using the HL7 encoding rules. This approach provides a standard open infrastructure for transporting text-based messages between applications. However, translation from program data
structures to text-based messages is still required, as is parsing from text-based messages to program data structures.

- Describing the current HL7 fundamental encoding constructs, such as messages, segments, and fields, and using these constructs to transmit ASCII strings which have been encoded using the HL7 encoding rules, but with fewer message delimiting characters. This approach provides a modest step towards defining a cleaner interface to the HL7 messages infrastructure in terms of object-oriented concepts [12].

- Developing a medical domain object model, including patients and care providers, and then defining OMG IDL interfaces for these objects which support the HL7-defined interactions. This approach might be the ideal approach, but it could require years of work before coming to fruition.

- Defining interfaces in OMG IDL for each of the HL7 Version 2.2 transaction sets, where each message in a transaction set is represented by an operation defined for the corresponding interface [12]. This approach offers a clean programming language and transport-independent definition of the abstract HL7 messages. Also, while this approach demands methodical work, it has the advantage of expediency, because it preserves the domain-specific knowledge embodied in the existing HL7 Version 2.2 Specification [13].

The basic approach to mapping the HL7 abstract messages for unsolicited updates to OMG IDL can be summarized as follows.

- Fields with simple HL7 data types (e.g. String, Numeric) are mapped as the standard OMG IDL data types (e.g. string, float).

- Fields which are complex HL7 data types (e.g. Person Name, Address) are mapped as OMG IDL constructed types (e.g. struct PersonName, struct Address) where the members are simple and/or complex fields.

- HL7 segments (e.g. Patient Identification, Patient Visit) are mapped as OMG IDL constructed types (e.g. struct PatientId, struct PatientVisit) where the members are fields.

- HL7 messages (e.g. Transfer Patient, Discharge Patient) are mapped as OMG IDL constructed types (e.g. struct TransferPatientMsg, DischargePatientMsg) where the members are segments.

- HL7 transaction sets are mapped as OMG IDL interfaces. Each event defined in the
transaction set is mapped as an operation on an interface. Each operation accepts a message of the appropriate type as its input parameter.

- An HL7 general acknowledgment is mapped as the return value for an unsolicited update operation.

4 The strategy selected

Due to the requirements of the hospital that only a subset of HL7 messages (QRY) were to be used for this system, and in view of the shortage of programming time, it was decided to use the first approach for modelling HL7 to CORBA. In this approach, HL7 messages are treated as ASCII strings and parsed by the CORBA objects. Figure 6 shows the implementation framework. It was discovered during this project that, while it might be desirable to do so, it is difficult to eliminate an interface engine at this early stage of prototyping, because the interface engine provides interoperability across a variety of HIS applications conforming to different versions of HL7, supported by the Cloverleaf interface engine, in a production environment.

The proposed solution with the introduction of a CORBA server would result in the following scenario, where the need for the interface engine is mandatory for compatibility reasons, as shown in Figure 6.

The developed program has three components:

Client—The client is basically a front end CORBA object that asks the user for the Medical Record Number (MRN) of the patient whose medical results have to be queried. On the basis of this MRN, the client program creates an HL7 query message, registers itself with the server and sends this HL7 message to the server. When the results come back, it is displayed to the user. A professional GUI has not been developed for this system, as the application is to be integrated with existing applications running at the hospital.

Server—The server is a CORBA server which waits for clients to connect and, once they are connected, creates a slave process (implementation) to handle all further communication.

Implementation—The implementation program connects to two ports on the interface engine. One port is for sending the query messages and the other port is to get the results of the queries. When a client sends a query, it registers the client as a CORBA object as well as registering the HL7 query message. This is to identify the client to whom the result of the query is to be sent. Once the registration process is completed, the query is then sent to the interface engine on its sending port. An acknowledgement is sent back from the interface engine, which is passed on to the client. The results come back on the other port and this again is passed on to the client. Now the implementation program creates an acknowledgement to indicate that it has received the results. Once all results have been obtained, the client is deregistered.

The software system developed enables a client to query a back-end system for medical results. This may be for charting or reporting purposes. The client-server interactions are in terms of HL7 messages. Due to the fact that all communications with the back-end system are through the interface engine, the reliability of the system increases, as the engine logs all the transactions, and any downtime at the back end will not affect the querying client.

The next phase of the project would be to create a domain and define interfaces in OMG IDL for each of the HL7 transaction sets, where each message in a transaction set is represented by an operation defined for the corresponding interface. The changes that can be achieved after implementing the HL7/CORBA server are illustrated in Figure 6 below.
Evaluation results

The above prototype was evaluated by using it as middleware for the application called “E-health-Endocrinology”. Our prototype was integrated with this application to support HL7 query messages across the interface engine from the various databases existing in the e-health information system in various heterogeneous networks, such as the pathology and radiology networks.

The application is designed to meet the specific needs of the Department of Endocrinology. As endocrinology deals with child development and growth, patient information needs to be maintained and compared over many years of treatment. Current systems do not allow this level of flexibility, so it had to be specifically developed. The HL7 interface components which were developed allow pathology data to be queried using HL7 from the pathology system (Cerner Pathnet) and directly fed into the endocrinology system, as shown in Figure 7. This data can then be manipulated to meet the user’s requirements. An example of this is results from tests on a child’s bone density plotted against the child’s age, giving height velocity measures (how fast the child is growing).

The HL7 components developed will also be used in other systems developed at the CHW requiring direct interfacing to pathology results.

The following is a sample from a log on the server monitoring the messaging on the CORBA Object to the Interface Engine, which forwards the request to Cerner and results coming back.

Client querying MRN: 9988771 has been Registered at 20010418091850
Query written to Engine.
Query Message Ack (ACK) recd from Cerner
Result message received
Result message received
Result message received
Result message received
Result message received
Result message received
Query complete for Query request recd from Cerner
Client Successfully De=Registered
Fig. 7 Typical user interface screen of the endocrinology application

Direct access to the pathology results offers the following advantages.

- Reduces data entry requirements by obviating the need for manual re-entry of data.
- Reduces error rates by transferring data electronically.
- Improves patient care by giving the clinician timely access to the data via a single system, in a format that meets their needs.
- Historical data reviews and charts, covering several episodes of treatment, allowing the clinician to review progress at a glance.

This section has demonstrated how CORBA/Java based middleware was integrated into a live HIS application.

Conclusions; future work

This paper has presented our experience in the development and deployment of distributed object-based middleware for the interoperability of e-health information systems. We started with an evaluation of a real system, based on the three major approaches to middleware for interoperability: language independent/platform-dependent (DCOM-based), platform-independent/language-dependent (Java-based), and platform/language-independent (CORBA-based). This was followed by a description of our prototype, based on CORBA and Java. Finally, we have shown how this middleware was embedded in a live endocrinology application at the Children’s Hospital at Westmaed.

We have learned the following major lessons that may be of interest to developing countries.
It is possible to implement the interoperability of HIS applications through CORBA, Java and HL7, offering a number of advantages.

It is not possible to eliminate the interface engine from a live HIS, because there are many versions of HL7, and different live applications might be using different versions.

There was a steep learning curve for CORBA-based development. Although the CORBAmed SIG of OMG has defined a number of objects for e-health, we could not use any of them in this project due to practical difficulties. Microsoft .NET architecture overcomes many of these difficulties through easier-to-use web services [15].

This case study has illustrated certain problems that developing countries could face in implementing e-health, and presented solutions in the integration of heterogeneous telemedicine systems. While this paper has focused on the software interoperability problem at the specification level, there are a number of other issues at the semantic level that must be addressed to solve the interoperability problem. These are the subject of ongoing work [12], [14].

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References


4.2 Interoperability considerations for e-health in developing countries\textsuperscript{18}

Introduction

There is a common misconception that utilizing ICT for e-health purposes in developing countries is a wasteful expenditure of scarce resources. Unfortunately, this is not always very far from the truth: not only do expensive hi-tech projects sometimes act as attractive showcases for politicians, sometimes they also provide avenues for the flow of illegitimate resources.

Nevertheless, despite legitimate misgivings, it can be argued that there are even more reasons for introducing telemedicine and modern ICT to health services in developing countries than for doing so in advanced developed countries.

If starting from scratch — do it properly

In most cases advanced countries already possess well-functioning, sophisticated health systems; if anything, these tend to be averse to undergoing costly change. By contrast, many developing countries are in the throes of introducing systems that have to be set up from scratch. More often than not, the business case for building systems that harness the advantages of new technologies is stronger in situations like these, and the practical arguments are more weighty. This is especially true where a sophisticated system has not yet been set up, because this obviates the need for a costly transition — with accompanying financial, technological, administrative and cultural implications.

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\textsuperscript{18} Dr James Kass is a senior scientist at the European Space Agency, Life Science Unit, and is a member of the Telemedicine Alliance team.

\textsuperscript{19} Reproduced with permission from the TM Alliance; ESA-BR-229, July 2004.

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Fig.1 TM Alliance: vision for citizen-centred e-health\textsuperscript{19}
Develop a vision for your own country and people

Nonetheless, e-health should not be viewed as an end in itself, but rather as an enabling technology that brings an otherwise unattainable vision into reach. Before investing energy and resources, however, the appropriate vision must be developed. The telemedicine Alliance\textsuperscript{20} recently published its “Vision for citizen-centred e-health”, depicted below. This vision—albeit created in the European context—can be used for countries around the globe, whether developed or developing, with some adaptation to local needs and available resources. In many ways, this vision represents a luxury, a 'nice to have' for Europe, something that will keep Europe at the leading edge for advanced e-health technologies in the developed world. Nevertheless, as seen by the rest of the world, Europe already enjoys unparalleled e-health, the level of quality of which is the envy of all. In the developing world the situation is usually very far from ideal; good e-health is, more often than not, enjoyed by the privileged few, mainly in developed urban centres; the masses, especially those far from cities, suffer from a dearth of qualified personnel and adequate facilities. It is exactly these groups who could benefit most from telemedicine and e-health technologies, if these are introduced with a well conceived vision, with a focus on the citizen. In many countries this is associated not with some concept of citizen’s rights, but with the efficient utilization of resources, where the focus is on providing the service close to the patient instead of making him or her travel to a medical centre. This is where e-health can pay its own way, as expertise can be provided remotely, to achieve this goal. The empowered patient/citizen might be introduced as a strategy, but this assumes a level of education and competence that may not be available at the start.

Where there are inadequate services and resources, new technology can help

Moreover, whereas advanced countries usually have more than adequate e-health services almost everywhere, and speedy transportation is available, this is often not the case in developing countries. Modern healthcare facilities and trained personnel are usually concentrated in large advanced urban areas, leaving vast swathes of countryside with limited and primitive facilities. Far easier than moving personnel and equipment (and, assuming the realization of this impossible task, building the necessary facilities to accommodate them) is the moving of information (using modern ICT). There are already many successful examples of the low-cost, useful implementation of e-health methods and technologies to provide speedy solutions to e-health provision\textsuperscript{21}.

Here are many more arguments that could be cited with regard to the ‘why’ of introducing e-health in developing countries, but this is not the purpose of this chapter; rather, the purpose is to ensure that it will be implemented in a sensible way, making maximum use of resources, with a long-term strategy in place in order to ensure sustainability and a basis to build on.

E-health — what are the prerequisites for successful implementation?

In a recent study\textsuperscript{22}, experts in advanced countries were asked what were the main barriers to successful e-health implementation. The majority identified interoperability as being one of the

\textsuperscript{20} Telemedicine Alliance, or TM Alliance is a partnership of the European Space Agency (ESA), the World Health Organization (WHO, Europe), and the International Telecommunication Union (ITU), sponsored by the European Commission (EC); http://www.esa.int/telemedicine-alliance.

\textsuperscript{21} Good examples of providing healthcare in poor areas with a dearth or complete absence of doctors by means of Telemedicine and eHealth technologies was provided recently at Medetel 2005.

\textsuperscript{22} Telemedicine Alliance, Del.12-Experts Interviews, April 2004, Question 2: ‘...List the 3 most important show-stoppers’.
main obstacles, and advised urgent action in this direction. This issue was identified as being critical, for the advanced countries. Various reasons were given. Much effort has already been invested in some countries, without necessarily taking the need for interoperability fully into account at those early stages. There remains the grave danger that interoperability across Europe will be all the more difficult in the future, given that inadequate provisions were made as the systems were being developed. Patching up at later stages could be much more costly; the mobile citizen and mobility of health services across borders would remain difficult. The market would remain divided and weak; private investment in the development of applications would remain low, if no broad market existed. Moreover, the front would be open for stronger (outside) forces to invade and conquer the market.

Although the above arguments may not necessarily be carried over one-to-one to developing countries, the situation in these countries speaks to even greater, rather than lesser, urgency and seriousness as regards the criticality of issue. In many cases, the field is still open and little investment in IT infrastructure has been made, let alone ICT. Contrary to the situation in advanced countries, a good start is still possible. Taking care at an early stage to assure that a sound interoperability philosophy is adopted will pay rich returns in the future. Existing solutions can be carried over and adapted. New solutions can be marketed in other developing countries (or even in developed countries). If care is not taken, on the other hand, then the market could become even more segmented and non-interoperable; moreover, these countries could be falsely coaxed into adopting diverse specialized solutions (e.g. by parties associated with providing aid or loans), which would later make them dependent on special sources and specific solutions that may not have strategic value. Such countries could find themselves in the unenviable situation of having adopted different incompatible solutions in different regions, thus precluding trans-regional compatibility even within the country. Vigilance, good preparation, and wise advice with a long view to interoperability are paramount for long term success.

A systemic & holistic approach

Definition of terms

Before progressing with the discussion of interoperability in e-health, a definition of the terms used is called for.

One accepted definition for interoperability is:

the ability of systems, units or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together

An appropriate definition for e-health is this:

The use of information and communications techniques including health-related activities, services and systems carried out over a distance for the purposes of global health promotion, disease control and health care, as well as education, management and research for health

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Domains of e-health

It is advisable to view e-health in its entirety as a complete system in order to understand the complexity of interoperability and then to ensure that the systems can interoperate. Although this approach may at first seem rather academic, which to a great extent it is, its practicality will become apparent when applied even to simple systems with limited domains. Of course the full benefits are reaped when these systems expand, their domains widen, and hence interactions with other systems become more complex.

Care

This has traditionally been the historic core of e-health—providing health for a patient. But in order to do this there are other domains associated with it: some accompany it out of necessity in a developed world, such as administration. But there are other domains that also play important roles regarding the patient/citizen’s health, but which are sometimes ignored, such as education and surveillance.

Although, in developed countries, popular applications of e-health implementation include the virtual health record, smart health cards, and distributed databases, there are other, sometimes more urgent, applications in developing countries, such as teleconsultation, where expertise is not available locally. But all these applications require as a basis interoperability between health systems.

Education

It has long been accepted that prevention is better than the cure, but exactly how to realize this is less obvious. Having the right information at the right time is a powerful tool in the battle of prevention; ICT could certainly play a key role in providing such educational information, provided that it is available, and provided that the potential user knows how to access it and it is in a form that can be understood (interoperability).

Surveillance

Surveillance can play an even more important role in developing countries, where epidemics, or abnormal occurrence of disease, are more rampant; adequate surveillance can play an important role for early warning and prevention of further spreading of disease. The infrastructure of e-health is a necessary basis for a useful surveillance and early warning system, which by implication requires interoperable data collection.

Administration

This domain varies from being a bureaucratic necessary evil, hampering and perhaps delaying the provision of health services in some cases, to being a nightmarish quagmire, sometimes even endangering the lives of patients. ICT can certainly play a useful role in speeding up these processes, if it is applied properly, and provided the various cogs are able to communicate with each other.

A stable layered framework—the “egg”

It is necessary not only to study the full gamut of domains of e-health in preparation for e-health implementation, but also to view these domains along the various possible

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25 These four domains were identified in TM-Alliance’s Deliverable 18: Final Report, which is summarized in ESA publication BR-229, July 2004 (see also, http://www.esa.int/telemedicine-alliance).
frameworks: interoperability of e-health systems is often erroneously viewed as being mainly a technical issue. It is, but this is only one of the frameworks of analysis. Although ensuring technical interoperability is basic, organizational, cultural, and policy frameworks must also be worked through in order to reap the full benefits of interoperable e-health. The Telemedicine Alliance recently proposed that implementation of e-health be viewed along the lines of a hypothetical egg, whose core is the technical framework, assumed to be indispensable; the next layers are organizational and social frameworks, which are often neglected during preparation for implementation, at the peril of failure; the next layer is policy: without a tactical and strategic plan, effort may be wasted, disorganized and fragmented, and the enterprise may grind to a halt. Only when all the layers have been systematically built is there successful implementation — or, to carry the analogy through, does a healthy e-health ‘chicken’ emerge from the ‘egg’. This framework analogy is illustrated below:

**Some considerations for interoperability**

**Systems need not be identical — but they must be able to talk with each other meaningfully!**

A frequent misconception about interoperability is that adoption of the same technical standards, organizational or social systems, or policies is a prerequisite. This is not the case — instead, what is necessary is that the diverse systems be able to communicate meaningfully with each other. Different standards may indeed be used across regions, provided that they allow interoperability. Applications may and should compete with each other on an open market in order that diverse solutions may be tested and the best may survive. Sameness everywhere is not the solution—but interoperability is. Thus, it is important to stress that the most important element in any e-health strategy is the definition of the network and interfaces to it. These have to be standard, and there can only be one for the whole country. (Intra-institutional is different.)

![Multi-layer structure of interoperability for e-health](image)

**Fig.2** Multi-layer structure of interoperability for e-health

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Prepare for interoperability right from the start — it will save a lot of headache and cost later on!

If interoperability is planned in at the early stages of development of a health system, it can save a lot of headache in the long term. Once micro-systems have progressed technologically, in complexity, and with use of advanced ICT, introducing the changes needed for these micro-systems to communicate with each other as part of a larger macro-system becomes a costly and major undertaking. However, if the concept and importance of interoperability is realized early on, when a health system is being modernized, assuring interoperability can be a relatively simple task, the added costs can be kept under control, and major value added. It is for this reason that technologically advanced nations have much more trouble navigating the transition to interoperable e-health than do developing nations. The new member states of the EU serve as good examples — they are in the process of redesigning and recreating their health systems along the lines of interoperable e-health, and are able to do this quite successfully. The long-established states, on the other hand, are having major problems revamping and modernizing their health systems: there is far too much effort already invested in diverse parallel developments, not only in the different regions of a state, but in the thousands of e-health institutes (hospitals, clinics, rehabilitation centres etc.) where different, sometimes very incompatible modern systems have already been installed; staff have already gone through costly training programmes, and reluctant doctors and nurses have been persuaded to use specialized modern software. In such a situation, there is naturally great difficulty and reluctance for further change. Developing countries have a golden opportunity, which should be grasped without hesitation: it is paramount to make wise and careful choices before expensive investments are committed. Thus, it is best avoid any application that only purports to provide a base for future development without immediately providing daily benefits to the population. Keep in mind that resources are limited and costly mistakes cannot be afforded.

Keep in view the complete holistic picture — even if only a very limited domain is being implemented

There may be a temptation to ignore the broad holistic approach because only a small limited solution for a specific problem is being implemented. There is nothing wrong with a limited approach — indeed it would often be the wisest route, rather than attempting to implement a complete set of solutions all at once. However, this limited solution must nevertheless still be governed by strict interoperability precepts; moreover, it must be able to fit into a grander and broader set of solutions at later stages without requiring major redesigning or having to be abandoned at a later, more advanced stage.

Remember that e-health is not simply a set of technical standards — it is about people working with people

One of the hurdles to introducing e-health methodology and technology is that it seems unnatural to many users, and therefore associated with a vague fear of the unknown. To a certain extent this fear is well-founded, as most non-expert IT users have suffered trying to install or use devices touted as being ‘plug-and-play’ — which is far from the truth, much of the time. Overcoming these cultural barriers must comprise part of the roadmap drawn in preparation of e-health implementation.

Well before new systems are installed — even while they are being conceived — the cultural, educational, and training implications must be studied, and tactical and strategic plans prepared and drawn up for the introduction and operation of these new systems. Interoperability here could mean making systems interoperable between people/users of
different (e.g. technical) cultural backgrounds, as well as tailoring training programs and applications that are suitable for the different requirements. This is particularly true for developing countries, but also for advanced countries, where different generations and types of people make up a very wide gamut of heterogeneous needs.

**Simulation and testing in limited but realistic environments may be boring and delay the “real thing” — but it pays off in the long run**

There are many approaches to implementing e-health in a region or system.

1) At one extreme is (a) introducing a complete system, comprising all possible applications for e-health, administration etc., and (b) implementing the new technology as widely as possible.

2) At the other extreme, (a) only a few applications are introduced, and (b) these are introduced in only a very limited population of users.

The first approach is sometimes referred to as the ‘big-bang’ approach. It is rather risky. This author recommends the second approach. It is less risky, allows for learning and limits the damage of errors (which are inevitable). It is recommended to introduce e-health technology and applications in independent, but interoperable blocks. They must be conceived as being the building blocks of a much larger and complete system that will be upgraded with complexity and population in gradual steps, with time after each step for stopping, learning and reflecting. Successfully implementing a small set of applications in a limited population will provide the experience and confidence to expand and upgrade.

Crucial to the introduction of applications and technologies is that they be conceived to operate with one another and, most importantly, with the user.

**Although seemingly unrelated, different e-health domains are interdependent and need to interoperate with each other**

Some of the different domains of e-health outlined in the above introduction may seem rather unrelated. Careful reflection will show the interrelationships. One example is surveillance, which is important for recognizing unusual spreading of disease, or frequent occurrences of new or unusual symptoms. However, good surveillance is only possible with good administration of e-health, and frequent or continuous collection and analysis of e-health data (e.g. from virtual electronic health records or EHRs). But this can only be achieved if the e-health technologies and applications for these domains can communicate easily and intelligibly with each other, i.e. if these domains are interoperable. Moreover, expanding on this example, with increased travel between countries, disease can be carried across very great distances; so that the analysis and comparison of data across very disparate regions becomes paramount. This is only possible if interoperability across national borders — even across continents — is built in at the design stage of the systems. The same arguments hold true for health education, whether referring to the citizen-patient, or the citizen-health provider.

**Don’t be too proud — be ready to learn from the experience of others, instead of “reinventing the wheel”**

There is a strong temptation to design things as one would like them to be and use home-grown technology and applications wherever possible. It is indeed true that local industry should be stimulated; furthermore, different countries, environments, and cultures have different needs. Nevertheless, it is prudent to study what is available elsewhere and build on this, rather than reinventing from scratch. Learning from the experience of others can spare much waste and pain. Of course this requires a healthy dose of humility, sometimes
particularly lacking where it is most needed.

**Think and plan trans-nationally, not in isolation — remember that technology permeates borders**

There are other good reasons for analysing what is available on the market, to avoid unnecessary duplication of effort: interoperability and its accompanying business case. Interoperability is not only important in order to allow the transfer of health data across regions and nations. Careful and astute development of interoperable applications broadens the market for selling them outside the primary region of application. Nevertheless, the focus should be on achieving short-term goals in a standards-based approach, rather than trying to establish too much when internal problems are perhaps more pressing.

**Keep your sights on the higher goal — a vision of citizen-centred e-health: about the citizen, for the citizen, and by the citizen**

In all the planning being carried out in the introduction of e-health one must not forget the ultimate goal: realization of the vision of citizen-centred e-health for all, with faster, better and cheaper e-health delivery to all, facilitated by e-health methodologies and technologies. The technologies themselves are not the goal, but what they can and should enable — a better life for all.

Finally, create the vision for your country, and then design the roadmap, ensuring that you keep interoperability as a basic core requirement — you are then more likely to be on the road to success!

**4.3 Standardization activities**

**4.3.1 Current situation in e-health standardization**

The growing demand for connectivity between health-related organizations, with the aim of giving support to data sharing and services interoperability, has been addressed in different standardization initiatives in the last decade. In this field, traditionally characterized by solutions developed on a proprietary or ad-hoc basis, with subsequent integration barriers and incompatible services, many standards development organizations, both national and international, have been working together in order to harmonize the health area by the adoption of common rules and procedures.

Even though important results have been achieved and the use of standards is considerably more widespread than at the beginning of the last decade, in some cases standardization in e-health does not yet meet the existing needs of users. Medical advances and rapidly evolving requirements make a continuous upgrade process necessary in order to maintain the standardization situation.

Standardization in e-health has yet to overcome some important barriers. Despite the large number of standards development organizations, there is often a lack of information about their work, and about the available standards. Additionally, collaboration problems and the lack of a common strategic vision facilitate the existence of competing standards.

The standardization challenge currently facing the e-health community is not to extend

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standardization to new areas, but to make the existing standards coherent and eliminate duplication. There is a need to coordinate efforts between the parties involved, through the dissemination and the development of supplements to the already available standards, rather than invest money and time in the development of new ones. Normative documents regarding fundamental aspects like the Electronic Health Record, specific terminology, medical imaging, teleconferencing, communications security, data codification and user interfaces have been developed and applied to the health field to take advantage of the numerous advantages derived from standards compliance:

- facilitate access and acceptability on global markets
- promote interoperability and compatibility between manufacturers
- public and universal knowledge
- fair market competition (so customers are not tied to a single provider)
- performance reliability and stability
- reduced investment of development time, obtaining competitive advantages by reducing launch times on the market
- cost reduction in e-health systems, maintenance and upgrades, a particularly important issue for developing countries, which need to optimize their investments
- reduce the danger of system obsolescence

Additionally, a distributed scenario for data and resources sharing would enormously facilitate the provision of medical and health-related educational services in developing countries. For instance, database sharing in a distributed manner and global repositories would be helpful in reducing costs, e.g. with the early detection of epidemics [3]. However, the interest that developed and developing countries have in telemedicine is usually different. While developed countries concentrate their efforts on the discussion of standards suitability, developing countries look at e-health applications in a more pragmatic way, because they expect these services to do more with their limited medical resources.

Other important problems in the application of standards to e-health derive from the slow pace of the standardization process. As a result, some countries are using their own EHR instead of waiting for the final, internationally standardized version.

A complete analysis of the current situation in e-health standardization should cover:

- an approach to the main activities of the SDOs involved
- a list of the standards that have been approved so far in the national and international arena
- a detailed review of those that have had the best acceptance by health stakeholders (this is best done by compiling current best and real practices incorporating medical standards)
<table>
<thead>
<tr>
<th>Organization</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISO</strong> International Organization for Standardization</td>
<td>A network of national standards institutes from 148 countries working in partnership with international organizations, governments, industry, business and consumer representatives. Between 1947 and the present day, ISO published more than 13700 International Standards. ISO's work programme ranges from standard to traditional activities, such as agriculture and construction, through mechanical engineering, to medical devices, to the newest information technology developments, such as the digital coding of audio-signals for multimedia applications.</td>
</tr>
<tr>
<td><strong>ITU</strong> International Telecommunications Union</td>
<td>ITU is an international organization within which governments and the private sector coordinate global telecommunication networks and services. It is also considered as the leading publisher of telecommunication technology, regulatory and standards information. ITU operates primarily in three different sectors: Radiocommunication (ITU-R), Telecommunication Standardization (ITU-T), and Telecommunication Development (ITU-D). Since 2003, ITU has been seriously involved in the process of developing detailed e-health standards and in ensuring that ITU-T Recommendations explicitly support e-health requirements.</td>
</tr>
<tr>
<td><strong>ECMA International</strong></td>
<td>Since 1961, ECMA International facilitates the timely creation of a wide range of global Information and Communications Technology and Consumer Electronics standards for: scripting and programming languages; communication technologies; product safety; environmental design considerations; acoustics and electromagnetic compatibility; optical and magnetic storage; volume and file structure and high speed interconnections.</td>
</tr>
<tr>
<td><strong>IEC, the International Electrotechnical Commission</strong></td>
<td>The International Electrotechnical Commission (IEC) is the leading global organization preparing and publishing international standards for all electrical, electronic and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts.</td>
</tr>
<tr>
<td><strong>IEEE</strong></td>
<td>IEEE is a non-profit technical professional association with more than 360 000 individual members in approximately 175 countries. Through its members, the IEEE is a leading authority in technical areas ranging from computer engineering, biomedical technology and telecommunications, to electric power, aerospace and consumer electronics, among others.</td>
</tr>
</tbody>
</table>
### American standards organizations

| **ANSI**  
| American National Standards Institute | The ANSI is a private, non-profit organization that coordinates the US conformity assessment system and promotes the use of US standards internationally. |
| **HL7**  
| Health Level 7 | The HL 7 is an ANSI-accredited standards developing organization which has as its mission to provide standards for the exchange, management and integration of data that support clinical patient care and the management, delivery and evaluation of e-health services; specifically, to create flexible, cost effective approaches, standards, guidelines, methodologies, and related services for interoperability between e-health information systems. |
| **NEMA**  
| National Electrical Manufacturers Association | NEMA is an American federation of over 50 diverse product sections. Its member companies manufacture products ranging from x-ray machines and CT scanners to motors and generators, luminaries, cable tray, batteries, residential controls, and more. It provides a forum for the standardization of electrical equipment, enabling consumers to select from a range of safe, effective, and compatible electrical products. |
| **ASTM**  
| American Society for Testing and Materials | ASTM International is one of the largest voluntary standards development organizations in the world. ASTM International standards have an important role in the materials used in construction. |
| **DICOM**  
| Digital Imaging and Communications in Medicine | The DICOM Standards Committee exists to create and maintain international standards for the communication of biomedical, diagnostic and therapeutic information in disciplines that use digital images and associated data. The goals of DICOM are to achieve compatibility and to improve workflow efficiency between imaging systems and other information systems in e-health environments worldwide. |

### European Standards Organizations

| **CEN-CENELEC** | CEN was founded in 1961 by the national standards bodies in the European Economic Community and EFTA countries. It contributes to the objectives of the European Union with voluntary technical standards which promote free trade, the safety of workers and consumers, interoperability of networks, environmental protection, exploitation of research and development programmes. |
| **CEN tc215** | This group works in standardization in the field of Health Information and Communications Technology (ICT) to achieve compatibility and interoperability between independent systems and to enable modularity. This includes requirements for health information structures to support clinical and administrative procedures, technical methods to support interoperable systems as well as requirements regarding safety, security and quality. |
| **ETSI** | The European Telecommunications Standards Institute (ETSI) is an independent, non-profit organization, whose mission is to produce telecommunications standards. It unites 699 members from 55 countries, and brings together manufacturers, network operators, service providers, administrations, research bodies and users. |
The adoption of information technology in the health care sector must be accompanied by stronger coordination amongst the key players involved in the area of e-health standardization, i.e. manufacturers, users, authorities, public institutions etc.

It is essential to identify points in common in the different telemedicine standards in order to avoid duplication of work and ensure the pertinence of standardization.

Thus, in May 2003 the workshop on “Standardization in e-health” held in Geneva established the E-health Standardization Coordination Group (eHSCG) as one of its significant outcomes. The group was formed with representatives of several standards bodies and WHO, and endorsed by ITU-T’s Study Group 16.

The group is intended to be a place for the exchange of information. It will work towards the creation of cooperation mechanisms, with the following objectives.

- Identify areas where further standardization is required and assign responsibilities for such activities.
- Provide guidance for implementation and case studies.
- Consider the requirements for appropriate development paths for health profiles of existing standards from different sources in order to provide functional sets for key health applications.
- Support activities to increase user awareness of the existing standards, case studies etc.

The main achievements of the eHSCG since its establishment are the compilation of best practices and available standards related to e-health [4].

The eHSCG performs informal consultation and coordination on a voluntary basis and its recommendations are purely advisory. In particular, the group does not supersede any official and legal coordination procedures in place at the national and international level.

It has been observed that one of the activities which have to be supported most is the promotion of the use of existing standards. Through activities in which the benefits of standards compliance are made clear, manufacturers are encouraged to make use of them. A study of international experience confirmed that few standards are actually applied on the real life. The following table lists the standards which enjoy particularly great acceptance in the medical world.
| **VITAL** | VITAL specifies a common representation of vital sign information. It is non-device dependent, and a first step to achieve interoperability in areas like anaesthesia, UCI etc. |
| **DICOM** | DICOM defines the coding of medical images, the protocols of interchange between both sides and a security policy to protect confidential information. DICOM is currently applied in nearly every medical specialty. DICOM uses JPEG and JPEG2000 compression techniques, and TLS and ISCL security protocols. |
| **MEDICOM** | This standard is the European contribution to DICOM. |
| **ENV 1064** | This standard provides specifications for the interchange format, but also requirements for data compression and accuracy of signal reproduction. It thus supports quality assurance in processing and communication of electrocardiograms. |
| **HL7 Version 2.x** | HL7 standards are focused on the exchange of medical information, principally in an intra-hospital environment. The new advances in version 3 of the standard offer a new design methodology, security options and XML support. |
| **ENV 13607** | Specifies a message, called a prescription dispensing report message, containing information about prescription items; it is sent from the dispensing agent to any other party that is legally permitted to receive such message. |
| **CCOW V1.5** | CCOW synchronizes and coordinates different applications' access to heterogeneous patient information sources in a guaranteed, sure and reliable manner. |
| **LOINC** | The purpose of the LOINC database is to facilitate the exchange and pooling of results, such as blood haemoglobin, serum potassium, or vital signs, for clinical care, outcomes management, and research. |

**Reference**

4.3.2 ITU standardization activities in telemedicine

After years of research and pilot projects, telemedicine is beginning to come into its own. A large number of telemedicine systems and devices exist on the market. Services are evolving faster than the underlying platforms. As a result, the inter-working of products from different providers remains a major obstacle for the wider deployment of these applications. There is a clear demand for development and implementation of a global set of standards for telemedicine.

This necessity is clearly underlined both in the Action Plant eEurope 2005 (http://www.europa.eu.int/information_society/eeurope/health/whatishealth/index_en.htm) and in the Ministerial Declaration of 22 May 2003. The latter was announced in Brussels, when ministers of EU Member States, Acceding and Associated countries and EFTA countries met in the framework of the e-health 2003 conference.

“e-health refers to the use of modern information and communication technologies to meet needs of citizens, patients, e-health professionals, e-health providers, as well as policy makers. On this occasion, Ministers expressed their commitment to the development of national and regional e-health implementation plans as an integral part of eEurope 2005. Ministers declared their willingness to work together towards best practices in the use of Information and Communication Technologies (ICT) as tools for enhancing health promotion and health protection, as well as quality, accessibility and efficiency in all aspects of health care delivery .... Ministers supported concerted actions to address particularly the development of standards enabling interoperability of diverse systems and services and to especially explore the possibilities of open source applications for achieving this objective.”

Who should participate in development of telemedicine/e-health standards?

In formulating standardization decisions, the involvement of all relevant stakeholders is of great importance. Representatives of the e-health sector, including governments, insurance companies, health professionals, telemedicine vendors and patient associations must be involved. Other important parties are WHO, ITU, EC (European Commission), European Health Telematics Association (EHTEL) and the CEN Sector Forum for the medical sector (CHEF).

The participation of the main stakeholders is essential as the standards have to satisfy at least the following points.

• To serve various business models, as standards are essential for the open market.

• To consider the needs from the political side (an example is the implementation of e-health cards in the European Union).

• To keep in mind the requirements of the eEurope 2005 Health actions, as they have a global application, i.e.:

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Dr Vicente Traver, Rapporteur, Question J16, ITU-T Study Group 16.

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— implementation of user-friendly, validated and interoperable infrastructure;
— enhanced interoperability between systems, and patient information exchange between health care organizations to improve efficiency and quality of care, plus enhanced cross-border exchange of health information;
— quality criteria for health-related websites;
— identification and dissemination of best practices in e-health;
— establishment of a series of data networks assisting e-health planning in Europe;
— clarification of legal aspects of e-health.

• To take into account other global policies and local legislation.

On the other hand, e-health standardization has to be considered as an essential component of any global, European, national or regional strategy for e-health. Resources, in the form of money and experts, should be made available for standards activities carried out internationally and, when required, with national implementation guides.

What ITU has done so far

Due to complexity of the issues, increased cooperation within ITU and with other bodies (SDOs, other fora and consortia) is necessary.

ITU-T with the support of ITU-D has undertaken a first step in organizing a workshop (ITU-T/ITU-D Workshop on Standardization in e-health, Geneva, 23–25 May 2003), which has allowed the SDOs, industry, operators, users and other relevant bodies to present their views on the standardization aspects of e-health. The workshop not only brought together key players in e-health standardization and interoperability, but also defined a framework for standardization, identified areas of possible coordination and cooperation, prepared a standardization work plan, and identified the roles of ITU-T and ITU-D.

Opening the Workshop, Mr Houlin Zhao, the Director of TSB, clearly stated that “...standardization in e-health has long been sought as a key element in support of these activities”. There are many generic standards used in e-health applications for video coding, security, multimedia transmission, and languages for instance. And many of those have been developed by ITU-T.

The issue of standardization, especially interoperability, is very urgent for the deployment of e-health in developing countries. As a rule, hospitals in developing countries are receiving telemedicine workstations from different donors, and communication between these workstations is difficult. Among the 114 participants from 41, countries including 25 developing countries, were representatives from telecommunication systems manufacturers, system integrators, end users and ICT professionals within the medical profession, international and intergovernmental organizations, university hospitals, medical associations and NGOs. Many speakers agreed that standardization in telemedicine/e-health is a way to increase levels of interoperability, but most also agreed that there are too many standards, and that these are often in conflict, introducing competing solutions for similar problems or simply ignored. A stronger coordination of standardization effort is seen by many as imperative.

As a further follow-up to this workshop, an e-health Standardization Coordination Group (eHSCG) was created at ITU in October 2003. The strategic objectives of eHSCG are to act as a coordination group on all aspects of telemedicine/e-health standardization; to strengthen cooperation amongst the SDOs; to focus on technical aspects, taking into consideration
regulatory, economic, medical and social issues; to consider requirements for development paths of existing standards from different sources; to act as supervisor for implementation and case studies, especially in developing countries; to increase awareness of existing standards; etc.

Another result of the ITU-T/ITU-D Workshop on Standardization in e-health was the introduction of a new official study “Question” for ITU-T’s Study Group 16 (Multimedia Systems, Services and Terminals, see www. itu. int/ITU-T/studygroups/com16). It is entitled “Multimedia framework for e-health applications”, and is intended to coordinate the technical aspects of multimedia services and systems to support telemedicine/e-health applications. Briefly, this question aims at the following.

• Prepare a catalogue of existing telemedicine/e-health standards.

• Gather and analyse the standardization requirements of major telemedicine stakeholders and identify standardization items with the highest priorities.

• Develop a Recommendation on “Generic Architecture for Multimedia Telemedicine Applications”.

• Provide inputs (if necessary) for extending and improving existing Recommendations on MM-Systems (e.g. H.323, H.264, V.18).

The challenge in developing telemedicine/e-health standards is to make several different industries and governmental bodies work together. Cooperation between industry, health-care, governments and citizens, to name just some of the stakeholders, is a must.

With so much effort dedicated to the creation and implementation of global telemedicine standards, what will be the advantage of their introduction? The benefits have been succinctly set out by Philippe Boucher (2004):

1) Reduced design burden in telemedicine sector:
   a) common methods and tools;
   b) reusability;
   c) faster design time.

2) Better compatibility between telemedicine/e-health applications thanks to:
   a) common representation and transport formats;
   b) easier creation of transforms from one data set to another.

3) Consistency across e-health applications by:
   a) helping to reuse technologies, implementations, concepts, and skills;
   b) enabling more consistent application models

4) Long-term benefits:
   a) reduced development costs;
   b) improved quality;
   c) data sharing rather than replication;
   d) applications can provide more authoritative sources of electronic health information.
4.3.3 TELEMEDICINE AND BIOMETRICS\textsuperscript{29}

1. BACKGROUND

1–1 What is biometrics?

Biometrics is an individual identification technology utilizing the unique biological characteristics of humans, and is typically used to identify the owner of forms of identification such as cash cards, driver’s licenses, and health insurance ID cards. The conventional technique is to compile information on individuals in the form of a database and then identify individuals using a PIN, password, and ID cards based on the stored information. This technique, however, is vulnerable to illegal acts such as forgery, theft, tapping, and identity theft.

The biometric method measures biological objects having the following three characteristics:

1. Universality (characteristics common to everyone)
2. Uniqueness (characteristics unique to each individual)
3. Permanence (characteristics that do not change over time)

Such individual characteristics--well-known examples include fingerprints, the retina, iris, voice, hand shape, palm print, and face--are stored in a database for identification.

This technique simply analyzes the biological characteristics that are expressed using images

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{error_types.png}
\caption{Error types}
\end{figure}

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and signals, and estimates the probability of pattern matching with the data in the database. As a result, the output is only a positive recognition or negative recognition, as shown in Fig.1; note that the matching probability is not 100%

1–2 Market

Increasing global concerns about terrorist activity and identity have boosted the demand for improved security. Increased media attention has raised end users’ awareness of the potential of biometric technologies in security applications. Significant market opportunities are thus emerging in application areas such as physical access control, citizen identity, network security, financial services, entitlement and healthcare. For example, InfoShop-Japan reports that the world market size for access management (keyless entry) alone was USD13 million in 2002 and will reach USD70 million in 2007 (Fig.2)[1]. As shown in Fig.3, 50% of 2004 biometric products are fingerprint sensors. Non-contact sensors are expected to increase in popularity in the near future. If they are used in the areas of telehomecare and geriatric care, the market may explode in advanced countries.
1-3 Necessity of biometrics in telemedicine

With the increasing importance of the comprehensive management of medical information in our aging society, individual identification is essential not only for telemedicine but for information management for individual information browsing and making insurance payments. Japan is facing the problem of an increase in the number of people who do not pay health insurance fees. As the number of patients who attempt to receive medical services in an illegal manner through identification theft is expected to grow, the importance of individual identification will be enhanced.

We have identified the following needs in telemedicine for individual identification:

1. Health insurance ID certificate (or ID card in some countries)
2. Remote consulting
3. Emergency transport
4. Health check (except for diseases)
5. Return of medical fees
6. Patient chart browsing (for the patient only)

The above six applications require identification accuracy as high as that needed for the online banking system.

2. PROPOSAL

We feel that the following optical sensor using the videophone system is a promising biometrics system for telehomecare.

2-1 Face

A Methodology: We learn the characteristics of each face using CCD cameras and photos in advance, prepare a database, and examine the target face based on the face patch theory (which is totally different from the neural network theory that has already been discussed extensively).

Preliminary learning: Extracts the relative positions of the eyes, nose, and eyebrows, and draws an identification curve using Adaboost Image matching: Extracts the eye, nose, and eyebrow characteristics of the target face, and matches them with data in the database

B Advantages: A videophone system using a PC-based or dedicated terminal device is used in telehomecare. Thus, compared with other applications, it is easy to capture the patient’s face image from the front each time with almost the same size under uniform illumination conditions that are close to ideal. Because the high-quality CCD device allows the doctor to see the symptoms of anemia, icterus, spider angioma, and nerve damage, the visual check and face identification can be performed simultaneously. It is, however, difficult to maintain consistent identification accuracy, as the face characteristics may change over time. False identification as a result of plastic surgery on the eyes, nose, and jaw may also be possible. Thus, it is preferable to use another identification technique in addition to face identification.

2-2 Iris

A Methodology: Individuals can be identified based on the iris pattern, which is unique to each person.[2] The iris pattern is formed within six months after birth and stabilizes within one year after birth, and does not change until death. Two devices can be used to measure
the iris pattern, as follows.

1. If the videophone system is equipped with a zooming function, it can work as an iris identification device.

2. A dedicated light-reaction device can measure the speed of light reaction and examine the iris pattern simultaneously.

In the identification process, the analysis zone is selected from the iris pattern sampled using the CCD, its profile is extracted using a Gabor filter and then coded. This code is used to select the closest iris code in the database based on the Hamming distance value. The error rate is $2^{-244}$, the same probability of a coin toss ending with the same result 244 times in a row.

**B Advantages**: Non-contact, easy to use, and accurate. It would be very difficult to fake an iris, even with advanced plastic surgery and eye operation techniques. In combination with the light-reaction device, it can measure the iris reaction speed (which aids in diagnosis of problems with the brain stem and oculomotor nerve) and identify the iris pattern simultaneously.

### 2-3 Retina

**A Principle**: The vessels pattern of the retina can be used for identification. This vessels pattern remains unchanged unless the veins shrink due to diabetes or other illness. It is normally difficult to see the vein pattern without expanding the iris using chemicals (e.g., Mydrin). In recent years, however, a device has been developed that can see the vein pattern without the use of iris-opener chemicals. As dedicated equipment is necessary in both cases, it is not possible to conduct retina identification using a normal videophone system alone.

**B Advantages**: Non-contact and accurate, but not easy to use. The biological origin of the retina is the same as that of the brain. In fact, it is possible to estimate the condition of the blood in the brain from that in the retina, and the brain pressure from the optic papilla on the retina. Some easy-to-use devices are expected to be developed in the future. We should focus on the retina device as a promising telehomecare device.
3. PROSPECTS

3-1 Reluctance to use fingerprints

The U.S. Visit Program employed by the immigration authorities in 2004, which uses fingerprints for individual identification, has been poorly evaluated by those visiting America. This is due to the fact that this FBI technique, known as AFIS (Automated Fingerprint Identification System), has been used to identify criminals in the United States. Many people may not accept the use of such a criminal identification system for totally different medical use. Most users may prefer non-contact-type biometric techniques that do not use fingerprints. Diagnosis using the videophone system provides information on the patient's physical characteristics. Thus, it is natural to use such physical information for user identification.

3-2 Three accuracy levels

A number of biometrics companies have developed a variety of identification techniques using fingerprints, vein patterns of the palm, face, iris, and retina characteristics. These techniques are completely unrelated to each other.

Although more than one algorithm and measurement device are available, the identification result can only be one for each individual. As in the case of mathematics, there is only one correct answer. If the identification accuracy is not sufficiently high, users will be inconvenienced. Unless an identification system is shared by many users, as many sensors and devices as the number of such systems will be necessary. This is unreasonable for users. Since the 9/11 terrorist attacks, homeland security has been focused on, so it is currently difficult to establish an international standard for individual identification. However, at least objective accuracy guidelines should be considered. We feel that the following accuracy evaluation should be included in such guidelines.

1. Accuracy evaluation of the matching algorithm: Numeric degree of pattern matching between two input images
2. Accuracy evaluation of the matching device: Accuracy of hardware, including sensors
3. Accuracy evaluation of identity matching: Accuracy of identification of the correct person

Without these three accuracy evaluations, no identification technique can be objectively evaluated. Objective evaluation is the first step toward international standardization.

3-3 Efforts for standardization

The standardization of biometrics is underway in ITU-T SG-17 Telebiometrics and ISO/IEC SC37/SC17/SC27.[3] However, there is no forum for discussing applications to telemedicine. If E-Health is standardized by ITU-T SG-16 Q-28 in 2004-2007, discussions on the standardization of biometrics for telemedicine should be kicked off as early as possible jointly with SG-17. As mentioned above, the medical needs are diverse and the telemedicine market is growing faster than expected. We feel that biometrics for telemedicine should be included in the ITU scope. If we lose this opportunity, the importance of telemedicine standardization by ITU will fall drastically. This is due to the fact that the ICT technology will involve the elderly, who often do not go out for medical care, and to the fact that the biometric market is expected to explode. If there is no international standard, the market may be driven by a de facto standard. Although de facto standards are acceptable for applications in a free market, they may cause many problems in medical applications that should be under national control. As a result of such problems, many developing countries and the weak and elderly will be left
behind. Therefore, ITU is required if standardization is to be achieved in a timely manner.

References

4.3.4 Metadata Standardization for Telemedicine

1. Introduction

Telemedicine is expected as a definitive means of providing medical services in rural areas or outsourcing them in hospitals where no specialized doctors (e.g. pathologists) are present, and many attempts have been made for developing experimental systems and services. In order that advanced telemedicine systems and services are plentifully provided in the medical information system market and we can choose the best ones for our purpose and budget, however, there is a lack of standardization framework for ensuring interoperability among telemedicine systems.

Nowadays, clinical data standards are becoming widely accepted. Such systems as HIS (Hospital Information Systems) or PACS (Picture Archiving Communication Systems) that conform to HL7[2] or DICOM[3] respectively have come into wide use. Conforming to these standards, interoperability in medical information systems has been improved, and now we have a wide variety of choices for such systems.

There is no problem in syntactic interpretation of clinical data if it conforms to HL7 or DICOM. It is reported, however, that it can become difficult to read images by human eyes using different kind of equipment because light sensitivity in image acquisition can be different among DICOM conformant equipment. On the other hand, PACS can produce inconsistent visual display if display capabilities of PACS monitors are different or image layout information is lost, doctors can feel difficult to communicate using PACS. In addition, when security means are different, clinical data cannot be referenced from other hospitals.

For teleconferencing, we already have many audio coding standards[16][17][18], video coding standards[10][11][13][14][15], stream data transmitting and control standards[6][7], and call signaling standards[8][9]. If any single set of these standards is selected as a part of the telemedicine standard, however, interoperability can not be guaranteed. The reason is that different standards are adopted in existing equipment and communication lines. Because telemedicine systems owe their usefulness to various kinds of equipment and communication lines, it is difficult to force them to conform to a single standard. In addition, it is also difficult that we adopt a single standard of error correction, for the patterns and rates of errors are different among communication lines.

In this report, we explain the resolution of these problems in telemedicine systems by metadata standardization[1], and propose to start a working team of metadata standardization in Question 14 of Study Group 2 in ITU-D.

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2. Metadata in Telemedicine

Metadata is referred to as data about data, and corresponds to the bibliographical information of books. It is indispensable to search and use data, and has attracted public attention as the development of digital libraries and the Internet. Among standards of bibliographical information, the Dublin Core\textsuperscript{19} is most well-known. In many aspects of telemedicine systems, we need metadata information.

For hospital information systems, information on the degree of conformance to HL7/DICOM, medical equipment, security technologies, or PACS monitor display capability and display layout should be exchanged. Using the information on the degree of conformance to HL7/DICOM, we can exchange clinical data for the common elements of HL7/DICOM to which both hospital information systems conform is known from the exchanged metadata. By correcting the image data with the metadata of imaging equipment conforming to DICOM, we can get an equivalent display of image data to that of local hospitals. By exchanging metadata on security, doctors who have the authorized credentials can access to data in remote hospitals through translation of authentication and methods of encryption if necessary. And, by using metadata of PACS monitor capability and display layout, doctors can communicate on watching almost identical display of image data at remote hospitals.

In real-time telecommunication, it is necessary to exchange information on data source, communication lines and data destination.

Information on image acquisition equipment is an example of information on data source. Especially, light sensitivity of video camera is needed in real-time video communication. We can correct the color of video display by using the metadata on the data source, and doctors can judge the patient’s complexion and the state of the disease more precisely.

Using the information on communication lines, we can get the line speed and estimate the patterns and rates of data error. There is little need for such information in asynchronous medical imaging services which can be done with batch processing and require only reliable transfer to the destination. In contrast, video and audio data must be transferred to the destination within certain delay in order to communicate without difficulty. With this information, coding the audio/video signals at the appropriate bit rate and adding error-correcting codes on communication lines with high error rates as mobile phones can achieve smooth communication.

Processing power and display capability of the terminals are some of the information of data destination. For example, the types of coding standards that can be decoded and the resolution and color depth of monitors must be exchanged. This information on data destination enables the data source site to select the coding method that can be decoded and the resolution that can be easily viewed on the destination terminals.

3. Metadata Exchange

We also need standardized storage and exchanging methods for effective use of metadata.

For storage, first we should consider the format of metadata. The format of metadata is determined from its structure. The structure of metadata is determined by its language and element-vocabulary-scheme set on the language.

Language is a specification that gives the structure of textual data. Historically, KIF\textsuperscript{20} (Knowledge Interchange Format) and KQML\textsuperscript{21} (Knowledge Query and Manipulation Language) were early attempt for metadata exchange. SGML\textsuperscript{22} (Standard Generalized
Markup Language), HTML[23] (HyperText Markup Language), and XML[24] (eXtensible Markup Language) are general purpose languages for structured textual data. Most languages seem to become XML-based today. In addition, metadata language should have the ability of describing tree structure hierarchically. RDF[25] of W3C is a well-known example satisfying this requirement.

Element-vocabulary-scheme set defines the construction of metadata as a whole. Elements are items that comprise metadata, vocabulary is the content written in elements, and scheme is a framework that defines elements and vocabulary.

In addition, we need the method of storage and transport of metadata. Analogy to e-business might help standardizing this part. E-business process can be seen as a process of exchanging metadata of merchandise. So e-business standards such as ebXML or Web Services define the method of storage and transport as their main parts. If we use the general Web Services terminology, data storage corresponds to UDDI, data access corresponds to WSDL, messaging service corresponds SOAP. There exist similar standards in this area, so we should choose the appropriate one carefully.

4. Some issues on Metadata Standardization

Lastly, we mention some issues that seem to have to be investigated in the process of metadata standardization.

First, there is an issue on how to achieve the interoperability of metadata itself. While much of the above mentioned metadata for telecommunication interoperability have not been standardized yet, some already exist in one or more standards. In order to achieve interoperability of metadata among several standards, two principles are known. One is to define correspondence among metadata regulations, and another is to delete qualifier of elements while keeping consistency of element meaning. Both methods require registry on schema of metadata.

Second, there is another issue on how to reduce the cost of creating metadata. Although many attempts have been made on the automatic extraction of metadata using image or voice recognition, no full automatic extraction method for universal data seem to be realistic. It seems to be necessary that semi automatic method supporting metadata extraction specific to medical information must be investigated.

References

Standardization”, APT Telemedicine Workshop 2005
[23] HyperText Markup Language (HTML) Home Page : http://www.w3.org/MarkUp/
5 Project Design for e-health

Assessing the benefits of high-technology projects, such as telemedicine/e-health projects, is a rather challenging task as these projects often combine state of the art technology, long-term implementation and application, and market uncertainties, and are bound to political decisions. There is no universal metric for a priori evaluation. Every project proposal, in order to be fully evaluated and properly funded, must follow some specific rules or design template. Depending on how clear and precise a project proposal has been prepared, the chances that it will obtain funding will be better or worse. The following paragraphs aim to provide brief outlines for project preparation, and are aimed at colleagues who are planning to submit project proposal to ITU’s Telecommunication Development Bureau (BDT- seeking assistance, or to any other international or regional organization.

Usually, BDT applies a “one-stage submission” procedure, i.e. proposals are submitted in a single stage — in the form of a complete proposal application.

Structure of a proposal

Proposals, whatever the form of the application, have to contain two parts :
1 An administrative part that gives information about the proposal and the proposers, e.g. proposal title, proposers’ names and addresses, a brief description of the work, total funding requested, broken down by type of activity, etc.
2 The second part comprises the scientific and technical content of a proposal. It includes the nature of the proposed work, the participants and their roles in the proposed project, the reasons for carrying out the work, and the expected benefits.

Part 1: Administrative information

The reader’s first impression is formed by the title page and overall impression from the project proposal. The title page is very important. It should contain :
* Proposal full title and acronym, if any. The project title has to be understandable even to the non-specialist in field.
* List of participants, with coordinator first, along with the coordinating organization’s name, e-mail and fax.
* Project duration: the estimated duration is usually provided in full months. Estimated start and end date.
* Initiative/project site.
* Beneficiary country.
* Total cost of the project and desired contribution from the financing organization.

Including a table of contents, immediately following the title page, makes reading easier. The table of contents should be detailed.

A proposal summary is optional, but highly recommended. It should give the full title of the proposal (and acronym) and provide a proposal abstract. The latter must be succinct and provide, at a glance, a clear understanding of the objectives of the project proposal and how these objectives will be achieved. It is strongly recommended to use plain language, avoiding formulae and special characters.

The proposal summary is also the place where to include information on previously submitted similar proposals or signed contracts. If one or several of the partners have previously submitted or are in the process of submitting the same or a similar proposal to other funding programmes, this information should be provided either here or further in the project proposal text. This is to avoid potential conflict of interests.
Part 2: Project description

This is the core of the proposal, the most important part. It has to include the background and justification of the proposal. To be clearer, it is recommended that this part be divided into several sections, as follows:

Background

Partners should provide information, including an assessment of the situation and why such an initiative or project is needed. What critical deficiency or shortfall would the proposal address?

Objectives

This section has to indicate the strategic objectives addressed. If there is more than one objective, their order of importance in the project has to be indicated.

The objectives should be stated in a measurable and verifiable form. In later reviews and assessments, the progress of the project work is measured against these goals.

Evaluators would like to see a description of the manner in which the proposed project’s objectives contribute to the scientific, technical, social and policy objectives of ITU in the areas concerned, as well as the anticipated results of the project.

It is of advantage if partners are able to describe the impact of the proposed project in the area concerned.

Implementation plan

This section describes in detail the work planned to achieve the objectives of the proposed project.

An introduction should explain the structure of this work plan and how the plan will lead the participants to achieve the objectives. It should also identify significant risks and contingency plans. The plan must be broken down according to types of activities.

Within each activity the work plan should be broken down to tasks, which should follow the logical phases of the project, and include management of the project and assessment of progress and results. The plan should include a work schedule, showing the timing of the different tasks and their components (Gantt chart or similar). This graphical presentation of the components has to show the interdependencies of different tasks.

The number of tasks and sub-tasks must be appropriate to the complexity of the work and the overall value of the proposed project. Each task should be a major sub-division of the proposed project and should also have a verifiable end-point. The planning should be sufficiently detailed to justify the proposed effort and allow progress monitoring.

This is also the place to explain whether (and why) new technology or new processes will be utilized. If a summary pages has not been provided, this is the place to explain whether similar initiatives have been developed and what account is taken of other national or international research activities, and to discuss any other related projects that influenced the approach for this project. If necessary, describe the added value that is expected form carrying out the work at national or international level.

Partners have to be very specific as to what the project proposal will deliver. The next section is closely connected with the deliverables. This is the dissemination plan.
Dissemination

The exploitation and/or dissemination plans have to reveal and ensure an adequate and optimal use of the project results, where possible beyond the beneficiary region/country.

Cost

This section gives cost estimates and possible sources of funding. Partners have to show that the overall financial plan for the project is adequate.

Other issues

If there are ethical or gender issues associated with the subject of the project proposal, they have to be taken into account. It is recommended to indicate which national and international regulations are applicable and explain how they will be respected.

Consortium and project resources

Proposals must be presented by an existing unit, either independent or functioning within a locally established research organization, and preferably having distinct organizational and administrative boundaries. This part aims to demonstrate how the project will mobilise the critical mass of resources (personnel, equipment, funding etc.) necessary for success.

The consortium description has to include the following.
—Official names of participant organizations, including short names, if any, addresses and countries.
—Information on activity type (industrial organization, education or training organization etc.) of each partner.
—Legal status (governmental, international etc.).
—Brief description of activities and expertise.

In addition, detailed descriptions of the role of participants, their complementarities, and in what way they are suited and committed to the tasks assigned to them, must be included. Any unusual staffing requirements, such as consultants or outside specialists, have to be identified here. Possible partners and donor also have to be identified, accompanied by an explanation of why the consortium needs them.

Management

This section should include a description of how the project will be structured and managed, i.e. the organization, management and decision-making structures of the project, the plan for the management of knowledge, intellectual property and other activities arising in the project.

Depending on the size and scope of a project, a specially constituted management team with dedicated staff covering a range of skills may need to be set up. Consortium management may include coordination at the consortium level of the technical activities, knowledge management and other innovation-related activities of the project; overseeing science and society issues related to the research activities conducted within the project; overall legal, contractual, ethical, financial and administrative management of the consortium; preparing, updating and managing a consortium agreement between the participants, if and when necessary; etc.

Check list for proposers

Before making your submission, you should check the following.
—Have you included all main topics and sections?
—Does each page of the proposal have a header showing the proposal name?
—Are all pages numbered?
—Is the proposal prepared as a complete, single-sided paper copy (remember to keep a complete copy for yourself)?
—Has the complete set of proposal documents been packaged and correctly addressed?
—Do you have all the necessary authorizations from each member of the consortium to submit this proposal on their behalf?
6 How to make a telemedicine/e-health project sustainable:

The example of Japan\textsuperscript{31}

Introduction

We examine here the current situation of telemedicine in Japan, especially telehomecare, along with a cost-benefit analysis. Japan is now leading the world in this field in terms of the number of the systems implemented by local governments and the manufacturing of devices related to telehomecare. Based on field research on those systems, we present the characteristics and issues of the Japanese telehomecare system.

A. Definition of telehomecare

Telehomecare implies the use of electronic signals to transmit medical information on patients from remote areas. This is a real-time and two-way interactive transmission of information of large capacity, such as images and data. Telehomecare differs from telemedicine in the sense that persons who transmit and receive medical information are not medical doctors, but the patients themselves and their families, nurses, caregivers, household helpers, medical technical experts, and so on. With the current level of technology, telehomecare cannot provide advanced medical treatment and services, and the focus is on primary care and mental care, such as diagnosis of the patient at home by examining the images on PC or TV screens, and observation of health data transmitted by the system.

The telehomecare system in use today in Japan can be broadly categorized into three groups, in terms of aim, nature of medical information, equipment, and type of network: (a) telehomecare; (b) telehealth; and (c) type of community health and welfare management. In the following, these are examined one by one.

B. Telehomecare system

This system aims at providing telehomecare, for example, for bedridden patients and patients stricken with terminal diseases who require medical care. The characteristics of this system are the real-time and two-way interactive transmission of motion pictures via videoconference systems or videophones. This system is classified into three subcategories according to network type: (a) CATV-Broadcast; (b) CATV-LAN; and (c) ISDN. The CATV network is utilized by (a) and (b), and can transmit high-definition film data at 30 cells per second using a colour digital (CCD) camera with 360,000 elements. As far as the system is concerned, (a) uses the broadcasting network, and (b) the LAN network. Existing examples of the use of (a) include the systems of Goshiki Town in Hyogo Prefecture and Kamaishi City in Iwate Prefecture. For (b), there is the care-at-home support system called “Anshin-netto” in Minami-Shinano Village in Nagano Prefecture, which is the only working example of the LAN type.

The ISDN type of telehomecare (c) utilizes ISDN 64 kbit/s as the network, and image information is transmitted by the videophone system. The image quality on the videophone screen is 10 to 25 cells per second, and is inferior to that of the CATV type. On the other hand, ISDN offers easier correspondence, such as the exchange of messages among patients, and families of the patients can exchange information through ISDN. This type of system is in operation in twenty regions, including Bekkai Town in Hokkaido, Mogami Town in Yamagata Prefecture, and Mitoyo Region in Kagawa Prefecture.

\textsuperscript{31} Prof. Masatsugu Tsuji, Osaka School of International Public Policy, e-mail: tsuji@osipp.osaka-u.jp
C. Telehealth type system

The telehealth type and regional health and welfare management systems differ from the previous telehomecare type in that neither uses image information. The aim of the health system is not to treat the patient’s illness but to routinely observe the health condition of elderly residents or patients, for instance following release from hospital.

The system consists of the following devices. First, at the patient’s home, a camera, PC, and remote monitoring equipment (remote sensor), are installed to measure temperature, blood pressure, pulse, heartbeat, electrocardiogram, and blood oxygen. The medical information obtained through these instruments is transmitted to medical institutions such as the local health centre via the telecommunications network, which may be public telephone lines, leased circuits, ISDN, or the CATV network.

Several household electric appliance manufacturers such as Panasonic, NEC, Fujitsu, Sanyo, Hitachi etc. have brought remote monitoring equipment on the market, and the current price is USD 2,000 to USD 3,000 per set. This system is a simple device, but when it is used continuously, the condition of the illness such as a chronic disease is shown in graphs, which are then used for diagnosis and consultation. The system is also effective for encouraging patients to take more interest in their health condition. Some of the terminals are equipped with a simple voice function, and the doctor can examine the condition of the patient’s health by talking with the patient. Local governments operating a homecare-type system, as mentioned, also use this system. There are seventy-six local governments across Japan which operate the telehealth system, including Kiwa Town in Mie Prefecture, Tadami Town, and Nishi-Aizu Town in Fukushima Prefecture, and Manmoku Village in Gunma Prefecture. The total number of devices amounts to more than 11,000 as of March 2003, more than anywhere else in the world.

D. Regional health and welfare management system

The regional community health and welfare management system is not only aimed at providing information on the patients’ health condition, but also at providing complete information regarding health/medical care/welfare services by making a database of residents’ information. Via this database, information is shared among local government departments which provide each service. As society ages, it is highly desirable for all kinds of information related to the elderly to be centralized, and all medical institutions, administrative bodies, and volunteer groups in the community can share these information in order to ensure the adequate provision of services.

Local governments putting this system to practical use are not great in number. Two examples are Kawai Village in Iwate Prefecture and Kakogawa City in Hyogo Prefecture. In the case of the “Yuitori Network System” of Kawai Village, the public health centre, welfare centre for the aged, Kokuho Clinic, special nursing home for the aged, supporting centre for homecare, day service centre and village office are linked together by optical fibre and LAN. In its database, information on medical care/welfare is captured and shared by all those involved in telehomecare: doctors, physiotherapists, public health nurses, dieticians, lifestyle instructors, and other village staff. In Kakogawa City, more than 160 local medical institutions are linked by the “Local Health and Medical Care Information System,” which is a 64 kbit/s ISDN network, and the medical information which has been entered by doctors is shared by those who are engaged in local medical activities. In this way, the system aims to prevent redundant medical examination, and redundant medication, and strives for a more efficient method of providing medical care to the community.
E. Effectiveness of the telehealth system

We conducted a field survey among users of a telehealth system in Nanmoku Village, Kamashi City, and Katsura Village, and obtained the following results regarding the effects of telehealth systems: (a) stabilizing the condition of diseases; (b) raising health consciousness; (c) decreasing anxiety about health; and (d) decreasing medical expenditures. Health data sent to the medical institution is simple, but basic. By examining the medical data each day, medical staff are able to recognize changes in health condition, and give advice to the users. By reading their data records, users are motivated to participate more actively in improving their health. Users can communicate with medical staff via the system 24 hours per day, which decreases their feelings of anxiety. According to the replies to our questionnaires, about 20 percent of the users claim their medical expenditures declined after they began to use the telehealth system. This is a rather surprising result, and we have to verify this hypothesis by other methods of research.

Regarding the assessment by users in our survey, in three regions more than ninety percent of users recognized the system as useful, and wanted to continue to use it. More than two thirds of users were satisfied with the functioning of the device and said that there was nothing to improve. Most of the users are elderly, and their indication was that it was easy to learn how to operate devices. In sum, we can conclude that the three systems surveyed are accepted by users.

F. Comparison of the telehealth systems

As mentioned earlier, Japanese household electric appliance manufacturers such as Panasonic, NEC, Fujitsu, Sanyo etc. are selling remote monitoring, and more than 8,100 have been used. The most popular is ‘Urara’, invented and manufactured by Nasa corporation. In Kamaishi City, Urara was adopted. Urara is designed for simple functions, and therefore rather inexpensive. Other monitoring terminals are manufactured by well-established companies: Sanyo sells ‘Medicom’, while NEC offers ‘Sukoyaka Mate’. These are multifunction units, and since the platform is a PC, functions such as transmitting image and voice data are easily attached. On the other hand, they tend to be expensive. Currently, local governments seem to be attracted to Urara due to its low price. With the development of Internet technology, however, telephony or even videophone systems will become available soon. At that time, the telehealth system will naturally expand to include functions.

G. Supplementary program to increase compliance

The important issue regarding the Japanese telehealth system is that the usage or compliance rate is quite low in some local governments. Most local governments provide the device without any cost to the elderly in the region, and they do not charge any fee. This means that there is less incentive to take health data measurements. Kamaishi City, on the other hand, charges about USD 25 per family, and compliance has been quite high. 26% of the users record their data everyday, and 29.1% at least once a week. The reasons are: (a) the system is operated by a medical hospital, and (2) the users’ association. Most of the systems of local governments are operated by public nurses, and not by medical doctors. The participation of medical doctors adds to the confidence of the users. The latter implies that the association regularly provides meetings and conferences on health, and this helps to promote health consciousness. These kinds of schemes are very useful to increase compliance.
II. Estimation method

A. Contingent Valuation Method (CVM)

- In order to measure the benefits of services which are not traded on the market, the following methods are utilized in this field: (a) travel cost method; (b) replacement costs method; (c) hedonic approach; and (d) CVM. In what follows, we use CVM, which has been recently widely adopted in the fields of Health Economics and Environmental Economics. In CVM, the benefits to users are measured in terms of WTP, which is the monetary amount which users are willing to pay for receiving the service. By asking the WTP of each user, we can then construct the surrogate demand function for the telehealth system. Although CVM and WTP have a strong theoretical basis, CVM tends to have a bias because it asks for concrete valuation and choice under fictitious circumstances. Care should be taken to clarify what kind of bias it possesses and to remove them.

B. Questionnaire

- We conducted surveys in Kamaishi City in October 2000, Katsurao Village in February 2001, Nishiaizu Town in July 2001, and Sangawa Town in January 2002. In the case of Kamaishi City, we interviewed 348 users of the telehealth system, and asked questions pertaining to the following: (a) WTP; (b) effectiveness; (c) frequency of usage; and (d) user properties such as age, gender, income, education, and health condition. The questionnaire related to WTP is as follows: We begin by asking whether they would be willing to pay monthly charges of 5,500 yen (USD 45). If their answer is “yes,” we then ask whether they would be willing to pay 7,500 yen (USD 62.5). If they reply “yes” again to 7,500 yen, their WTP is 7,500 yen. If “no,” then we lower the amount to 6,500 yen (USD 54.17). If they reply “yes” to 6,500 yen, then that is their WTP. If again their answer is “no,” we lower the amount further to 5,500 yen. We repeat this process until their WTP is determined. Out of a total of 348 replies, 291 had no missing value. The distribution of WTP from the survey is as follows: 10,000 yen (16 users), 8,000 yen (1), 7,500 yen (12), 6,500 yen (11), 5,500 yen (62), 4,500 yen (8), 3,500 yen (69), and 2,500 yen (112). The distribution of replies is shown in Table IIa. Those of other regions are shown in Tables IIb, IIC, and IID.

C. Estimation of demand function and WTP

Based on the above WTP of each user, we estimate the demand function of the system; more precisely, we estimate the probability of acceptance to amounts questioned and the number of users who will agree to pay. The functional form of demand to be estimated is assumed to be logistic, namely,

\[
\text{Probability of acceptance} = 1 - \frac{1}{1 + \exp(-\alpha - \beta \log \text{WTP})}.
\]

- The probability of acceptance is the ratio of the number of users who reply that they are willing to use the device at the amount of charges provided in the questions. The estimated

<table>
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<th>Table I</th>
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<td>518</td>
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<td>Katsurao</td>
<td>926</td>
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Table IIa  Distribution of replies (Kamaishi City)

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<th>4,500</th>
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<td>8</td>
<td>62</td>
<td>11</td>
<td>12</td>
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Table IIb  Distribution of replies (Nishiaizu Town)

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Table IIc  Distribution of replies (Katsurao Village)

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Table IIId  Distribution of replies (Sangawa Town)

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<tbody>
<tr>
<td>No. of users</td>
<td>93</td>
<td>3</td>
<td>14</td>
<td>38</td>
<td>3</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>WTP</td>
<td>3,500</td>
<td>4,000</td>
<td>4,500</td>
<td>5,000</td>
<td>5,500</td>
<td>6,500</td>
<td>10,000</td>
</tr>
<tr>
<td>No. of users</td>
<td>6</td>
<td>0</td>
<td>17</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table III  Results of estimation (Kamaishi City)

<table>
<thead>
<tr>
<th></th>
<th>Estimated</th>
<th>Standard error</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>27.441134</td>
<td>2.0739667</td>
<td>13.231</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\beta$</td>
<td>3.3033572</td>
<td>0.2474318</td>
<td>13.351</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Log probability function: -475.7578

coefficients $\alpha$ and $\beta$ are summarized in Table III.

* The estimated demand function for Kamaishi's telehealth system is shown in Fig.1. The average WTP is calculated as the area under this demand function, which results in 4,519 yen (approximately USD 37) per user per month. The demand functions of other regions have the same form.

In sum, the WTP of Kamaishi, Nishiaizu, Katsurao, and Sangawa are 4,519 yen, 3,177 yen, 1,640 yen, and 2,955 yen, respectively.

III. Cost-benefit analysis

A. Total benefits

In the cost-benefit analysis, total benefits and costs are compared over a period of several years. In this paper, the time span is assumed to be six years, since all device parts are held as inventory for six years. The WTP obtained above is per user and month, and it is multiplied
by the number of users and 12 months. At the time of the survey (October 2000), 348 users were registered. One-year benefits total approximately 18,871,344 yen (USD 157,261). In order to obtain six years’ worth of benefits, we calculate the present value of six years’ benefits with a 4% discount rate, and we assume that the number of registered users remains at the same level for six years. This results in six years’ benefits totalling 95,782,869 yen (USD 798,182). In the same way, total benefits for the other three are also calculated, as shown in Table IV.

B. Total costs

The cost of the system covers equipment, salaries and wages of doctors and nurses, and other miscellaneous costs which include maintenance. The cost of host computers at the hospital is about 1,700,000 yen (USD 14,166) which includes instalment fees, at the cost of 250,000 yen (USD 2,083) per device. The total cost of 200 devices is about 37,600,000 yen (USD 313,333). Development of software prior to instalment cost 4,000,000 yen (USD 33,333), which is also considered part of the initial costs. We assume that 10% of the value of equipment can be considered its residual value after six years of operation; therefore 90% of the value of equipment is included in the costs, which amounts to 38,970,000 yen (USD 324,750). This is paid for with a one-time payment at the beginning.

For salaries and wages, a part-time doctor is paid about 1,728,000 yen (USD 14,400) per year, a full-time nurse is paid about 5,040,000 yen (USD 42,000), and one part-time worker receives about 1,800,000 yen (USD 15,000). The doctor and part-time worker spend half of their working hours on this system. Thus, total yearly salaries are 8,568,000 yen (USD 71,400). Other maintenance costs (printing and postage) are about 1,851,600 yen (USD 15,430) per year. As mentioned earlier, there are no telecommunications charges. Thus, total annual operational costs are about 10,419,600 yen (USD 86,830). According to this calculation of six years’ operational costs as well as those of equipment with a 4% discount rate, the costs of the telehealth system in Kamaishi City total 95,782,869 yen (USD 789,190). The total costs of other regions are summarized in Table V.
C. B/C Ratio

From the above calculation, the B/C ratio over the six-year period is 1.07, that is, benefits exceed costs. This is a rather surprising result, because all other local governments where field research was conducted show ratios less than 1. The B/C ratio being larger than 1 does not necessarily indicate that the medical corporation, Rakuzankai, earns a positive profit. Since its revenues consist of user charges of 2,500 yen, this amount is smaller than that of WTP; more precisely, 211 peripheral devices are being leased, and 2,500 yen is being charged per family of up to four users. The monthly revenue from rental devices thus totals 527,500 yen (USD 4,396), with an annual revenue of 6,330,000 yen (USD 52,750). On the other hand, annual operational costs as obtained in the previous subsection are approximately 10,419,600 yen (USD 86,830). Thus, revenues are far less than operational costs. Though Rakuzankai is losing money by its operation, losses are covered by other hospital income. B/C ratios of other regions are shown in Table V.

D. B/C Ratio for local governments

If the telehealth system of Kamaishi City were to be considered as a private business, its profits would be negative; however, as a public project, it creates more benefits to society than costs. For the other three local governments, the costs are larger than benefits. Then why do they implement such projects? This is a common question to all local governments in Japan. Let us consider the viewpoint of local governments for this answer. Most telehealth systems in Japan are supported by the central government, that is, it provides subsidies to local governments in the amount of the cost of the equipment.

For all other local governments, excluding Kamaishi City, the B/C ratio is smaller than 1. This difference is due to the cost of equipment; Katsurao Village purchased rather sophisticated and expensive devices capable of transmitting motion pictures. Nishiaizu and Sangawa received subsidies from different ministries at different times, and since these devices cannot be utilized as a single system, it was necessary to install different kinds of equipment for each system. Kamaishi City purchased devices at the lowest price and this mainly contributes to its B/C ratio being the highest. Thus, local governments need only to cover operating costs such as salaries and wages, and maintenance costs. The B/C ratios recalculated in this way are denoted by (B/C)* in Table V. All (B/C)* become larger than 1, and this is the answer to the above question-for local governments, such projects create more benefits than costs.

IV. Cost-sharing among parties

A. Decomposition of WTP into effects

The previous result shows that WTP in Kamaishi is 4,519 yen. Here, we decompose this WTP into the effects of the telehealth system, and calculate who bears the costs of the telehealth system examined in the previous section, and to what extent.

In the survey of users, we asked whether the system provided four effects: (a) less anxiety in day-to-day life, (b) stabilization of illness, (c) enhancement of health consciousness, and (d) decrease in medical expenses. We regressed the users’ stated WTP on their replies. Thus, we estimated the following equation:

\[ W = ax_1 + bx_2 + cx_3 + dx_4 + e, \]

where a, b, c, and d are coefficients to be estimated, x1, x2, x3, and x4 are dummy variables which take 1 if their replies are “yes” and 0 if they are “no,” and e is an error term. The results are shown in Table VI.
Table IV  Comparison of benefits (Unit : Yen)

<table>
<thead>
<tr>
<th></th>
<th>No. of users</th>
<th>WTP</th>
<th>Benefit (6 years)</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamaishi</td>
<td>405</td>
<td>4,519</td>
<td>102.9mil.</td>
<td>2,500</td>
</tr>
<tr>
<td>Katsurao</td>
<td>926</td>
<td>1,640</td>
<td>99.4</td>
<td>none</td>
</tr>
<tr>
<td>Nishiaizu</td>
<td>518</td>
<td>3,177</td>
<td>107.7</td>
<td>none</td>
</tr>
<tr>
<td>Sangawa</td>
<td>484</td>
<td>2,955</td>
<td>106.5</td>
<td>none</td>
</tr>
</tbody>
</table>

Table V  Comparison of cost and B/C ratio

<table>
<thead>
<tr>
<th></th>
<th>Kamaishi</th>
<th>Nishiaizu</th>
<th>Katsurao</th>
<th>Sangawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of devices</td>
<td>211</td>
<td>400</td>
<td>325</td>
<td>225</td>
</tr>
<tr>
<td>Equipment</td>
<td>39.9mil. yen</td>
<td>136.7mil. yen</td>
<td>111.4mil. yen</td>
<td>133.5mil. yen</td>
</tr>
<tr>
<td>Salaries</td>
<td>8.6mil. yen</td>
<td>3.7mil. yen</td>
<td>3.36mil. yen</td>
<td>4.5mil. yen</td>
</tr>
<tr>
<td>Others</td>
<td>1.9mil. yen</td>
<td>1.9mil. yen</td>
<td>10.4mil. yen</td>
<td>3.0mil. yen</td>
</tr>
<tr>
<td>Costs (6 years)</td>
<td>95.5mil. yen</td>
<td>184.5mil. yen</td>
<td>184.2mil. yen</td>
<td>174.3mil. yen</td>
</tr>
<tr>
<td>B/C</td>
<td>1.07</td>
<td>0.58</td>
<td>0.54</td>
<td>0.61</td>
</tr>
<tr>
<td>(B/C)*</td>
<td>1.87</td>
<td>2.31</td>
<td>1.42</td>
<td>2.60</td>
</tr>
</tbody>
</table>

Based on the above estimation, the extent to which each effect had monetary value was calculated, that is, how the WTP decomposes into these four components. The p-value of “decrease in medical expenses” was not significant, so this component was ignored. The results are summarized in Table VII. The results of four regions are summarized in Table VIII.

B. Exact amount of reimbursement

• The effects of enhancement of health consciousness and less anxiety in day-to-day life contribute to the users themselves, since they enrich their personal life. On the other hand, in addition to this, stabilization of illness has another effect, since it is helpful to society by means of decreased medical expenditures, less medical resources etc. That is, it also has an external effect. This argument suggests who bears the cost of the telehealth system. If the effect benefits individual users, then they are willing to pay that amount. On the other hand, if it benefits the entire society, then it should bear that amount. According to the above figures, in Kamaishi City individual users bear 2,763 yen in cost, while society pays 349 yen as reimbursement. In Nishiaizu, reimbursement is 439 yen. Surprisingly, the amount of 2,763 yen obtained here is very close to the amount of 2,500 yen charged by Kamaishi City.

Table VI  Estimated components (KAMAISHI CITY, N = 288)

<table>
<thead>
<tr>
<th></th>
<th>Co-efficient</th>
<th>Stand. dev.</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization of illness</td>
<td>979.0</td>
<td>298.6</td>
<td>3.3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Enhancement of health consciousness</td>
<td>2612.9</td>
<td>224.1</td>
<td>11.7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Less anxiety in day-to-day life</td>
<td>1535.7</td>
<td>264.3</td>
<td>5.8</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Decrease in medical expenses</td>
<td>767.9</td>
<td>701.8</td>
<td>1.1</td>
<td>&lt;0.28</td>
</tr>
<tr>
<td><strong>Table VII</strong></td>
<td>Decomposition of WTP into four effects (Kamaishi City)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td><strong>Value (yen)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stabilization of illness</td>
<td>349</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhancement of health consciousness</td>
<td>1834</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less anxiety in day-to-day life</td>
<td>929</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease in medical expenses</td>
<td>not significant</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Table VIIIa</strong></th>
<th>Breakdown (Nishiaizu)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect</strong></td>
<td><strong>Value (yen)</strong></td>
</tr>
<tr>
<td>Stabilization of illness</td>
<td>439</td>
</tr>
<tr>
<td>Enhancement of health consciousness</td>
<td>1,075</td>
</tr>
<tr>
<td>Less anxiety in day-to-day life</td>
<td>680</td>
</tr>
<tr>
<td>Decrease in medical expenses</td>
<td>not significant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Table VIIIb</strong></th>
<th>Breakdown (KATSURAO)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect</strong></td>
<td><strong>Value (yen)</strong></td>
</tr>
<tr>
<td>Stabilization of illness</td>
<td>not significant</td>
</tr>
<tr>
<td>Enhancement of health consciousness</td>
<td>179</td>
</tr>
<tr>
<td>Less anxiety in day-to-day life</td>
<td>475</td>
</tr>
<tr>
<td>Decrease in medical expenses</td>
<td>not significant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Table VIIIc</strong></th>
<th>Decomposition (Sangawa)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect</strong></td>
<td><strong>Value (yen)</strong></td>
</tr>
<tr>
<td>Stabilization of illness</td>
<td>not significant</td>
</tr>
<tr>
<td>Enhancement of health consciousness</td>
<td>not significant</td>
</tr>
<tr>
<td>Less anxiety in day-to-day life</td>
<td>774</td>
</tr>
<tr>
<td>Decrease in medical expenses</td>
<td>not significant</td>
</tr>
</tbody>
</table>

V. Conclusion

So far, we have conducted surveys of four local governments. Except for Kamaishi City, their B/C ratios are approximately 0.5, that is, benefits cover only half of the costs. In addition, regarding the frequency of usage of the device, Kamaishi City also has a much higher ratio than the other local governments. Thus, Kamaishi City reveals quite specific characteristics. This is due to their efforts to promote usage, such as a users’ association which organizes events to enhance consciousness towards health, and the participation by medical doctors in this system, which increases the users’ reliance on the system.

It is clear from our previous studies that the telehealth system is useful for consultation and maintaining the good health of the elderly and patients suffering from chronic diseases who are in stable condition, but less so for curing disease. It therefore has a psychological effect such as providing a sense of relief to its users due to the knowledge of being monitored by a
medical institution 24 hours a day. This makes it difficult to estimate its benefits in concrete terms. We are only able to provide concrete amounts to this effect in this paper.

To date, Japanese local governments implementing this system have not charged any fee, except for Kamaishi City. They all receive subsidies from the central government. Kamaishi City, for example, receives subsidies from the Ministry of Welfare through collaboration in two of its projects – Special Project for Promoting Regional Health, and Pilot Project for Promoting Telemedicine. Katsurao Village received subsidies from the Ministry of Welfare and Ministry of Agriculture, Nishaiaizu from the Ministry of Welfare, Land Planning Agency, and the Ministry of Agriculture, and Sangawa from the Ministry of Welfare and Ministry of Agriculture. Due to the unfavourable budget situation in Japan, however, local governments can no longer rely on such subsidies. For sustainability of the telehealth system from a financial point of view, a new framework is required. Reimbursement using medical insurance is one possibility. In order for such reimbursement to be realized, analyses such as the cost-benefit analysis carried out in this paper provides a theoretical foundation.

Regarding the methodology of the analysis, in this paper we selected four regions, applied CVM to each telehealth system, and made a comparison of the results. This is, however, not the most appropriate method. It is necessary to pool the data of the four regions, and then proceed with the analysis. This is a separate task for the future.

References

PART 2

CASE REPORT

1 Bangladesh

Introduction

The advent of modern communication technology has unleashed a new wave of opportunities and threats to the delivery of health services. Telemedicine, a broad umbrella term for delivery of medical care at a distance, has reached around the world, and now health professionals can communicate faster, more widely, and more directly with clients and colleagues, no matter where they are. These kinds of promising approaches resulting in the optimization of the treatment of patients by establishing integrated and comprehensive e-health networks are in existence due to the rapid growth of Telemedicine. Hence, Telemedicine or Health Telematics or e-health has become the prime priority to the health policy makers, social security funds and e-health providers throughout the world. In Bangladesh, the status of e-health is similar to the one of many developing countries: medical practitioners in Bangladesh often operate in relative isolation, dealing with diverse health care needs, many of which arise infrequently because of the small populations served. Worldwide there is difficulty in retaining specialists in non-urban areas. The distribution of specialists in Bangladesh is indeed lopsided. There are more neurologists and neurosurgeons in some cities; similarly tertiary care hospitals are also concentrated in pockets with large segments of the population having no access. A proper deployment of telemedicine and assurance of a better telecommunication infrastructure can easily resolve these problems and also can ensure a better e-health condition for the entire population of Bangladesh [1].

Fig.1

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Country overview

Bangladesh, a country with the area of 144,000 sq km, is widely known for its heroic history of Independence. The country is situated in between India and Myanmar with having the Bay of Bengal at its southern border. A country with the population of 144,319,628 is also known as one of the most densely populated country in the world. Most of the country is situated on deltas of large rivers flowing from the Himalayas, thus often face the problems of floods. Despite of all these problems, Bangladesh is known as a land of miracles and heroic accomplishments. Using traditional methods, farmers produce enough food to maintain one of the densest concentrations of rural people in the world. Beside agriculture, Natural gas and Garments are the two important sectors that provide substantial support to the country’s economy. Bangladesh has a per capita GDP of $ 2000. The population below poverty line is 45% as of 2004. The population growth rate is 2.09%. Birth rate and death rate is 30. 01-births/1,000 population and 8.4 deaths/1,000 population respectively. The infant mortality rate is 62.6 deaths/1,000 live births [2].

ICT Infrastructure of Bangladesh

The rapidity and the ease of access to medical information are essential conditions for the quality of the help to the patients, for the medical researches and for the checking of the developments in the health service. This creates a strong emphasis on having a better ICT infrastructure in order to establish Telemedicine service in Bangladesh. Thus it is worthy to discuss about the current situation of the ICT network of Bangladesh, from which the future steps can be measured. The present status of the ICT network of Bangladesh is presented below with respect to telephone lines, ISPs and Wide Area Networking.

- **Telephone lines**: According to the CIA fact book, currently there are 740,000 fixed phone users and 1.365 million cellular phone users in Bangladesh. While each fixed phone line costs approximately USD 300 and each cell phone line costs from USD 5 to USD 300. [2]

- **Internet service providers**: A small Honolulu-based telecom and international satellite Internet services provider (SISP) called USAT is offering high speed satellite Internet services, marketed as SkyTiger. net, to businesses throughout Asia. The company is now uplinking high speed SkyTiger. net IP data services to all the Asian countries. The Internet came late in Bangladesh, with UUCP e-mail beginning in 1993 and IP connectivity in 1996.

![Fig.1 Next generation ICT networks in Bangladesh](image-url)
By July 1997 there were an estimated 5,500 IP and UUCP accounts in the country and by the end of 2003 the account holder reached to more than 240,000 through different Internet Service Providers (ISP), who are offering Internet services with bandwidth ranging between 65 kbit/s and 2 Mbit/s through VSAT, Broadband and Zacknet downlink.[2, 3, 4].

**Wide area networking:** Telecom networks in Bangladesh are being modernized. Data Networks (LAN, MAN, WAN-Local, Metropolitan, and Wide Area Network) are emerging. Digital switches capable of services such as ISDN are being installed all over the country. Various public/private organizations have or are in the process of installing LAN in their branches. When private providers’ modern infrastructure becomes completely functional, organizations will be able to interconnect their sites. Various private organizations are in need of such interconnectivity. As the demand of a better ICT infrastructure is increasing due to the recent deployment of Telemedicine, egovernment, the government has already proposed an next generation Bangladesh ICT infrastructure. The development of this network is now under process. The next generation ICT architecture of Bangladesh is depicted in Figure 1.

The characteristics of the proposed architecture consist of the following model:

- **Access networks:** Access provides connectivity from the customer premises to core network. Access may be provided through Packet switches, fixed wireless, Cable facilities and switched access scenarios.

- **Core networks:** Core/Backbone technology provides SONET/WDM/DWDM/ATM/IP based highly reliable, highly available, low cost, high capacity and scalable long haul connectivity between edge networks. The backbone network will be shared for voice and data. The core network will not provide features/services to end customers, nor will it interface with intelligence network.

- **Edge networks:** Edge networks will interface with customers via the access technology and with other networks via core technology. Edge devices will target specific traffic (such as, IP, ATM, Frame Relay and Wireless) allowing fast time to market for targeted customers.

- **Telephony call control:** Telephony services will be supported across a packet based Multiservice network using several options for establishing the voice path including IP, SVCs or VP PVCs. The packet based architecture will be based on the MGCP/H. 323/SIP architecture [3].

Above all, Bangladesh has signed a submarine cable agreement with other 12 countries on March 27, 2004 that will open a high-speed, low-priced Internet and telecommunications gateway to the users from June 2005. Bangladesh’s entry to the 13-member consortium, SEA-ME-WE-4 in acronym, will slash Internet and long-distance telephone call costs and greatly boost browsing speed. The county will have a 10-gigabyte data transfer capacity per second, 68 times more than the current capacity. The service is expected to be started from the middle of the year 2006 [5].

**Current Health Situation in Bangladesh:**

The overall condition of the health situation is needed to be reviewed in order to obtain a clear idea about the country’s overall situation. A comparison of some basic health indicators of Bangladesh for three different years is presented in table 1:
Table 1  Basic health care data of Bangladesh

<table>
<thead>
<tr>
<th>Indicators</th>
<th>1960</th>
<th>2003</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth rate %</td>
<td>2.5</td>
<td>2.3</td>
<td>2.09</td>
</tr>
<tr>
<td>Birth rate (per 1,000 population)</td>
<td>46</td>
<td>29</td>
<td>30.01</td>
</tr>
<tr>
<td>Death rate (per 1,000 population)</td>
<td>21</td>
<td>8</td>
<td>8.4</td>
</tr>
<tr>
<td>Infant mortality rate (per 1,000 live births)</td>
<td>149</td>
<td>46</td>
<td>62.6</td>
</tr>
<tr>
<td>Maternal mortality rate (per 1,000 live births)</td>
<td>3.8</td>
<td>3.8</td>
<td>3.0</td>
</tr>
</tbody>
</table>


Table 1 shows that all indicators have improved drastically in between the year 1960 and 2003. But after that it did not really changed at a considerable pace. In some cases, the level has decreased. One of the major reasons of this degradation of the indicators is the unavailability of the proper health care systems especially in the Rural and Remote areas of Bangladesh [1]. Thus Telemedicine can be a suitable solution for establishing a better health care system in Bangladesh.

Demand of Telemedicine in Bangladesh

Telemedicine may in fact have a more profound impact on developing countries such as Bangladesh than on developed ones. This is because most of the developed countries already have a proper health care system installed. Moreover, all those countries have a proper access to all the places in the country. While, in Bangladesh, all these facilities are absent. This has made Bangladesh a perfect place to flourish Telemedicine. The prime reasons, which have made the demand of establishing Telemedicine stronger, are as follows [8, 9]:

• High rate of foreign travel of Bangladeshi patients: Most of the people in Bangladesh do not really rely on the current health care system. Above all, Bangladesh is not such a country, which is well equipped with the modern medical tools. As a result, most of the people have a tendency to visit the neighbouring countries such as India, Thailand, and Singapore etc. where they can find reliable medication. By implementing Telemedicine, a reliable health care system can be established.

• Lack of proper diagnostic facilities: As a poor country, Bangladesh cannot always afford to buy all those costly diagnostic medical facilities. But Telemedicine can always provide those facilities without spending a huge amount of money.

• Lack of qualified allied health care professionals and specialized physicians: The following table summarizes the health resources available in Bangladesh:

<table>
<thead>
<tr>
<th>Number of Registered Physician</th>
<th>29,746</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician- Population ratio</td>
<td>1 : 4,521</td>
</tr>
<tr>
<td>Number of Registered Nurse</td>
<td>16,972</td>
</tr>
<tr>
<td>Nurse-Population ratio</td>
<td>1 : 7,127</td>
</tr>
</tbody>
</table>

Source: Country Health Profile by SNDP Bangladesh [7]

Table 2 shows that Bangladesh is severely suffering from the problem of not having sufficient number of qualified professionals. In some cases, it does not have specialized physicians in certain fields. Through the Telemedicine network, Bangladesh can easily get the access of the
vast number of foreign physicians as well as the local specialized physicians.

- **Improper distribution of health care system**: The health care system is not properly distributed in Bangladesh. Most of the Rural and sub-urban area does not have proper health care facilities. In some cases, those areas are not well connected with the urban areas. Thus, during the critical situations it becomes almost hard to provide appropriate health care to the patients. A Telemedicine system can keep all those remote areas well connected with the better-equipped urban areas.

From the above discussion it can easily be realized that, establishing a proper Telemedicine network in Bangladesh would entirely be a beneficial approach. Some of the potential fields where this Telemedicine can be applied are listed below:

- Emergency Medical Care
- Tele-consultation
- Physician to Physician Second Opinion
- Follow-through medical consultation for
- Patients receiving treatment abroad
- Rural Health Care
- Post-disaster medical management
- E-health Professional Training Program
- Medical Education, Continuing Medical
- Education, and Patient Education
- Military and Prison E-health System
- Medical Research and Development

**Government Incentives on Telemedicine**:

The government of Bangladesh has taken Telemedicine as a potential solution to overcome the country's health care problem. For a better implementation of Telemedicine, the government included a few specific policies in the “National Information and Communication Technology (ICT) policy, October 2002” [10]. These policies are included under section 3.8. The policies are exactly quoted here:

- The main focus in the use of ICT and communication technologies in E-health will be to deliver new capabilities for hospitals and e-health providers. ICT should be used to develop such capabilities specifically in the areas of electronic medical records, telemedicine, medical and health education etc.

- Telemedicine System Network shall be introduced throughout the country for cost-effective delivery of health care services. The Telemedicine Network will be used for rural patient management, distant medical education, training of health professionals and to develop mass awareness for disease prevention.

- Development of Bangladesh Health Portal should be given priority for appropriate growth of e-health and telemedicine referral system. International tele-consultation through telemedicine for critical patients will be promoted in both private and public sector.

- All public hospitals and medical research centres shall be linked by computer networks with
Medical centre of excellence as the central hub in order to make expert services available throughout the country. This network may be gradually extended to the local level. Besides setting the policies, the government also arranged quite a number of workshops and seminars to train and encourage the physicians to use the Telemedicine facilities. The Honorable State Minister chaired a workshop on Telemedicine and e-health including some 200 physicians for Health and Family Welfare, Government of Bangladesh, on 9 January 2004. The workshop was a huge success as it greatly attracted the electronic media as well as the entire general people of Bangladesh as a part of public awareness. Bangladesh Telemedicine Association (BTA) had taken a concrete step towards organization of a telemedicine network in South Asia, called “South Asian Association of Telehealth Initiatives” (SAATHI), which supposes to include SAARC countries, Bangladesh, India, Sri-Lanka, Pakistan, Nepal, Bhutan, and Mal-Dives in 2002. The SAATHI also wanted to extend to Myanmar, Thailand and other countries of the Far-East including China. SAATHI suppose to establish from an international meeting on telemedicine in Bangladesh in early 2003, however it is still in the discussion level.

**Foreign Incentives on Telemedicine in Bangladesh:**

As a third world country, it is beyond the capability of the Government of Bangladesh to conduct full-fledged Telemedicine projects with out the help of foreign authorities. Thus, most of the progress that has been done in the Telemedicine sector was with the involvements of foreign bodies. In fact, the very first Telemedicine initiative in Bangladesh was taken by the Swinfen Charitable Trust of United Kingdom [11].

In July 1999, the Swinfen Charitable Trust in the UK established a telemedicine link in Bangladesh, between the Centre for the Rehabilitation of the Paralysed (CRP) in Dhaka and medical consultants abroad. This low-cost telemedicine system used a digital camera to capture still images, which were then transmitted by email. During the first 12 months, 27 telemedicine referrals were made. The specialties that were involved in consulting: neurology (44%), orthopaedics (40%), rheumatology (8%), nephrology (4%) and paediatrics (4%). Initial email replies were received at the CRP within a day of referral in 70% of cases and within three days in 100%, which shows that store-and-forward telemedicine can be both fast and reliable. Telemedicine consultation was completed within three days in 14 cases (52%) and within three weeks in 24 cases (89%). This successful telemedicine system worked well as a model for further telemedicine projects in Bangladesh.

Another project on Telemedicine named as “e-health & Learning Project” was conducted by Elena Murelli of University of Piacenza, Italy and Theodorus N Arvanitis of The University of Birmingham, UK in January 2003 and ended in April 2004 [1, 18]. The project was conducted with the aim to promote international co-operations on Telemedicine. The creation of a Medical Portal and a series of seminars were seen as an eminent step forward to improve international co-operation and understanding, being a basis for the worldwide implementation of secure medical networks, cross-sectoral communication and the provision of high-quality websites for the health-related information of consumers and patients. The focuses of the e-health & Learning project were to provide knowledge and instruments useful to the development and the management of health information systems, to the automatic support to clinical research, epidemiological surveys, tele-consulting and tele-diagnosis services and integration between health infrastructures in Europe and Asia, in order to give to the patients a better and faster medical treatment and care. Students, researchers, ITC professionals and health operators from public and private institutions (national and international), in particular from Europe and Asia were attended a series of seminars delivered via videoconference using a VSAT and the Mymensingh regional node. These seminars were especially addressed in areas,
which were among the most central issues in information and communication technology for the health care [1, 18].

Based on the outcome of a workshop on telemedicine that was held in Dhaka, Bangladesh, in January 2004, the Swedish South Asian Studies Network proposed a project to develop some basic telemedicine services to be provided to rural health-centres in collaboration with Grameen Healthping, Mlrdaden in Vster and the BIRDEM hospital in Bangladesh. The network has planned to develop guidelines for proper management of medical equipment for clinical data collection, reliable transmission of data between the patient at the rural centre and the specialists at the referred centre by developing reliable software and hardware platform appropriate for the existing infrastructure. The project also evaluates the clinical effectiveness, security, reliability of telemedicine technology and its effects on quality, cost and accessibility of care and investigates ways for its sustainability [12].

Above all, it should be noticed that all these projects were pilot projects and none of these foreign bodies has started the commercial implementation of Telemedicine in Bangladesh.

**Incentives by the NGOs on Telemedicine in Bangladesh:**

The very first commercial approach to establish the Telemedicine service in Bangladesh was taken by a local private company called “Bangladesh Telemedicine Service (BTS)” in 2002. Even though the core initiative was originated from BTS, the Government of Bangladesh has provided their every support to make this entire effort a successful one. The BTS, which is also known as The Telemedicine Reference Centre Ltd. (TRCL), is headed by Dr Sikder M. Zakir. TRCL has pioneered development of international tele-consultation services in Bangladesh in partnership with University of Nebraska Medical Centre/Nebraska health System (UNMC/NHS) and Second Opinion Software, LLC.

On November 2002, TCRL of Bangladesh and FONEMED Global Health Services has signed an official agreement. Under the pact, FONEMED will assist TRCL to expand access to health care and create physician networks throughout Bangladesh. The team will collaborate with leading university medical centres, international financial institutions and foundations in extending family health care to rural communities and connecting doctors from remote cites to national and international telehealth facilities [13]. This particular approach has helped the Telemedicine sector of Bangladesh to cross a milestone.

On June 2004, Meridian Holdings Inc.’s subsidiary CGI Communications Services Inc. has entered into a teaming and joint marketing agreement with TRCL. Under the terms of the agreement, both companies will jointly market and promote their complementary and compatible products for telehealth and telemedicine to current and prospective customers, as well as supporting the pursuit of mutually advantageous business opportunities, in the global telemedicine arena. They also have agreed that the joint team of TRCL and CGI Communications Inc. will setup pilot rural medical centres in Bangladesh under the “Integrated Rural Health Information System” (IRHS) project of TRCL in Bangladesh. Under this IRHS project, TRCL has the plan of deploying 64 rural medical centres in all the 64 districts of

![Fig.2 BTS network infrastructure in Bangladesh](image-url)
Bangladesh. The current network infrastructure of TRCL/BTS has shown in Figure 2. Although it is a privately funded project, Government of the People's Republic of Bangladesh is playing a significant role in IRHIS program implementation [14, 15].

**Recommendations and Future Initiatives:**

Although, physicians say that in theory they are interested in Telemedicine service, local physicians have so far proved reluctant to use the first telecentre in Sonagazi, a village of Bangladesh [16]. Health experts suggest that this may be the cause that rural doctors are reluctant to publicly show their lack of knowledge. Others feel that there is a tendency to use their own computer rather than visiting the centre. But perhaps the biggest stumbling block to the success of this service is the fact that at present the courses and CD-Rom study is not recognized by an official certificate from the Bangladesh Medical Council. Thus the government should play a vital role in order to resolve this problem. Besides solving these problems there are a few initiatives that are needed to be accomplished in order to have a proper infrastructure for Telemedicine. They are as follows:

- **ICT infrastructure development**: This particular approach will be fulfilled by mid 2006 when Bangladesh will be connected in the SEA-ME-WE-4 submarine cable.
- **Cost-effective and affordable Telemedicine system development**
- **More research for Clinical success**
- **Low-cost device for end-user**
- **User-friendly system for physicians and professionals**
- **Inter-country, cross-country and trans-continental cooperation for continued research and development of telemedicine network for e-health delivery, education and scientific works.**
- **Proper training to the physicians**: The doctors are needed to be trained properly in order to ensure an efficient service. Once the doctors become familiarize with the system and start understating the benefits of the service, they will continue to rely on Telemedicine.

Lastly some great words from Prof. Dr Yunus should always be kept in mind, “... *If you want to change the world, don’t get stuck with the infrastructure! Connectivity is not a problem. People are the problem. We need futuristic thinking-in health care as well. We see that components are getting cheaper and easily available. What is needed is content and to create awareness. And-it should be a business-model: This project or service should stand on its own feet, may be not in the first years, but as an aim. It should not depend on donors and project funding....*” (http://www.ehealth.bham.ac.uk/description/description.htm)

**Conclusion**

Nevertheless, Telemedicine is beginning to have an important impact on many aspects of health care in Bangladesh. If it is implemented nicely, telemedicine may allow Bangladesh to leapfrog over other developed neighbors in successful health care delivery. Medicine rests on solid principles, which can transcend political and social divisions. Telemedicine should allow Bangladesh to implement advances in the spirit of historical roots, even at a distance.

**Reference**


factbook/geos/bg.html


[18] Website: http://www.ehealth.bham.ac.uk/description/description.htm

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2 Bhutan

“Watson, come here. I need you”. The message spoken by Alexander Graham Bell over the first telephone is considered by many to be the first online health message. Since then, quite a phenomenal changes have taken place in the Information Technology and its applications. Telemedicine, Health Telematics, Telehealth or lately e-health are some of the popular terminology used to define the use of telecommunication in health and is a major application that is gaining momentum.

Background

Bhutan is a land locked country, located in the eastern Himalayas between China and India and covers about 46,500 square kilometres. It was never colonized and has a largely self-sufficient population that had limited contact with the outside world until the turn of the century. The total population is estimated at about 0.8 million and about 80 percent of the people live on subsistence farming, scattered in sparsely populated rural villages. Determined to balance development and change, the essence of modernization in Bhutan has been a blend of tradition and progress with strong environment conservation as clearly reflected in the developmental philosophy of Gross National Happiness (GNH) rather than Gross Domestic Production (GDP). The per capita GDP stands just at USD 758 with agriculture as the dominant sector and Hydropower as the highest revenue earner.

Telecommunication facility in the country is now fairly well established with state-of-the-art nationwide 34 Mbit/s digital microwave system and few minor switching centres with 8 Mbit/s links. DrukNet, the only Internet Service Provider (ISP), provides dial-up Internet connections at 33.6 kbit/s and leased line options of 64 kbit/s, 128 kbit/s, 256 kbit/s and 512 kbit/s. It has two symmetrical upstream connections with 1 Mbit/s to British Telecom Concert, 1 Mbit/s to KDDI, Japan and the third link from INTELSAT. DrukNet, with three international connectivity and small customer base, is better off than most regional ISPs.

With a strong Primary Health Care (PHC) approach, the country has achieved about 90 percent health coverage. The successive annual health surveys of 1984, '94 and 2000 clearly show the improving trend in most of the health indicators.

Bhutan is a socially welfare oriented state and it gives the highest priority on equity, gender balance and protecting the interest of the vulnerable and disadvantaged. Education and health are delivered mostly free. Despite all effort to ensure equity in access to health care services through an equitably balanced placement of infrastructure and services, it is likely that level of access is not the same as rate of utilization of these services and facilities. As seen elsewhere health inequalities probably do exist between regions and across the population groups. The country now has a well-spread network of 29 Hospitals, 166 Basic Health Units (BHU) and 455 Outreach Clinics (ORC). The age-old traditional medicine system is well integrated within the overall health sector and is available in all the twenty dzongkhags (districts).

Though the referral system has been strengthened

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33 Kinlay Penjor, Gaki Tshering, Telemedicine Focal Person, Ministry of Health.
mostly through a fairly well maintained fleet of ambulances and use of telecommunication facilities, the higher and secondary level of health care is comparatively underdeveloped. At the same time, there is no medical college or university in Bhutan. The number of medical doctors is 122, or doctor/population ratio is about 1 : 6557\textsuperscript{34}, which by any standard is very bad. Although primary health care system is offered by nationally trained paramedics, the secondary and tertiary level care is in need of more concerted efforts, like elsewhere most of the specialist doctors are concentrated in bigger referral hospitals.

The rapid transition of population from a largely agrarian society to a market economy brought about a rapid change in the epidemiology of diseases. Lifestyle related health problems are now emerging. Modern day’s diseases as diabetes, cardiovascular problems, cancers, road traffic accidents, industrial injuries and occupational diseases are assuming gradual importance. Therefore while ensuring a continued expansion of basic service packages, increasing attention must be paid to the need for secondary and tertiary level care.

Provision of free health care brings into focus the issues of sustainability. The recurrent cost of the large number of health care professionals and the cost of drugs and hospital equipment is escalating. Further, with enhanced knowledge about health care and the available facilities there is a growing demand for better and higher services from the citizens. Sending patients to India for tertiary level care is still considered more cost-effective. Most of these costly referrals can be attributed to delayed diagnosis due to the remoteness of the patient and lack of proper diagnostics facility in the peripheral hospitals.

Additional burden of immediate e-health delivery is the specific nature of Bhutan. This is amongst the most rugged and mountainous countries in the world. The terrain ranges from about 100 meters sub-tropical foothills in the south, through the temperate zones, to dizzying heights of over 7,500 meters in the north. While the high Himalayan Mountains in northern Bhutan are under perpetual snow, rainfall can differ within relatively short distances and is heavy during the monsoon season with high risk of cutting off the peripheral areas through road blockages. Over 72% of the country is covered with forests and the Government is determined to conserve this wealth through a national policy to maintain at least 60% forest coverage. This natural landscape has made the delivery of basic health services not only difficult and costly but also often delayed.

| Table 1  Key Health Indicators |
|--------------------------|--------|--------|--------|
| Indicators               | 1984   | 1994   | 2000   |
| Infant Mortality Rate (per 1000 live births) | 102.8  | 70.7   | 60.5   |
| U5MR (per 1000 live births)                  | 162.4  | 96.9   | 84.0   |
| Maternal mortality ratio (percent)           | 7.7    | 3.8    | 2.55   |
| Population growth rate (percent)             | 2.6    | 3.1    | 2.5    |
| Trained birth attendance (percent)           | NA     | 10.9   | 23.66  |
| Contraceptive Prevalence rate (percent)      | NA     | 18.8   | 30.7   |
| Access to Safe Drinking Water (percent)      | NA     | NA     | 77.8   |
| Sanitation (L latrine) coverage (percent)    | NA     | NA     | 88.0   |

Source: National Health Surveys of’94, ’84 and 2000

\textsuperscript{34} Rough estimate for 122 doctors with estimated population of 0.8 millions.
Telemedicine in Bhutan

The high commitment of the government to the health sector is reflected in an average annual allocation of 10–11% of the government expenditures for health. However, the yearly increase of 18% in health care expenditure over the years has been a concern to the health sector. The government is seeking various financing mechanisms to address the issue of sustainability. The Health Trust fund, which has been operationalized, is expected to support the basic essentials of the Primary Health Care, while other options like user fees on selected services are being implemented. The reliance on donors, mostly for capital expenditure, is quite heavy at about 55% during the Eighth Five-Year Plan period.

In general, the earliest usage of telecommunication technology in Health could be the period when the first telephone service was introduced in the country about three decades ago. The prominence and importance of such telecommunication network was intensified during the 7th Five Year Plan when many remote BHUs were connected with solar operated single channel VHF radiotelephones with the support of WHO and latter Danida. The utility and benefit of such communication technology is apparent from the fact that it helped in making expert consultation possible for the remote health workers with the doctors in the hospitals. Perhaps the greatest benefit was in bringing about quicker and better-managed referrals from the BHUs to the Hospitals thereby saving many critical lives. Some 30 remote BHUs not reached by telecommunication network are still using those VHF phones quite effectively.

Coming of Telemedicine

The latest and more advanced application of IT in Health, telemedicine, emanated from no other than His Majesty, the King himself during the audience to the then Director General of WHO, Dr H. Nakajima in 1997. The thought of having Internet was nowhere in sight at that time and thus development of the initial telemedicine proposal was based on an idea of intranet network. Almost a year later the Telecommunication Sector was preparing towards establishment of a nationwide Intranet connection. However, the inauguration of the Internet service to mark the Silver Jubilee Celebration of the Coronation of His Majesty the King in June 1999 accelerated the development of Telemedicine in the Bhutanese Health Sector.

IT/BDT Multipurpose Community Telecentre Project

As part of the framework of the Buenos Aires Action Plan (BAAP) Programme 9-Integrated Rural Development, the Telecommunication Development Bureau (BDT) of International Telecommunication Union (ITU) launched a pilot project in Bhutan on Multipurpose Community Telecentre (MCT) wherein Telemedicine was one of the components. It was executed in 1999 and Jakar in central Bhutan was chosen as the ideal site mostly for convenience of readily available telecommunication infrastructure. In conjunction with this MCT project, a tele-radiology pilot project was conducted between 1999 and 2000 by connecting the district hospital at Jakar with Jigmi Dorji Wangchuk National Referral Hospital (JDWNRH) in Thimphu. The objective of this pilot project was to demonstrate the feasibility of transmitting X-ray images and ECG patterns to facilitate expert consultation from JDWNRH. Through the donated telemedicine equipment the image transmissions were conducted successfully thereby demonstrating the applicability of the technology.

WHO’s participation

Following the historic audience of the former DG with His Majesty, WHO has supported in development of telemedicine activity in Bhutan by fielding in various consultancies. During July and August 1998, Dr Narong Kasitipradith of Thailand in his preliminary report to
WHO, SEARO came up with five models. In April 1999, a mission from the Information Systems Management (ISM) of WHO, South East Asian Regional Office (SEARO) headquarter was fielded in to study the situation of health, IT and telecommunication infrastructure in the country and also to advice the appropriate technology for a telemedicine system for the country. This mission validated and supplemented Dr Narong’s report thereby finalizing the telemedicine proposal of connecting Mongar Regional Referral Hospital in the east with JDWNRH to be funded by WHO. Accordingly both the hospitals were equipped and the Bhutan Telecom made the connection of the two hospitals to the Internet through 64 kbit/s dedicated lease lines.

Health Telematics

The importance of taskforce to monitor and guide the development of the project was felt rightly from the inception of the telemedicine activities. In April 2000, the Taskforce was formed consisting of personnel from the Ministry of Health (MoH), hospitals and the WHO Country office under the chairmanship of the Director of Health. Further, it was strengthened to include more members from the relevant sectors like the Bhutan Telecom, Department of Information Technology and the Drugs, Vaccine and Equipment Division.

The formal beginning of the Bhutan Health Telematics Project was made on 11th November 2000, when the Telemedicine connection between the two major referral hospitals in the country was inaugurated by the then Head of the Government, Honorable Lyonpo Yeshey Zimba. In April 2000 WHO enlisted the services of two short-term consultancies to perform an in-depth investigation of technologies and services required for implementation of Health Telematics throughout the Kingdom. The consultancies consist of first six months study by an IT expert that latter was followed by a three weeks study by an expert in IT with medical background. The study culminated in development of a preliminary draft Health Telematics Master Plan.

In collaboration with the Tokai University, Japan, two Tele-ECG projects through Japan’s Grant Assistance for Grassroots Project (GGP) has been operationalized in March 2003. Under these projects, the two hospitals in Lhuntse and Trashiyangtse are both equipped with a lap-top computer and a multi-purpose ECG machine which has a 12-lead ECG, Cardio echogram, Phonocardiogram, and computer aided analyzer software for facilitating Tele-ECG and Tele-echocardiograph consultations. The linkages of the two hospitals with JDWNRH are through Dial-up type workstation linking with PSTN and Internet. The Tokai University has conducted voluntary training and tutorials for the users of the two hospitals and a follow-up visit was made at the end of one year to extend further training and tutorials to overcome the interpretation and technical shortcomings. Such collaboration, we hope, will be continued in years to come and thus help fulfill the goal of covering all the remote hospitals under the Health Telematics Project.

Current Situation

Services provided:

The BHTP is envisaged to provide consultations in radiology, dermatology, cardiology and other general consultations in addition to the benefit of accessibility to the World Wide Web
Further it was also envisaged that the network would be useful in bringing about a better-coordinated referral of the patients to the JDWNRH.

Gelephu General Hospital in south is the next to be added to the network with the support of WHO. In addition other hospitals having access to Internet, like Riserboo in the east, are also conducting simple tele-consultations through e-mail, which is very encouraging. The last to be added to the network as of now are Trashiyangtse and Lhuentse hospitals.

There were only 363 consultations carried over during the period from Sept. 2001 to Feb. 2004. Due to equipment breakdown in Mongar, there was no telematic activity during February 2002, which exposes the vulnerability of the project to virus threats and fluctuating voltage of the electricity supply.

Figure 1 shows that Tele-Radiology with 134 consultations (37%) is the most popular application followed by Tele-Medical (21%) and Tele-Dermatology consultation (15%). Tele-Orthopedics (9%) and then other consultations that include Surgical, Paediatrics, Psychiatric, Pathology, Gynaecology, ENT, Oral Surgery, Anaesthesiology and ENT consultations mark up to the rest 18%. Beside these data there were 70 telecardiology consultations from Trashiyangtse and Lhuentse hospitals with the APT 2nd opinion centre at Tokai University.

The average monthly Tele-consultations show positive results that could be translated both economically as well as patient welfare. In an average referrals in Orthopaedic cases decreased by more than 40% within the first year of operation that could be attributed to better diagnosis facilitated by Tele-radiology and Tele-orthopaedic consultations. Dr Yongguo Zhao calculated a direct saving of Nu. 5,400 (USD 1 = Nu. 48) for each avoided referral case. Referral in medical cases however increased substantially from the second year, which partly can again be due to better diagnosis from Tele-ECG consultations. This reflects that telemedicine while bringing about reduction of referrals in certain field can also increase the referrals in certain other fields, which in both cases can go a long way in bringing about timely treatment and thus cost savings to the Health Sector and the individual patients.

Further, the overall average monthly patient referral after introduction of telemedicine has increased indicating that telemedicine cannot be expected to make a drastic or remarkable reduction in patient referrals. This increase in referral in medical cases is understandable. With the availability of teleconsultations and equipments like ECG and echocardiogram machines new cases and previously undiagnosed cases are being diagnosed. For example, a nineteen year high school student at Trashiyangtse district was having persistent hemoptysis and dizziness for the last two years but remained undiagnosed. She was immediately referred to JDWNRH after echocardiogram showed aortic root dilatation caused by severe aortic regurgitation. Similarly the physician at remote hospital will keep on treating a case of heat failure with diuretics but with the availability of teleconsultations and echocardiogram, a referral may be needed to remove the cause of heart failure like rheumatic mitral valve. A couple of children with the congenital heart defects of VSD were also referred. Thus within two years since its operation the Health Telematics Project demonstrates positive benefit even in its clinical applications.

**Future Prospective**

The Project enjoys the highest political commitment. At the policy level, the Ministry of Health (MoH) always sees telemedicine as an effective strategy to meet the challenges of reaching the un-reached, enhancing quality and sustainability. Hence the future of telemedicine is very optimistic and many expansion programs are thus in the pipeline.
Since helping the Health Sector in initiating the Telemedicine Project, WHO has been active by supporting in human resource development and equipment supply through its biennium country programmes and other mechanisms. It is envisaged that WHO will continue its support especially in critical software components like human resource development.

**Tele-radiology** as reflected is popular and Bhutan should capitalize on it. Currently film digitizer is used to acquire digital image of the X-ray film taken on conventional machine. Use of digital X-ray technology will be cost efficient and convenient in the long run as it will get rid of many running expenses like reagents and chemicals as well as reducing the repeated exposure of patients to the X-ray. Further it will bring about faster service and space economy. For a developing country like Bhutan where even the film quality is poor, such digital X-ray technology should be the first line of choice in Tele-radiology. As such Digital Radiographic Equipment should be considered for procurement of any X-ray machines.

The present **telecardiology** links between Trashiyangtse and Lhuntse hospitals and MRRH, JDWNRH and 2nd opinion centre at Tokai University showed promising results in timely diagnosis of life threatening diseases, pinpointing necessary referrals and improved patient care and management. Such telecardiology projects should be considered to further remote district hospitals.

**Collaboration with Bhutan Telecom**

The telecommunication infrastructure, without any dispute, is the main backbone of any network for use of DrukNet of Bhutan Telecom, which is the country’s only Internet Service Provider (ISP). A high-level study tour to Thailand and Malaysia in early 2001 fully convinced the Health Sector that the expansion of telemedicine activity should be in parallel with the development of telecommunication infrastructure in the country. To further enhance the collaboration and to also ensure their continued support the expansion of the existing Health Telematics Taskforce with the inclusion of a representative from the Bhutan Telecom has been made. This is also in line with the resolution 41 agreed by all member country during the World Telecommunication Development Conference of Istanbul, 2002.

The Ninth Five Year Plan has commenced with effect from July 2002. Within the main objective of 'enhancing the quality of service', Information Technology (IT) is slotted as one of the critical strategies. Recognizing the potential of IT as a cost effective strategy in view of the country’s unique features, the experience gained from the telemedicine linkage between the Mongar and Thimphu has been used for further expansion. With a vision to cover all the district hospitals under the Project a budgetary provision of Nu. 31.132 million, mainly for recurrent expenditure, has been earmarked.

**Conclusion and Recommendations**

The telemedicine activity in Bhutan through the Health Telematics Project is thus becoming an effective complimentary strategy in addressing the issue of “reaching the un-reached and sustainability”. The long-term goal of the Project is to cover all the District hospitals under the project and given the useful experiences so far there is no turning back on this drive of expansion. As such the following sets of recommendations basically stemmed up from the experience of the Project thus far:

- The popularity of Tele-radiology should be capitalized upon by incorporating it in future expansions. To ensure long run sustainability and also with its far-reaching advantages Health should opt for Digital Radiographic Equipment (X-ray machines) and in Computerized Radiology.
- The draft Master Plan of Health Telematics needs to be reviewed and finalized at the earliest
to provide a strong basis for the expansion of the telemedicine activity in the country.

- The Human component is very critical and the Project should strive to update its limited personnel through periodic trainings. In this relation identification of training institutes both in the region and abroad needs to be undertaken.
- The training of doctors and other users needs to be continued vigorously as a regular activity of the Project. The Project through its local sites should enhance its capacity as trainers.
- Continued Medical Education: Telemedicine consultations enables the physicians at remote district hospitals to learn about some of the advances in diagnosis and management of medical and radiology patients. To improve their learning and quality of patient care, physicians at remote district hospitals should compile a complete record of each patient with proper history, physical examination and results of diagnostic tests available at their hospitals to promptly respond to the questions raised by specialists.
- The existing Health Telematics Taskforce has greater role to play for not only guiding the future development of the Telemedicine activity but also in garnering support from various stakeholders. As such it needs to be strengthened with the inclusion of not only representatives from the Telecom and other government Sectors but also from broadcasting Sector.
- The collaboration with the Tokai University Institute of Medical Sciences, Japan will be further continued not only for developing sound grant proposals but also to collaborate in the field of Human Resource Development.
- The possible role of the Project in Public Health and Management through collaboration with the existing HMIS/Information Unit could be worth exploring. This will ensure a single network which will be used more effectively. The positive results that have been generated so far are quite shaky in absence of a more realistic and effective analysis purely due to small and greatly fluctuating data. As such a comprehensive situational and cost benefit analysis needs to be conducted to validate the positive results.
- Quite a number of inexpensive wireless gadgets are now available, which guarantees speed and reliability in terms of data transmission capacity. To reduce the overhead expenses and to enable efficiency, use of wireless communication technology could be worth exploring.
- To keep abreast with the changes, the terminology Health Telematics should be upgraded to e-health. In this line it is proposed that the Project be renamed as Bhutan e-health Project (BEP).

All recommendations are applicable to other countries.

**Acknowledgement**

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**Recommended Literature**


2) Yongguo Zhao, et al, Nakajima Laboratory, Tokai University Medical Research Institute, Kanagawa, Japan : Health Telematics in the Land of Thunder Dragon

3) Dr Yongguo Zhao, WHO Short-term consultant : Review of Medical Aspects of Health Telematics Project in Bhutan, Assignment report : 17 Nov-7 Dec 2001

5) Dr Isao Nakajima, MD, PhD, Tokai University School of Medicine, Kanagawa : The Future of Telemedicine Implementation, Study Group 2, Question 14/2, ITU-D Study Groups, Document 2/189-E, 23 August 2000


7) Bhutanese economy doing well, Kuensel's online article on Friday, October 11 2002 @ 21:22:13 EDT BST, http://www.kuenselonline.com/article.php?sid=2028&mode=&order=0&thold=0

8) East Bhutan Tele-ECG Project, Application form for Japan’s Grant Assistance for Grassroots Project (GGP)


10) PPD, Ministry of Health & Education. Bhutan ; Health Sector 9th Five Year Plan (draft)
3 Bulgaria

Background

Bulgaria has a total area of 110910 sq. km and population of 7,600,000. Located on the Balkan Peninsula, South-Eastern Europe, it controls key land routes from Europe to Middle East and Asia. Bulgarian Ministry of Health retains responsibility for overall supervision of the health care system, administered through the 28 Regional Health Centres and through management of all regional emergency care centres and hygiene-epidemiological inspectorates plus a number of national research centres. Polyclinics, small and medium-sized hospitals and hospitals providing secondary care is own by municipalities. The private sector consists mainly of pharmacies; dental clinics, laboratories and specialist care rather than first contact primary care. The numbers of physicians, dentists and nurses per 100,000 people are 354, 66 and 603 respectively. Bulgaria had 9.8 hospital beds per 1,000 population (1997) and 5.9 physician contacts per person (1998), which is in the average range for European countries. Financing: Health expenditure is 3.8% of GDP (1998) The Health Insurance Act (1998) set up a Bismarckian National Health Insurance Fund (NHIF). Funds dedicated to e-health informatics are parts of the budgets of Ministry of E-health and Ministry of Science and Education.

Introduction

The purpose of this essay is to present telemedicine application in rural area and its pros and cons as foreseen in ongoing Bulgarian pilot project.

The project is co-funded by Bulgaria and International Telecommunication Union (ITU), has started at October 1st, 2003 and will continue for two years. It was developed in conjunction with the Valetta Action Plan (http://www.itu.int/ITU-D/univ_access/program3.html) that sought to promote universal access to basic telecommunications, broadcasting and Internet as tools of development in rural and remote areas. The project focuses it efforts toward introducing e-health in rural and semi-mountainous region in Bulgaria. It has to develop, test and evaluate the effectiveness of a local, packet-based wireless access infrastructure relying mainly on 2.4 GHz frequency band and optic connections in rural area, building and equipping public tele-centres in 10 villages and connecting them in a network. In addition, the network is connected to local Emergency medical centre and specialized tele-server at Bulgarian Academy of Science. Thus the project has to provide a platform for the wide introduction of multimedia services such as telemedicine (especially telecardiology), telepsychology, teleeducation etc. Project partners are: from Switzerland ITU and from Bulgaria-Ministry of Transport and Communication, national Telecommunication Company, the Association of Telecentres.

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Septemvri Community (the region where the project takes place) and Solar-Terrestrial Influences Laboratory at Bulgarian Academy of Sciences (STIL-BAS). STIL-BAS is responsible for the e-health part of the project, including tele-cardiology and telepsychology.

Project’s target region is a small semi-mountainous district, Septemvri community. The reason to direct attention to a rural area is that 31.6% of Bulgarian population lives in remote villages. If the percent of citizens from small towns is added, more that half of Bulgarians lives in rural areas. People in rural areas are in unfavourable conditions when access to IP-based technologies is considered.

Today, a wide variety of new telecommunication applications such as e-mail, telemedicine, e-commerce, tele-education and etc., have made access to interactive multimedia services as important for rural and remote communities as voice connectivity alone. Since each rural district or community requires a different mixture of voice, text, image, video and audio communications to meet its needs best, today’s telecommunication network operators must be able to support a wide range of services, applications and bandwidth levels at a reasonable cost. To accommodate these new applications, the focus of new network construction around the world is shifting rapidly from conventional PSTN to IP-based technologies. It is important that rural areas not be sidelined during this process.

Septemvri Community is an ideal representative of rural area. It covers 349 km$^2$ including north parts of Rodopi mountains and west parts of Sredna gora mountain and has 30,136 inhabitants living in town Septemvri plus 13 villages most of them with 1,000–2,500 residents. With its scarcity of public facilities and technical personal, difficult topographical and climatic conditions that make critical demands on equipment plus low level of economic activity, based mainly on agriculture, and low per capita income, high percentage of unemployment, underdeveloped social infrastructures and high calling rates per ordinary telephone line, Septemvri community is perfect place to develop and test wireless infrastructures and its multimedia applications. It was also chosen because of concentrated network of existing telecentres. The personnel on hand is highly qualified and in position to operate and maintain the Wireless IP based system; the area is semi-mountainous that requires significant investments for cable communication network; the percentage of the population with home computers is negligible and the cost of telephone and leased lines is very high.

**Network**

The existing wireless access technologies will not be discussed here, neither this is the place to explain the final choice of both wireless and telemedicine equipment that will be used. All devices are picked out by the ongoing auctions. It is important to mention once again that the goal is to connect ten public sites in the community, which is almost 65% of community villages (Fig.2). The network consists of ten wireless routers and for the connectivity between any two nodes at least three paths are possible. The wireless system interconnects with public switched telephone network through the transit gateway (TGW) that will be installed at the local exchange in the town of Septemvri. 3 already existing telecentres (villages in black on Fig.1) are incorporated in the network. In the remaining villages, telecentres are organized and

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**Fig.2** Villages included in the network
equipped as part of the project.

**Telecardiology**

The project gives special emphasis to tele-cardiology, due to the fact that cardiovascular diseases are leading cause of death in Bulgaria (WHO, 2003). The examination of pulse, blood pressure and electrocardiogram are the first and that’s why the most often used tools providing clues to cardiovascular problems. A physician can easily detect many heart conditions before symptoms become apparent by measuring pulse, blood pressure and by using an electrocardiogram. That is why the abilities of the physicians/GPs to monitor precisely and quickly these parameters are the most advanced method to reveal first symptoms of coming myocardial infarct or other cardiovascular complications.

Groups that will benefit from telemedicine application are patients suffering from cardiovascular diseases; patients on medications, which may affect the heart as ECG, blood pressure and pulse monitoring determine the immediate effects of changes in activity or medication levels; elderly. The latter group is especially important as congestive heart failure, is the single most frequent cause of hospitalization for people aged 65 years or older and because the percentage of elderly in our population is rapidly increasing (Fig.3). The network and the services are presented schematically on Fig.4.

Local telecentre is depicted on the left side of the picture. Its wireless routers will provide connection to all other telecentres from the network and to Septemvri Emergency Medical Centre (central part). As part of the project general practitioners in the villages are supplied with electronic telecare devices-portable blood pressure meters and portable 4 channel electrocardiographs (ECG holters). It is a decision of local GP to whom from all patients in the village to offer the possibility for long term monitoring and further tele-consultations. The ECG holters have 12 MB flash memory, where depending on the batteries used from 30 up to

![Fig.4 Project’s network and telemedicine services](image_url)
72 hours ECG records may be saved. The available with the holter software is user-friendly and allows continuous real-time ECG analyzes; ST measurements and analyses tracks for rhythm and morphological changes; marks any abnormal ECG epoch; computes every minute heart rate, QRS width and RR variability; etc.

The possibility that village GP will analyze the ECG record using the available software is not excluded. If the GP is not skilled enough or if he/she feels necessity to consult specialist, he/she has the chance via local telecentres to transfer abnormal parts of ECG record or all ECG records difficult for diagnostics to local medical centre. The feedback helps for proper and fast treatment and follow-up of patients. Thus both local medical personnel and patient are included in the process of tele-consultations, tele-diagnostics and tele-treatment.

Septemvri Emergency services centre net is represented in the centre of fig.3. Its participation in the networks is an excellent decision, as the high qualification of medical personal from this centre will provide continuous tele-consultations during the time of the project and after its end. The equipment of medical centre include among all other medical devices additional computers, video cameras and telephone lines, specially dedicated to connection with the community public net. Tele-consultations will be organized at specific prearranged hours, which may vary for different villages.

In order to make all consultations, distant diagnostic and treatment easy and controllable, electronic versions of patients’ records will be used. One of the available at the market electronic data packages, approved by National Health Insurance Institution, will be chosen. Thus all data may be checked periodically and analyzed in details during project time and after its end. What is more, to make the tele-cardiology sessions more effective, cardiologists, consultants from the emergency centre will receive the same blood pressure and ECG software package that are available with blood pressure and ECG holters. In a short time after analyzing patients' ECG records cardiologists will send via e-mail or voice mail their recommendations for further treatment and monitoring.

One additional tele-server is included on the right hand side of fig.4. This is the tele-server at STIL-BAS, which is under the supervision of STIL-BAS Telemedicine group. The latter has to:

—Serve as methodological supervisor, i.e. to follow and help both village GPs and Septemvri medical centre staff to organize and carry out all telemedicine services;

—Follow the strict fill in of all patients’ electronic data records; the precise and correct use of cardiovascular devices; precise application of blood pressure and ECG software;

—Store tele-e-health service data for future analysis.

In addition Telemedicine group has to study and analyze:

—Medical effect of telemedicine service in terms of time of treatment, time for receiving consultations etc.;

—Financial effect of telemedicine application compared to normal face-to-face visits (reduction of health care costs by reducing the number of visits that medical staff needs to make to their patients; by cutting down on patients’ journeys to health centres or specialists consultations; by reducing the length of stay in hospitals and etc.),

—Psychological effect of telemedicine service, i.e. assessment the satisfaction of the medical staff applying tele-consultations, analyzing tele-e-health acceptance from the point of view of patients and relatives etc.

BAS tele-server may have 3 more applications:
To organize, if and when necessary, consultations with highly qualified medical specialist. Negotiations are in progress with the medical staff of Dr Greenberg clinic in Sofia.

To organize, tele-education and tele-training for medical doctors and nurses from the rural area, to organize tele-conferences, tele-trading for telemedicine products etc.

To organize, if and when necessary, tele-psychological consultations. The staff of the Institute of Psychology (IP), BAS, will be involved in distant psychological consultations. This is most appropriate decision as IP-BAS is the largest national centre for fundamental psychological studies and transfer of scientific achievements in different branches of psychology and technology.

Telespsychology

Another strategic goal of the project is to develop and offer a virtual high quality psychological service to people from remote areas that had no possibility to consult professional. Text, colour images, short-segment video and audio clips will be transmitted during the course of the project. Thus the project employs state-of-the-art remote networking technology to enable experts to communicate directly with patients and to perform remote consultations, supervision, psychological evaluations and continuous monitoring as well as to advise rural psychologists and e-health workers.

Three are the main reasons to include telepsychology in the project:

The means to offer e-psychological consultations are available. Experience of other countries revealed the importance of e-psychology and its effectiveness (Ainsworth 2004; Garcia et al. 2004; Lahad 2004; Wildermuth 2004). But foreign expertise is not applicable if there are not accurate conditions to introduce it and if this expertise is not adjusted to local characteristics and requirements.

In Bulgaria there is a demand of such services. Although computers and Internet are not available in every household, about 1% of Internet visitors are looking, for psychological information and support. What users are looking for? The answer is simple—many people know how they should live healthier (food, weight, exercise etc.) but are not able to adjust their life to this knowledge. Internet users are very much looking for such information. In addition, they are looking for psychological advice and counselling in lots of areas covering life-style problems, loneliness, melancholy, jealousy, marital problems, alcohol and drug dependence, bulimia etc. All of this may be just a part of everyday life, or may be serious mental illnesses, or anything in-between. Even less serious problems are often a cause of misery and lack of capacity for productive work and healthier life. Several web sites already exist offering exclusively or as part of their service virtual psychological consultations (Fig. 5).

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**Fig. 5** Local virtual psychological site offering on- and off-line consultations
Some are free, some require small fee. The users contact these sites usually from home. In the project's target region home computers and Internet access from home are rare. Development of local public free of charge tele-centres, as realized in this project, is a solution offering a bigger proportion of population access to virtual psychology consultations.

In addition, traditionally, psychological help has been treated as the Cinderella of health services despite of its importance. World Health Organization estimates that nowadays almost 1,500 million people suffer from psychological problems and need help. Despite of this fact, psychological consulting, with some exceptions, is not covered by insurance funds. E-psychology offers relatively cheap solution which may satisfied patients and will not put enormous burden on health care budget.

Enthusiastic licensed psychologists are involved in virtual psychological consultations. Potential patient/users have to visit local telecentres where specialized, hidden from view and sound proof places for psychological consultations are equipped. Thus, if and when necessary, users rely on technical advises and on the help of tele-centre staff. The technical staff will not attend tele-sessions. Direct connection is organized between local tele-centres and a server at STIL-BAS. The latter is the working place for virtual psychological consultations (Fig.6). In order to make e-psychological contact as easier as possible, 3 models of contacts are foreseen:

— Exchange of text messages, i.e. e-mails;
— Internet telephony and
— Video connection.

Both on-line and off-line sessions are planned. Off-line sessions rely entirely on text messages. Visual contact will be used only in case of necessity and after preliminary agreement between user and psychologist. It is essential to be underlined that the project does not focus on treatment of severe mental conditions. It is not oriented towards the serious illnesses, which may require hospitalization. E-psychology, as foreseen in the project, is targeted at those many people, from all age groups, who are suffering in silence, who do not seek a doctor or psychiatrist but who can be aided in achieving a better and more productive life by psychological advice.

In a word, we prefer and put the stress on text-messages as main communication source of e-psychological counselling. Reasons to prefer e-mail contacts are:

— E-mails are easy to use, familiar to many potential patients and very similar to writing letters. In addition they provide a non-visual and non-auditory, private and reliable way of communication and create a psychological space in which pair of people interacts,

— E-mails create a text talk as John Suler (2004) brilliantly explains. For those who love to write, e-mail is a heaven. Lots of people feel that they can express themselves better in the written words. A skillful write is able to communicate considerable depth and subtlety in the deceptively simple written word. Writing may involve different mental mechanisms than
in-person talk as written dialogue reflects a distinct cognitive style that enables some people
to be more expressive, subtle, organized, or creative in how they communicate. Thus written
text often reveals personal characteristic, which is of significant help during virtual
consultations.

—E-mails may be anonymous as average Internet users are not aware how to track down the
origin and identity the message. If users want, they may use pseudonym, not real names.
The only requirement is to keep the same pseudonym during the entire duration of
e-psychological contacts. This potential for anonymity and the lack of face-to-face cues
disinhibits some people, which is very important in small patriarchal communities as those
engaged in the project. People feel free to say things they wouldn’t ordinarily say,
encourages them to be more open, honest, and affectionate.

—E-mail contacts usually are off-line and do not occur in real time. This is essential for
users/patients as gives time to think, evaluate and compose their messages in a most
appropriate way. The same count for licensed psychologist, who is not pressed to respond
on-the-spot and if necessary may take advantage of this and dedicate more time on
considering every particular case. In addition, the asynchronous character of e-mail
exchange gives chance to adjust the speed of virtual counselling according to the needs of the
users. Interactive time can be shortened or stretched, as needed.

—Last but not least, e-mails exchange enables us to record the interactions by saving the
typed-text messages.

Of course, usage of e-mails has negative sites too:

—Some people may not be attracted to e-mail because it involves typing. Everyone knows
how to talk but not everyone feels comfortable typing. Definitely, the typing/writing barrier
will filter some users.

—E-mail anonymity is not fundamentally a “good” thing. It may turn out to be “bad” as
well. It cuts both ways.

—Spam is another negative aspect of e-mailing. All e-mail users are subjected to junk mails
aimed to sell something. This may be a serious problem, as people subjectively experience
e-mail as a personal space. Receiving spam may beat back some users.

Foreseen solution is available Internet telephony and pre-scheduled sessions with licensed
psychologist for those who are not willing or ready to rely on e-mail contacts.

**Expected outcomes**

—Cheap telemedicine service suitable to improve quality of health care and health monitoring
of patients from a distance;

—Development of advanced interactive environment for medical staff and patients;

—New knowledge acquired concerning the acceptance of intelligent environment by patients
and the influence of telemedicine service on life satisfaction and on satisfaction from virtual
health supervision;

Significant reduction of part of health care budgets dedicated to home health visits.

**Potential problems**

Partners are well aware that they’ll face significant problems during the entire duration of the
project. Some of these problems are already a reality, other are still latent. Few of the
problems that we are looking to overcome are:

—Negative attitude or at least suspicion towards telemedicine applications and especially to distant consultations as compared to face-to-face service. This is a problem we have already met and trying to beat down. Both medical staff and potential users are suspicions. This attitude is changed very slowly and with lots of efforts.

—The lack of technical experience of both local medical staff and patients. For the moment two are the ways to overcome this obstacle: (1) training courses for volunteers to use and become familiar with Internet technology and (2) technical support of users in local telecentres.

—Another serious problem is uneven access to Internet. The profile of Internet users in the country reveals that (a) Internet usage in small villages is times smaller than in the capital or big cities; (b) There is a significant age and sex differences in Internet usage too-with the increase of mean age the percent of Internet users drops and reaches 3.1% in the age group > 50 yrs. In addition, men assess Internet almost times more than women (ABC Design & Communication 2003 a & b). This problem is not easy to overcome. Partial solution is development of free community telecentres, which is a strategic goal of the project. Advertisements and active involvement of local administrative and medical authorities also helps. In some cases general practitioners are those who have to push a little people to use virtual consultations.

—Fears of loosing profits. This is a significant problem especially in the case of telepsychology counselling although it is corresponds to tele-cardiology, too. These are the main fears as for the moment adequate reimbursement policy does not exists. Health insurance funds do not cover virtual consultations. Or again, this is the problem to separate charity and business. But these fears are not well-founded at least in the case of virtual psychology help. It is recognized that traditional psychology consultations serve only fraction of the population who really need it. To many people Internet seems more private, and this perceived privacy helps them cross the barrier of stigma to seek help through tele-counselling. Internet is providing a bridge across one of the barriers that keep people from getting the help they need. Thus telepsychology expands the group of potential patients and reaches people that in most cases will never meet psychologist face-to-face. About 60% of virtual psychology patients consult licensed psychologist for the first time in their life. What is more, over 65% of telepsychology patients undertake the next step toward face-to-face consultations and treatment (Ainsworth 2004). Thus, simple estimations revealed that even when virtual psychology consultations are free of charge, even when they are offered as charity, the result is an increase of paid face-to-face consultations. Put in another words, efforts dedicated to tele-psychological charity at the end received reword. Or, in the case of virtual psychology, charity enhances business. There is no doubt that the same scheme will apply to tele-cardiology as well.

—Ensuring technical security and confidentiality of virtual consultations may also be a problem as despite of numerous technical solutions, the possibility for un-authorized access to virtual information cannot be totally neglected.

—Another problem accounting mainly to telepsychology and to a smaller extend to tele-cardiology is the lack of nonverbal communication channels. This is the biggest disadvantage of virtual communication as human face and body language are rich in meaning and emotions. These accounts both for psychologists and for patients. When one cannot see other people’s faces or hear them speak he is loosing all subtle voice and body language cues. Thus assessing the nuances of communicating is very difficult. The lack of
face-to-face cues may result in ambiguity. This enhances the tendency to project once
expectations, wishes, anxieties and fears into what the other person wrote, unto the somewhat
shadowy figure sitting at the other end of the Internet. Psychotherapists call this a
“transference reaction” or “projection”. It is unconscious and could lead to
misunderstandings as people do not realize how it is steering their behaviour. As usual, the
coin has two sites, i.e. the position of other authors is just the opposite. They claim that
exchange of text messages carries us “past the distracting superficial aspects of a person’s
existence and connects us more directly to their mind and personality”. For them seeing is
equal to believing. These are the advocates of video channels. In an attempt to minimize
this problem, the project gives a possibility to add video connection if and when necessary.
This will be done only after preliminary agreement of users. Under discussion is a
possibility to “project” a photo of psychologist leading virtual consultations. Hopefully this
has to decrease the transference reactions.

Despite of the above mentioned problems, partners believe that expected outcomes will
compensate all difficulties. Predictable results at project’s end are:

— Improved quality of e-health service due to easily, cheap, fast, private, at any time and from
  anywhere contact between medical staff and patients;
— Development of advanced interactive environment for medical staff and patients;
— New knowledge acquired concerning the acceptance of intelligent environment by patients
  and the influence of telemedicine service on life satisfaction and on satisfaction from virtual
  health supervision;
— Significant reduction of part of health care budgets dedicated to home health visits as a
  result of avoidance of inconvenience of travelling;
— Cost and time saving and increased psychological comfort.

In addition, we hope to find the precise border line between charity and business. The initial
idea is to offer free service till the end of the project. After a two years period the project has
to become self-supported. This will be done as keeping many services free of charge but at the
same time introducing some pre-paid services, too. An idea that will be checked is to ask
small fee when e-consultations exceed a given pre-defined number. Thus both users and
medical staff will be protected—those users who need short term treatment will continue to
receive free advices, while at the same time payment will be ensured for professionals.

References

4 Cambodia

Background

Cambodia (Fig.1) is Southeastern Asia, bordering the Gulf of Thailand, between Thailand, Vietnam, and Laos. Most Cambodians consider themselves to be Khmers, whose Angkor Empire extended over much of Southeast Asia and reached its zenith between the 10th and 13th centuries. At present Cambodia has a total area of 181,040 sq km and population of about 13,600,000. The government is multiparty democracy under a constitutional monarchy established in September 1993.

Introduction

The Internet Village Motoman project connects small villages in Cambodia to the Internet and e-mail communications through an innovative, yet surprisingly simple, system. Solar-powered village schools, telemedicine clinics and the governor’s office have been connected to the larger world, through five Honda motorcycles equipped with Mobile Access Points and a 256 Kbps Satellite uplink. Each of the schools in surrounding villages can send and receive email. Many of these villages had no previous communications infrastructure. No postal system, no telephones. Many villages can only be reached via ox-cart or motorcycle. It is a vital, first step for these villages in gaining access to much needed educational, medical and economic opportunities that they would otherwise not have. CambodiaSchools.com operates 225 rural schools throughout Cambodia with funding from private donors and the World Bank. More than 50 of these schools are linked to the outside world via Internet with Mobile Access Point (MAP) placed on motorcycles.

Project

Objectives of this communication system is to provide very low-cost system for villages that lack communications infrastructure, like phone line or cellular coverage, but have vehicles that pass by frequently. The system gives village people, not-always-on, store-and-forward connections, sharing its access device, i.e. computers plus WiFi access point, located at schools and village kiosks.

The system has three main components:

- Hub (Hub Internet Access Point): This is a place in a town (not rural village) where there is a reliable connection to the Internet (dial-up, fibre or Satellite)

- Mobile Access Point (MAP): A wireless device mounted on a vehicle that travels from the Hub to the villages and back. In this project in Cambodia, motorcycles and sometimes ox-carts are used as the vehicle for MAP. In other project, for example in India, buses were used as MAP.

- Village Fixed Access Point (FAP): Schools or village Kiosk where computer(s) are installed. Villagers and school children use them to send and receive messages. Messages to be exchanged are temporary stored in a

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PC-box connected to the computers until they are collected by MAP. In this way, messages can be retrieved even if users turned off the computers.

Operations of the communication systems are as follows:

• Motorcycles (MAP) drives by village to pick up message from village access point that stores message originally created at the computers. Motorcycles need not stop for pick-up, only drive slowly at the village access point.

• The motorcycle visits other villages on the pick-up route for more messages.

• When returned to Hub place, MAP sends its stored messages to the hub and onto the Internet.

• Next day, or in next pick-up ride, motorcycles obtain messages at the hub. They, then, drop off messages at village access points and at the same time pick up new messages.

• This collection and delivery cycle creates a “store-and-forward wireless network” with a large capacity-average volume of 40 Mbytes per village access point.

![Fig.3](image) a) School and Village Kiosk (Village Fixed Access Point) and b) Motorcycle (Mobile Access Point)

**Technical characteristics for WiFi access points (Hub, MAP, and FAP):**

• Radio card: IEEE 802.11 b/g interface at 2.4 GHz, 100-mW output

• Interface: 2 x 10/100 Mb Ethernet ports

• 1 x serial port

• CPU: custom embedded PC running Linux

• Memory: 64 MB SDRAM, 256–512 MB compact flash memory

• Power: accepts 8–14 v DC power supply

• Environment: operation temperature 0–60 degrees

The prices for access points are about USD 600, slightly different depending on the type of access points in the communication system.

When a motorcycle comes within the range of Village Fixed Access Point, a “session” occurs. During this period motorcycle transfers data with the FAP. The average length of a session is about 2 minutes and 20 Mbytes of data could be sent from motorcycle to FAP
and the same amount of data FAP to motorcycle. This 40 Mbytes corresponds to 2,000 e-mails, or if photo is sent, 200 pictures. Fig.2 presents the conceptual illustration of this store-and-forward system, while Fig.3 and 4 illustrates the reality.

Benefits of the project

Internet opens the large knowledge sources for the school children. If some children can be educated to benefit from their knowledge of computers, English and in manoeuvring the Internet, the future prospect of bringing computer-related work into these villages can raise the economic level and well being of its people. We are in the process of helping to construct 200 rural schools in Cambodian villages, under a matching-fund program where donors contribute $14,000 to build a three-to-five room school with their name on it and this contribution is matched by the World Bank through Cambodia’s Social Fund, for an additional $12,000. The donor may add an optional $1,700 to cover the cost of solar panels, placed on the roof, which provide sufficient energy to operate a computer (donated by Apple-Japan, The MIT Media Laboratory, Deutsche Bank in Tokyo and several others) for five-six hours a day so the schoolchildren can get some training in working with computers.

Children in these villages are taught how to use computers by orphans aged 8 to 11 who have mastered computer literacy and Internet surfing over the past year and a half at a computer centre we helped to establish at the Future Light Orphanage in a village outside of Phnom Penh. The Computer Centre was built with a donation.

These orphans have been transferring to the rural schools, as they go up, where we have set up computers, and are teaching the other children and teachers how to work on a computer.

The Media Lab gives technical advice to this Motoman project. Components for the communication system are products of First Mile Solutions based in Boston, USA. WiFi store-and-forward systems from First Mile Solutions have been adopted by similar projects in India, Nigeria, Jordan and Colombia.

Contributions were also made by Honda for the motorcycles for Motoman, as well as by Sanyo for the solar panels at the schools.

The Internet Village Motoman project was first established to provide rural children opportunities to learn the computers and communicate with the world by e-mails. This infrastructure gave the opportunity to establish a telemedicine program by enabling to send medical photos. In a village visited, doctors transmit their findings via the Internet, with digital photo attachments, to the charity Sihanouk Hospital and to Doctors of Telepartners at the Massachusetts General Hospital in Boston, USA for diagnosis and evaluation. Based on the findings transmitted back within hours, the patients are taken to Provincial Hospital (two hours away) or to Phnom Penh, the capital of Cambodia, if the case is serious.

Fig.2
Conclusions

This project has cracked the digital divide by opening up remote, rural villages to e-commerce, telemedicine, participatory democracy, e-mail exchanges among children in-country and overseas, as well as to e-learning. It opens the path to poverty reduction and economic development. It can eventually provide employment opportunities in the rural areas, such as in data entry, greater localized governments so that rural populations do not have to move to the inner cities and potentially make them richer than those who have moved to inner cities.

Additional Literature

www.cambodiainschools.com
www.villageleap.com
www.futurelight.org
www.save3lives.com
www.cambodiadaily.com
www.sihost.org
www.ratanakiri.com
www.TravelWithaHeart.com
www.povertyredux.com(under construction)
5  Ethiopia

Telemicine pilot project

Background

Ethiopia is situates Eastern Africa, west of Somalia. Unique among African countries, the ancient Ethiopian monarchy maintained its freedom from colonial rule, with the exception of the 1936–41 Italian occupation during World War II. In 1974 a military junta, the Derg, deposed Emperor Haile SELASSIE (who had ruled since 1930) and established a socialist state. A constitution was adopted in 1994 and Ethiopia’s first multiparty elections were held in 1995. A two and a half year border war with Eritrea ended with a peace treaty on 12 December 2000. Final demarcation of the boundary is currently on hold due to Ethiopian objections to an international commission’s finding requiring it to surrender sensitive territory. Ethiopia has a total territory of 1,127,127 sq km and population of 73,053,286.

In Ethiopia the health care system is able to provide basic services to only about 64% of the population. It is estimated that about 60–80% of the health problems are related to infectious and communicable diseases and nutritional problems (Ministry of Health, 2004). Most of the rural population distributed in distant geographical locations apart from the high density urban areas in response has no access to or is far from modern health care, leading to inability of the health care delivery system to respond both quantitatively and qualitatively to the health needs of the people. This problem further aggravated by lack of investment for health care in rural areas and shortage of medical doctors and lack of incentives in retaining them in rural areas.

The ratios of health facilities/population of the country for 2003 show 1 : 584,522 (hospital), 1 : 163,155 (health centres), 1 : 27,414 (health stations) and 1 : 5,740 (hospital beds). This calls to give attention to invest on ICT for efficient health care delivery system by improving health management, facilitating referral system, reduction of medical cost and enhancing curative and preventive medical care. Among these Telemedicine will be one of innovative technologies using the telecommunication infrastructure to revolutionize the health care delivery system of our country.

The pilot project has one purpose and four outputs:

Purpose

The purpose of the pilot project is to reach the underserved by efficiently utilizing the clinical Specialist, Biomedical scientists and public health professionals who are concentrated in the bigger cities using the Telemedicine system.

Outputs and activities

- Allow the underserved regions to get access to Medical and Health information over the National Telemedicine Network from the central Medical Database and other international

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— 152 —
medical websites through the Internet to grant consensus building and awareness rising.

- Help/allow the underserved regions get medical consultancy services from the centre and other sites where medical specialists and consultants are appropriately available or concentrated. This is the major part of the project application using Telemedicine as an information and communication tool (ICT).

- Assist health professional get simple form of distance medical education over the national Telemedicine network from the centre to wherever they are located.

- Enable the medical/health professionals who are nominated to use the telemedicine system installed at those sites in the underserved regions to be able to operate the system, and browse the Internet and also enable the Ethiopian Telecommunication Corporation technical staff be acquainted with the telemedicine system configuration.

**Coordination**

In close cooperation of Ethiopian Telecommunication Authority (ETA) the National Telemedicine Coordinating Committee (NTCC) established having members from Ethiopian Telecommunication Corporation (ETC), Ministry of Health (MOH) and Addis Ababa University Faculty of Medicine (AAUFOM). The Ethiopian Telemedicine pilot project connects the central referral hospital to 10 rural sites (Fig.2).

In this project it is supposed to practice Teleradiology and teledermatology by using Tikur Anbessa, Gonder and Jimma university hospitals as specialty centres for Radiology consultation, and ALERT hospital for dermatologic consultation.

The Ethiopian Telemedicine pilot project commenced by conducting basic IT and telemedicine training for 20 physicians from 10 pilot project sites from August 9/2004 up to August 20/2004 in African information Society initiative training centre in UNECA. The training includes use of Internet, www browsing, file transfer protocol, application of telemedicine, and
practical demonstration of teledermatology and teleradiology conducted. Along with this equipments from ITU (International Telecommunication Union) and ten telemedicine desktop computers are dispatched to ten pilot sites.

This pilot project will stay for one year by practicing teleradiology and teledermatology in the above mentioned sites. During the trial phase of the project the telemedicine software from WDS company works for 28 days and it is expired and needs activation again. It is activated in five centres but still the software developed technical errors. Because of these technical difficulties with the help of Ethiopian telemedicine expert from abroad, it is possible to develop new user friendly software which fits for the pilot period and which needs further improvement and development for future multipurpose use.

Areas of concern:

- Telemedicine training and Study tour in a well established Telemedicine centres.
- On job training
- Local software development

Objectives of training and study tour:

- Establish technical project team : technical experts will be recruited to participate in the telemedicine and future Telehealth program and the allocation of resources and tasks will be agreed.
- The technical work of the project will be continued after the study tour along with the development and agreement of a plan to provide effective telemedicine network by its terms of reference.
- Establish technical liaisons : there are many groups at a national and international level interested in the use of Telemedicine network technology to support the underserved and vulnerable people at their home place. Relevant groups need to be identified and a liaison established to identify the issues from their perspective and benefit from a technical dialogue about the key issues in this arena.
- Stakeholder consultation : technical experts and user representation groups with an interest in this area will have an opportunity to identify the key issues, contribute towards identifying where consensus building is necessary, and influence the issues agenda on telemedicine.
- The ethical and security issues of ICT access and usage will be studied and the implications for harmonization identified so that appropriate recommendations for our use can be developed.
- Conclusions and recommendations will be made on the basis of the experience from the study tour and will be adopted to our situation and develop as a report for our immediate use.

Output of training and study tour:

- To have experts on telemedicine applications who can be Trainers of trainees on telemedicine.
- Training of the technical working group on practical telemedicine applications, especially on Teledermatology and Teleradiology.
- Adopting a good ICT policy on health and telemedicine strategy which is addressing the underserved rural population.
• Reduction in travel costs for patients was demonstrated;
• Physicians and allied health professionals will have increased access and a high degree of satisfaction with the continuing professional development and education opportunities;
• Expected Improvements in quality of care
• It stimulates and participate many public and private health sector organizations to think about how they can use telemedicine to improve their services;
• To develop efficient monitoring and evaluation system.

On the job training

Objective :
• To have trained Telemedicine expert on each pilot area.

Output :
• Health professional able to send and receive medical data through the network.
• Benefiting a patient from going further distance
• Benefiting physicians at the remote site to have teleeducation service through web browsing, recorded CD materials and from teleconsultations process.

Funding source: World Bank, ITU, UNECA

Local software development

Objective :
• to have locally adopted friendly software
• Strengthening local capacity
• Software compatible to local telecommunication technology.
• Ensuring the sustainability of the project.

Output :
• Developing a Telemedicine software which is reliable, affordable, and compatible, user friendly and time efficient.
6 Georgia\textsuperscript{38}

Background

Georgia is located in the South Caucasus; in the longitude of 40°–47° E., in the latitude of 41°–44° N. Area: 69,700 km\textsuperscript{2}.\textsuperscript{1}

Its population is 4,693,892 (July 2004), 56%-residential, 44%-rural. Birth rate: 10.1 births/1,000 population. Death rate: 8.98 deaths/1,000 population. Life expectancy at birth: total population-75.62 years; male-72.35 years; female-79.44 years\textsuperscript{2,3}. The capital Tbilisi has 1,253,000 inhabitants\textsuperscript{1,3}. The country is divided into 9 districts, 65 regions, 5 towns of Republic Dependence (without Abkhazia and Tskhinvali)\textsuperscript{1,3}.

Major economical vectors of Georgia are agriculture (vines, tea, citrons, hazelnut, mineral waters), transit of oil and gas from Caspian basin, mining, trade. GDP-purchasing power parity $ 12.18 billion. GDP-real growth rate 5.5\%\textsuperscript{3,4}.

Telecommunication

Georgia does not have state- or private company-owned satellite, major contracted satellites — Intelsat, Turksat and Eutelsat. Fibre optic cable network system is functioning as in the capital of Georgia — Tbilisi, so in regions. The magistral optical fibre cable is organized by STM-4 and STM-16 systems of SDH generation. It belongs to the private operator company Foptnet. There are two connection points with Trans-Asia-Europe project — Poti and Tbilisi\textsuperscript{7}. Internet Service Providers — licensed — 30, actively working 6 with around 100,000 subscribers (<2.5% countrywide, approximately 7% in Tbilisi). Internet connection is realized by dial-up, leased lines and DSL technology. Since 2004 the wireless connection through Motorola's Canopy technology is available (Point to Point and Point to Multipoint connections in 5.7 GHz Frequency range with TDD/TDMA Half/Full Duplex RJ45 Auto Detect 10/100 BaseT Interface)\textsuperscript{8}.

Number of telephones in the country- > 600,000 (140 per 1.000 population), in Tbilisi — over 450,000 (340 per 1.000). Number of decade-step automatic phone stations countrywide — 33; coordinate automatic phone stations — 48; electron automatic phone stations — 12; digital automatic phone stations — 19. Length of interurban magistral routes — 4,173,5 km; coaxial and symmetrical interurban magistral routes — 7,142 km; air magistral routes — 350,4 km; radio relay lines — 803 km\textsuperscript{9,10}.

Mobile phones — 3 operators (2 GSM standard, 1-analogue) with over 350,000 mobile phone users\textsuperscript{11,12}. MagtiCom — 55.9% subscribers; Geocell — 37.3% subscribers; MegaCom — 6.8% subscribers.

\textsuperscript{38} E. Kldiashvili, T. Berishvili, Georgian Telemedicine Union (Association), Tbilisi, Georgia, kldiashvili@georgia.telepathology.org; gtu@georgia.telepathology.org

Fig.2 Major fiber optic cable
Health Care System

Number of health care organizations countrywide — 251; number of medical doctors — 43.9 per 1,000 population; number of nurses — 50.9 per 1,000 population.

Management of the sector is mainly implemented by the Ministry of Labour, Health, and Social Affairs (MoLHSA). Under the 1995 reforms, restated in the 2000–2009 health program, the Ministry has changed its emphasis from implementation of health care to support for preventive activities, as well as regulation and accreditation of health services and training. After the completion of the reform planning process in 1995, reforms were rapidly introduced in a number of areas, such as privatization, the establishment of social insurance and the introduction of new means of paying health care staff. Yet, despite some of the successes in undertaking these changes, the reforms have not yet, by and large, brought about the expected health benefits to the population. One of the main challenges has been the overall very low allocation of funds to the health budget and consequent high levels of individual direct payments by patients with inadequate risk sharing. In terms of financial reforms, Georgia has completely changed the funding of the health system from an entirely state funded system to one of social insurance and some state and private funding.

The State Medical Insurance Company was created in 1996 to administer the new national health insurance system. It is financed both by State transfers and 3+1% taxes from employers and employees and covers the care to only about 10% of population under special 16 state-supported programs (psychiatry, mother and children care, invalids, impoverished, hemodialysis, oncologic and TB patients, refugees, inhabitant of mountain regions etc.) . There are at least 3 private insurance companies-Aldagi, Imedi L International, British-Caucasian Insurance Company, however, with only <5% of adult population participating in private medical insurance schemes. There is no financial support for medicines purchase, or public regulation of pharmaceutical prices, unless the person is covered under the special state-supported program (e.g. provision of insulin for diabetes patients, TB drugs for TB patients etc.).

Telemedicine projects

In Georgia there were implemented two ITU supported telemedicine projects. The first one was started in September 1998 and involved the connection of the Institute of Radiology in Tbilisi to the Diagnostic Imaging Centre in Lausanne, Switzerland via the Internet in order to acquire medical second opinions. In the frames of this project Vidar VXR-12-Plus was used for CT and MRI images digitization.

The second telemedicine project — Telecardiology, it was implemented the simple method of ECG transfer using ordinary telephone receiver. It was partly funded with excess revenues generated by the International Telecommunication Union (ITU) Telecom exhibitions. Project enabled a trans-telephonic electrocardiogram for diagnostic and emergency services. The project was one of several others which were implemented in selected developing countries as part of the ITU’s strategy to use information technology to help health professionals solve some of the most acute health care issues in developing as well as emerging economies, according to Recommendation Nine of the Valetta Action Plan adopted by the ITU in 1998. Partners in the project include the Tbilisi Cardiac Clinic GULI, Telecommunication Company of Georgia and the Telemedicine Foundation of Russia.

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12% 53% 10% 14% 11%

Fig.3 Level of computerization
But in Georgia there were implemented other telemedicine projects too. In 1996 and 1997 National Association of Cancer Control established e-mail communication and conducted teleradiological and telemorphological conferences through financial support of Open Society Georgia Foundation. Particularly, X-ray grams, histograms and cancer incidence data base were transferred from Batumi (Adjara region) to Tbilisi National Cancer Centre by e-mail.16

Heart and Vascular Clinic uses Agfa Deluxe Slide Scanner for teleradiology. The centre also transfers phonocardiograms, ECG and Video .avi files to medical centres in Germany and US for second opinion gathering.

Emergency Cardiology Centre and National Information Learning Centre are implementing telecoronography (telecardiology/teleradiology) — transfer of x-ray images for second opinion to German and Turkish colleagues (by usage the both HP Scanjet and Apple 1 scanner as well as Olympus Camedia D-620L high resolution digital camera).4

Centre of Disaster and Emergency Medicine has developed software and tested TelCoNet — Teleconsultation network project for emergency medicine.

In 2004 in Georgia was established non governmental organization Georgian Telemedicine Union (Association), which organizes remote consultations and educational sessions in different medical fields. Remote consultations are implementing as in static (through consultational servers and e-mail) so in dynamic (teleconferencing) modes by using NetMeeting. The same approach is used in carrying out of educational sessions. At 2005 Georgian Telemedicine Union (Association) starts implementation of NATO Networking Infrastructure Project “Virtual Health Care Knowledge Centre in Georgia”18, which aims creation of telemedicine consultation server, organization of e-Learning courses and also set-up of telemedicine unit in Kutaisi. Georgian Telemedicine Union (Association) is also implementing BSEC project “A system to fight HIV/AIDS, tuberculosis and malaria in BSEC countries with a help of infocommunication technologies”17 in collaboration with Russia and Ukraine.

References
[1] www.parliament.ge
[7] www.foptnet.ge
[8] www.telenet.ge
[9] www.telecom.ge
[10] www.elektrokavshiri.ge
[12] www.geocell.ge
[18] www.vhccgeorgia.blogspot.com
7 Greece: Maternity Telemedicine Services in the Aegean Islands

Background

Greece is situated in Southern Europe, bordering the Aegean Sea, Ionian Sea, and the Mediterranean Sea, between Albania and Turkey. It has a population of 10,668,354 (July 2005 est.) and a total area of 131,940 sq km.

History of Telemedicine in Greece

Greece has been engaged in Telemedicine Services since 1989. The experimental and pilot application period lasted from 1988–1991, where it was demonstrated beyond any doubt the beneficial use of Telemedicine in primary e-health settings, the majority of which were in island and mountain areas.

The design and implementation strategies of the services were done by the Medical Physics Laboratory of the School of Medicine of the University of Athens. The support centre was established in the Sismanoglion Regional General Hospital, which is located in the greater Athens area.

The service period started in 1992 with the installation of 12 remote terminals in primary e-health centres all over Greece. The Sismanoglion General hospital remained and still remains the supporting tertiary hospital. Today the Sismanoglion Telemedicine Centre and the hospital clinics and staff support 42 E-health Centres and 20 Public Surgeries. The medical stations operate with software and hardware handling electronic e-health records and ISDN communication capabilities including videoconferencing. Sismanoglion physicians have been supportive to the distant E-health workers and patients in more than 9,000 cases so far.

An outstanding result of the support of primary e-health units from the Sismanoglion Hospital is that nearly 40% the requested evacuations were averted thanks to the Telemedicine Services with considerable cost saving and convenience for patients and their families.

Since 1998 several other institutions have been involved in the design and implementation of Telemedicine services in Greece. The majority of the initiatives stem from clinics and medical units operating in the context of the National Health Care System. The private sector is lacking behind, despite a number of noticeable initiatives several years ago.

Telemedicine applications and demonstrations were made in large numbers in Greece in the context of the participation of Greek institutions (Universities in particular) in R&D projects co-financed by the European Union. Examples of Telemedicine activities include those in General Practice, Cardiology, Maternity, Asthma, Tocography, Orthopedics etc.

In assessing the developments that have taken place in Greece in the past 10 to 12 years one can see several issues clearly related to the rather slow uptake of Telemedicine Services in Greece. These conclusions might be helpful to persons interested in pursuing similar endeavours in their own environment.

Telemedicine services require a new framework for e-health services delivery, team work, suitable medical guidelines and protocols, complete and unambiguous documentation of all acts, continuous audit and evaluation, literacy in telematic.

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The list indicates where attention has to be placed and what precautions have to be taken to overcome obstacles. Hard work, persistence, dedication and knowledge are needed to complete successfully a Telemedicine Service project.

Introduction

HERMES (Telematic E-health Remoteness and Mobility Factors In Common European Scenarios) a 4th Framework Programme Project of the Commission of the European Union, designed a platform for the development of quality assured Telemedicine Services at the point of need. In the context of the platform’s evaluation, the HERMES consortium has implemented Maternity Telemedicine Services between the Primary E-health Centres of the Islands of Naxos and Mykonos, in the region of the Aegean Sea, and the Aretaieion University Hospital in Athens, Greece.

Maternity services are of major importance for the Aegean Islands, mainly due to their isolation, especially during winter. Traditionally, maternity services in Naxos and Mykonos are offered by the E-health Centres of those islands, as well as by obstetricians working in private practices. E-health Centres in both Naxos and Mykonos are manned by Internists, General Practitioners and young, non-specialized physicians. The lack of gynaecologists/obstetricians together with the limited experience of the serving staff on obstetric issues, pose difficulties in the routine follow-up of pregnant women and in the handling of emergency cases. Private practices, on the other hand, are usually not adequately equipped to handle difficult or emergency cases.

As a consequence, pregnant women choose to take their follow up examinations at tertiary hospitals in Athens. Furthermore, they prefer private over public maternity hospitals. During their pregnancy they have to travel to Athens as many as 10 times. Travel costs, including clinic fees, hotel staying and travel expenses, are (in the majority of cases) undertaken by the ladies themselves. Emergency cases are evacuated to tertiary hospitals either by boat or aeroplane, depending on the severity of the case and on weather conditions. It is a rather common situation that during winter, travelling by boat or even by plane is often impossible due to adverse weather conditions for as long as one week.

In order to assist primary care physicians to better handle difficult to diagnose and/or emergency maternity cases, and in providing quality routine follow up services to the local populations, we have introduced Maternity Telemedicine Services between primary e-health units supported by a tertiary Obstetrics and Gynaecology Clinic.

Methods

Maternity Telemedicine Services have been designed according to the HERMES 7-step methodology\(^1\). All user categories (physicians, midwives, technicians, representatives of the local community) involved have played an active role during the entire design process. User views have been systematically gathered with the aid of a specialized tool, the HERMES Question Set\(^2\). The services have been modelled according to the services provided in the Lothian Region of Scotland, by the Royal Infirmary of Edinburgh.

Physicians and midwives have studied the Guidelines for Antenatal Care\(^3\) in use at the Edinburgh region and have agreed that they can be used in Greece as well.

Routine examinations of pregnant ladies are based on physical examinations such as blood pressure recordings, urine analysis and measurement of the uterine size. The wellbeing of the baby is assessed using fetal movements (‘kicks’) as well as recordings of the foetal heart rate, obtained using a cardiotocograph. Cardiotocograms are easy to acquire in every day practice.
and they pose no threats to the health of either the mother or the foetus. They provide important information on the dynamic condition of the foetus.

The hardware and software infrastructure of the participating sites includes a Intel Pentium based PC, equipped with 32 MB of RAM, running Microsoft’s Windows NT Workstation or Windows 98. The PC is able to participate in a point-to-point videoconference session using Intel’s Business Conferencing System. The ISDN adapter of the Conferencing system is also used to establish a ISDN (TCP/IP) link between the participating sites for the transmission of a patient’s Electronic Record. The link was established through the ISDN router (CISCO 1604) of the Medical Physics Laboratory.

In this study cardiotocograms (CTG) were acquired using the Huntleigh Baby Dopplex4 digital cardiotocograph and were recorded in a database using the Oxford Instruments Teamview software5. Teamview Software was also installed at the supporting hospital and was used as a viewer for the transmitted CTGs’. 

The Teamview Software and web-based viewer are composed of four parts:

a) Administration: physicians and/or midwives use this module to create patient Electronic Records. Basic administrative data (name, date of birth, expected date of delivery) were recorded and all patient data including the CTG traces were stored in a relational database, typically based on Microsoft’s Access®.

b) CTG Traces: the module is used to acquire, view and annotate CTG traces. Traces are displayed synchronously to their acquisition. The usual recording time of a CTG is 20 minutes.

c) Dialog boxes where physicians or midwives can describe questions to the experts: Using the same dialog boxes the experts at the supporting hospital can record their opinion, which can be viewed later by the remote physicians.

d) Telematic module for transmission: with a click of a button the Electronic Patient Record (EPR) can be transmitted to and stored in the ‘medical server’, which is situated at the Medical Physics Laboratory of the University of Athens. From the medical server, data can also be retrieved and updated by the supporting hospital. The medical server is based on Microsoft’s SQL Server, installed on Intel’s Pentium Workstation running Windows NT Server.

Telemedicine Services are initiated by primary care physicians’ and/or midwives, when they are confronted with an emergency maternity case, or they are in need of expert advice on a routine follow up examination of a pregnant woman. Telemedicine sessions are initiated with patient consent and they typically include:

1) Creation (or update) of the patient’s Electronic Patient Record (EPR);

2) Recording of the cardiotocogram (CTG) trace and insertion in the record;

3) Transmission of EPR to the medical server hosted at the Medical Physics Laboratory (School of Medicine, University of Athens);

4) Alert of the physicians of the 2nd Obstetrics and Gynaecology Department of the Aretaieion University Hospital in Athens via e-mail, telephone or videoconference;

5) Review of the EPR of the patient by expert physicians, recording of their opinion and storage of the added information to the server archives;

6) Discussion of the case between hospital experts and remote physician and/or midwives, via
telephone or videoconference (depending on the case) if need arises;

7) Handling the case at remote site as agreed.

Results
During the initial implementation phase, both technical and clinical aspects of the service have been evaluated. Evaluation of the Electronic E-health Record, videoconferencing and CTG recording and processing modules focused on their reliability, user-friendliness and availability. Network evaluation focused on its reliability, availability and speed, expressed in terms of the time required to perform key operations. Clinical evaluation focused on the adequacy of the communicated information for reaching a decision when distance separates patient and expert physician.

During the period being reported (August 1998 — February 2000) thirty Telemedicine sessions have taken place between the E-health Centre of Mykonos and the 2nd Obstetrics and Gynaecology Clinic, while ten sessions were originated from the E-health Centre of Naxos.

In all cases a single attempt sufficed to establish the Telemedicine link. The time required to transfer patient EHCRs between the primary and tertiary sites was always less than 15 seconds. Communication problems were not encountered during the entire period.

Videoconferencing links were established after EHCR data had been transferred, to allow communication between the consulting and the primary care physicians and/or midwives requesting assistance. The links were again easily established, remained active during the entire consultations and were found to be of good quality for the purposes of the service.

The Electronic Patient Record and the CTG recording and processing modules were found to be reliable, as no problems were encountered. Their availability was expected to be high by design, which proved to be true. The availability and reliability of the server on which the patient EPRs are stored, at the Medical Physics Laboratory, were also found to be high.

The use of all modules proved to be easy. Participating medical professionals felt comfortable with the software after a short training period of about one day. The average time required to study and update an existing patient EPR was approximately five (5) minutes, while the time required to create a new EPR was 10 minutes. The time required to record a CTG trace and to attach it to the patient record was around 25 minutes. This is in accord with the Maternity Guideline, which states that each recording should be of at least 20 minutes duration. The overall time required to record patient data for the first time was, therefore, less than 35 minutes, which was considered acceptable.

Maternity Telemedicine services were offered in 40 cases. All cases, concerned pregnant women taking routine follow-up examinations. All cases but one were found to be normal. Only one of the patients presented with a complicated clinical condition, namely that of premature labour associated with placenta praevia. Primary care physicians, following the advice obtained using the telemedicine system, evacuated the patient to Aretaieion hospital. Overall in this study, the contents of the patient EPR, including the CTG trace, proved to be adequate in reaching a safe decision for all 40 cases.

Maternity Telemedicine services were found to be a significant aid to Primary Care Units that do not have access to specialized obstetric expertise. By providing e-health employees of those units with easy, on-demand access to expert advice, they improve the quality of the services provided to pregnant ladies; they allow an optimal selection of cases that are in need of evacuation to tertiary units, which, together with improving the quality of locally offered routine follow-up examination, may lead to a substantial reduction of costs and patient
satisfaction. As a result, patient displacement can be reduced to a minimum for routine
examinations. Due to the big number of pregnancies per annum in the two islands (50 on
average), this leads to a considerable reduction of mobility costs. The return on the
investment of the telematic infrastructure and the medical devices can thus be achieved in a
little more than a year.

Discussion

Despite the fact that the content of patient records, including CTGs, were found to be
sufficient for treating maternity cases, it was generally recognized that a more generic
customization of the EPR software would increase the richness of information it contains and
would facilitate experts in gaining a better understanding of the cases being handled.
Information provided orally (e.g. via videoconference) and not stored in patients’ records
increase the length of Telemedicine sessions and increase the risk of loosing or misinterpreting
the data.

The Medical Physics Laboratory of the University of Athens in collaboration with the
participating sites has now developed, a sophisticated, web-based, Electronic E-health Record
Software (EHCRS), which addresses the above mentioned requirements. The software is
currently being tested and it should be installed at the participating sites within the next few
months. In addition to CTG traces, EHCRS allows patient records to contain all information
required to establish a diagnosis for a presenting complaint and to decide on required
follow-up actions. Examples of such information are: the complete medical history of the
patient with emphasis on important obstetric and gynaecological data, ultrasound data, the
results of previous physical examinations and the results of laboratory and other investigations
undertaken in the past.

Further more, Medical Physics Laboratory is testing the possibility of transferring, in real-time,
ultrasound video signals, by using the videoconferencing equipment. Initial tests have been
successful. The supporting hospital will decide whether the quality of the transmitted data is
adequate for diagnostic purposes.

In addition to improving technical and functional aspects of maternity services in the Aegean
region, future work will focus on their more rigorous evaluation. The initial results, however,
are encouraging

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References

Plans, for Harmonisation. Demonstration and Uptake of ‘A Global 24 Hours TMS Platform of Urgent
Requirements for The Initial HERMES Proto-Platform Including a Functional Marketing Specification.
HERMES European Project Deliverable 2.1, April 1998.
8 India

Background

India (Fig.1) is a vast country of 1.4 billion population occupying an area of 3,287,268 Sq. kms. It is situated in Southern Asia, bordering the Arabian Sea and the Bay of Bengal, between Burma and Pakistan. It consists of 29 states and 6 Union Territories governed by a federal system. There is no national health insurance policy for the country. Government supported e-health delivery follows a three tier system and is the primary responsibility of each state. Besides state sponsored health system private agencies are also involved in e-health delivery in the same tier level which takes care of illness rather than wellness and public health. One can see world class hospitals run by corporate agencies which are mostly located in big cities. The scale of e-health services in India, though has been very small so far considering it’s size and health infrastructure and mostly limited to medical business process outsourcing for the western world the scope has been expanding to Telemedicine, Hospital automation and health portal in the recent past.

Introduction

• According to industry analysts, any hospital with a minimum capacity of 100 beds is a potential IT-buyer. It is estimated that there are over 1,000 hospitals in that category in the country. National Association of Software manufacturers are services Companies (NASSCOM) believes that e-health organizations in India will spend around INR 100 million on IT in the current year. The major component of this will be hospital management systems and networking hardware required for processes like telemedicine. Even with such a small scale of operations, some significant changes are being made nationwide that will strengthen telemedicine initiatives and the e-health industry as a whole. The most important initiative being, the standardization of exchange of health information between different entities within the e-health sector. The Ministry of Health & Family Welfare and the Ministry of Communication and Information Technology are jointly creating a national health information infrastructure, for easy capture and dissemination of health information. To support this infrastructure, necessary steps are also being taken in creating a legally safe environment that will protect the privacy and confidentiality of health information. Steps are also being taken to educate various stakeholders of the e-health industry about the need for complying with health information standards. The above-mentioned initiatives of the government are indirectly going to bolster the growth of cross border e-health services. E-health is becoming more and more regulated in developed countries such as the USA. E-health payers and providers are willing to outsource work

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easily to countries/companies that comply with health information standards and have a robust legal framework for privacy and security of health information. In principle, telemedicine has bridged the urban rural divide by taking e-health to interiors of India. There are more than 150 telemedicine initiatives today most of it are supported by Indian Space Research Organization and IT Ministry. On an average close to 6 (range of 2–10) telemedicine encounters take place per day in each of these centres. These figures are very low considering the dearth of e-health services in the same areas of India. However, a start has been made. These figures are only going to increase as the technology costs are falling regularly, e.g. telecommunication costs have reduced by 3 times since the last two years.

Specific Activities in e Health in India

Hospital Information System (HIS) in India

- Majority of the hospitals in the country are rooted in manual processes, which are unable to cope with the volume of data generated. In the larger hospitals, patient records remain difficult to access and these adversely affect quality of health delivery. The demands of the insurance sector for more efficient information storage and retrieval are also going to add to the pressure on hospitals and health providers. This may, in fact be the major driving force for modernization of this sector since the health insurance sector is poised for major growth in the coming decade. The current Government health policy is also shifting its emphasis towards health insurance. Automation is the only solution that can help hospitals to meet the challenges of modern health care delivery. However, IT has been a late entrant in this field and most hospitals which forayed into this area started with small systems that were developed in-house. Till the mid 90s no standardized solutions were available and these local innovations were the pioneers. However, they neither give the desired results nor can they be integrated with newer systems. The major demand for updated solution started with the establishment of the large corporate hospitals many of which like the Apollo group, implemented strong IT solutions in the latter half of the nineties. With the increasing demands of the market, many sturdy, standard HIS solutions were developed by the major IT companies. Today, the E-health segment is, in fact, going through the kind of evolution that the banking and financial services sector went through a decade ago. This is being driven by the huge annual increase in the number of hospital beds mostly in the corporate sector. However, the government still owns 66% of the Indian hospital market. The Central Government has also announced setting up of large new hospitals. The public sector hospitals have realized the direction in which the wind is blowing. This can be appreciated by the fact that Delhi Government has recently approved HIS solutions for four of its major hospitals.

HIS solutions available

Although a large number of products are available in the market, the major players in this field, are Centre for Development of Advanced Computing (CDAC), Wipro GE e-health, Tata Consultancy Services (TCS) and Siemens Information Systems Ltd (SISL). CDAC, an autonomous government IT organization, was a pioneer in developing HIS solution in India. They have developed the first total HIS software in collaboration with Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow in 1997. This has been implemented at SGPGI, Lucknow and GTB hospital, New Delhi as also at other ongoing sites. Wipro GE e-health, offers a reasonably complete range of IT services including domain specific solutions for e-health organizations. Their end-to-end solution covers the entire spectrum of the e-health industry’s needs including a Hospital Information System (HIS), Picture Archiving and Communication Systems (PACS) and telemedicine solutions.
• Telemedicine in India:

E-health is a state subject which follows a three tier system — primary health centre catering a group of villages, Secondary level health centre located at district level and medical college hospitals constitute the tertiary level located in the big cities. Besides, there are few advanced medical institutes of national importance having clinical, teaching and research facilities in many super-specialties. In addition to government run health system, same hierarchical e-health services exists in private sector too. There is no national health insurance system, though the government, public sector and corporate organizations sponsor the e-health expenses of its employees and family. In the recent years few insurance companies are venturing into health sector. In spite of well networked health care system access to e-health in rural areas is far from satisfactory. In the current scenario, 75% of the qualified consulting doctors practice in urban, 23% in semi-urban (towns) and only 2% in rural areas where as the vast majority of population live in the rural areas. Hospital beds/1,000 people are 0.10 in rural as compared to 2.2 in urban areas. Further, a vast proportion of north and north-eastern region of country lie in hilly terrain and some territory in remote islands making e-health reach impossible to such far flung areas. Tele-e-health concept is no longer new to the country. Both government and private agencies are venturing into it. Few Indian companies are being capable of providing hardware and software solution for telehealth care. Products of reputed overseas telehealth industry have their presence. Efforts are directed towards setting up standards and IT enabled e-health infrastructure in the country. All those activities carried out by various agencies are collected and summarized below.

Indian Space Research Organization (ISRO)\(^2\)

Indian Space Research Organization (ISRO) as a part of application of space technology for Health care and education, under GRAMSAT (rural satellite) programme, has initiated number of Telemedicine pilot projects which are very specific to the needs of development of the society. ISRO Telemedicine projects are very specific to the needs of development of the society. These projects consist of, linking through Indian National Satellite (INSAT), remote/rural areas like Jammu, Kashmir & Ladakh in north near Himalayas, Offshore Islands of Andaman and Lakshadweep, North Eastern States & some of the remote and tribal districts in the main land States across the country.

While ISRO has impressive record of achievements in space technology covering satellites, launch vehicle services and applications, it is one of the ISRO’s continuous endeavours in bringing application of space technology for the benefit of the grass root population. In this regard the telemedicine pilot projects initiated by ISRO is very specific to the needs of development. While health care is not ISRO’s primary subject, application of space technology for health care and education under the GRAMSAT program is the focus. ISRO has plans to build sophisticated satellites for meeting the requirements of education & health in the coming years. Since health care is the state subject and run by the State Governments, the thrust of ISRO is to introduce Satellite Communication based Telemedicine technology in the remotest part of the country through pilot projects so that the health system adopts the technology and test its potential in quality e-health delivery and subsequently introduce Telemedicine in operational mode.

ISRO’s Telemedicine initiative has been broadly divided into the following areas:

a) Providing Telemedicine Technology & connectivity between remote/rural hospital and Super Speciality Hospital for Teleconsultation, Treatment & Training of doctors & paramedics.
b) Providing the Technology & connectivity for Continuing Medical Education (CME) between Medical Colleges & Post Graduate Medical Institutions/Hospitals.

c) Providing Technology & connectivity for Mobile Telemedicine units for rural health camps especially in the areas of ophthalmology and community health.

With larger requirements of the different States proposing to introduce Telemedicine facility in their district hospitals, the Telemedicine system configured for the ISRO’s Telemedicine project initially started with “point to point” system between the patient and, which is a general hospital located in a district. Town and expert doctors end which is a specialty hospital situated in a city. Subsequently the need for Server/Browser based Telemedicine system was evolved for multipoint connectivity and the same is adopted for multipoint connectivity between remote and rural hospital and Super Specialty Hospital located in different Towns/Cities.

The standards adopted for transfer of medical images conferred to the DICOM; and for the patient record information, part of Health Level-7 (HL-7). The Telemedicine Centres, both at the district/rural hospitals and at the specialist hospitals were set up under standard room conditions and lighting suited to videoconferencing standard — H.325. Further, the mode of telemedicine consultations were based on real time transfer of patient’s medical data and images, followed by videoconferencing. The bandwidth used during telemedicine sessions is 384 kbit/s. The minimal medical diagnostic instruments provided at the remote end are the 12 lead ECG, X-Ray digitiser/scanner and a pathology microscope with digital camera. However with the experience of utilization of the facility it was observed that the pathology microscope & camera is found not essential for many of the remote district hospitals and they are not being provided subsequently. The connectivity was provided through flexi-DAMA based VSAT system with 3.8 M antenna with 2 W transmitter for the mainland states & 5 W transmitter for the off-shore islands and North Eastern Region. The satellite connectivity is in Extended C-band mesh configuration controlled by the ISRO Hub Station providing Network monitoring & Control serviced through the bandwidth from INSAT satellite

**Tele-education**

In view of the challenges faced by the nation in the field of education and considering the potential use of satellite communication technology to support education, ISRO is planning to launch a satellite dedicated to meet the requirements of the entire education sector in India. This satellite called as EDUSAT has been configured to meet the requirements of the entire India. The satellite will carry high power transponders operating in the Ku band and generating multiple spot beams to meet the regional coverage requirements. The satellite will also have national coverage beams in the Ku band and Extended C band to provide support to the ongoing developmental communication activity initiated already in the country. The ground segment is designed to cater to multimedia education package delivery at a reasonable cost.

During the pilot phase of the project IP based techniques for distance learning will employ some interactive and some non-interactive satellite terminals in the remote classrooms of three states of India, namely, Karnataka, Maharashtra and Madhya Pradesh. It is proposed to connect various engineering colleges in these States to the respective teaching end. The impact of the programme will be evaluated in each region by independent agencies to suggest improvement or modification in overall programme. It is expected that, during semi operational phase, which follows the pilot phase, each spot beam will serve 1,000 classrooms. During Edusat operational phase 5 or 6 uplinks per beam will support 5,000 classrooms per uplink. The technology employed in the operational system of Edusat will be DVB-RCS.
Telemedicine

ISRO’s telemedicine pilot project was started in the year 2001 with the aim of introducing the telemedicine facility to the grass root level population as a part of proof of concept technology demonstration programme. The telemedicine facility connects the District Hospitals/Health Centres with Super Specialty Hospitals for providing expert consultation to the needy and underserved population.

Telemedicine system consists of customized medical software integrated with computer hardware, along with medical diagnostic instruments connected to the commercial VSAT (Very Small Aperture Terminal) at each location. Generally, the medical record/history of the patient is sent to the Specialist Doctors, who will in-turn study and provide diagnosis and treatment during videoconference with the patient’s end.

Presently ISRO’s Telemedicine Network consists of 90 Hospitals — 69 Remote/Rural/District Hospital/Health Centre connected to 21 Super Specialty Hospital located in the major cities with the following highlights (Fig. 2):

- 9 Hospitals in State of Jammu & Kashmir, 6 District Hospitals including Leh & Kargil and 3 Medical College Hospitals connected to All India Institute of Medical Sciences, Delhi; Apollo Hospitals, Delhi & Amritha Institute of Medical Sciences, Kochi.
- 5 Islands of Lakshadweep namely Kavaratti, Amini, Agatti, Andrott & Minicoy connected to Amritha Institute of Medical Sciences, Kochi.
- 5 Remote/field/Base Hospitals for Indian Army connected to Research & Referral (R&D) Hospital at New Delhi.
- 4 hospitals of North Eastern States-STNM Hospital Gangtok, Sikkim; Regional Institute of Medical Sciences, Imphal, Manipur; Medical College Hospital, Guwahati & District Hospital at Udaipur, Tripura connected to Asia Heart Foundation, Kolkata.
- Mobile Teleophthalmology Unit for the Eye Care Camps with connectivity to Shankara Netherlaya, Chennai & Banglore.
- Tata Memorial Cancer Centre, Mumbai connected to B. B. Barua Cancer Centre, Guwahati.
- Three Medical College Hospital of Orissa are connected to SGPGI, Lucknow.
- Establishment of temporary Telemedicine facility for 2 months at Pamba at the foothills of Sabarimala shrine for the benefit of visiting pilgrims during Dec 2003–04.
- Under the Mobile Telemedicine, the Mobile Teleophthalmology facility is provided to Shankara Netherlaya, Chennai to provide the service to the rural population of the State of Tamilnadu.

More than 12,500 patients have been provided with Teleconsultation & treatment

Regarding the cost effectiveness of the Telemedicine, an Impact Study conducted on one thousand patients revealed that there was a cost saving of 81%. That is the patients spent only 19% of money which they would have otherwise spent in terms of expenses towards travel, stay & for treatment at the Hospitals in the cities. In case of off-shore Islands the cost saving is enormous both to the Govt. and the Patients.

ISRO’s Telemedicine Project is gaining more acceptability and has potential to open up new frontiers for the rural health care in India. Some States have come forward to introduce Telemedicine in an operational mode and have prepared the District Hospitals with
Telemedicine facility both for ambulatory & Intensive care for cardiac related treatment. Recently the State of Karnataka have initiated the establishment of SatCom based Telemedicine facility in all their district hospitals & a few trust hospitals which will be connected to different Specialty Hospitals in the major cities. This will soon be followed by other States also. ISRO has plans to integrate telemedicine with tele-education wherever applicable under the GRAMSAT programme to reach more rural areas in India.

Department of Space/Indian space Research Organization, in its endeavour to reach the benefits of the space technology to the grassroots and the needy sections of the society, has been developing and implementing newer and innovative applications. The telemedicine initiative, developed and implemented in selected parts of the country, on pilot basis, during the past two years, has been one such effort to reach the specialty e-health to the rural population living in geographically distant, remote, and interior parts of the country.

With the growing demands for telemedicine facilities across the country; and several district/ rural hospitals desiring to have connectivity with the same, and also more than one specialist hospitals; further compounded by the willingness express by a number of specialist hospitals to provide telemedicine service to more rural hospitals; the importance of introducing the ‘Multi-Point’ connectivity at the specialty hospitals was realized. Accordingly, at one of the super specialty hospitals, viz., the All India Institute of Medical Sciences (AIIMS), New Delhi, multi-point specialty consultation nodes were set up/tried out across selected departments — connected through LAN for routing the incoming tele-consultation requests.

Further, towards reaching specialty e-health to larger sections of the society, across the country, and in various faculties of medical specialties; the need for demonstrating further ‘technology packaging’ and implementation efforts—by way of ‘Point-to-Multipoint’ and ‘Multipoint-to-Multipoint’ types of connectivity has been realized. These efforts would also facilitate imparting training to general physicians and paramedics working in rural areas, besides supporting Continuing Medical Education (CME) efforts.

Presently ISRO has configured server/browser system in the client/server configuration which is being adopted widely in various nodes. A patient-end terminal generally consists of a PC, videoconferencing camera, TV monitor, printer, hub, UPS, A3 size film scanner, 12 Lead ECG,. In the client-server architecture apart from patient-end and doctor-end system a Server is located at the super-specialty hospital which stores all the information of a patient including his past illness, previous visits and medical images; DICOM and Non-DICOM. When a specialist is giving teleconsultation the patient information is accessed from the server. Other functionalities of patient-end and doctor-end systems remain same in both the architectures. A terminal at doctor-end consists of a PC. Videoconferencing camera, TV monitor, UPS and a hub connected to VSAT terminal. Depending on the size of the network the server is sized like 1:8/2:16/4:48/8:100 which indicates the number of doctors terminal to patient end. It is observed that the cost of the remote terminal get reduced drastically with number of client nodes. In the present Karnataka State operational network, with the communication router the server is configured to connect five different specialty hospital in one city of Bangalore.

With the steady growth of Telemedicine application, it is also envisaged to develop an exclusive “HEALTHSAT” for meeting the health care needs of the country at large. The technology of DVB-RCS is proposed to be adopted for the Future Telemedicine Network.

**Department of Information Technology, Ministry of Communication & IT, Government of India**

Realizing the benefits and having the capability in terms of the technical and medical expertise
in India, Department of Information Technology (DIT), Indian Space Research Organization (ISRO) of Department of Space, and other public and private organizations have started Telemedicine projects in different parts of the country. As a facilitator, DIT has taken initiatives for development of technology, initiation of pilot schemes and standardization of Telemedicine in the country. The pilot schemes were carefully chosen to take into account the diverse issues related to currently available telecommunication infrastructure, specialist availability, geographical considerations etc., Some of these initiatives are briefly presented below:

- DIT has supported development of telemedicine software systems — the prominent ones by C-DAC. Under this ongoing project, technology developed has been used for connecting three premier medical institutions-viz. SGPGI Lucknow, AIIMS New Delhi and PGIMER Chandigarh- using ISDN connectivity. The technology developed is now being deployed for setting up other Telemedicine systems in the country.

- Telemedicine for diagnosis & Monitoring of tropical diseases in West Bengal using low speed WAN, developed by Webel (Kolkata), IIT, Kharagpur and School of Tropical Medicine, Kolkata has been implemented. The system has been installed in School of Tropical Medicine Kolkata and two district hospitals. About a thousand consultations have already taken place over this network. Another project on setting up of telemedicine facilities at two referral hospitals and four district hospitals using West Bengal State Wide Area Network of 2 Mbit/s is also under implementation.

- An Oncology Network for providing Telemedicine services in cancer detection, treatment, pain relief, patient follow-up and continuity of care in peripheral hospitals (nodal centres) of Regional Cancer Centre (RCC) has been established. The Telemedicine network utilizes Internet connectivity in addition to leased lines. The project was implemented by C-DAC, Trivandrum and RCC. More than 4,000 patient consultations have been done till date using the network. A cost benefit analysis has shown that economic benefits to the patients have been far more than the investment made in this project.

- To provide specialty health services to remote areas of north-eastern states of India an initiative of setting up district-level telemedicine centres is underway. A telemedicine solution has been provided at Naga Hospital, Kohima with support from Marubeni India Ltd., Govt. of Nagaland and Apollo Hospital, Delhi. Two more hospitals in the remote states of Mizoram and Sikkim are being provided Telemedicine facilities.

- In addition ISRO, Department of Space, Govt. of India has also given major thrust to Telemedicine by providing Satellite connectivity. Under this facility 34 remote/rural hospitals are connected to around 12 super specialty hospitals in various parts of the country by November, 2003. More than 12,000 teleconsultations have been carried out in the ISRO network.

Standardization activity in Telemedicine:

To streamline establishment of telemedicine centres and standardise services available from different Telemedicine centres need to define a set of standards and guidelines for practice of telemedicine is felt. The document, “Recommended Guidelines & Standards for Practice of Telemedicine in India”, has been prepared by Department of IT through deliberations of a Technical Working Group and is aimed at enhancing interoperability among the various Telemedicine systems being set-up in the country (Fig.3). In addition to suggesting standards for various equipment needed for setting up Telemedicine centre, it also provides guidelines for
conducting Telemedicine interactions. The standards will also assist the Department of IT and Department of health of the state governments and e-health providers in planning and implementation of operational telemedicine networks linking various district hospitals with super specialty hospitals, community health Centres (CHC)/Primary health Centres (PHC) to the respective district hospitals for providing health care to the needy and under served population irrespective of their geographical location.

There is an ongoing process of experimentation, evaluation and implementation of telemedicine applications in many urban and rural locations around the country, and the advocates for these technologies are numerous and enthusiastic. However, the potential of these has not been fully exploited and the communications and other capital resource infrastructure that supports them is not universally available. The potential effects of their widespread implementation on the health care delivery system for a country as vast as India is immense. Looking at the current activities in telemedicine as a whole, it is reassuring that information technology holds promise for improving access to health care services for rural patients through telemedicine.

**Telemedicine Initiatives of Apollo Telemedicine Network Foundation**

Apollo Telemedicine Networking Foundation (ATNF) is a foundation established by Apollo Hospitals Group, for charitable purpose to develop and promote telemedicine and distant medical facilities in remote areas and to provide communication amongst medical community by dissemination of specialized medical knowledge through a technologically advanced network.

Apollo is a pioneer in the field of Telemedicine in India and is credited with being the first to set up a Rural Telemedicine Centre in the village of Aragonda in the state of Andhra Pradesh. Even though the first Telemedicine site was launched in 1999, Apollo’s initiatives with Telemedicine started well before that. Some of the earlier experiences with Telemedicine applications are given below:

- Apollo experimented with Telecardiology more than 5 years back through the usage of Transtelephonic ECG machines, which were set up in various smaller hospitals whereby a doctor based in the Tertiary hospital could monitor his patients from a distance.

- Simulations of Teleconsultations between Apollo Hospitals, Hyderabad, Chennai and Dubai for cases specific to Cardiology, Neurosurgery & Orthopedics were done.

- Medical Conference-Brussels. Surgical procedure in Cleveland, USA-received in Apollo Hospitals Delhi, Chennai, & Hyderabad in 1997.

**Telemedicine Centres set up by Apollo**

Apollo has set up over 57 Telemedicine Centres across different locations in the country and abroad with many more in the pipeline. Apollo has worked with different kinds of entities in the e-health industry ranging from large Corporate hospitals and Government hospitals to small clinics and Information Centres. Apollo has the expertise to execute different kinds of Telemedicine projects.

**Example: Aragonda-A Rural E-health Model**

Aragonda is a remote village in the C hitoor district of clinical/laboratory evaluations. Andhra Pradesh having local Registered Medical Practitioners and the Mandalam Primary
Health Centre, manned by a single registered doctor, who delivers e-health services to all the adjoining villages of the Thavanampalle Mandalam. There were no diagnostic facilities at Aragonda. Local General Practitioners depended on Chittoor and Vellore for clinical/ laboratory evaluations.

Aragonda was selected to become our first Telemedicine Centre because Aragonda was also like any other typical Indian village with only the basic medical facilities. The major occupation of the people of Aragonda and surrounding areas is agriculture. The ailments were seasonal; during summer ailments were of malarial nature and during monsoons, water borne diseases were rampant. It did not have sufficient doctors and medical facilities to provide secondary and tertiary care. Keeping these factors in view, Apollo decided to start its pilot Telemedicine project in Aragonda by connecting Aragonda to the Apollo hospitals in Hyderabad and Chennai hospitals, thereby bringing tertiary care at their doorsteps. Incidentally, Aragonda is India’s first Rural Telemedicine Station.

A 50-bedded hospital was set up in Aragonda with state of the art equipment, which included CT Scan, Ultrasound, X-ray and an array of medical personnel to give good secondary care facilities. A Telemedicine Centre was also set up to facilitate one to one interaction between the doctor and the specialists located either in Apollo, Hyderabad or Chennai. Since its inception, the Aragonda project is doing extremely well taking valuable second opinion via satellite from Chennai and using the land line from Hyderabad.

Aragonda Telemedicine was first viewed by Mr Bill Clinton, former President of the United Stated of America in March 2000 during his visit to Hyderabad. He viewed a live teleconsultation between Aragonda and Apollo Hospitals, Hyderabad. Mr Pramod Mahajan inaugurated the Aragonda Telemedicine Centre in April 2000. Rural e-health professionals who use Telemedicine at Aragonda today feel less isolated from medical colleagues and resources. In this model Telemedicine is simply a tool used to extend the hospital’s referral base and is not a profit mechanism. Costs and limitations on technology are considerably reduced.

Results of this Pilot study thus led to a consensus that enough evidence exists to justify incorporating Telemedicine as a “model of care” not just for the Aragonda Hospital but to many more villages and towns that lack access to medical care.

**Telemedicine Initiatives at Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow**

Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow is a tertiary care referral hospital and a premiere centre for teaching and training of super specialist medical professionals. It also conducts research in the high priority health areas of national importance. This is the first tertiary care hospital in public sector in India to introduce Hospital Information System in 1998. The software was developed in collaboration with the Centre for Development of Advanced computing (C-DAC). It is the first public sector hospital in the country to start a telemedicine program in 1999 and conducted a large number of telemedicine projects to test the technology in different health related applications. Currently, Orissa Telemedicine network project is running in full swing, Uttaranchal network is under implementation phase and Uttar Pradesh Network is getting designed. SGPGI telemedicine programme also makes the professionals and lay public aware of the use of the telemedicine through its organizational activities such as conferences, seminars and workshops. To meet the current and future need of health technologist in IT enabled health sector and creating a platform for researchers from diverse fields to carry out Research & Development in this area, SGPGI is setting up a School of Telemedicine and Biomedical Informatics.
**Telemedicine Infrastructure at SGPGIMS:**

Currently, the infrastructure at SGPGIMS Telemedicine Centre consists of several independent telemedicine work stations equipped with teleradiology, telepathology, and videoconference units with large display devices like plasma screen. It can carry out medical data transfer and videoconference with six remote locations simultaneously. Communication set up consists of six ISDN lines, one Ku band DAMA and one extended C band VSAT (Fig.2). All telemedicine sessions are of real time live in nature. Operation theatre of SGPGIMS are equipped with high resolution video camera to transmit live telecast of surgical procedures. The intra-campus telemedicine network also include 700 seated main Auditorium and 120 seated mini Auditorium through optical fibre backbone to telecast the live interactive proceedings of seminars, workshops and conferences and also to receive the same from different parts of India and abroad (Fig.3).

1) **Tele-e-health**

**a) Teleconsultation, treatment planning and tele-mentoring**

SGPGIMS has been active in telehealth care since September 2000. This was carried out in September 2000 between Pithoragarh district hospital, and SGPGIMS, Lucknow, Uttar Pradesh. Pithoragarh is located in the Kumaon hill range of Uttar Pradesh state and is 275 kms away from Lucknow. Video clippings of the patient, ultrasound and X-ray images typed and hand written notes and audio clippings were transmitted from the said hospitals to SGPGIMS. There were data exchanges of thirty patients. After that Balrampur and Civil hospital, located in Lucknow city were linked with SGPGIMS — remote connectivity for Teleconsultation. In the year 2001, SGPGIMS was connected with S. C. B. Medical College, Cuttack in the state of Orissa situated 1,500 km away from Lucknow various departments of the institute provide teleconsultation and second opinion to the doctors and patients. Since March 2003 two other medical colleges of Orissa state, VSS Medical College, Burla and MKCG Medical College Berhampur have also been networked via VSAT provided by Indian Space Research Organization (ISRO), for the same purpose. An audit of the telehealth care services is depicted in Fig.4 SGPGIMS designed and implemented another state wide
telemedicine network project for the state of Uttarakhand in April, 2004. In the first phase two district hospitals at Almora and Srinagar have been receiving teleconsultation mainly in cardiology, gastroenterology and gastrointestinal surgery specialties. Recently new modules like nursing skill development and hospital administration have been adopted. For the first time in India, a case of telementored surgery was carried out between SGPGI and Amrita Institute of Medical Sciences, located 2,500 kms. away in Cochin, South India.

b) Telefollow-up

There are frequent Tele-follow up clinics in the departments of Rheumatology, Endocrine Surgery and Nuclear Medicine to help the patients of the state of Orissa. It has to a great extent saved their time, money and efforts by avoiding a trip of 1,500 km to Lucknow for follow up.

Distant Medical Education

Since 2001 Tele-continuing medical education for postgraduate students of S. C. B. Medical College, has been started with 128 kbps ISDN media. Various departments are taking part in this tele-teaching programme; those are departments of Surgery, G. I. Surgery, Urology, Pathology, Radiology, Paediatrics, Rheumatology, Endocrine Surgery. Such distance education programme for postgraduate medical students offered by a tertiary care medical centre is happening for the first time in India. The response from students is prompting us to continue on a long term basis. So, in 2003 with the support of Indian Space Research Organisation and Government of Orissa three medical colleges of Orissa i.e. SCB Medical College, Cuttack, MKCG Medical College, Berhampur and VSS Medical College, Burla were connected to SGPGIMS via broadband VSAT. Beginning from March 2003 there are regular sessions of different departments held daily. This distant education programme has immensely benefited the postgraduate students and doctors of these medical colleges in enhancing their knowledge and keeping them abreast with the recent advances and research in various super-specialties and treatment of the patients.

In September 2003, SGPGI got connected through VSAT with another tertiary care academic medical center, Amritha Institute of Medical Sciences (AIMS), Cochin located 2,500 kms. away in south India. Since the statures of both the institutes are similar the level of interaction and the objectives are different. The departments of Endocrinology, Endocrine surgery, Surgical Gastroenterology are actively participating in this programme (Fig.5). The two day conferences of Endocrine surgery and Cardiology were directly telecasted to SGPGIMS from AIMS which immensely benefited the Postgraduate students. Conference lecture of one of the faculty member of SGPGIMS, who could not participate physically due to his hard pressed engagements, was transmitted from Lucknow to Cochin. There was one session on telementored surgery carried out by department of Endocrine Surgery.

- Professional Career development of rural doctors in practice:

In July 2003, National Informatics Centre (NIC), New Delhi sponsored the above programme in which faculty members of different departments of SGPGIMS has been delivering lectures through video conference interactively with eight North Eastern States head quarters and broadcast to 450 Community Information Centers located in the same region (Fig.6). The
various departments participated are Endocrine Surgery, Microbiology, CVTS, Gastroenterology, Rheumatology, Gynaecology, Immunology, Neuro-ophthalmology, Anaesthesiology. This programme is benefiting the doctors at the peripheral and remote hospitals to become aware of the recent advances in management of common medical problems. Initially started as a monthly session the frequency has been increased to twice a month because of its popularity and increasing demand. Currently, NIC has decided to telecast this programme to the state of Uttarakhand also.

- **List of Tele-CMEs carried out by SGPGIMS**

Apart from these activities there are many Tele-educative workshops, seminars, conferences and courses held at SGPGIMS. Entire proceedings of these educational sessions had been telecasted live, either through ISDN or VSAT media to various hospitals located in different states of India. These live interactive sessions were attended by many renowned international faculty, national faculty and delegates. Some surgical procedures were also transmitted with interactive question answer sessions. During one of the conferences SGPGIMS had also been connected to European Institute of Telesurgery, Strasbourg and European Institute of Telemedicine, Toulouse, France. Chronological order of these sessions is:

1) 1st Endocrine Tele-surgery workshop-October 1999-SGPGIMS, Lucknow with Cochin hospitals and European Institute of Telesurgery, Strasbourg, France

2) Tele-CME in Gastroenterology-December 1999-SGPGIMS, Lucknow with AIMS, Cochin.

3) Tele-Endocrine Pathology Workshop-February 2000-SGPGIMS, Lucknow with PGIMER,
Chandigarh

4) Tele-Endocrine Imaging workshop-September 2000-SGPGIMS, Lucknow with PGIMER, Chandigarh

5) 2nd Endocrine Telesurgery Conference-March 2002-SGPGIMS, Lucknow with SCB Medical College Cuttack, Orissa

6) 3rd Endocrine Telesurgery Conference-October 2003-SGPGIMS, Lucknow with SCB Medical College, Cuttack, Orissa, Bangalore and Chennai hospitals

7) Endocrine Surgery Conference at AIMS, Kochi telecast to SGPGIMS, Lucknow-Conference lecture transmitted from Lucknow to Cochin

8) Cardiology Conference at AIMS, Kochi telecasted to SGPGIMS, Lucknow-July 2004

9) 28th Annual conference of Indian Association of Medical Microbiologist-November 2004-SGPGIMS, Lucknow with SCB Medical College Cuttack, Orissa 1st SGPGI, Breast Course-March 2005, SGPGIMS, Lucknow with SCB Medical College Cuttack, Orissa and AIMS, Cochin.

Research and Development

a) Tele-e-health in extreme locations and Disaster Management
Every year thousands of pilgrims go to Kailash Mansarover located in Himalayan mountain in the Chinese territory to perform religious rituals. Weather is extremely cold and unfavorable and terrain is difficult. In June 2001 SGPGIMS telemedicine team comprising one doctor and one telemedicine engineer joined the 12th batch of pilgrims at Dharchula base camp and accompanied them through out their trek till the Indian border. On the way they stopped at the camps located at Sikha, Gala, Bundhi, Gunji, Kalapani. From all these points ECG was transmitted successfully through Inmarsat satellite.

SGPGIMS carried out a telemedicine application project during the last Maha Kumbh mela (Indian festival) held in January 3rd to 26th February, 2001 to find out the benefits of new health technology use over and above the traditional health care delivery system in such situation in which large congregation of people occurs at one time (approximately 10 million people)6,7,11,15,16. A telemedicine network with 128 kbps ISDN was set up connecting five locations which included festival site hospital, local medical college, SGPGIMS, a tertiary care hospital, Public health department and Mela monitoring cell located at Lucknow 300 kms. Away. Regular exchange of health related data and video-conference were carried between these nodes. Also, public health related issues are of important in temporary shelters created to accommodate people temporarily. Monitoring public health facilities are of immense importance to prevent epidemic outbreaks.

b) Development of Telemedicine Software
SGPGIMS has been a partner in development of indigenous software for Telemedicine and its application in collaboration with Centre for Development of Advanced Computing (C-DAC) and Center for Electronics Design and Technology of India (CEDTI). The software being interphased with medical accessories like telepathology, teleradiology

Fig.7 Mobile tele-hospital
telecardiology and Video-conference is currently deployed at three premier institutes of India i.

e. All India Institute of Medical Sciences (AIIMS), New Delhi, Post Graduate Institute of
Medical Sciences and Research (PGIMER), Chandigarh and SGPGIMS, Lucknow.

c) Development of Mobile Telemedicine Units
Mobile telehospital projects were launched in the middle of 2001 in collaboration with Online
Telemedicine Research Institute, Ahmedabad. It was aimed at providing telemedicine facility
in a mobile setting which can find application in emergency health care (Tele-ambulance) and
rural health care (Mobile Tele-hospital). The prototypes have been developed and tested
successfully in the field. Commercial production is awaited.

d) Development of Portable Telemedicine
Units in suitcase.
This is a spin off product of mobile telemedicine project in which telemedicine units fitting in
a suitcase was developed in collaboration with industry. These units are currently in use in
Tsunami project.

Participation in Telemedicine awareness programmes.
In order to develop awareness of health care providers, policy makers and public on the utility
of telemedicine in modern day health care, SGPGI has been participating Health exhibitions
and organising conferences.

a) National Conference on Telemedicine, April 2001-Five international faculty delivered State
of the art lectures. Around 150 delegates participated and 25 delegates presented papers.
Indian Society of Telemedicine was launched.

b) First Annual Conference of Telemedicine Society of India, November 2002-The
conference was attended by eleven eminent international, 22 national speakers and 158
deleagates. Direct telecast of two guest lectures from National Technology University,
Singapore and CNES, Tolouse, France and two keynote lectures from European Institute of
Telesurgery and European Institute of Telemedicine-University hospital of Toulouse, France
at higher bandwidth (384 kbps) was greatly appreciated. The entire 3 days proceedings of
the conference were telecasted live to SCB Medical College, Cuttack in Orissa through
satellite.

c) 2nd Asia Pacific Telecommunity Telemedicine Workshop, February 2004-This two day
workshop was organised by SGPGIMS at New Delhi. It was supported by Asia Pacific
Telecommunity (APT), International Telecom Union (ITU), Tokai University Institute of
Medical Sciences, Telemedicine Society of India (TSI). The conference was attended by 28
International invited faculty and 49 National delegates from different profession such as
medicine, engineering and Information Technology.

Consultancy & Project Implementation for States
SGPGIMS has been involved in the development and deployment of the Orissa and
Uttaranchal telemedicine network project in collaboration with its technical partners.

Ongoing Projects

Establishment of School of Telemedicine & e Health
SGPGIMS, Lucknow has taken up the initiative to set up a School of Telemedicine and
Biomedical Informatics in its campus.
The disciplines which are going to be created in this School are Telemedicine, Hospital Information System, Bioinformatics, Medical Multimedia, Medical Knowledge Management, Artificial Intelligence in Medicine, Virtual Reality and Robotics in Medicine. The objectives of the school are creation of various resource facilities, structured training programme, research and development, providing consultancy to government and private e-health organizations, collaboration with technological and medical universities in the country and abroad.

**Asia Heart Foundation telemedicine initiative**: ¹⁷

Asia Heart Foundation (AHF) is one of the largest organizations working towards establishing cardiac network in and around the country with establishment in Bangladesh and The Republic of Yemen. Many more upcoming projects are in the offing in Assam, Bangladesh and Malaysia. AHF is basically involved towards the building and commissioning of hospitals with the objective of reaching out to the common man and making cardiac care available to one and all at an affordable price through its highly efficient, motivated and committed team of doctors and service providers.

Installed in 2002 by Narayana Hrudayalaya, Bangalore, Karnataka it has now achieved a figure of more than 2000 tele-cardiology consultation through an enterprise based network, creating a Hub and Spoke Network between the Tertiary Care Centres in the Cities and the peripheral Coronary Care units in the remote areas. This will facilitate connectivity through satellite thereby ensuring consultation to the distant patient and carry out critical surgeries through video conferencing.

**Escort Heart Institute & Research Center Project**: ¹⁸

Installed in 2002 by Escort Heart Institute & Research Center, it has been involved in telecardiology service.

**Mobile Tele-Ophthalmology service**: ¹⁸

With the support of ISRO, Shankar Nethralaya at Chennai and Meenakshi Eye mission at Madurai have launched Mobile Tele-ophthalmology service. The picture of the Tele-ophthalmology unit is shown in Fig.8.

**Telehealth Industry in India** ¹⁹

Technically India is now self sufficient in meeting the need of hardware, software, connectivity and services. Industries providing hardware and software support are Apollo Telemedicine Network Foundation, Chennai; Online Telemedicine Research Institute, Ahmedabad; Televital India, Bangalore, Vepro India, Chennai and Centre for Development of Advanced Computing.

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![Fig.8 Vans-Mobile Tele-ophthalmology](image-url)
Table 1  Statistics of Mobile Teleophthalmology service by Shankara Nethralaya, Chennai (upto March 16, 2005)

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Camps</td>
<td>315</td>
</tr>
<tr>
<td>No. of patients examined</td>
<td>15,043</td>
</tr>
<tr>
<td>No. of Teleconsultations</td>
<td>5,852</td>
</tr>
<tr>
<td>Spectacles given</td>
<td>819</td>
</tr>
<tr>
<td>Bangalore Teleconsultation</td>
<td>250</td>
</tr>
<tr>
<td>Awareness meeting attended</td>
<td>14,791</td>
</tr>
<tr>
<td>Door to Door Enumeration</td>
<td>7,393</td>
</tr>
</tbody>
</table>

Conclusion

e-health services are being adopted by e-health provider organizations in India gradually. The growth of e-health services has given rise to the need for a new breed of e-health professionals, e-health administrators and e-health technologists. This industry needs people who can understand any two of e-health, business and technology. Historically the e-health industry has been the last adopter of technology; the same has been the case with e-health education. Even till today, many of the medical, dental, nursing, pharmacology and other e-health degrees do not have courses on information technology. The industry has grown to such a size that people from non-e-health backgrounds are being recruited and trained. Interestingly, a lot of youngsters with traditional e-health degrees such as MBBS and BDS are exploring career options in e health. As technology is pervading more into our education system, learning is becoming “anywhere and anytime”. E-learning enables students to study and appear for exams at their convenience from any place they want to, as long as they have a good internet connection. Some forward thinking companies such as Medvarsity have started offering e-health courses to e-health students and practitioners. It is helping medical students to prepare for higher studies through online courses. It also has courses directed to both students and practitioners. e.g. -courses in subjects such as emergency medicine, health insurance, etc. E-Health service companies can get business more easily if their employees’ qualifications are recognized by their clients. Since majority of revenue comes from American companies, many companies are encouraging their employees to enroll for online e-health courses recognized by American educational institutions and associations. In the coming years India is going to have more e health activities considering the present trend.

References

[15] Telemedicine Application in Maha Kumbhmela (Indian Festival) with A Large congregation (Poster); Saroj Kanta Mishra, Archana AyyagariMahendra Bhandari, B S Bedi, Ragesh Shah, 9th Ninth Annual Meeting and Exposition, 2004, Tampa Convention Center, ATA, Florida

— 180 —
9 Indonesia \[^{41}\]

**Background**

Indonesia is an archipelago, a country of thousands of islands (≈13,000) with a population of 220 million. Medical experts are rarely found and they are unevenly distributed; primarily in the main cities in Java and Bali; such as Jakarta, Bandung, Surabaya and Denpasar. The wide-span and the nature of the country that consists of many islands is the main constraint in raising social health care of the people. Therefore, telemedicine is arguably the most suitable tool to solve the community health problem in the country.

Here, we describe some of Indonesia telemedicine expertise. Since most of the activities are not well disseminated to the publics and scientific meetings in this field are a rarity, not to mention that telemedicine in itself is quite a new technology for the country, this presentation will only cover a part of it. Nevertheless, it will hopefully be able to spot the past, current and future developments of telemedicine in Indonesia.

*Telemedicine in Indonesia: Past and Present Activities*

The first computer and satellite based telemedicine experiment in Indonesia was conducted in 1985 — 1987, along side with other academic interaction in the SHARE (Satellite for Health and Rural Education) project sponsored by INTELSAT to commemorate her 20th anniversary. The Faculty of Medicine Diponegoro University (Semarang, Central Java) and the World Health Organization (WHO) conducted a teleconference on Tropical Diseases with medical societies in Canada, the USA and Europe. The information exchanged was in a text mode. The results were evaluated in terms of technical performance and user’s subjective evaluation.

In the early nineties we conducted a low cost “Still Picture Transmission by Narrowband Technique” for educational and medical services, and continued by a series of image processing experiments in a laboratory scale, which required further field tests regarding operational application.

A new regional cooperation called PARTNERS (Pan Asia-Pacific Region Telecommunication Network for Experiments and Research by Satellite) sponsored by the Ministry of Posts and Telecommunications (MPT) of Japan and managed by ARIB (Association of Radio Industries and Business) was introduced to conduct experiments on ETS-V L-Band (Engineering Test Satellite-Five) transmission and its application. The 64 Kbps stream was utilized for slow scan video lectures among our PARTNERS members (1992–1997). The finding was that this kind of application can be used appropriately for educational as well as for medical communications. Tokai University’s School of Medicine was one of the most prominent members and partners for Institut Teknologi Bandung (ITB).

In the year 1997, a satellite based telemedicine experiment was conducted between three

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institutions: Faculty of Medicine and Faculty of Engineering of the UNJANI (Universitas Jenderal Ahmad Yani) in Bandung as the center/control station, while the Central Hospital of Mataram (Lombok, about 500 km east of Bali) and the “Harapan Kita” Hospital in Jakarta as the clients. The demonstration was on maternal care using three full television party conferences dedicated for the development of remote/outreach in the Eastern Territory of Indonesia.

Another joint Post-PARTNERS telemedicine experiment was the wireless based telemedicine system (Fig.2) connecting two Schools of Medicine in Bandung, Hasan Sadikin Hospital (RSHS) and UNJANI, by 2.4 GHz Wireless LAN, through JCSAT 3 satellite link between ITB and former CRL (Communication Research Laboratory, now become NiCT: National Institute of Information and Communication Technology) in Tokyo, further connected by ISDN to Ohkura National Hospital in Hibiya, Tokyo.

Meanwhile, research on image coding and information search and exchange has been conducted since 1999. In 1999, a research paper on a neuro-VQ X-ray image coding system was presented in IEEE-ISPACS [2]. The system (Fig.3) is further developed and designed for telediagnostic purposes [3] and implemented in a web-based system that was reported recently in APT Workshop India, 2004 [4]. Some encoding-decoding results are displayed in Fig.4. At present, we are working on a new image C-S coding based on wavelet and the decoding results for the system’s prototype are displayed in Fig.5.

Fig.2 Early 2.4 GHz Wireless LAN-based Telemedicine connecting ITB, UNJANI, Hasan Sadikin Hospital (Indonesia) and CRL, Ohkura Hospital (Tokyo)

Fig.3 Block Diagram of VQ-Based Client Server Image Coding for Telediagnosis
Fig.4 Retrieved X-ray image of articulation genu with osteoarthritis (osteophite) at client side showing (a) reconstruction by VQ at low rate, (b) enhanced image at ROI after sending the residual image and (c) zoom of (b) around ROI. Blocking artifact due to VQ coding is observed in (c) at the outer of ROI when the image detail is observed. On the other hand, the image inside ROI is perfectly reconstructed. Medical analysis is being conducted in ROI which shows osteophite (contrast and intensity of the images have been adjusted for a better print view).

Another activity on telemedicine is being conducted in the Biomedical Laboratory (now, the Graduate School of Biomedical Engineering) ITB. Focusing on telemedicine for Primary Community Health Center (Puskesmas) in the country, the research team developed an internet-based telemedicine system. Applications being served include the following: tele-consultation, simple tele-diagnostic, tele-coordination, tele-education and a drug database. This activity is supported by a grant from the PanAsia Foundation. Some of the initial results have been reported at the first APT Telemedicine workshop [6, 7].

At the Faculty of Medicine, Padjajaran University, a group of researchers developed telebiomicroscopy [8]. In the system, a biomicroscopic image of eye disease is transmitted through a wireless communication channel. It is concluded that the diagnosis of eye disease
Fig.5  Prototype of wavelet-based quality-adjustable coding with rectangular ROI, showing three-levels of reconstruction (extendable to N-level). Even at the lowest reconstruction level, the image visual quality is very high although some information is lost. At the highest level, the image at ROI is perfectly reconstructed

can be conducted remotely by a telemedicine system. Another research group conducted experiments on hemodynamic status of critically ill patients’data [9] which is then transmitted via a communication line. The haemodynamic deals with cardiovascular performance in supplying oxygen to peripheral tissue to maintain metabolism. It was reported that the experiment results are promising.

Besides of the universities, some telemedicine activities are also being conducted. At PT Telkom (National Telecommunication Company, Indonesia) R&D Center, a group of researchers have developed a web-based medical information system for the public community [10]. The system integrates a medical information database and information delivery system using Wireless Access Protocol (WAP). The current ongoing research is being supported by a grant from APT.

The second notable activity was initiated by MediFa. Their system utilizes a videophone connecting a primary care clinics and a referral hospital. The features being introduced are tele-consultation and tele-education [11]. Recently, this system is extended by using the most recent technology available in the local market: the video streaming, SMS (Short Messaging System), and WAP are to be used by family doctors [12].

The Future of Telemedicine in Indonesia

The above mentioned activities are certainly not a complete list. It is noted that telemedicine
has also begun to attract also interests of the telecommunications society [13] and policy makers [14] too. Trends in communication technology will also greatly influence telemedicine.

In rural areas, internet and wireless communication is growing rapidly. Wireless LAN technology on 2.4 GHz has now become very popular and quite affordable for the community. Focusing on rural areas, special attention should be made on this technology. Telemedicine systems based on this technology have a great opportunity to be developed for the rural areas.

The development of telemedicine in many countries, in some respect, depends on the availability of the equipments within the market, the existing telecommunication infrastructures and the enthusiasm of the users. The current trend among medical doctors or paramedics is the use of the MMS (Multimedia Messaging System) on mobile phone (for example: streaming 3GPP with image capture resolutions of 640×480 pixels; video capture of H. 263 inside 3GP file format/ MPEG. 4, supported by Java MIDP 1.0 technology to send MMS or email to a compatible phone or PC). Data transfer is capable up to 43.2 Kbps in a high speed circuit switched data networks, or up to 40.2 Kbps in GPRS networks) as a communication tool for the first aid in an emergency situation. However, they are quite aware that it is necessary for it to be upgraded or refined to meet the minimum requirements of the medical imaging services.

At present, there is a collaboration project supported by a grant from APT, between PT Telkom (R&D center), Pertamina Jakarta Hospital, Telecom College STT Telkom Bandung, MediFa, the CRL-Japan and the UEC (University of Electro Communication) Japan. The objectives of this project are to develop an integrated medical contact center for enhancing public health services in Indonesia using a combination of the most up-to-date technology available in the market. The system will be accessible through a hand phone with WAP (Wireless Application Protocol) capability, SMS (Short Messaging System), as well as over fixed land phone and fax machine, which then will be answered via IVR (Interactive Voice Response system) or a human operator, in additional to being accessible through the internet. This integrated medical contact center provides easy access to the medical database for people.

Parties involved in telemedicine within the country: government/regulator, research centers / universities, industries/telecommunications operators, NGO and the users, should works hand in hand to develop this technology for the sake of the community’s health (Fig.6). At present, the cooperation among the players and the coordination between parties in the same sector-research centers is not well established.

**Issues**

Last but not least, there are some remaining issues to be addressed in conducting telemedicine activities, among others are:

- **Who pays?** Most of the patients who need help belong to the poor, located in remote areas where the communication infrastructures are poor. Satellite communication systems are expensive and the interface equipments for telemedicine are scarce. This requires huge funding.

- **Diagnosis at a distance.** There are problems in providing the equipment for a proper and responsible diagnosis at a distance. Another problem is the cultural environment or background, which could be refused because of a more traditional way.

- **Legal issues : who is responsible for the remote patient?** This issue needs a firm act, whether it is a state regulation, accreditation or a liability which involves agencies and/or
professionals.

- Medical Laws: who has the duty to whom? How far are medical practices without direct examination considered with regards to ethics?

- Privacy and confidentiality of the patients which must be protected in the radio and digital environment.

- The necessity to anticipate some structural changes in traditional e-health delivery is another problem.

- Other issues to be considered are results of the fast development in technology and human dynamics.

- Overall, it is vital that we need to know the acceptance of all sides which are involved in this system.

Acknowledgements

The authors would like to acknowledge Prof. I Nakajima and the Telecommunications and Microwave Laboratory, EE Department ITB, for their continuous support on our telemedicine activities.

Reference


Image Coding System for Mobile Tele-diagnosis: A preliminary design and result", *Proc. of APT Workshop-MCMT02*, Jakarta, Indonesia, pp.130–133


10 Japan

This report consist of the following two parts; A: the outline of JICA’s policy to aid a developing nations in the field of ICT and B: Japanese trends in the telemedicine policy.

A: JICA’S development assistance policy to healthcare in developing countries through better use of ICTs

1 Japan’s ODA

Currently in Japan, various groups and organizations-the central government, international organizations, non-governmental organizations (NGOs), and the private sector-are providing assistance to support socio-economic development in developing countries. Assistance in the form of funding and technical cooperation provided by the government is called official development assistance (ODA).

According to Japan’s ODA Charter revised in August 2003, the objective of ODA is to contribute to peace and development in the international community, and thereby to help ensure Japan’s own security and prosperity.

2 JICA’s Assistance

Founded in 1974, the Japan International Cooperation Agency (JICA) is an implementation agency for technical assistance, focusing on institution building, organization strengthening, and human resources development that will enable developing countries to pursue their own sustainable socio-economic development.

JICA’s work is broad in scope and reflects international concerns and changing needs in developing countries. To traditional sectors such as agriculture and social infrastructure, JICA has recently added assistance to combat infectious diseases such as HIV/AIDS and SARS, support to encourage free market economies or set up legal systems, and support for the peace-building and reconstruction efforts in such countries as Afghanistan and East Timor. In future programs, greater involvement on the part of Japan’s local governments, NGOs, universities, and ordinary citizens is planned.

3 JICA’s ICTs for Development Policy

Under the framework of “Comprehensive Cooperation Package for Bridging the International Digital Divide” following G8 Kyushu-Okinawa Summit, JICA published two policy documents, namely “The Information Revolution in Development Assistance” (June 2001) and “Approaches for Systematic Planning of Development Projects-Information and Communication Technology” (March 2004).

Five key objectives were identified: 1) Strengthening Capacity for IT Policy Formulation; 2) Human Resources Development in IT; 3) Improvement of Communication Infrastructure; 4) Improvement of Efficiency and Effectiveness of Every Sector through the Use of IT; and 5) Improvement of Efficiency and Effectiveness of Development Assistance through the Use of IT.

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42 Mr. Ichiro TAMBO, Japan International Cooperation Agency (JICA), Shinjuku Maynds Tower Bldg. 2-1-1, Yoyogi, Shibuya-ku, Tokyo 151-8558, JAPAN, Tel.: +81-3-5352-5052 Fax: +81-3-5352-5079/5094 E-mail: tambo.ichiro@jica.go.jp
4 ICT Utilization in Healthcare Sector

ICTs can be applied to every sector, which can improve the quality of JICA’s assistance and expand its scope. ICTs are especially useful for (1) collecting, compiling, disseminating and sharing information, and (2) implementing distance assistance and follow-up assistance.

In healthcare, ICTs have possibilities for applications in:

- Improvement of the quality of medical staff and data collection for healthcare through distance information provision and/or exchange;
- Efficient consultation;
- Cross-border consultation

Issues to be considered in this sector include: economic efficiency; operation and maintenance of equipment and materials; confidence among healthcare professionals; quality of medical care; security and privacy protection; and legislation.

B: Inclined Trends in the Telemedicine Policies of Japan\(^{43}\)

Key words: Aging society, Telepharmacy, ODA

1 Purpose

This paper reports on the findings of an investigation of the status of Japanese telemedicine laws, social insurance medical fee payment fund systems, and their effects from 1997 to 2005. Analyses of telecommunication fees, which will have a significant impact on the future of telemedicine, were made with eventual liberalization in mind.

2 Background

2-2 Medical Expenditures and Deregulation in Japan

There are two potential dynamics at work in the trends and activities of Japanese telemedicine. The first is increasing medical expenses, and the second is deregulation intended to simplify the structure of our society.

Consider the first force, medical expenditures. Medical expenditures account for 7.3% of the Japanese national budget, and this figure is increasing at an annual rate of 5%. In recent years, halting or slowing soaring medical expenses has become a matter of national urgency. Consequently, telemedicine has received a great deal of attention, as it is viewed as a means by which the efficiency of medical systems can be increased.

In regard to the second force, individual ministries and agencies have been reviewing deregulation measures since the beginning of the 1990s. A substantial effort was made to

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implement deregulation, in an attempt to increase the efficiency of medical treatment and reduce medical expenses. In the field of home medical care or DPC/RMO, the “face-to-face examination principal” (Article 20, Medical Practitioners’ Law) was revised. Acts prohibiting home-delivery services for prescriptions (Article 37, Pharmaceutical Affairs Law) and those prohibiting home services for nurses and physicians were also revised.

3 Investigation of the System

3-1 Direct Patient Care

HPB #1075 (Official notice issued by the Director General of the Health Policy Bureau, Ministry of Health and Welfare)
On December 24, 1997, a history-making notice in the Japanese medical industry was issued to all prefectural governors by the Director General of the Health Policy Bureau. The official notice describes the Bureaus’ basic position regarding the “face-to-face examination principal” of Article 20 of the Medical Practitioners’ Law and on telemedicine. This new notice was announced in response to a report submitted by the Telemedicine Research Group (Ministry of Health and Welfare), which has been studying the issue since 1996. The noteworthy points of the official notice are summarized in the 10 items below (see attached information). The most significant point is the Bureaus’ approval of the use of DPC, particularly in emergency situations.

1. Telemedicine utilizing telecommunication and IT (Information Technology) devices does not infringe on Article 20 of the Medical Practitioners’ Law.
2. Telemedicine complements “face-to-face examinations” and should be administered to patients with chronic diseases who are in stable condition.
3. Telemedicine should be administered in accordance with patients’ requests, and must be beneficial to the patient.
4. Telemedicine can also be administered to patients who are otherwise unable to have a “face-to-face examination” with a physician, such as patients in isolated areas and bedridden elderly patients. (DPC approval)
5. Not only does Telemedicine enable sufficient explanations to be provided by attending physicians, it also clearly defines the responsibilities of the patient.

3-2 Telepharmacies

Official notice #90 issued by the Division Chief, Pharmaceutical and Medical Safety Bureau, Planning Division

An official notice pertaining to the matter of the “Receiving of prescriptions by fax and the home delivery of prescriptions to patients” was issued on December 25, 1998 by the Division Chief of the Pharmaceutical and Medical Safety Bureau’s Planning Division, Ministry of Health and Welfare. This notice was intended to provide information on the Pharmaceutical Safety Bureau’s activities, and was written in response to another notice issued to various ministries and agencies pertaining to “Initial views on deregulation,” dated December 15, 1998.

This does not mean that there were no instances of pharmaceuticals being delivered to patients’ homes prior to official notice #90. For example, there have been cases in which peritoneal lavage fluids were delivered to CAPD (continuous ambulatory peritoneal dialysis) patients, as the fluid is very heavy. In such cases, the pharmaceutical manufacturer used a parcel delivery service to deliver the fluid to the patient’s home.

— 190 —
Official notice #90, however, makes it legal to receive prescriptions through telecommunication lines and to send prepared prescriptions by mail, provided that the service satisfies the conditions specified below. It should be added here that Article 9 of the Mail Law stipulates that a patient’s privacy must be strictly guarded and that delivery personnel are responsible for doing so.

1) Patients must agree to receive deliveries made by persons other than a pharmacist.
2) Delivered prescriptions must be verified as being identical to the prescription order transmitted by fax.
3) Said pharmacy must have records of the drugs dispensed to said patient.

3-3 Payment of Telemedicine Fees (corresponding actions by the Social Insurance Medical Fee Payment Fund)

Actual funding for telemedicine by the Social Insurance Medical Fee Payment Fund began in Japan in April 2000. More specifically, the Fund for the payment of medical expenses approved that “telediagnosis using pathological images during surgery” can add points in the table of points for fees[6, 7]. However, the conditions were limited in this case, as described below.

(1) Facility standards subject to prior notification and approval (In general terms, must be highly advanced medical treatment centers: consultation recipient)
(2) Medical institution with a clinical engineer on staff with more than five years of experience in the field of pathology (consultant)

In the future, telediagnosis utilizing x-ray images or endoscopic images may gradually be incorporated into the medical billing system, but it is not clear when this will come about.

4 Observation

4-1 Prospects for Home Medical Care in Japan

First, let’s look at the prospects for Japanese home medical care by introducing an example in which DPC and telepharmacies are combined. A case in point is the “Multimedia Village Project” in Katsurao village in Fukushima prefecture, in which telecommunications and IT networks were installed through subsidies from the Ministry of Posts and Telecommunications’ “Municipality Networking Facility Development Project” of 1997. There were three main objectives of the “Multimedia Village Project.” The first was to promote communication between villagers, the second was to compensate for the various disadvantages of rural living, and the third objective was to eliminate disparities with urban areas. In order to achieve these objectives, “Reexamination via interactive TV phones with ISDN (Integrated Services Digital Network) connections and drug delivery service by mail” were implemented. This system is currently in operation primarily for patients with chronic disease, but TV phones (Phoenix mini) have been installed in all village households (500 in total). Furthermore, medical institutions (outside of the village) — as many as nine hospitals, including those illagers’ regular hospitals — were connected to the network of TV phones. Based on this network between patients and hospitals, the system works in the following manner. First, Hospitals administer DPC to patients with chronic diseases based on data (i.e., electrocardiograms) obtained from their bio-data-retrieving terminal (NEC product: Sukoyaka-mate). Second, upon completion of the examination, the prescription is sent to the pharmacy. The prescription is then filled and sent from the pharmacy to the post office. Finally, the medicine reaches the patient by regular mail, and telepharmacy Service is complete (Fig.1). All medical and prescription bills can be paid through the use of postal money orders.
Here, we would like to elaborate on the prospects for home medical care. The Figure 2 shows the estimated transition of the senior-citizen’s ratio. It is predicted that by the year 2010, Japan will be second to none in terms of its drastically reduced childbirth rate and the consequent aging of society, with 22.0% of the population being senior citizens 65 years of age or older.

In the year 2000, the elderly in need of care — 1) Bedridden, 2) Dementia, 3) Senile — was total 2,800,000 people (Fig.3). However, special nursing homes in the year 2000 was only accommodate up to 692,000 people. Therefore, 2,100,000 people was receiving care at home, either from their family members or a home helper. By the year 2010, the total number of elderly in need of care is expected to increase to 3,900,000. The maximum capacity at that point would only total up to 800,000, and it is estimated that 3,100,000 elderly will be potential candidates for home-care. We feel that DPC utilizing interactive TV conferencing systems through ISDN (Integrated Services Digital Network) lines, in tandem with telepharmacies, would effectively enhance the quality of home medical care. This is due to the fact that most patients in need of home medical care or home-care are those who have a chronic disease but are in stable condition, and for whom DPC would therefore be a viable option. To patients in stable condition, the administration of medication through mail delivery is not regarded as having a high risk potential in comparison with that to patients who are in serious condition or are under immediate intensive care. There is another reason

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**Figure 1** DPC and Delivery of Drugs by Mail

**Figure 2** Transition of Senior Citizen’s Ratio in Japan (Estimate) [1995-2025]

**Figure 3** Number of elderly in need of support (Estimate)
that DPC and telepharmacies may spread and be widely accepted: the ability of a patients’ family members to consult a physician in their homes. This would be a great help to family members who must provide long-term care for their loved ones. Due to Japan’s unique background, it may become a huge telemedicine market for home medical care and home-care.

4-2 Outsourcing and Telemedicine in Japan

Rationalization within the medical field is progressing at a rapid pace due to stagnant economic growth, low birth rates, and our aging society. Japanese hospitals, which formerly functioned as “stand-alone” (self-sufficient) entities, are resorting to a similar course of action as hospitals abroad. That is to say, they are outsourcing linen supplies, meals, clinical testing, and the filling of prescriptions in order to rationalize the business-administration aspects of hospital management. “Filling prescriptions” refers to the preparation of medication in which the amount and combination of drugs is adjusted based on a patient’s age, weight, and the like. It should be mentioned here that the three largest profit margins (profits derived from the difference between wholesale prices and patients’ retail prices), which may or may not put hospital business administration in the black, are as follows: 1) drugs, 2) clinical testing, 3) artificial dialysis. The current Japanese prescription-drug market totals 21. 4-billion dollars ($1.00 = ¥100). It is expected to achieve an annual growth of 12% within the next five years, and the market is expected to total approximately 37.6-billion dollars in the year 2005. In spite of the large market, most pharmacies are individually owned small businesses. We believe that the telepharmacies created by official notice #90, issued by the Division Chief of the Pharmaceutical and Medical Safety Bureau’s Planning Division, will be effective in the field of pharmaceutical outsourcing in the future. The integration of small pharmacies and large corporations is also likely.

On the other hand, there are no legal barriers on the outsourcing of image diagnoses in Japan. However, the authors of this paper believe that inter-hospital “Second Opinions” (X-ray images, specialized image diagnosis, pathological images) will not progress to the extent that the pharmacies mentioned above (The telepharmacies) will. This is due to the fact that the Japanese medical funding system is fundamentally different from its American counterpart, in that the Japanese system does not take into account the “evaluation (experience or track record) of the examining physician” in its payments. Put more simply, the same number of billable insurance points (money) is calculated for payment by the medical funding system, regardless of who interprets an X-ray image. Insurance points do not reflect whether a specialist or an intern just out of medical school with minimal experience is interpreting an X-ray image. Moreover, there is no “ranking of physicians” or “ranking of hospitals” in the Japanese medical system. That is to say, communication may occur between hospitals seeking or providing a “Second Opinion” in Japan, but only due to the humanitarian spirit and the belief in community service. This is due simply to the fact that there is no advantage whatsoever to such communication to the business-administration side of the hospital. The authors of this paper believe that inter-hospital telecommunications for “Second Opinions” will not initially represent a large market, due to Japan’s current insurance policies and billing system.

If there could be a market in which “Second-Opinion Centers” would be viable businesses, it would have to be a case in which a hospital has no choice but to recover the initial costs for very expensive medical equipment, specifically special imaging devices (MRI, CT-SCAN, Electronic endoscope, etc). In addition, hospitals would be forced to operate and transmit images so that they could accumulate billable insurance points, simply to pay the initial costs for the equipment purchased. This may be regarded as a viable application of telemedicine, but strictly from the standpoint of business administration. This case illustrates the point that
immediate growth in image-diagnosis outsourcing is not possible without some advantage or incentive attached to its implementation. To cite an example, in April 2000, the Social Insurance Medical Fee Payment Fund approved the use of insurance points as payment for the remote diagnosis of pathological images during surgery. However, the annual number of consultations regarding the remote diagnosis of pathological images during surgery is considered to be extremely small in terms of market size, totaling some 2000 consultations nationwide in 80 Japanese medical schools (one to two schools/month). A second factor in “Second Opinions” encountering difficulty in the initial stages is barriers within the medical education system. Strong factions and affiliations between Japanese universities remain, and it is considered taboo for most universities to request a consultation or “Second Opinion” from medical institutions outside of their own faction or affiliation.

4.3 Telecommunication Fees (Free Market vs. Management Policies)

The state of Japanese national finance is extremely severe, with the national deficit constituting 10% of the GDP, and total accumulated debt amounting to 108% of the GDP. This current state of national finance is worse than that seen in New Zealand in 1984. In addition, current government policy on public enterprises (including the telemedicine project) requires that not only the central government but also the local government pay (up to 25%-50%) for the enterprise. Finances at the local government level are also becoming an extremely serious problem. There is reason for optimism concerning the widespread use and application of telemedicine in terms of the legal framework and basic technology. However, the implementation of telemedicine-related projects involving local government is in fact at a standstill. This is due primarily to the fact that Japanese local governments nationwide are in a state of virtual bankruptcy due to insolvency. In view of this situation, there is no choice but to limit the implementation of such projects. The implementation of telemedicine in Japan must, for the time being, be limited to operations at individual hospitals and private corporations. At this level, the key to the widespread use and application of telemedicine is minimizing telecommunications fees, which represent the majority of running costs. Generally speaking, there are two ways to minimize telecommunication fees. One is to create a free market and reduce fees through competition. The other is to adopt a management policy (Universal Service) and lower the fees on specific charges.

New Zealand was one of the first nations in the world to strive to create a free-market system [11]. The country embarked on major reforms, starting with a change in the ruling party from the National Party to the Labor Party in the national election in July 1984. As the results in graph 5 indicate, the charges are only slightly less than those for NTT (Nippon Telegraph and Telephone Corp.). In short, telecommunication charges are not necessarily less, even in a free-market system. Even the United States, with its inexpensive fees, is implementing a type of management policy (Universal Service) that indirectly supports telemedicine. The authors of this paper are convinced that unless a Japanese version of Universal Services is created, we will not see the widespread application of telemedicine in Japan. As of the summer of 2000, we have yet to see the formulation of a study committee on a Japanese version of Universal Service, initiated by the Telecommunications Policy Bureau of the Ministry of Posts and Telecommunications. Even if such a committee were to be formed after the year 2001, the committee would require several years to make its findings. Therefore, any implementation thereof would certainly come after the year 2005. It is our observation that without the enactment of a Japanese version of Universal Service, inter-hospital communication for “Second Opinions” will not occur to a great degree in Japan.
4-4 Philosophy of Telemedicine

The Gigabit Policy of the Ministry of Posts and Telecommunications was implemented in 1997 in parallel with the implementation of telemedicine. This policy has brought about a communication environment enabling enormous amounts of medical information to be transmitted. This Gigabit Policy connects major institutions (Universities, National Medical Schools, and Institutes) nationwide to an ATM network. Singapore is the only other nation besides Japan that is attempting to install a Gigabit (high-speed) telecommunications network in every home, office, and building throughout the country. The environment for telecommunication systems is such that one of the highest-speed telecommunication systems is already available in Japan if telecommunication fees are of little concern (i.e., for telecommunications with little or no effect on hospital management: public enterprise in education and emergencies, etc.). There is a very real possibility that many Japanese will benefit from various telemedicine applications in the not-too-distant future. For example, all homes may be equipped with an ISDN (Integrated Service Digital Network) connection enabling telediagnosis. The “three-hour wait for a three-minute examination” characteristic of outpatient treatments (in cases in which the patient’s disorder or ailment is not extremely serious) will become a thing of the past. Instead, we will all be able to receive examinations from superior physicians “whenever and wherever” we choose.

Medicine and medical treatment began in ancient times, with faith healers and shamans and their fortune-telling magic rituals. Leaving the issue of accuracy aside for a moment, the basic principle of providing treatment on a one-on-one, face-to-face basis with the patient was upheld even in those times. This is due to the fact that it was understood that the single most important principle of medical care is to provide satisfaction for the patient.

It can be assumed that the advent of high-speed digital or fiber-optic telecommunication will bring about unbelievable social reforms. However, we must be careful to remind ourselves
that telemedicine utilizing telecommunication lines is clearly a deviation from the “face-to-face examination” principle. We also cannot deny the fact that telemedicine can be used on the medical side to suit its needs. The authors of this paper are in agreement that telemedicine should not be implemented or administered for the purpose of reducing medical expenditures or to provide convenience for physicians. Particularly regarding the area of DPC, all subsequent examinations, diagnoses, and treatments must be solely for the benefit of the patient. Telemedicine should never be forced on to a patient; rather, the patient must want it. The reasoning behind this is simple: medical care is a humanitarian volunteer service built upon patients’ satisfaction.

Conclusion

Trends and activities regarding telemedicine were analyzed through a review of the relevant laws and the medical funding system during the period between 1997 and 2004. A milestone in the telemedicine field occurred in April 2000, when the medical funding system approved the use of billable insurance points for the “remote diagnosis of pathological images during surgery.” This date essentially marks the commencement of telemedicine in Japan.

Annex 1

HPB 1075
December 24, 1997

To: Prefectural Governors

From: The Director General, Health Policy Bureau Ministry of Health and Welfare

Title: The use of Communication and Information Technologies to Deliver Medical Care—Telemedicine—

With recent advances in communication and information technologies, the potential benefits of telemedicine, that is, use of communication and information technologies to deliver medical care (will called telemedicine hereafter) are becoming well recognized.

Some telemedicine applications, in particular those between hospitals and physicians or dentists, have already come in practice. Examples include the use of telecommunications to transmit diagnostic images such as pathological images from physicians or dentists to specialists for consultation.

From now onwards, telemedicine is expected to be used for a variety of purposes.

Telemedicine might be used, for example, to deliver care based on technology such as video to people in their home in isolated islands or remote rural areas where face-to-face contact with physicians or dentists is hardly available.

The use of telemedicine between hospitals and physicians or dentists would not be contrary to Article 20 of Medical Practitioner Law and Article 20 of Dental Practitioner Law (which will be called Article 20 of Medical Practitioner Law hereafter), since care is given face-to-face in this case. The issue arises in the use of telemedicine with respect to Article 20 of Medical Practitioner Law, however, when care is delivered to the homes of patients.

Under such circumstances, the principles which telemedicine applications should be based on are shown below. Listed also in the following are what should be noted in the use of telemedicine with respect to Article 20 of Medical Practitioner.

The following shall be noted and known to those who may concern.
A copy of a published report from a study group on telemedicine, founded by the Ministry of Health and Welfare, is included herewith for your reference.

1 Principles

Medical care should be given face-to-face in principle, and telemedicine should be used to complement face-to-face care.

The term “medical consultation” referred to in Article 20 of Medical Practitioner Law implies conduct of medical practitioners which, from viewpoint of modern medicine, allows a certain diagnosis to be established for a given disease irrespective of means such as anamnesis, inspection, palpation, auscultation, and so on. The use of telemedicine therefore would not be contrary to Article 20 of Medical Practitioner Law when information about the patient’s conditions may be obtained which is, if not equivalent, as useful as to substitute for information obtained from face-to-face contact.

The following shall be noted for the time being for the use of telemedicine to be put into practice appropriately.

2 Notice

(1) For the first time visit and for individuals who are acutely ill, face-to-face contact between physician and patient should be provided.

(2) Telemedicine should be used for patients with stable clinical condition, for example, such as those who are chronically ill and who have long and continuously been receiving care till quite recently.

(3) Telemedicine should be used only when it is difficult to deliver face-to-face care. Example might be the delivery of care to those who reside in isolated islands or remote medically underserved areas where time exhausted for traveling and/or danger incurred when physicians or patients have to travel for consultation make the delivery of care via telemedicine the only choice. Whenever face-to-face care is available at the site of care or is made available by affiliating with other clinical institutions, face-to-face contact should be performed.

(4) Telemedicine should be applied upon request of patient taking into account the benefits of the patient, and telemedicine services should be used on combination with face-to-face care.

(5) When starting telemedicine services, sufficient explanation should be given to patients and their family, and their understanding should be confirmed. It should be explained in detail how to use the information and communication devices and their characteristics.

(6) When transferring video images of a patient, consideration should be given to patients privacy. In particular, for videotaping of patients and storing images, care should be given regarding patients will.

(7) In case of malfunctioning of communication devices, measures should be discussed sufficiently with a patient and physicians or dentists.

(8) Article 24 of Medical Practitioner Law and Article 23 of dental Practitioner Law about entering medical record apply equally to telemedicine services as to face-to-face delivery of care.

(9) Physicians or dentists who conducted medical care are responsible for medical services when delivered by means of telemedicine.
(10) A patient and his or her family should be fully informed in advance that when some damages incurred on a patient during delivery of telemedicine because they did not follow the instructions or note, the patient and his or her family are responsible if they are fully given instructions and note by physicians or dentists in advance.
11 Kenya

Methodology applied by ITU for the development of the Telemedicine Project “The Global Fund to Fight AIDS, Tuberculosis and Malaria”

Background

The Republic of Kenya is situated Eastern Africa, bordering the Indian Ocean, between Somalia and Tanzania. It has a total area of 582,650 sq km and a population of 33,829,590.

Introduction

As a follow up of its internationally recognized prior pioneering records in the telemedicine domain, ITU has received a formal request from the Administration of Kenya for a guidance and assistance to develop an innovative telemedicine project.

Towards this end the Board of Communication Commission of Kenya has committed the amount of US$ 300,000.00 as recipient country contribution seed money to be used for fund rising action by ITU with potential sponsors once the project document developed, but on the condition that ITU will also commit financial contribution from its own resources in such an innovative project. Commitment of ITU proper funds was also conditional, based on overall fund rising success of the project.

National Telemedicine Task Force set-up

ITU has recommended to the Administration of Kenya to set up a National Telemedicine Task Force comprised of representatives and experts from the Ministry of Health, Leading Hospitals and Research institutes, Medical Associations and Medical Faculty at the University, WHO Country Office, as well as from the Ministry of Transport and Communications, the Regulatory Agency (Communications Commission of Kenya), Telecom and Satellite Service Providers, Internet Providers and Broadcasters.

As a result the National Telemedicine Task Force was set-up and its National Coordinator appointed.

Project Concept and Project Document Development

Under ITU initiative, the Administration of Kenya has provided excellent working conditions for two weeks meeting in Nairobi in October 2002, where the National Telemedicine Task Force worked jointly with a team of eleven international Telemedicine Experts from Japan, India, Russia and Switzerland, selected and supported by ITU.

The first week was of brain storming nature enabled practical understanding at national level of what the Telemedicine could do as well as to jointly agree on telemedicine project priorities, objectives, areas of operation and cooperation, distribution of tasks, project activities, etc.

The second week required very skillful steering of the project development work done by such an intersectorial and multicultural mixture of eminent international and national experts and specialists. The work usually started every day at 8h30 and was never ending before midnight.

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44 Mr. Petko Kantchev, Former ITU Telemedicine Focal Point, petko.kantchev@itu.int
Saturday and Sunday inclusive.

Lack of skilled medical personnel was identified. In a country of over 30 millions population only six radiology specialists were doing their best to provide their professional service. Majority of medical professionals graduating in Kenya were settling to work abroad for better remuneration. Vast areas and predominant percentage of the rural population were either underserved or not served at all by health professionals. In response the project concept was elaborated to serve the underserved, use more efficiently available medical skills, and enhance the competence and field experience of young doctors/health staff at much higher pace. The priority was given to the early discovery of the decease (malaria, tuberculosis and AIDS), prescribing initial treatment on situ as well as further treatment within the available health treating system of Kenya. It was enabling much higher percentage of recovery of the sick persons with cheaper, shorter and more efficient treatment. The diagnosis was to be made available next day following the check-up. For complicated cases, an international consultation system was conceived. The patients were not to travel away before the diagnosis known and treatment prescribed. Specially designed Mobile Van Medical Laboratories were to be used, interconnected via satellite to the telemedicine centre in Nairobi, where diagnosis made and results automatically transferred to national medical/health statistical data. New technologies were to be used for reliable, efficient and quick check up and screening of all the population in priority areas of high percentage of malaria, tuberculosis and AIDS. The system planned was very flexible to be expanded or restructured. Licensed Kenyan Satellite Service Providers were identified to become the backbone of the system. Extensive measures for staff training, correct operational maintenance, and supply of all necessary medication at Mobile Van Medical Laboratories for one-year period were foreseen. Measures for evaluation of the improvements achieved were also foreseen. We believed that upon successful trial of this project proposal approach, Kenya would become the know-how center of excellence in Africa, promoting and training medical/health professionals from other African countries concerned. We expected that other countries will join, Global Fund expand its funding to similar projects aiming to fight if not eradicating the propagation of said deceases in Africa.

The National Telemedicine Task Force and the international experts have achieved a consensus on the draft project document elaborated. It was also agreed that the National Telemedicine Task Force Coordinator will finalize the project document taking into account the requirements in force of the Global Fund as well as incorporating any further comment submitted by the participants at this meeting by e-mail.

The Global Fund was identified as the key investor for the Telemedicine Project proposal. In accordance with the established rules for application by the Global Fund, it was in the prerogatives the Ministry of Health of Kenya to be responsible for the Telemedicine Project submission to Global Fund for approval.

**Project Document Submission and Lesson Learned**

The Administration of Kenya (the Ministry of Health) has submitted formally the said Telemedicine Project to fight tuberculosis, malaria and AIDS, together with another two Kenyan project proposals, to the Global Fund for funding in mid 2003. From all three Kenyan project proposals received the Global Fund has selected only one for funding with smaller budget than the Telemedicine Project proposal.

The innovative pioneering Telemedicine Project proposal was developed prior to the financial institutions or sponsors being ready to back and fund it accordingly.

From the point of view of the authors of Telemedicine Project proposal, the submission of
three projects for funding has reduced the chances that the *Global Fund* will be willing to take the risk of funding a pioneering project with concept never done before.
12 Kosova

The anatomy of the need

The needs for advanced technology and telemedicine in Kosova are clear and obvious. Kosova medical system and medical education are not up to speed with world standards. The toll of many decades of neglect and occupation, as well as war, has left the medical system in Kosova crippled and in absolute disarray.

June 12, 2005 will celebrate six years since the end of the last war in the Balkans which freed Kosova from the Serbian regime. Although six years have past since NATO and UN took over the security and development of Kosova, the medical needs for more than two million people have not been met.

There is a lack of fundamental medical standards, policies and practice management guidelines. The hospitals are extremely crowded, yet underutilized. There were no new diagnostic or treatment modalities for most of the diseases. There was and still is a lack of the most basic medical systems such as trauma surgery, oncology, cardio-thoracic surgery, spinal surgery, transplant or immunotherapy. A large number of patients were coming back to hospitals with advanced diseases. Most of them could not be taken care in Kosova, thus were being sent abroad for treatment to other countries in the region such as Turkey, Albania, Croatia, Slovenia, Bulgaria, Serbia or other countries. The diseases are diagnosed at the very late stages, and cancer is devastating the region. There is a backlog of operating procedures and the list of patients awaiting operations continues to grow. Patients wait for operations in the hospital for days and weeks, even for relatively minor surgical procedures, for lack of water, electricity, and sterile instruments. There is no one-day or ambulatory surgery. The infant mortality rate is the highest in Europe and new infectious diseases including tularemia and cases of Congo fever are common. Tuberculosis is on the rise. There is a great fear that AIDS will soon become a serious problem in Kosova. The air pollution is extremely high, and there is a lack of public education on health-related issues and health hygiene. Smoking and smoking related diseases are very serious health care problems in Kosova. Found in the middle of this real human catastrophe one has difficulties to prioritize and focus human volunteering energy to help the country in disarray. What should be done first? So we opted to establish sophisticated technological system that will help Kosova for decades to come.

Objectives and Goals of the Kosova Telemedicine Project

We set up objectives that were simple: Implement and establish the Kosova Telemedicine Network and set up a sustainable and functional telemedicine system and network that will provide state-of-the-art medical education, consultation and transmission of medical clinical data between the University Clinical Center (UCCK) and the regional hospitals in Kosova, as well as between Kosova and the international medical community. We were convinced that the realization of these objectives will greatly narrow the gap between Kosova and the rest of the world and to bring Kosova to the current century of medical development. The breakdown of long term goals is outlined below:

1) Establishing advanced and sophisticated communication systems within the UCCK in Pristina and between UCCK in Prishtina and regional hospitals, health houses in Kosova;

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2) Create human capacity to independently run the telemedicine program and all its services (technological, educational, electronic library);

3) Using these communication tools by physicians and patients from Kosova to access first class hospitals and medical institutions around the world;

4) Providing medical students and Medical Faculty in Prishtina and its Dentistry, and Pharmacy branches with electronic medical books, scientific journals and other teaching and didactic materials that are equal to that of peers of medical schools through out Europe and the Western world;

5) Developing, popularizing, and integrating telemedicine applications with special attention to the most remote areas of the country;

6) Integrating health organizations, hospitals and medical school in Kosova with telemedicine which will integrate the clinical curriculum of the Medical Faculty of University of Prishtina in Kosova;

7) Developing, conducting and supporting research protocols not only in the telemedicine area, but also in other clinical fields, in order to test and obtain evidence based medicine.

8) Performing outcome analysis of telemedicine applications in Kosova and developing new tools and means to provide telemedicine and virtual medical education, and finally by

9) Creating a web portal and providing links to the existing web-based educational programs in one organized stop.

**Basic Resources and Requirements**

**Philosophy of all inclusive program**

Telemedicine and information technology overall is being introduced in developing countries or countries in transition as a measurement to improve health systems, but more so to improve medical education and narrow the gap between those who have and have not. This is achieved through the efforts to increase medical technology standards. This was a case with Kosova as well, but in addition to this noble cause it was set up to serve as the center for excellence in Telemedicine and technology in the Balkans. However, there are significant factors that influence such an endeavour, and in case of Kosova are very favorable. One can summarize the project of telemedicine in Kosova, that in addition to telemedicine it was taking on the creation of the electronic medical library and the electronic laboratories that were missing or were destroyed for the only medical school in the country, where books that students were learning medicine were older than the students themselves!

When an institution or a country decides to implement such programs there are two options: one, to start with a small pilot program, and than have the governmental officials by into it, invest, and disseminate to other sites, and the other one is to start with a robust program, all inclusive, state of the art center and create a very dedicated personnel and a team that will take on an enormous task. **In case of Kosova we choose the later option.**

**Facility**

The TCK is located at the UCCK in Prishtina. It has approximately 1,000 m² and includes electronic auditorium or what we call it classroom of the future, a telemedicine training room, technology laboratories, computers, connectivity, video equipment, video streaming, servers, resource room and an electronic library (Fig.1). All equipment is state-of-the-art, has been selected for compatibility, interoperability, and overall effectiveness and will ensure
sustainability. The electronic library and resource room offers instructional modules with various electronic books and scientific journals through different world wide programs and other publishing companies and resources. It is open 24 hours/365 days a year and is widely used by physicians, medical students, nurses and other e-health professionals.

*International collaboration*

As for any other institution from any developing countries, international cooperation and collaboration is mandatory for successful development. During these three years TCK has collaborated with more than 20 universities and institutions, publishing companies and others to help enrich its activities and knowledge. This successful international cooperation has been in the form of educational programs, videoconferences and seminars, lectures, consultation and other forms of mutual collaboration with European and United States universities and universities from other countries. This activity and partnership is being coordinated into a coherent schedule of year round teaching, curriculum.

The consultations between the Western universities and TCK, and (soon) other regional hospitals in Kosova are conducted live using IP protocols or ISDN mode, or store and forward mode, when applicable. This activity is enriching the expertise and subsequently improving medical care for the people of Kosova, especially in fields lacking in expertise.

*Management*

TPK and TCK is being managed by Kosovar doctors, engineers, nurses and others who have become effective partners in world of global Telemedicine. The technical training is being coordinated by the TCK and Kosova Foundation for Medical Development and is taking place in part in formal training sessions in Kosova, the United States, Europe, and in and other countries. Much more training will be done on site to prepare the students, physicians and administrators to use the equipment in order to make the technology as transparent and user friendly as possible. To ensure sustainability of this project, a permanent part of medical development, a cadre of professionals fully conversant in the technology is being created in order to support the physicians, students, and other e-health workers. These highly skilled personnel have become an integral part of the logistics of project management.

The TCK has created its own **Virtual Private Network (VPN), and Local Area Network (LAN)**. A Telecom of Kosova has installed the ISDN lines, the highest existing quality through out UCCK for the needs of the TCK network.

*Activities*

The establishment of telemedicine protocols, consultation policies, second opinions and development of other modes of collaboration within the centre, and between the UCCK and other regional medical centers in Kosova in the fields of dermatology, pathology, family practice, ENT, ophthalmology, surgery, internal medicine, cardiology, and dentistry have been accomplished. A database of all clinical activities has been created.

This VPN, extended to the operating suites through out the UCCK, is providing abilities for live broadcasting of general surgery procedures, endoscopic procedures as well as dental

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*Fig.1 Learning and Resource Room at TCK*
surgical and is offering telesurgical training and mentoring to a wider audience of local surgeons. Live and interactive teleconferences from the operating rooms are transmitted to a larger audience in one or more classrooms, instead of large groups of students crowding into operating rooms. This also adds significantly to the exposure of medical students to clinical education. This approach will be used for other clinical disciplines, such as radiology, dermatology, infectious disease, cardiology, pathology, psychiatry, pediatrics and others.

As part of Prishtina Summer University (2004) (36 medical, dental, pharmacy, engineering, and business students of University of Prishtina finished successfully a three weeks intensive telemedicine course: “Telemedicine and telehealth in modern medical care”. This course offered state of the art telehealth education and hands on knowledge of the equipment used in telemedicine. These graduated students represent a powerful base of cadre to support and advance telemedicine in this country and ensure sustainability of telemedicine program.

Furthermore, this represent a good base for a one-year fellowship on Telemedicine and e-health that is being developed at the TCK in collaboration with renowned telemedicine programs in the USA, and which will ensure continuation of telemedicine in Kosova, and creation of the sustainable and continuous expertise.

The Learning Center encompasses the latest in image projections systems, interactive capabilities and diagnostic tools. This center has the capability to effectively encompass, store and deliver educational content within the UCCK, regional hospitals and the world. Current systems within the facility allow for acquisition, editing, storage and streaming of educational modules created by the staff of the TCK and its collaborators.

Electronic library

The faculty and the students of UCCK have direct and unrestricted access to more than 2,100 electronic journals, as part of HINARI program, the latest medical publications and books, in the English language through the state-of-the-art electronic medical library at TCK. More than 22,000 visits by doctors, students, nurses and other health care providers have been registered in the electronic library since January of 2003. Through direct relationships with publishers we have ensured unrestricted access to their publications such as Landes Bioscience publisher (Austin, Texas).

Phases of Development and Implementation of a Telemedicine of Kosova:

Phase I

The first year or Phase I, has come to an end and has involved creation of the Telemedicine Center of Kosova in Prishtina as the portal that ensures telecommunications with all clinics and institutes within UCCK. At the same time, preparations are underway to create nine other telemedicine centers in Kosova.

Phase II

In the second year or Phase 2 of the project will integrate the nine regional telemedicine centers in Kosova in Gjilan, Ferizaj, Prizren, Gjakovë, Pejë, Mitrovicë, Skenderaj and two in Prishtina (Fig.2).

These nine centers in Kosova will make arrangement for, and ensure the regional health houses and medical practices will be included in the telemedicine network on the third phase of the project. Their local and regional programs will ensure that proper education is provided for those centers and individuals and make certain proper leadership is in place in preparation for the implementation of the third phase.
**Phase III**

In the third year of Phase III, the health system of Kosova will be fully integrated by information, an instructional and consultative system, and supported by a dedicated network of telecommunications. This will include total access to Telemedicine system in Kosova from every hospital, health house and private medical practice in the country. These will be supported by IP/ISDN or by wireless technology.

**Conclusion**

The telemedicine project of Kosova is without a doubt one of the most dramatic examples of the use of technology in developing countries in an attempt to improve the health status of its people. The TPK has been enthusiastically accepted and adopted in Kosova as the catalyst of information technology and change and as such has become the Balkan’s Center of Excellence for Telemedicine, Telehealth and Telesurgery.

**Suggested Readings :**


13 Latvia

Teleradiology Project

The Republic of Latvia is situated in Northern Europe and has borders with Estonia to the north, Lithuania to the south and Russia and Belarus to the east. In the west Latvia shares a maritime border with Sweden. Latvia has a total area of 64,589 km² and population of 2,302,700. The capital of Latvia, Riga is the largest city in the Baltic States.

“It’s an amazing invention, but who would ever want to use one?” Rutherford Hayes (in 1882), upon using the telephone for the first time.

“Teleradiology is not appropriate if the available teleradiology system does not provide images of sufficient quality to perform the indicated task. When a teleradiology system is used to produce the official interpretation there should not be a clinically significant loss of spatial or contrast resolution from image acquisition through transmission to final image display.” This is only part of recommendations for digital radiography developed by American College of Radiology (ACR).

No one doubt that PACS benefits are numerous. Some of them are:

• Immediate availability of duplicate original images-The system can immediately produce an exact duplicate of the image without loss of image definition that results with film.
• Ability to adjust image contrast and other parameters-Image contrast can be adjusted essentially eliminating the problems of images being “too light” or “too dark.” In addition, images can be magnified, rotated and flipped, measurements can be made and the images can be annotated as needed.
• Increased quality of patient care-The system automatically enters patient demographic and exam specific data on every image, and allows instant access to specific images. The computerized records will be securely archived on a hospital server. Upon request, the patients’ images can be copied to a CD to give to their PCP.
• Improved communication—“One significant advantage is the PACS allows radiologists to type in short reports that are stored digitally and will stay with the images,” said Robert Posteraro, M.D., radiologist on staff at Covenant. “This will certainly improve communication between physicians, which can lead to better care for our patients.”
• Complete image management-Radiology staff will no longer be concerned with tracking down files and travelling to multiple storage areas to retrieve old films. Images will be accessible at all times and instantaneously retrievable

Having in mind the above mentioned, Riga Municipal Agency “Telemedicine Centre” was created. It’s intimate goals are:

• Development and coordination of telemedicine development projects in the City of Riga

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• Development of a single telemedicine network in Riga
• Organisation of practical telemedicine consultations
• Attraction of the EU financing and other international finances to the City of Riga

• The Agency has also created the main Directions of the Development of Telemedicine in the City of Riga, i.e.: teleradiology
  • Telecardiology
  • Patient consulting
  • Telemedicine system in emergency assistance
  • Telemedicine anti-terror systems
  • Home telemedicine
  • Teletraining.

Teleradiology Project of Riga city

This project is developed as part of the activities of Riga Municipal Agency “Telemedicine Centre”. The project has to develop the radiological information system (RIS), the medical image archive and communication system (PACS) and a videoconference system for Riga City medical institutions that would ensure linking of the medical institutions through the Internet and ISDN lines with Latvian hospitals and competence centres of foreign radiologists. The development of the project is a must as at present Latvia suffers from:
  • Decreasing number of qualified medical experts
  • Necessity of involving qualified external medical experts in treatment process
  • Lack of information exchange between Riga’s hospitals
  • The hospitals are partly ready for operation with digital format (only part of apparatuses has DICOM output option)

Teleradiology Project Benefits are:
  • Significantly reduced patient consultation time
  • Substantially shorter time of setting diagnosis
  • Earlier started therapy of the patient
  • Reduced period of time spent by the patient in a hospital
  • Improved general health condition of residents of Riga

Tasks of Telemedicine Centre
  • Financing teleradiology project by using the grant
  • Attracting additional investments
  • Renting the teleradiology system to the various hospitals
  • Central data storage and technical support service

In comparison of many other projects all over the world, Riga teleradiology project will start with renting teleradiology equipment. Advantages of the renting systems as a method of project implementation are:
  • Implementation the project in the maximum number of medical institutions
  • Implement the project under the supervision of the involved municipal department
  • Eliminate the activities related to technical maintenance and service for the hospital
  • Facilitate the establishment of Telemedicine Centre, that will provide common data storage and technical support services

Project Implementation will Reduce

○ personnel costs (reduce of the number of radiology laboratory assistants)
○ material costs (film images)
○ costs for storing of digital data in CDs
Fig.2  Dynamics of Reduced Costs or Alternative Income  
Created by the Project for a Seven-Year Period for one  
Hospital

Fig.3  Dynamics of Expenditure Created by the Project for one  
Hospital

Fig.4  Dynamics of Net Profit Created by the Project for one  
Hospital
**Necessary Hospital Investments**

- repair and development of premises for placement of teleradiology equipment
- installation of ISDN line
- financial investment to cover the additional costs in first project implementation phase

**Teleradiology Project Additional Costs**

- additional expenditures for electricity
- depreciation of capital assets
- payment for rent of teleradiology equipment
- data transfer costs for subscription of ISDN line and INTERNET line
- purchase of data storage floppy disks

**Step-by-Step Implementation of the Project**

- the images fully duplicated by the film images-half a year period
- decrease duplication of images to 50%-one year
- decrease duplication of images till 20%-one year
- about 5% using films for the rest of the seven year period

**The Income From the Project**

- will start with the moment when the digital images will be duplicated by film images only for 50%
- the initial investments of the hospital will be justified in 1.6 years
14 Lithuania

Background

Lithuania (Fig. 1) is the largest and most populous of the Baltic States and has around 100 km of sandy coastline, of which only about 38 km faces the open Baltic Sea. It has a population of 3,592,561 (July 2005 est.) and a total area of 65,200 sq km.

Lithuanian experience — A web based system for sleep disorders management

Sleep complains are common in population affecting their health status and quality of life [1]. Insomnia among sleep disorders is extremely common, affecting at least one third of adults in general and cross-cultural studies. About 85 percent of persons with significant insomnia have never consulted a physician about it [2]. Physicians, especially at primary care level, are not properly trained to diagnose and treat sleep disorders. In 96 percent of cases general practitioners did not ask a patient on sleep complains, and the initiative for discussions arises from the patient [3]. Presently in Lithuania there are only few experts providing treatment of sleep disorders and consultations to patients encountered the sleep problems. Therefore Internet based learning, diagnostic, and consultation tools related to sleep disorders can be expected to have significant medical, social and economic implication for patients, families and health-care providers.

The goal of the study was development of a public Web-based system for sleep disorders management: specialized diagnostics, treatment regimens, education and consultations with physician on sleep disorders, psychoemotional status and quality of life.

Structure of web-based tool

The implemented web based system is based on client-server architecture. The structure of the Web-based system is shown in Fig.2 and 3. The system consists of a number of components: server storing database and controlling main systems functionalities, client providing access to the server, and the network connecting users with the server. System configuration is set up and tested on a fully configured Linux — based web/database server running international open source technologies including Linux operation system, Apache web server, PHP script language, Octave and MySQL database. The system is required to process data supplied by the user in a form of answers to the questionnaires related to the sleep of users. The answers are evaluated, and evaluation results are visualized. The system grants a user a possibility to consult a sleep medicine expert via the internet, and to learn about sleep diseases. The high performance and system reliability is required. A Web-based system is easy to maintain and guarantees user access to the latest, most recent versions. The clients connect to the Web server using Web browser. The web based system consists of a number of different modules.

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User’s registration module supports two types of users: non-registered and registered. The system database collects registered users’ general data (name, surname, date of birth, etc.) and results of number of self-assessment tests.

The web-based expert system contains standard components: a fact base, a rule base, and an inference mechanism. The fact base and the rule base form the knowledge base of the system. The knowledge base consists of linguistic “IF... THEN...” rules and facts about sleep disorders, stored in a MySQL database. The inference mechanism is implemented using PHP scripts which generate diagnosis in a form of probabilities of possible outcomes. The explanatory system presents arguments implying the made diagnosis.
Two types of self assessment questionnaires are available. First type questionnaires (containing 25 Quest and 175 Quest) collect data for a preliminary diagnosis potentially indicating 6 sleep disorders made by an expert system and second type questionnaires (HAD, SF-36 and PSQI) aim to assess sleep quality of a user. Self assessment module includes visualization algorithm implemented in Octave. To pass the data from the web page to the visualization module and to return the results, PHP script is used. The PHP script processes user’s data presented as the answers to a questionnaire and sends them to the Octave program to perform visualization by means of the Multidimensional scaling algorithm. Then generated picture is sent to the patient to show his status with respect to status of other patients in the two dimensional scale of risks. Web page of the system contains learning material such as e-textbooks, frequently asked questions, recommendations about sleep disease treatment, physician-patient dialog via email, information about sleep medicine experts in Lithuania. The Web page disseminates the relevant information, and aids the people to self-assess their sleep. In the present paper main attention is paid to the subsystem of self-assessment. Depending on the results of the self-assessment the patients are taught to improve their sleep, are advised via Internet, and in case of necessity are invited to visit an expert physician.

Sub system for self-assessment

Many people feel that their sleep is not perfect. The first steps towards sleep improvement should be learning, and self-assessment. Activity of a user logged in the web based tool is illustrated in Fig.4. A user logins to the system and his general data is stored in the system database. The user can choose either to make a self assessment tests or to read e-textbooks which contain information about various sleep disorders, educational material on pharmacological or non-pharmacological sleep disorders treatment, and frequently asked questions. We assume that a user of the web page has read general information on basic factors influencing the sleep quality, and has concluded that his sleep improvement is a

![User activity diagram.](image-url)
sufficiently serious health problem. To aid the user to self-assess his health state, he is asked to answer a questionnaire containing 25 questions. The data elicited from answers is visualized showing the point corresponding to the date of the user in the two dimensional scale of risks explained below. The answers are processed also by an expert system. If the user would be assessed as healthy, he would be given some advices how to improve his sleep. The answers can imply a conclusion on the following possible sleep disorders: Insomnia, Sleep apnea syndrome, Restless leg syndrome, Gastroesophageal reflux, Hypersomnia and Narcolepsy. In this case the user is asked to answer the more extensive questionnaire containing 175 questions. The answers imply assessment of the health status. The results again are visualized and shown to the user in the two dimensional scale of risks, and an advice is given, e.g. to contact an expert via e-mail. Before a visit to physician the patient is advised to self-test his quality of sleep, the presence of the symptoms of anxiety and depression, and to assess the quality of life. The web page teaches the patient to understand his health problems and health status, as well as helps a physician to save the time on the diagnostics. Sleep quality complains are particularly relevant to mental illness. The factors relating to anxiety and depression are one of the most concomitants of sleep complains in general population. Because of that the Hospital Anxiety and Depression Scale (HADS) was chosen for assessment of those symptoms [4]. The global score evaluates the level of presence of the symptoms of anxiety, depression, or both, anxiety and depression.

The Medical Outcomes Study 36 Item Short Form Health Survey (SF-36) was used to quantify general health-related quality of life [5]. The multi-item scales of the SF-36 measure even health-related concepts: physical functioning, role limitations as a result of physical health problems, bodily pain, general health perceptions, vitality, social functioning, and role limitations caused by emotional health problems and general mental health. All dimensions reflect physical and mental summary measures.

A patient submits information on his health problems answering the questionnaires mentioned above: PSQI, HADS, SF-36. The user’s data are processed by means of a Multidimensional Scaling algorithm, and the results are presented to the user in a visualised form. A point corresponding to the data of the user is shown in a two dimensional scale of different risks. An advice is given corresponding to the results of the self-assessment. The scale of risks is used to monitor the treatment progress.

We will illustrate the visualization of the results of self-assessment by an example of self-assessment of sleep quality according to the Pittsburgh Sleep Quality Index [3]. The basis for self-assessment is the comparison of the answers of the user with the answers of the patients in data basis of the Sleep Medicine Centre of the Institute of Psychophysiology and Rehabilitation, containing the data on sleep quality of 350 patients. The diagnoses of patients in the data basis are known. The two dimensional scale of risks is formed by means of a multidimensional scaling technique (MDS) [6, 7]. The image obtained by means of MDS is used to visualize the data basis. Let us briefly introduce the idea of MDS. The answers of $k$ patients to $n$ questions of a questionnaire are denoted by $n$ dimensional vectors $X_i$, $i = 1,...,k$, $X_i = (x_{i1},...,x_{in})$, i.e. the set $X_i$, $i = 1,...,k$, corresponds to the data basis of patients whose diagnoses are known. The idea of MDS is to map a set of $n$ dimensional vectors to a two dimensional plane preserving as much as possible the mutual distances between vectors. Mathematically this problem can be formulated as minimization of

$$stress = \sum_{i=1}^{n} \sum_{j=1}^{n} (d_{ij}(Z) - \delta_{ij}(X))^2$$

with respect to $Z = (Z_1,...,Z_k)$, where $d_{ij}(Z) = \|Z_i - Z_j\|$, $\delta_{ij}(X) = \|X_i - X_j\|$, and $\|\cdot\|$ denotes a norm in the $n$ dimensional space and in the two dimensional space correspondingly. The
minimization problem is solved by a hybrid algorithm combining evolutionary global search and local descent [8]. The two dimensional vectors $Z_i$ corresponding to minimum point of stress are images of data vectors in the data basis. The data basis is visualized by means of the Fig.5 where $Z_i$ are shown by points. The patients are classified into four risk groups and these groups can be indicated, for example, presenting different groups of $Z_i$ by different colors. Now we want to show in this two dimensional scale a point corresponding to the answers of the user. Mathematically this problem can be formulated as a minimization problem. Let $Y$ is an $n$ dimensional vector corresponding to the answers of the user. A two dimensional vector $V$ is calculated whose distances from $Z_i$ are as much as possible similar to the distances of $Y$ from $X_i$. In Fig.6 an example of visualization of PSQI data of a user is presented. The new point representing data of new subject shows the position of the user with respect to the patients in data basis; it belongs to the risk group with very bad quality of sleep. The user can estimate also, how his data is similar to the data of other risk groups.

Conclusions

A Web-based tool combining e-learning and tele-medicine techniques is useful to enhance in Lithuania the health care of patients suffering from sleep disorders. Visualization by means of multidimensional scaling improves explanatory possibilities of the expert system for assessment of sleep quality. The on-line visualization of multidimensional data using MDS methods aids the discovery of structural properties of data; inasmuch such two-dimensional visualization extends human heuristic capabilities to analyze multidimensional objects.
The Pittsburgh Sleep Quality Index (PSQI) 16

Subjective sleep quality 2
Sleep latency 1
Sleep duration 3
Habitual sleep efficiency 3
Sleep disturbances 2
Use of sleeping medication 3
Daytime dysfunction 2

Fig.6 Visualization of PSQI data of a new user.

References
2. Rajput V., Bromley; Primary Care Physicians Ignoring Patient’s Sleep Problems.
15 Mali

Background

Mali is situated Western Africa, southwest of Algeria. It has a total area of 1.24 million sq km and population of 12,291,529 (July 2005 est.). It gained its independence from France in 1960.

Introduction

Telemedicine tools enable the communication and sharing of medical information in electronic form, and thus facilitate access to remote expertise. A physician located far from a reference center can consult his colleagues remotely in order to solve a difficult case, follow a continuing education course over the Internet, or access medical information from digital libraries. These same tools can also be used to facilitate exchanges between centers of medical expertise, at a national or international level

The potential of these tools is particularly significant in countries where specialists are few, and where distances and the quality of the infrastructure hinder the movement of physicians or patients. Many of the French-speaking African countries are confronted with these problems, and, in particular, large and scarcely populated countries such as Mali (twice the size of France, 11 million inhabitants) and Mauritania (twice the size of France, 3 million inhabitants).

The usefulness and risks of these new communication and collaboration channels must be assessed before large-scale programs are launched. Prior experiences in the field include ISDN-based videoconference for tele-cardiology and tele-neurology between Dakar and Saint-Louis in Senegal, a demonstration project (FISSA) of the use of satellite-based prenatal tele-echography between Dakar and the Tambacounda region in Senegal, and tele-radiology experiences in Mozambique. However, there is not so many publications on the use of low-bandwidth, Internet-based telemedicine applications, although there is a significant investment in these technologies in developing countries.

The development of the national network for telemedicine in Mali was used as a pilot case in order to get a better insight into these aspects.

Methods

The project in Mali, named “Keneya Blown” (the “health vestibule” in Bambara language), was initiated in 2001 by Mali University Medical School in Bamako, and financed by Geneva government and Geneva University Hospitals. Strategic goals were:

- To develop and use Internet-based connections between national and regional e-health institutions,
- To implement basic services such as e-mail and a medical Web portal, and train users,
- To implement a low-bandwidth, Internet-based distance learning system and

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50 Antoine Geissbuhler, MD, Ousmane Ly, MD, Christian Lovis, MD and Jean-François L’Haire.
• To evaluate the feasibility of long distance collaborations for continuing medical education and teleconsultations.

The national network infrastructure is based on IEEE 802.11 b wireless metropolitan area network in Bamako, and on digital telephony network to regional hospitals.

The e-mail and Web services are hosted on Linux-based servers, protected from instability of electric power supply by three dozens of truck batteries.

The distance learning system, developed at Geneva University, is specifically designed to minimize the use of network bandwidth while providing high-quality sound and display of didactic material, as well as feedback from the students to the teachers via instant messaging.

The student can adjust the quality of the video image of the “talking head”, which educational value is limited, in order to save resources. A bandwidth of 28 kbits/second is sufficient and enables remote areas to participate in distance learning activities. It is based on free and widely available tools, browser-based, and works on most desktop operating systems (Table 1 and 2).

Similar projects, using the same technologies, are now being deployed in Mauritania, Morocco and Tunisia.

**Results**

Over 18 months, the project in Mali has enabled the development of a functional national telemedicine network, which connects several health institutions in Bamako, Segou and Tombouctou, where medical teams have been trained for the use of Internet-based tools. The medical Web portal is in place. Web casting systems for distance learning have been implemented in Geneva and Bamako. Continuing medical education courses are now broadcast on a weekly basis.

Teleconsultations were organized, to follow patients that were operated in Geneva and then returned to Mali. The teleconsultation system is also used to select appropriate cases and guide their work-up in order to optimize patients’ evacuation to hospitals in the North or to prepare humanitarian missions. The number of these consultations is currently limited by the number of partners in the network.

<table>
<thead>
<tr>
<th><strong>Table 1 Hardware and software requirements of the distance learning client</strong></th>
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<tbody>
<tr>
<td>• Operating system: Windows 95, 98, 2000, Mac OS, Linux, Solaris, Irix</td>
</tr>
<tr>
<td>• PC 166 MHz, 64Mb RAM</td>
</tr>
<tr>
<td>• Sound card</td>
</tr>
<tr>
<td>• Screen 1024 x 768 preferred, 800 x 600 possible</td>
</tr>
<tr>
<td>• Netscape 4.0 or Internet Explorer 4.0 or later, Java enabled</td>
</tr>
<tr>
<td>• 28 kbits/s Internet connection (56 kbits/s bandwidth necessary for video images)</td>
</tr>
<tr>
<td>• Real Player and Acrobat reader plugging</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Table 2 Hardware requirements for the distance learning server (web casting equipment)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• PC 500Mhz, Windows 98, 128 Mb RAM, sound card</td>
</tr>
<tr>
<td>• Web cam server AXIS 2400</td>
</tr>
<tr>
<td>• Microphone</td>
</tr>
<tr>
<td>• Document video camera WolfVision or equivalent</td>
</tr>
<tr>
<td>• Ethernet hub or switch, 10 or 100 Mbits/s</td>
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</tbody>
</table>
Various types of collaboration have been enabled by the project:
North-South tele-education: topics for post-graduate continuing medical education are requested by physicians in Bamako; courses are then prepared by experts in Switzerland and broadcasted over the Internet from Geneva. New courses are prepared on a bi-monthly basis, on a variety of topics (Table 3). The material is also saved and can be replayed from the medical Web portal. Typically, these courses are followed by 50 to 100 physicians and students in a specially-equipped auditorium in the Bamako University Hospital, and also by smaller groups or individuals in the Segou and Timbuktu regional hospitals as well as in other French-speaking countries in Africa: Senegal, Mauritania, Chad, Morocco and Tunisia.

- Web casting of scientific conferences: several sessions of international conferences have been broadcasted, with simultaneous translation in French, in order to make the presentations accessible to colleagues in Mali, where the practice of the English language is still limited. Using the instant messaging feature of the system, remote participants can intervene and ask questions to the speakers.

- South-South tele-education: post-graduate and public health courses, developed by the various health institutions in Bamako, are web casted to regional hospitals in Mali and other partners in Western Africa (Fig.2). The contents produced are anchored in local, economical, epidemiological and cultural realities, and provides directly applicable information.

- South-North tele-education: medical students training in tropical medicine in Geneva follow courses and seminars organized by experts in Mali on topics such as leprosy or iodine deficiency. The exposure to real-world problems and field experts enables a better understanding of the challenges for developing and implementing e-health and public health
projects in unfamiliar settings.

- North-South tele-consultation: the same system was used to send high-quality images enabling the remote examination of patients or the review of radiographic images. Tele-consultations are held regularly, in areas where expertise is not available in Mali, such as neurosurgery or oncology (Fig.3).

- South-South tele-consultation: physicians in regional hospitals can request second opinions or expert advice from their colleagues in the university hospitals, via e-mail, including the exchange of images obtained via digital still cameras.

- South-North tele-consultation: the case of a leprosy patient, followed in Geneva, has been discussed using the tele-consultation system, and enabled the expert in Bamako to adjust the treatment strategy.

Lessons learned

At the infrastructure level, three kinds of problems are identified:

- The instability of basic infrastructure and in particular of the electric power supply;

- The limitation of the international bandwidth, which, is often misused, in particular by e-mail accounts hosted out of the country and

- The unavailability of reliable connectivity beyond large cities.

These problems are improving with the overall development of the national infrastructure, although the deregulation movements in the ICT sector and the deployment of mobile telephony will, at least initially, favour the most profitable markets, which are not those where telemedicine tools are most needed. For instance, the focus on mobile telephony probably limits investments in wired infrastructure that is needed for Internet access. Similarly, the deployment of wireless metropolitan area networks rapidly provide the needed connectivity, but
should probably be gradually replaced by the more sustainable, wired, optical communication infrastructure.

Basic communication tools such as e-mail are efficient and can be used productively. It is important to develop local capacity to implement and exploit these tools, not only to improve the technical expertise and the reliability of telemedicine applications, but also to limit the use of international bandwidth for information transfer that remains local. Most physicians in Mali still use US-based e-mail accounts for exchanges that remain local, due to a lack of reliable local e-mail services.

At the contents level, there is a steady demand for North-South distance learning. However, several topics for seminars, requested by physicians in Mali, could not be satisfactorily addressed by experts in Switzerland, due to major differences in diagnostic and therapeutic resources, and to discrepancies in the cultural or social contexts. For instance, there is no magnetic resonance imaging capability in Mali and the only CT-scanner has been unavailable for months. Chemotherapeutic agents are too expensive and their manipulation requires unavailable expertise. Even though diagnostic and therapeutic strategies could be adapted, practical experience is lacking, and other axes for collaboration must be found. A promising perspective is the fostering, through decentralized collaborative networks, of South-South exchanges of expertise. For example, there is neurosurgical expertise in Dakar, Senegal, which is a neighbouring country to Mali. A tele-consultation between these two countries would make sense for two reasons: a) physicians in Senegal understand the context of Mali much better than those from northern countries, and b) a patient requiring neurosurgical treatment would most likely be treated in Dakar rather than in Europe.

Beyond contents, collaboration between the stakeholders of telemedicine applications must be organized, in order to guarantee the reliability, security, safety and timeliness for exchanging sensitive information, in particular when the communication is not synchronous. Computer-supported collaborative work environments have been developed. For example, the iPath project\(^3\), developed by the Institute of Pathology in Basel, organizes “virtual medical communities”, which replicate organizational models of institutions in distributed collaboration networks, including clearly identified responsible experts and on-call schedules. These new forms of collaboration over distances, across institutions, and sometimes across national borders also raise legal, ethical and economical questions, questions that are beyond the scope of this paper.

The “induced digital divide” is another potential problem. The centrifugal development of the communication infrastructure implies that the remote areas, where telemedicine tools could be most useful, will be served last. As in most developed countries, physicians are reluctant to practice in remote areas, and the ability to interact with colleagues and follow continuing medical education courses can be significant incentives. Besides the accessibility problem, this also influences the contents of the telemedicine tools, which typically will initially be geared towards tertiary care problems. It is therefore important to make sure that the needs of the periphery of the health system are taken into account. An efficient way to do so is to have the periphery connected early to the telemedicine network. Satellite-based technologies for Internet access, such as mini-VSAT, are sufficiently affordable to consider developing remote access points before the ground infrastructure becomes available.

Finally, there is a need to develop local content-management skills. Local medical content is a key for the acceptance and diffusion of health information, and is also essential for productive exchanges in a network of partners. It enables the translation of global medical knowledge to the local realities, including the integration of traditional knowledge. Medical
content-management requires several levels of skills: technical skills for the creation and management of on-line material, medical librarian skills for appropriate contents organization and validation, and specific skills related to the assessment of the quality and trustworthiness of the published information, including the adherence to codes of conducts such as the HON code.

**Perspectives**

Based on the lessons learned during the pilot project, a larger, four-year project involving twelve countries of Western Africa was launched in 2003-the RAFT project (Telemedicine Network in French-speaking Western Africa, Fig.4). The following aspects are emphasized:

- The development of a telemedicine infrastructure in teaching medical centers, and their connection to national and international computer networks, in order to foster multi-lateral medical expertise exchanges, with a predominant South-South orientation;

- The use of asynchronous, collaborative environments that enable the creation of virtual communities and the control of workflow for getting expert advice or second opinions, in a way that is compatible with the local care processes. The open-source tool developed for telepathology at the University of Basel is being implemented, not only for telepathology, but also for radiology and dermatology;

- The deployment of internet access points in rural areas, with the use of satellite technology, enabling not only telemedicine applications but also other tools for assisting integrated, multi-sectorial development, and, in particular, education, culture and the local economy. The mini-VSAT technology, recently deployed over Western Africa, offers an affordable, ADSL-like connectivity. Sustainable economical models, based on the successful experiences with cyber cafés in Africa, are being developed to foster the appropriation of this infrastructure by rural communities.

- The development and maintenance of locally- and culturally-adapted medical contents, in order to best serve the local needs that are rarely covered by medical resources available on the internet. New tools are being developed: regionalized search engines, open source approaches, and adapted ethical codes of conduct. The Cybertheses project and the resources from the Health On the Net Foundation are used to train physicians, medical documentalists and librarians.

**Conclusions**

Telemedicine tools have an important role to play in the improvement of the quality and efficiency of health systems in developing countries, as they offer new channels for communication and

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*Fig.4 RAFT project partners-circle represent teaching institutions located in capitals or large cities, while squares denote remote access points (fixed or mobile) connected via satellite links*
collaboration, and enable the dematerialization of several processes, that are usually hindered by deficient physical infrastructures. They also expose some risks, and in particular the exchange of inappropriate or inadequate information, and the potential aggravation of local digital divide between the cities and the rural areas. These risks must be examined when designing telemedicine projects and can probably be mitigated by the development of South-South communication channels, the use of satellite-based technologies to incorporate remote areas in the process and by fostering a culture and skills for local medical contents management. These aspects are being further investigated by the RAFT project.

Acknowledgements

This project is supported by grants from the Geneva State government and Geneva University Hospitals

References

[8] www.cybertheses.org
16 Malta

Background
Great Britain formally acquired possession of Malta in 1814. The island staunchly supported the UK through both World Wars and remained in the Commonwealth when it became independent in 1964. A decade later Malta became a republic. Since about the mid-1980s, the island has transformed itself into a freight transshipment point, a financial center, and a tourist destination. Malta became an EU member in May of 2004.

Malta is an island nation with around of 380,000 inhabitants situated close to Italy in the middle of the Mediterranean Sea. It is a highly developed country with levels of health services similar to Western European countries and having an information and communication technology infrastructure that is among the most advanced in the region. In 1998, Malta hosted the World Telecommunication Development Conference (WTDC) and in the run up to this Conference, the national telecommunication operator, Maltacom, encouraged the Government of Malta to consider undertaking a pilot projects in the field of telemedicine.

What could be the potential benefits in this case?

Improvement the access to care
This is one of the telemedicine’s greatest benefits. But it was considered unlikely to be an important benefit in Malta in view of the small size of the country and the limited dependence of the Maltese health service on foreign health resources. However, it was considered relevant to the care provided to the inhabitants on the sister island of Gozo, a separate island a few kilometres north of mainland Malta with about 30,000 inhabitants.

Improvement in quality of care
This benefit was considered to have high importance to both public and private health services in Malta, to be achieved through improved collaboration between medical institutions making it much easier through telecommunication channels.

Reduction in professional isolation
This was considered relevant to medical professionals working in Gozo. With telemedicine connection to the main hospital in Malta, they can easy participate in any meeting or training courses at a distance.

Reduction in costs
In general, telemedicine can reduce duplication of services and also reduce travel of doctors to remote small health care centers to see a patient. It is also reduce the time and money spent

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by patients in order to visit a doctor or medical specialist.

**The project**

The objective of improved quality of care was strongly supported by the Health Administration in Malta and the Maltese Government accepted a proposal of the Development Bureau of the International Telecommunication Union to set up a project establishing a telemedicine link between St. Luke's Hospital in Malta and Gozo General Hospital. The ITU/BDT has requested Telia Swedtel to assist Maltacom and the Health Administration in Malta to define, plan and implement this project.

It was decided to set up of a real-time dedicated teleconferencing link between St. Luke's Hospital and Gozo General Hospital that would be available to medical professional at both the Gozo and Malta ends 24 hours a day, 7 days a week. This generic link was selected to allow clinical case discussions and/or interactive education and training.

One of the main requirements of the pilot project was to utilize existing infrastructure as much as possible with a view of minimizing the cost involved of using video conferencing equipment. The data network was already in place and moreover the hospital in Malta has 10 Mbit/s LAN, it was no problem to connect the PC based video conferencing unit. The data rate between the Malta and Gozo hospitals decreased to 2 Mbit/s.

The video codecs required to transform the video signals from the PC-based video cameras into a data digital stream were purchased from Picturetel. Now the name of this company is Polycom. The video and audio signals were hence transformed into the H. 323 standard that allows video and audio signals to be transported over a TCP/IP data network. In Gozo a high resolution Sony camera was installed but keeping a standard Picturetel camera at the Malta end. It was done because in the majority of cases the consultation will be provided to the patients in Gozo hospital and they need better quality for medical information transmission.

The main issue that arose from this trial was that, at times, the moving image froze for short instances. This mainly happened because of the bursty nature of data traffic profile which does not immediately transform well into a smoothly running video. Hence, some adjustments were made over the data network in order to set such parameters as prioritization and bandwidth reservation in order to minimize such ‘freeze-outs’. It is also envisaged that a further upgrade of the data networking equipment being used would help eliminate this problem. Finally, one cold also add that by installing a single ISDN gateway on the data network, it would also be possible for all video conferencing stations on the health network to access other international sites.

From March 1998 the telemedicine link was put into operation and in the beginning it was used for a number of peer to peer clinical discussions. The equipment performed well, however from time to time there were irritating dropouts in transmission that interrupted the smooth flow of the discussion. The video quality through good enough for person-to-person contact was too poor for real time transmission of clinical quality images. It was necessary to introduce some special measures to improve quality.

**Evaluation of project’s results**

The evaluation of this project has to be carried out by comparing results achieved so far with objectives at the outset of the project:

The first objective was to further enhance the quality of the e-health system. This was achieved, as physicians in Gozo now have added tools at their disposal, that they previously
did not have, with which to exchange clinical data with peers in Malta. In the several cases when these tools were actually used, there were definite indications that the quality of patient care was improved.

The second opinion was to reduce costs. This was not achieved, as the volume of use of the telemedicine link did not reach a level that would give tangible cost savings from reduced patient/service provide time and travel.

The third objective was to acquire experience and competence. This was certainly achieved. The doctors and managers involved now have a much clearer idea of what a real-time telemedicine link involves and can give clearly focused opinions on the modalities that would be of greatest benefit to patients and their doctors in the Malta/Gozo situation. The health authorities have also been sensitized to the relevant issues, especially regarding organization, human resources and financing.

The sustainability of the project was never in doubt. This project was designed from the very outset to remain operational. The equipment is available for use 24 hours a day, 7 days a week. The significant recurrent expenditure involved in the 2 Mbit/s link between hospitals was planned for and falls within the Health Division’s ongoing commitment to the provision of a high capacity wide-area-network (WAN) between all Malta’s public hospitals.

It is interesting to present a few real clinical cases discussed over the telemedicine link:

- Congenital hypertrophic pyloric stenosis;
- Evaluation of barium studies;
- A conclusive diagnosis was reached with excellent patient outcome post-surgery;
- Calcified cerebral arterio-venous malformation;
- CT brain images and angiographic images sent over the telemedicine link. Arrangements for further imaging studies were made. The mutual diagnosis was received;
- Osteomyelitis of rib-Transmission of X-ray images and live images of patient examination, patient directly interviewed over the link;
- Vesico-ureteric reflux-DMSA renal images were transmitted and discussed;
- Pericardial cyst-transmission of X-ray and ultrasound pictures.

As the main conclusion from this pilot project we can state that it takes time before doctors can realize that telemedicine connection is a useful tool for them. They still prefer to proceed in the traditional way and avoid the second opinion or further consultation if it is not a very serious acute case directly related to the life or death. Today more and more doctors are using computers in their everyday practice; nevertheless they need good training on how to operate the telemedicine workstation. It is necessary to include telemedicine into the training program of medical schools. By studying basic telemedicine services in medical schools/universities, the new generation of doctors will be willing to get benefit from modern information technology incorporated into routine medical practice.

It is also important to select the right location of telemedicine work station. In Malta for security reason it was located in the Gamma Camera Unit of the Radiology Department. It should be better to install the telemedicine workstation in the emergency department. Taking into account the existence of LAN in the hospital, technically it is not difficult to install video conference software at several PC in different departments.
During the planning stage of this project, it was decided that a generic teleconferencing link may be more useful than a specific teleradiology link. Although this decision was probably sound, the fact that in practice the link was mainly used for the discussion of X-ray and other images, and that was laborious and time-consuming, suggests that the procurement of equipment that is more specific for the capture, storage and forwarding images may be a useful step to enhance the clinical value of the link.

It was also recognize that telemedicine link could be used for distance training of nurses and other health professionals in Gozo. There is also potential for the system to be used for post-graduate and continuing medical education of hospital’s staff.
17 Mozambique

Background

Mozambique is situated in South-eastern Africa, bordering the Mozambique Channel, between South Africa and Tanzania. For almost five centuries it was a Portuguese colony and gained its independence in 1975. Mozambique has an area of 801,590 sq km and 19,406,703 population.

Telemedicine Project

The first telemedicine project of the ITU was implemented in January 1998 in Mozambique, one of LDSs in Africa. As a result of BDT/ITU telemedicine mission, it was discovered that in the main hospital in the second big city in the country there is no radiologist and all serious cases have to be sent to Maputo, the capital of the country situated approximately 1,000 km away from Beira.

It was decided to connect two central hospitals, one in Maputo and one in Beira by telemedicine link for teleradiology using the existing telecommunication infrastructure. The project used standard low-cost teleradiology equipment which is based on two PCs (Pentium MMX 200) equipped with a radiological film digitizer (CobraScan CX-612 T) and the appropriate software and telecommunication interfaces. The system conforms to the guidelines stipulated by the American College of Radiology concerning image quality. Radiological images are digitized in less than 30 seconds in up to 4,096 gray-level with up to 300 pixels per inch. Images are compressed automatically without any loss of information at a factor ranging from 1.5 to three. A special tool permits erasure of all names on the image in order to guarantee partial or full anonymity.

The transmission link between Maputo and Beira consists of digital microwave system from Maputo to Boane where the satellite earth station is located, and then from Boane till Beira is satellite communication via Intelsat VI 63 degree. The medical information is sending using store-and-forward mode of transmission via modem (up to 56 kbit/s).

On 30 January 1998, the Prime Minister of Mozambique, Mr. Pascoal Mocumbi, inaugurated this telemedicine link. “Telemedicine will end the isolation which has, until now, existed between health professionals in the country”, the Prime Minister told participants who witnessed the historical launch of one of Africa’s first pilot projects in telemedicine. “I urge all participants in this project, I particular the Empresa Nacional de Telecomunicacoes de Mocambique, to continue their efforts in finding innovative applications to telecommunications for the benefit of the entire society”, he added.

Doctors from both hospitals have expressed their strong feeling that the system is useful and that they would like it to be upgraded in order to extend the range of telemedicine services.

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Every month several files are received from the hospital in Beira. As a rule a file consists of the patient’s history, the radiographs and laboratory tests. The doctors discuss the diagnosis and treatment. This link was also used for teleconsultation in such specialties as internal medicine, neurosurgery and orthopaedics.

One year later, in 1999 the International Telecommunication Union received request from the Government of Mozambique to assist the country to extend the telemedicine link to the third big city in the country, Nampula. This time the Government promised to support this project financially by providing 50% of the budget. In November 2002 the extension was done and all transmission links were upgraded to ISDN which is now available in Mozambique. Now it is already small telemedicine network which included three hospitals and the Medical School of the University in Maputo. The transmission via ISDN provides superior image quality. This network will be the core for the national medical information network connecting in due course all hospitals of the Ministry of Health. The extension to Nampula is using satellite communication link.

Due to the lack of specialists it is much easy to convince doctors to use telemedicine link. But they need also good training. There is another problem. The work load for radiologists in Maputo is increased because many additional cases are receiving from Beira and Nampula. The Ministry of Health needs to take it into consideration. It is also important to develop local medical protocol on how to use telemedicine connections and to indicate clearly the responsibility of partners.
18 Nepal

Background

Nepal is a landlocked country situated between China & India in southern Asia. Geographically, Nepal elongates within the longitude of 80 to 88 degrees east and latitude of 26 to 30 degrees north in the global map. The total area of the country is 147,181 square kilometres and it comprises three main geographical regions: the Terai (flat river plain of the Gangas) in the south, the central Hill region and the rugged Mountain (Himalayas) region in the north. Mount Everest and seven other of the world’s ten highest peaks lie in this region. Administratively, Nepal is divided into five development regions: Eastern, Central, Western, Mid-Western and Far-western. These regions are further divided into 75 districts and each district consists of strategically divided Village Development Committees (VDCs). There are 3915 VDCs in all of Nepal.

The population of Nepal is approximately 23.4 million and the annual population growth rate was 2.24% according to the 2001 National Census. About 85% of the population lives in rural areas. The capital city is Kathmandu. The current GDP per capita income of Nepal is about US$ 248; thus the World Bank considers Nepal a low-income country. Approximately 38% of the population lives below the national poverty line. In terms of GDP, the sectoral structure of the Nepalese economy in 2000 was 39% agriculture, 22% industry and 39% services and the annual growth rates over the 1990s for these three sectors were 2.5%, 7.2% and 7.1% respectively. The health status data per doctor is 18,439; per Nurse is 4,987; per hospital bed is 2,349 as per 2001AD calculation. The life expectancy at birth is 58.95; maternal mortality rate per 100,000 live births is 415.

The number of working telephone lines is 386,267 (fixed), post paid mobile subscribers is 59,882 and mobile prepaid subscribers is 43,599 as in January 2004. The telephone network penetration rate is currently 2.13% of the population. The technology used by Nepal Telecom to serve the different VDCs are digital C-DOT wire line exchanges, MARTS, VHF/UHF radio, Digital microwave, HF radio, VSAT etc.

**Telecom Act**

The Telecommunications Act, 2053 (1997) became effective on January 1, 1997. The Act established a modern framework for the regulation of the telecommunication sector in Nepal to make the telecommunications service reliable and easily available to the public, to involve private sector as well in telecommunication services and to regularize and systematize such services. The Act also established the Nepal Telecommunications Authority (NTA) as the regulatory and licensing authority for the Nepalese telecommunications sector. The Ministry of Information & Communications (MOIC) is the body responsible for Policy Formulation/Co-ordination. The National Telecommunications Policy, 2056 (1999) has been replaced by

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the new telecomm policy, 2060 (2004). Its main objective is to create a conducive environment resulting in a variety of reliable telecommunication services being readily available to all people in all areas of the Kingdom, at a reasonable service charge, and to contribute to the social, political and economic development of the country.

**Health Policy**

The National Health Policy was adopted in 2048 BS (1991 AD) to bring about improvement in the health conditions of the people of Nepal. The primary objective of the policy is to extend the primary health care system to the rural population so that they benefit from modern medical facilities and trained health care providers. Likewise, the Ministry of Health of His Majesty’s Government of Nepal developed a 20-year Second Long-Term Health Plan (SLTHP) for 1997–2017AD. Its vision is a e-health system in which there is equitable access to co-ordinated health care services in rural and urban areas, characterized by self-reliance, full community participation, decentralization, gender sensitivity, effective and efficient management, and private & NGO sector participation in the provision and financing of health services resulting in improved health status of the population. The Ministry of Health (MOH) is responsible for formulating health policies. And the departments of health services and other government and private hospitals, research centres are the medical service providers. The MOH in partnership with the EDPs also carries Information Education & Communication (IEC) for health programme to raise the health awareness of the people.

**Telemedicine Overview**

Telemedicine is generally defined as the communication of medical, health or educational material over a distance by electronic means. A typical telemedicine system consists of a computer with the appropriate devices for collecting information: camera, scanner, medical peripherals (derm camera, endoscope, microscope, ultrasound, etc), and the appropriate connections for communicating with other sites. Communication can be by phone line, internet, ISDN, ATM, satellite, etc.

Telemedicine is viewed as a tool for facilitating the collaboration between patients, physicians, and other health care providers. The use of remote medical expertise at the point of need can be achieved through interaction by both “store and forward” and “live” applications. There must be a defined need and a medical champion at the receiving side. Someone within the country or the local community being served must be willing to take an active role in defining the needs, organizing the resources, overseeing the process, and participating in the telemedicine network. Without someone on the inside, the telemedicine project will struggle through all phases of implementation and operation.

**Telemedicine scenario in Nepal**

Telemedicine has an equal application in developing and developed countries that may have unique needs, but the basic element of improving medical communication, education and quality of health care is the same. Though such activities have not begun in the government sector using the electronic at interactive way of providing medical care at distance in Nepal, some private organizations have begun to start the service through joint collaboration with the medical institutions outside Nepal. The Om Hospital & Research centre has collaborated with a renowned hospital in India in this field. The medical transcription service has already been started by companies called the creative technology and Unlimited Solutions Nepal, grooming required manpower by providing training nationwide.

However, the government has reacted slowly in institutionalizing the telemedicine practice and tele-education. One of the targets of the SLTHP is to improve the quality of e-health
provided through the public/private/NGO partnerships by total quality management of human, financial, and physical resources with the development and implementation of a national e-health technology strategy. Therefore, the Ministry of Health (MOH), together with its External Development Partners (EDPs) addressed a major task for the establishment of IT in health services and training, i.e. telemedicine & tele-education. The subject is under discussion nationwide and planning is at the preliminary phase so as to legislate and regularize the telemedicine service.

**Application of Telemedicine**

Telehealth can help in the field of clinical consultations, patient education and professional education. Clinical consultations are usually between a specialist doctor and a remote site patient. A medical provider present at the consultation can assist the doctor in his work, answer questions about the patient and take orders for medicine. Patient education is important to stress self-help and prevention before the patient has a consultation. Likewise, professional education is for the medical provider to keep him/her up to date on the latest developments in the medical field and he can pass that expertise to his patients. Telemedicine has the potential to improve the delivery of health care by bringing a wide range of services such as radiology, mental health, dermatology, mother and child health protection, homecare etc. to under-served communities and individuals in both rural and urban areas.

For Nepal with few doctors and medical health centres in place, it plays a vital role in addressing and solving the needs of those in remote and rural areas where the basic telecommunication service is available. The essential care services MOH has recognized in its plan are reproductive health, immunization, TB and leprosy control, condom promotion and distribution, Integrated Management of Childhood Illness (IMCI), environmental sanitation, mental health services, post-trauma disabilities, community-based rehabilitation, school health services etc. Those services can be achieved through telemedicine by the above-mentioned three approaches.

**Technical infrastructure**

The National Telecomm Policy also identifies the objective to make available all appropriate Information & Communication Technologies (ICTs) in support of rural development and poverty alleviation, drawing on the full range of options — including, for example, radio, television, video cassette recorders, and stand-alone computers, as well as fixed and mobile phones and internet. For the provision of e-health services, it is mostly essential to provide universal access to the common telecommunication services throughout the country. In areas with a limited telecom infrastructure the internet is probably the best platform to use. The problem with the internet would be the lack of quality of service, where the required bandwidth may not always be available for live interactive consultations. The best solution for Nepal would be store and forward technology using the internet and available lower speed connections, such as the common phone lines. The conventional way of telephone conversations, using fax or simply email may do well for the purpose and it has been adopted so far in Nepal. Media like radio and TV can be helpful in disseminating the informational programmes to the remote areas. Radio Nepal and Nepal Television have, so far, been broadcasting basic health programs including live conversations with doctors on diverse disease problems and their care. Basic telemedicine requirements can consist of a camera with a monitor and the doctor in a central location administering to the needs of the remote site.

As the next generation of broadband and wireless technology comes on line, a telemedicine application can be merged with that system. The future technologies used for this purpose are mobile device technologies including satellite, virtual reality technologies, PDA etc.
interactive TV, DAB, VOD will be commonplace in the near future. Similarly, intelligent medical monitoring equipment and use of electronic patient records (EPR) can be utilized when giving advice to the patients electronically. Different software for digital imaging, user training, patient support and operation of biomedical devices will be helpful too. HMF of Nepal has also enacted “the electronic transactions and digital signature Act” in 2000 AD for making different transactions and delivery of electronic data reliable and safe. This will enable an environment conducive for the provision of telemedicine services within Nepal and abroad.

Factors for growth of telemedicine activities

In general, the growth and implementation of telemedicine practices and their application depends upon the following factors:

- Telecommunication infrastructure: Though the growth of the national network and its penetration rate has increased in the last 10 years in Nepal; it is still insufficient and most of the population in the rural and remote areas do not have access to the basic telecommunication services. Expansion of network capacity and its extension in the VDCs has to be carried with a higher priority before introducing the telehealth services in these areas.

- Bandwidth of connection: The other important factor for smooth delivery and transmission of digital images and multimedia information is the bandwidth offered by the telecommunication lines. Though the Nepalese national trunk network consists of a 140 mbps broadband microwave system, the “last mile” copper lines can hinder the flow of data. For interactive videoconferencing, it is required to have at least 384 kbps line, in order to have good quality and acceptable video and voice transmission. Otherwise, a significant lag time and jerkiness in the picture becomes quite annoying to the viewer.

- Safety and security issues: Doing telemedicine over IP using the existing network and with password protection may justify the basic requirements, but the issue of security and personal privacy still remains debatable. There is always possibility of someone hacking in. Therefore, educational and clinical guidelines and safety/security standards need to be developed to ensure the safety and effectiveness of the telemedicine devices along with blocking of piracy within the connection.

- Licensure: The legal and socio-cultural issues have to be overcome for the efficiency of the telemedicine policy. The physicians conducting regular consultations in other states or countries should be licensed in that territory or not remains important. As each country has its own medical practice act that defines the licensing and practicing procedure and telemedicine technology knows no boundaries, there should be a clear, unique standard and licensing procedure globally.

Conclusions

Health care systems are very much a product of the nation in the same way as its culture, the medical traditions, the socio-economic situation and demographic factors. Although the development and use of telemedicine will be adopted differently in the different health care systems due to availability of telecommunication infrastructure across the nations, international interaction in the field is essential. Faced with limited resources and budget restrictions, government expenditure on e-health has been reduced in Nepal. There is an urgent need for partnership between universities, SMEs, government and non-government bodies across the globe for enabling efficient know-how and technology transfer and reducing disparity in e-health between developed countries & LDCs.
Likewise, as many medical professionals are skeptical of new technology, they should be provided with regular training and educational opportunities through the telemedicine network. Then, they can determine how well it works and what kind of information can be shared easily. Furthermore, a successful telemedicine network is collaboration between the local and remote medical personnel, as well as the technical experts within the system. So, the medical institutions and telecommunications providers must work together when establishing and monitoring the network.
19 The Pacific Open Learning Health Net\textsuperscript{54}

\textit{Its purpose:}

To provide alternate means:

\begin{itemize}
  \item for access to continuing education opportunities for healthcare workers,
  \item for access to upgrading of education qualifications of healthcare workers,
  \item for sharing of health related information between healthcare workers in the region and globally,
  \item to provide a facility for inter-country consultations and learning opportunities
\end{itemize}

Initially serving the Cooks, Federated States of Micronesia, Fiji, Kiribati, Marshalls, Palau, Samoa, Solomons, Tonga and Vanuatu

\textit{What is it?}

It currently consists of:

**Within each learning centre in each of the ten countries**

\begin{itemize}
  \item Between ten to twenty networked computers which are connected to the internet,
  \item A server, data projector and data screen, webcams and headsets, and a networked laser printer
  \item Self learning course materials
  \item IT training at the basic and intermediate levels with self learning course materials
  \item various specially designed healthcare self learning course materials
  \item Learning resources
    \begin{itemize}
      \item blue trunk library kits — a set of around 150 specifically selected medical books and subscriptions to medical journals
      \item various IT resource and learning materials
      \item various medical and health resources available in print and/or CDs
    \end{itemize}
  \end{itemize}

**Outside the learning centre**

\begin{itemize}
  \item POLHN web site—this is the main site for Net (www.polhn.com).
  \item Specially developed database of health resources, course content, special publications, premium materials and treatment search (www.colfinder.org/wolhn)
  \item A generic operations manual providing guidelines for each country task force to adapt and thereby develop their own country specific operations manual for maximizing the use of the POLHN learning centre in their country
  \item Technical support from the technical units in Manila
  \item Training and motivation for the country task forces to draw on as they develop their own
\end{itemize}

\textsuperscript{54} The Pacific Open Learning Health Net WHO, SP Office Box 113, Suva, Fiji
Fax: (679) 3300 462 Email: polhn@sp.wpro.who.int
capacity to operate their POLHN learning centers as a tele-centre, tele-medicine and tele-health facility.

- Possible registry for the continued certification of healthcare workers

**It assumptions**

The items that make up the POLHN are provided to the Ministries of Health in each country to be administered by a “country task force” (CTF) which is mandated to ensure that the facilities are used for the up-skilling and up-grading of healthcare workers. It is assumed that continued improvements in the healthcare services will thus be realised in these countries.

**Operations of POLHN**

All the operations of POLHN are authorized and implemented by the CTF as delegated by the Ministry of Health. The CTF should ideally have representation from various sections of the Ministry and possibly from allied sectors of Government. Representatives on the CTF should normally be appointed by the CEO but each member should believe in the assumptions of the POLHN be willing to work hard for the objects of POLHN.

Firstly, IT skills are taught to selected persons in various sections of the Ministry of Health. These persons are to expected to be trainers/mentors of the other persons in their section. The IT section of the Ministry of Health (where it exists) will provide the basic IT teaching to healthcare workers to ensure that they all become computer literate.

Secondly, these trained persons will be provided with usernames and passwords which will enable them to access the POLHN computer facilities and the internet.

Finally, with these IT skills the healthcare workers should then be able to access the various self learning courses and on-line courses and resources accessible on the internet. Thereby improving their knowledge and skills and consequently providing better health services to the people.

It is expected wherever possible for the POLHN learning centre to be opened for 24 hours a day 7 days a week. A schedule (see Table 1) of the courses to be taught will be displayed, sections within the Ministry may also block book time and the remaining time will be left for private use (which will only be accessible to persons who have passed the basic IT skills course and have their own usernames and passwords) This will need a lot of organisation from the CTF and responsible use by the healthcare workers. Those misusing the facilities could be denied access to them.

**Courses for 2003 and 2004 for POLHN**

All the courses chosen as pilots are developed in the self learning format but have different origins and are used for a variety of purposes.

1. **POLHN courses** are those that were specifically developed for the POLHN for continuing education of healthcare workers (See list one below). These courses have numbers beginning with POLHN followed by three digits. These are non-credit courses, but could be used by the local Ministries for the continued certification of their healthcare workers.

2. **Credit Courses** are courses that are assessed via internet directly from institutions from anywhere in the world. These are credit courses and form part of a certificate diploma or degree of these institutions. Within the list of pilot courses offered in 2004 are three courses in this category (See list two below)
3. **Ready Made Courses**: are courses that were purchased off the shelf (See list three below). These courses have numbers beginning with POLHNS followed by three digits. These are non-credit courses, but could be used by the local Ministries for the continued certification of their healthcare workers.

**List one- POLHN Courses (institutions that developed them are given below)**

- POLHN 001 Mental assessment of patients — *James Cook University*
- POLHN 002 Physical assessment of patients — *James Cook University*
- POLHN 003 Clinical skills for Physical and mental assessment of patients — *James Cook University*
- POLHN 008 Counselling, Communications Advocacy — *Philippine Center for Communication Programs (PCCP)*
- POLHN 006 Schools outreach courses in the areas of HIV/AIDS, vector borne diseases, — *Pacific Resources of Education and Learning*
- POLHN 005 Diabetes Management — *Fiji School of Medicine and ITemedia*
- POLHN 004 Diabetes Education — *Fiji School of Medicine and Itemedia*
- POLHN 011 Clinicians as Researchers — *University of New South Wales*
- POLHN 009 Clinicians as Mentors — *University of New South Wales*
- POLHN 010 Clinicians as Administrators — *University of New South Wales*
- POLHN 012 Laboratory Technicians — *Pacific Paramedical Training Centre*

**List two-Credit Courses (institutions providing these courses are listed)**

- NUR 3060 Research methods in Health — *University of Southern Queensland*
- HEIX 701 Essential Information management skills — *University of Otago*
- PH 143 Introduction to Information Systems for Health Managers — *Fiji School of Medicine*

**List three Ready Made Courses (lecturer or mode of delivery is listed below)**

- POLHNS???: WHO blood safety course — Dr Penny Chan
- POLHNS???: Multisim-a software which provides opportunities for up-skilling bio-medical electronic engineers — A self learning package
- POLHNS???: Imaging resources for radiography — A self learning package

*It is hoped that from these pilots Ministries of Health will appreciate some of the potential of POLHN and the opportunities that it offers. It is further anticipated the Ministries of Health could use some fellowships and country budgets to provide more such opportunities.*

The country task force is expected to provide leadership in deciding (in consultation with the manpower training section of the Ministry of Health and Public Service Commission) what courses can be suitably accessed in-country via the POLHN.
### Table 1  Example of Scheduling of Learning Centre

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-10am</td>
<td>Nurse 1</td>
<td>POLHN002 tutorial</td>
<td>POLHN001</td>
<td>POLHNS001</td>
</tr>
<tr>
<td>10-12noon</td>
<td>IT Basic-Dentistry</td>
<td>POLHN005</td>
<td>NUR3060</td>
<td>POLHNS002</td>
</tr>
<tr>
<td>12-2pm</td>
<td>IT basic Public Health</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
</tr>
<tr>
<td>2-4pm</td>
<td>PH143 tutorial</td>
<td>POLHN006</td>
<td>HIS systems</td>
<td>POLHN003</td>
</tr>
<tr>
<td>4-6pm</td>
<td>PH143 Private study</td>
<td>POLHN002</td>
<td>NUR3060</td>
<td>POLHNS001</td>
</tr>
<tr>
<td>6-8pm</td>
<td>Private</td>
<td>POLHN 002</td>
<td>Private study</td>
<td>Private study</td>
</tr>
<tr>
<td>8-10pm</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
</tr>
<tr>
<td>10-12am</td>
<td>Private</td>
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<td>Private</td>
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<tr>
<td>12-2am</td>
<td>Private</td>
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<tr>
<td>2-4am</td>
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<tr>
<td>4-6am</td>
<td>Private</td>
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<td>Private</td>
<td>Private</td>
</tr>
<tr>
<td>6-8am</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
</tr>
</tbody>
</table>

Private = time persons can sign up to use the computers for unassigned work.

### Issues

The major barrier to the success of this project is the lack of empathy/support of the middle management within the Ministries of Health. There is tremendous support from the top echelons of the Ministries but the change presented by the project is not readily accepted and/or supported by the operational arms of the Ministries. A lot of advocacy work needs to be done by the CTF to get this vital group on side.

The high costs of internet connections coupled with the concerns of sustainability of such a project need to be addressed within the larger picture of up-skilling staff and getting output form them at the same time, keeping all the member of the family together during training etc.. this calls for a mindset change that the CTF needs to advocate for.
20 Pakistan

Location

Pakistan is strategically located in the heart of Asia. It holds a significant place among the comity of nations and is an important member of several regional organizations. The population of Pakistan is estimated at about 140 million, a major proportion of which resides in rural areas. Pakistan is a developing country with large amounts of natural and human resources. The mighty Himalayas in the north and the expansive Indian Ocean in the south bound the country. The road network in the country spreads out to all major cities and towns of the country but small towns and villages are inevitably left out, making it difficult to travel to and from.

E-health Services in Pakistan

Pakistan is one of the most densely populated countries in the world. However, the number of doctors in the country is not conversant with the number of patients. The doctor to population ratio is 1 : 1,555 in the country. This makes it difficult to get quick and easy access to medical services. The e-health infrastructure consists of rural health centers, basic health units, tehsil headquarter hospitals and final referral to district headquarters hospitals and teaching medical institutes. The remote northern areas of Pakistan are located at a large distance from specialized hospitals. The situation is compounded by the difficult terrain of mountains, which severely hampers mobility, access to modern e-health service, as well as travel cost. A large morbidity rate is a direct consequence of this situation.

Urban Rural Disparity

A large chunk of the population of Pakistan, about 75%, lives in rural areas while the percentage of doctors working in rural areas is only about 22%. The ratio of hospital beds is about 18% for the rural areas to nearly 82% for urban areas. As these figures indicate, even though the population of Pakistan is concentrated in the villages and small towns, the medical services in those areas are far from sufficient. To get a hospital under the supervision of experienced doctors, the people of rural areas have no choice but to travel to large cities, incurring expenditure and botheration that is an inevitable consequence of transporting sick patients. This is further compounded by the deficient road network and the low per capita income of average Pakistani. Moreover a doctor sitting at the remote center feels isolated as he doesn’t have any other doctor or a specialist to consult if he faces a problem case or any complication.

The Solution — “Telemedicine”

The telecommunication industry in Pakistan is undergoing a rapid development, as a result of which

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the communication connectivity all over the country has improved remarkably. The number of telephone lines in the country is well over three million. Internet has become a popular medium with about a hundred thousand users spanning more than eight hundred cities. These statistics depict the feasibility of the establishment of telemedicine network and its potential contribution to the well being of the citizens of Pakistan.

Nowhere in the world did Information Technology have a greater personal impact than in the delivery of health care. Energetic efforts are now being done all over the world to use IT for the improvement of quality of health care, provision of easy access to health care facilities and enabling the patients to improve their own health status.

**Pakistan : Existing Telemedicine Scenario**

**Role of Elixir Technologies**

Elixir Technologies is a leading software development company based in USA. Since its founding in 1985, Elixir has been pioneering the development of innovative software for form design, personalized document composition, data extraction, and printstream conversion. Envisioned to contribute to the well being of the people of Pakistan, Elixir Technologies introduced the concept of Telemedicine first time in Pakistan in 1998 in the form of a philanthropic project — TelMedPak. Since then Elixir is sponsoring the project. The organization has done a few pilot projects namely the Taxilla and Gilgit project to assess the applicability of telemedicine and telehealth in Pakistan. The success of these projects showed that telemedicine is not only possible in Pakistan but it can also uplift the health status of the remote areas by provision of the specialist care in areas where conventional face to face consultation with the specialist may not be possible.

**Initiatives of TelMedPak**

**A. Projects :**

**1 Taxilla project :**

To assess the applicability of Telemedicine and Telehealth in Pakistan, a prototype was setup in a private hospital (Ali Family Hospital) located in Taxilla, a small town 20 km from Islamabad. This hospital was equipped with PC having Internet access and a scanner, which was linked to Holy Family Hospital. Methodology used was “Store and Forward Teleconsultation” The hospital was to email case report of patients that required expert medical opinion to send along the case report. Then the concerned specialist was to study these case reports and reply back to the hospital. The complete record of the patients was kept strictly confidential, with limited number of people having access to the records. This project proved its success, thus implying that Telemedicine does have wide ranging implementations in almost very medical specialty.

**2 Gilgit project :**

Patients from remote northern areas have to travel more than 16 hours hard drive to the capital in search of specialized health care facility. Gilgit with a population of 250 thousand people having limited health facilities and severe climatic conditions is the ideal place where
telemedicine can help the population by reducing the travel time and cost to the patient.

Patients suffering from specific diseases are mostly looked after by the doctors who are not trained in that particular specialty and have no choice of discussion and second opinion with senior colleagues.

TelMedPak during its project in Gilgit, aimed at creating awareness among the population and sensitizing the policy makers about this easy solution to the health situation. A practical model of telemedicine was demonstrated by contacting the DHQ Gilgit with surgical unit Holy Family Hospital, Rawalpindi, where General surgeons, orthopedics, medical specialists were made available.

Various practical modalities of telemedicine were tested like sending the data about cold cases and getting the consultation, doing live chat, discussing the trauma and other intensive care patients with senior colleagues and involving voice chat among panel of doctors on both sides. Transferred data included digital photographs of the patient as well as scanned images of the relevant information like x-rays, E. C. Gs, CT scans and lab reports.

3 Telemedicine centers in upper Punjab:

After pilot projects, four cities of upper Punjab were identified and remote telemedicine centers were established there.

The doctors from these areas (Fig.2, Gujar khan, Pindi Gheb, Fateh Jhang and Jhand) were trained in telemedicine initially and then they are involved in teleconsultations by serving at their own remote sites. In two years of time more than 200 teleconsultations have been done from these areas.

B. Telemedicine Studies:

1 Web based Teleconsultations:

One of many features of the TelMedPak web site is a FREE Teleconsultation Clinic online with the name of “Ask A DOC”. It is available at www.telmedpak.com/askadoc.asp.

It uses simple store and forward technology User asking for a medical advice has to send his query via the online form. The query is then forwarded to the consultant of the concerned specialty who answers the query within 48 hours. Emergency queries are responded within 24 hours. Up until now about four hundred queries have been responded with an average of about seventeen queries a month. Gynaecology, obstetrics'and medicine are the mostly consulted specialities.

2 Teledermatology Study

To compare the accuracy of store and forward method of teledermatology with the traditional face-to-face consultation a study was conducted from the TelMedPak platform. The comparison was done between Institute of Dermatology King Edward Medical College Lahore that served as teledermatology center and Dermatology Department of Pakistan Institute of Medical Sciences Islamabad from where patients were selected. Telmedpak provided the technical support. Thirty three patients were selected from outpatient department of PIMS and
images were taken using a digital camera. Images were stored in computer and were sent to Institute of Dermatology via email for Teleconsultation along with a short history and examination findings. Diagnosis of consultant after face-to-face consultation was then compared with the image based diagnosis that is after teleconsultation.

3 Training of Paramedical Staff

LHV’s and TBA’s were educated through TelMedPak’s continued medical education Program via on line courses. In this way knowledge of paramedics and medical staff working in the remote areas was updated for the welfare of target population.

4 Telemedicine Training Manual:

Keeping in consideration the computer literacy of Medical staff, TelMedPak has devised Telemedicine training manual which includes basic computer skills, IT concepts, Telemedicine concepts and working. Doctors from the remote areas are being trained with this manual.

Role of Government of Pakistan

A. Establishment of Telemedicine Forum:

The Ministry of Science and Technology realizing the potential of telemedicine in Pakistan has established National Telemedicine Forum in September 2001 with the objective to oversee and drive the development and collaboration of IT and medicine with particular reference to Telemedicine. The main aim of creating the telemedicine forum was to create awareness about telemedicine in the country by arranging seminars and conferences at National level, which will not only encompass the medical arena but also focus the IT, Telecommunication community and the general public at large. National Telemedicine conference 2002 was organized by the forum on 22 June 22 2002. The conference not only successfully created a lot of hype about telemedicine in medical and IT community but also got a lot of exposure from the media. The conference was one of its kind as it demonstrated live telemedicine session for the first time in Pakistan, showing actual teleconsults between the doctor and the specialist and also between the patient and the specialist. Live Telesurgery operation was also shown in the conference with the use of Fiber optic technology.

B. Identification of Telemedicine Projects:

One of the objectives of the forum was to identify pilot projects, which can then be replicated to become complete projects. A brief note of the projects identified by the telemedicine forum is as under;

1 Health Management Information System (HMIS):

It is a system that deals with the collection of patient and disease information building a database which will help in statistical analysis which will in turn add to our knowledge about the primary health care sector also. It includes an electronic patient record. Once successfully introduced each and every health care unit can be linked to it and also to the Ministry of health, keeping them abreast of the latest developments in health sector.

2 Health Information Resource Center (HIRC)

This project aims at promoting health research and link research to development. It will be an online resource center about medical journals, medical research activities and database of hospitals and doctors of Pakistan. Through this online center not only the doctors will be benefitted but the general public will also be able to get a lot of useful information. It can also play a role in disease awareness.
3 Tele-psychiatry
This project will link the Institute of Psychiatry with other psychiatric care sites and connect these centers to remote sites for teleconsultations about psychiatric disorders. This project is a step to improve psychiatric problems all over the country.

4 Tele-dermatology
This project is substantially similar to tele-psychiatry. It links various existing dermatology centers with remote sites to exchange information about skin disorders. It is based in the Institute of dermatology, King Edward Medical College Lahore.

5 Tele-radiology Project
This project connects remote hospitals of Sindh with teaching hospitals for teleconsultations about Radiology.

The projects are at different stages of approval at the ministry. HIRC project has been approved and is in implementation phase. Three projects namely HMIS, Tele-psychiatry and Tele-dermatology are at the peer review stage.

C. Telemedicine Training of Pakistani Doctors
Pak-US collaboration in Science and Technology fields led to the opportunity of training of two Pakistani doctors in USA. These doctors were sent to the US to get trained from the US telemedicine experts at the best telemedicine centers in the world. These doctors will act as master trainers in the country and hence building a human resource in this particular field. Virginia commonwealth university, Richmond is running a telemedicine program with holy family hospital Rawalpindi focusing on use of technology in decision making and exchange of expertise.

Vision
The aim is to uplift the e-health conditions of the country especially the rural areas of Pakistan. The basic framework is to try and provide a role model to connect each and every Primary Health Care Center in Pakistan with Urban Hospitals and Teaching hospitals in the cities, and later establish international links.

Use of Information Technology in improving health care in Pakistan is the need of the time. The new I.T. Policy is addressing the issue of availability of Internet in virtually all the big cities of Pakistan at extremely economical rates. With this infrastructure in place, rural and urban areas of Pakistan can be linked through Telemedicine to provide specialized health care to the under-served areas of Pakistan. Remarkably low telecommunication and technology cost has begun to speedup of the use of computers. Most important, however, is the realization that the Internet can propel telemedicine in to a big role. As the Internet continue to grow more robust and incorporates video transmission in Pakistan, telemedicine in many of its varied forms will become ubiquitous.

Future Directions

1 Telemedicine — medical intranet of the country
The ultimate goal is to connect each and every health care unit of the country and thus making a medical intranet through which any doctor can consult any other doctor or a specialist at any time sitting anywhere in the country. It has been proven time and again that this type of telemedicine network is not only possible but feasible as well. It is not a dream
anymore and has become an evident reality. Pakistan has one of the best medical infrastructures in Asia but due to lack of implementation and geographical restrictions the doctor in a remote area feels isolated when it comes to treating a problem case as the specialist who can help him is sitting miles away. Information Technology in Pakistan is undergoing rapid progress in the current years. Increase use of internet, availability of fiber optic in the major cities and satellite technology are the factors which make best use of technology by incorporating it in health sector as telemedicine. Telemedicine can bridge that gap and the doctor at the remote center will have no problems getting to the specialist through the use of this simple yet phenomenal technology. Telemedicine can make the best use of the existing medical infra structure, with very limited expenditure.

2 Focus on the underserved specialities
As identified initially by Telemedicine forum, dermatology, radiology and psychiatry are the few areas which lack enough human resource factor. The focus in future will be on tele-dermatology, tele-radiology and tele-psychiatry to address this issue.

3 Continued Medical Education :
As mentioned above the use of this technology can not only make patient care a lot better but it can also help in improving the continued medical education (CME) program, helping the doctors at the remote areas or even in the urban areas to get the latest information in the field of medicine and be abreast of the latest trends and recent advances in patient management.

The increasing revolution of IT all over the world calls for the adoption of telemedicine in the course of medical studies early as the students are much energetic at this age and right from the beginning they can get a chance to increase their medical knowledge through the use of telemedicine

4 Training of LHV’s and Paramedical Staff :
Telemedicine can provide basic knowledge to LHV’s regarding use of computers, Internet and e-mail for health education purpose and providing free of cost training about family planning methods. In future this venture will hold intensive workshops regarding LHV’s and paramedical staff and also design on line courses for their training on family planning methods. This training will enable the paramedical staff to use Telemedicine for the early management of the patient in the rural center even in the absence of a doctor.

5 Development of indigenous Telemedicine Software and Hardware Industry.
Development of fully customized telemedicine software capable of incorporating various modalities of communication is the need of the hour addressing the computer literacy of our doctors. This telemedicine software will enable easy interaction between e-health provider, patients and medical students. The application of this software can be demonstrated by developing a model/Pilot telemedicine units including a teaching hospital (tertiary care hospital) and remote hospitals to demonstrate various applications of telemedicine using different modalities of communication. Pioneering work has been done in this regard by Elixir technologies. Using the input from the two internationally trained doctors specialized software will be ready for use in the next few months.

6 Regional and International Collaboration :
Our vision about the future of telemedicine doesn’t limit us to the boundaries of our country. With the use of the modern telemedicine technology we want to reach out to the international forum of telemedicine. Special consideration is collaborations among SAARC countries as all
of them are having same health issues and almost similar e-health infrastructure. Our real aim is to be one of the telemedicine centers connected to the main telemedicine network of the world.
21 Papua New Guinea

“Connecting Rural PNG to Information Age through Sustainable Engineering Solution”

Background
Papua New Guinea is located in Oceania and occupies a group of islands including the eastern half of the island of New Guinea between the Coral Sea and the South Pacific Ocean, east of Indonesia. Its total area is 462,840 sq km and has a population of 5,545,268 (July 2005 est.). This paper presents briefly Papua new Guinea experience in telemedicine/e-health.

Terms of Reference for TeleHausline Project
TeleHausline Pilot Project has to involve the following Participants as Project Partners:

Local
- The Papua New Guinea University of Technology; Electrical Engineering Department & Appropriate Technology Development Institute
- Internal Revenue Commission (IRC)
- Independent Consumer and Competition Commission (ICCC)
- Papua New Guinea Radiocommunication and Telecommunication Technical Authority (PANGTEL)
- The University of Papua New Guinea School of Medicine and National Health Department
- National Government through The Ministry of State Enterprise and Information
- Provincial and Local Governments of the selected Project Sites
- Local Population of the Project Site

Possible International Partners
- The International Telecommunication Union (ITU)
- Japanese International Cooperation Agency (JICA)
- Asia Pacific Telecommunity (APT)
- Others

Organize all activities including but not limited to:
- Conducting feasibility studies,
- Identifying funding sources,
- Identifying human resources required; and

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• Developing effective work programs in collaboration with local, regional and international partners for optimum progress while respecting the limits of the resources available.

Schedules of all work programs should duly consider the required timing of the expected output and the presentation of quarterly progress reports to all participating organization and the elected/appointed project manager/manageress.

Establish effective communication between each project sites, monitor and coordinate all project activities in collaboration with international and regional partners.

Work with selected officers and consultants from the participating institutions/organizations to achieve the objectives and goals of the project within the set time frame and budget.

Pay attention to the affected community and industry (e.g. Telikom PNG Ltd) and ensure that their interests and consent to any legal undertakings directly relating to the project or affected from the project are taken into due consideration. A bipartisan approach to achieve mutual recognition of any activity as a result of the project would be encouraged here.

Produce an Information Paper for the National Executive Council (NEC) through the State Enterprise and Information Ministry and Provincial Governments for deliberation of the Project findings. The paper would discuss the expansion of the project concept including the application of Telemedicine, Telehealth and Tele-education, which is also being considered at this stage in other rural areas of Papua New Guinea.

Recommend a strategy where industry and Government would collectively fund the project concept should the trials turn out successful. Such strategy may consider tax exemption for industries supporting and advancing the project concept in terms of resource allocation and financial commitment.

**Introduction**

In PNG approximately 90% of the total population of 5 million people are yet to have access to basic analogue telephone and fax services. Basic telephony for both fixed and mobile is a luxury where only a few, especially those living in urban centres with some form of income can afford it while the bulk of the population cannot afford the services and remain ignorant of their uses.

Whilst the rural areas are slowly being exposed to the basic voice-based technology, the urban centres are moving fast into digitalization thus making rapid progress in the application of Information and Communication Technologies (ICT) and Internet. This is attributed to the fact that the monopoly regime Telikom PNG Ltd is concentrating service investments in the urban centres and towns while claiming that rural areas are uneconomical due to less business activities and high infrastructure costs.

Currently, the incumbent carrier Telikom PNG Ltd has a fixed installed network capacity of about 84,000 lines, of which approximately 72,000 lines are currently connected. Cellular services (GSM) have approximately 25,000 subscribers and are used only in several urban centres. Comparing the number of fixed line and cellular subscribers with the country’s population of 5 million, it is obvious there is a need for the Government and its relevant institutions to show some responsibility in developing a rural telecommunication strategy that is technically, economically and sociably feasible and sustainable.

The strategy must be focused on delivering information and communication services to the rural areas at affordable costs. This may include the provision of Telemedicine, Telehealth and Tele-education via the rural network. Hence the best way possible is to develop a rural telecommunication network that supports telecommunication systems combining low costs
wireless access technologies with packet-based networks for possible delivery of Internet into rural areas. (Appendix A shows a diagrammatic representation of the concept of TeleHausline).

At this stage it is envisaged that if the project is successful, the provincial and local government in collaboration with the Industry, interested government and non government organizations and users would collectively maintain its long term sustainability. This gave birth to the concept of TeleHausline.

**Project Concept**

TeleHausline is a Research Project designed by PANGTEL especially to seek alternative engineering solutions to remedy disadvantaged rural population in PNG to access basic information and communication facilities. It is designed to investigate the applications of wireless access systems to support rural communications by providing viable engineering solutions that is cost affordable and offers long-term sustainability in the remote villages, districts and towns.

Considering PNG rugged topographical terrain and complex demography, the research aims to investigate, analyze and evaluate various wireless access systems, particularly Wireless IP Systems, utilizing appropriate cost affordable technology to provide rural areas access to the information age. Economic issues arising from interconnections like billings and value added services would be considered under the research for the benefit of future Government economic reforms like privatization, deregulation and liberalization.

The design configuration of the pilot project sees two networks interconnecting with each other. TeleHausline pilot network will interconnect with the existing Telikom Network. The pilot project aims to determine the feasibility of each province to manage their own rural telecommunication network, supported by wireless technologies and interconnecting with other network (Internet, PSTN, etc) in the future. The trial project will be used to investigate the fundamental concepts of interconnections, application technologies for interconnections, billings, tariffs and network management protocols.

Concurrent to that PANGTEL would invite the PNG University of Technology, Electrical Engineering Department and Appropriate Technology Development Institute (ATTDI) to investigate renewable rural energy solutions to support TeleHausline facilities. Energy source is an important aspect of providing rural communication therefore the university would be engaged as research partners to develop the alternative solutions. Other tertiary institutions like the University of Papua New Guinea (UPNG) School of Medicine, Health Department, Vudal University of Technology and Kerevat Agricultural Research Institute may be invited to participate.

Hence a practical engineering solution involving the people, industry, university, research institutions and the provincial and local governments would be identified to ensure that telecommunication and information services reach the rural areas through their communal participation. PANGTEL will provide the leadership to ensure every player through their participation in TeleHausline is satisfied of their contribution in developing telecommunication and ICT services in rural PNG.

Issues like interconnectivity policy that is being developed by PANGTEL and ICCC would be encouraged to acknowledge the project objectively thus providing leverage to rural areas through their provincial authorities to manage the rural telecommunication network.

The concept may enter a memorandum of understanding with the incumbent carrier to help the
monopoly regime; in this case Telikom PNG Ltd understands that this would be the best way forward to link the rural areas of PNG. Hence permission for interconnection and Voice over Internet Protocol (VoIP) services through Public Switched Telecom Network (PSTN) can be granted for the research purposes.

**Pressing Communication Issues**

After almost three decades of independence most of the rural population of PNG have purportedly been neglected and deprived of this century’s most crucial social and economic development infrastructure. This is largely attributed to the Government’s lack of awareness on how information technology and an effective and quality telecommunication services can progressively drive the country’s fledging economy through collective participation by the largely active rural population.

With the poor and insufficient road infrastructures and high cost of land, air and sea transportation, people in the rural areas experience little or no economic development. Local businesses, individuals, families, local governments, NGO’s, schools and health centers are gravely hampered by the high cost of accessing basic services due to insufficient or poorly managed national infrastructures hence, becoming economically less productive. This has contributed to a downfall in the living standards of people in the rural areas to below poverty line by world standards.

Both large and small communities in most rural areas of PNG share a common characteristic in that public service institutions, commercial or business services are either lacking, or their operation is very limited or are of low quality (i.e. education, health, social care, transportation postal services, banking, commercial supplies); job opportunities are scarce and/or non-existent. As a result, the rural population particularly, the youth — are disadvantaged, and human, community, natural and economic resources are under utilized.

The urban centres are experiencing relative growths in social and economic development because of the concentration of investments in urban centres while the rural areas have virtually remained stagnant. This has apparently created an “opportunity divide” between the urban and rural population. Service investments are concentrated in the urban areas while the rural areas continue to suffer.

No matter how hard PNG tries to resolve the issue of creating equal opportunity for its mass population living in the rural areas to access service infrastructure like telecommunication, the current adverse economic situation only makes it difficult to achieve. This has little effect on the urban areas since the opportunity divide is expanding as a result of significant improvements and growth in the telecommunication industry as it moves into digitalization and Internet era.

Hence a digital divide is being created, stemming from the opportunity divide between PNG and the rest of the world. PNG is now at the crossroad where the country is faced with the dilemma of how effectively it can bridge the two divide (opportunity and digital) simultaneously at reasonable cost. The challenge issues serious consideration for the regulator, governments, service providers and other industries.

The results of the opportunity divide is devastating to the country’s social and economic development as the majority of the population lives in the rural areas and are deprived of accessing information and communication technology to improve their social and economic well being. Rural areas without extraordinary local assets can dilapidate in an age when only a dynamic shift and development can ensure a chance survival and adaptation to new conditions.
Long Term Objectives and Goals

PANGTEL is committed to stand firm as the country project leader and ensure that this research achieves its objectives within the set time frame and budget. PANGTEL staff will provide the technical know how in collaboration with relevant industry and project consultants both on shore and abroad to ensure research is properly carried out with minimal inconveniences.

Being a technical regulator of the radio communication and telecommunication industry it is the long-term objective of PANGTEL to provide leadership in regulatory aspects of the service industry in a manner that promotes investments.

It is PANGTEL objective to research technical issues and identify alternative solutions for sensitive issues like rural communications and provide advice to the Government. The Government can use our research to plan and build infrastructure development to achieve long-term sustainable benefits for the largely disadvantaged rural population.

Under the project objectives, the following goals would be achieved.

- Provide sustainable alternatives for rural communications.
- Experiment the success of simple application of Telemedicine, Telehealth and Tele-education to ride on the rural network.
- Provide Government solid evidence on how to address rural communication problems.
- Provide Government critical information on how rural communication infrastructure can drive the local economy and improve people’s life.
- Equip and encourage PANGTEL technical workforce and policy developers to be innovative and visionary.

PANGTEL is also aware of the imminent changes in the telecommunication industry where the market is earmarked for privatization and deregulation. It is the purpose of this research to equip our engineers and technical officers to understand the basic concept of issues like interconnection, value added services and different network management protocols. By being involved in practical research, PANGTEL engineers will be challenged to the extent of coming face to face with realities where engineering, economics, culture and societies merge for sustainable development.

Methodology

TeleHausline research centers will serve as a multifunctional service locations where advanced information and communication technologies and services (Internet) are made available for all community, personal, business and civic uses regardless of their content (economic, educational, cultural, social, administrative, etc). These unique intelligence centres can therefore (1.) serve as universal outlets, (2.) open the gates toward larger regions and the entire world for small communities. Other facilities would include a computer centres while public libraries at the selected project sites are under consideration. It will also use modern telecommunications and information technologies to facilitate virtual working sessions and create continuous interest groups.

The research project is divided into two major components as illustrated below in Fig. 1.0 and will be shared by the PNG University of Technology and PANGTEL as major project partners while other participants positions will depend on their roles or responsibilities. Under PANGTEL, the research may trail several Wireless access systems and technologies.
Some technology that are envisaged at this stage includes narrowband packet radio, wireless local loop systems, wireless routers and voice over IP (VoIP), Satellite and VSAT, which is estimated to run for a period of 2–3 years. However, this period may be extended depending on the progress of the project.

During the trial period, system adaptability, network configuration, technology applications and other social and economic developmental issues will also be investigated. This is to develop a complete sustainable rural communication infrastructure to support remote villages, sub districts and small townships. This research will involve respective provincial authorities to determine their roles in sustaining a rural telecommunication network in full collaboration with the industry.

**Feasibility Study**

The project feasibility study is an important factor and PANGTEL will conduct it in selected remote areas identified for the pilot project. However, interested international and regional organizations like ITU, APT, JICA, AusAID, etc. may be invited to conduct joint feasibility studies where applicable. All studies will be done in full consultation with the local and provincial governments, non-government organizations, the people from the affected areas and interested companies or agencies.

The study will focus on last mile zone of Telikom activities, area topography, population distribution, weather, existing infrastructures and, political, economical and social activities in the area. Both Government and non-government run schools, health centres or aid posts, cultural centres and other facilities will be identified and mapped for planning purposes.

The Electrical Engineering Department and ATDI will be conducting their own feasibility study and that will focus on supplying renewable energy source. They will also work under the understanding of the joint research with PANGTEL, the international consultants and the domestic consultants engaged. Area topography, existing electricity infrastructure, hydro analysis, geotechnical analysis, weather analysis and other environmental issues are some of the areas that will be investigated.
The feasibility study will be assisted by the local authorities and provincial governments to ensure that it is run smoothly and the desired results are obtained within the time and budget allocated without unnecessary disturbances. PANGTEL will take charge and will be fully responsible of all data collected for the purpose of the research project.

**Planning and Funding**

The planning and appropriation of funding will be constructed after the feasibility study is completed and the necessary data collected for evaluation. Based on the studies, the technical team will plan and design the final details of how the project will be rolled out. All partners will submit a full cost of their designs after assimilating the results of their studies from the feasibility study. These would be incorporated during the planning stage for project design and funding appropriation.

PANGTEL may fund the feasibility study solely and submit final documentation from the study in the format of a proposal to various institutions that offer financial and technical aid for such projects. Under such circumstances, estimated costs of all expenditures for the feasibility studies are included herein. (See APPENDIX B)

The funding for the pilot project will be covered under PANGTEL’s budget for Research for Rural Communications which the board is yet to deliberate. However it is also envisaged at this stage that donor funding and funding from ITU would be solicited simultaneously to meet any short falls from our budget.

**Implementation**

The implementation of the pilot project will be finalized and tabled when the funding and other resources are made available based on the feasibility studies. Detailed implementation schedules of procurement, disbursement, supervision, post evaluation and monitoring after completion will be provided for all parties involved.

**Results**

The project is expected to run for 2–3 years at most, after which the provincial government will be invited to take over and maintain the operations while PANGTEL continues to provide technical assistance. The data collected from the duration of the research will be used to draw up a national rural telecommunication & ICT network strategy.

The strategy will be presented to the Government for implementation. Under this strategy, issues like interconnectivity, billing, VoIP services, network management etc will be finalized for rural implementation. These will be incorporated into PANGTEL regulatory policy and guidelines for industry regulation and Government use.

In addition the project would experiment some of the applications as outlined in the ITU DOC. FG 7-TF DOC 4 of 28 June 2002. One of the areas the project is interested to experiment is Telemedicine and Telehealth.

**Data Communication:**

- for simple application in Telemedicine (exchange of medical records, statistics, epidemic surveillance, transmission of X-rays and EKG test data, consultations with specialist through e-mail, etc,

- Education and Research (excess to electronically stored libraries, training material and research papers and, possibly, trial courses for teachers, based on existing material, adapted as required.

— 253 —
• Trade information services (access to databases with market information, contact with suppliers and customers through e-mail, etc.

• Government and community information services

• Voice Services (seeking permission from Telikom PNG Ltd): IP telephony (VoIP services)

• User training and support in use of IT and communication services.

• Interactive distance learning courses in relevant subjects, using multimedia and video conferencing facilities.

• Low cost access to email and data networks.

TeleHausline would encourage various companies to participate in developing the project in other remote locations based on a new tax exemption scheme that IRC, PANGTEL and ICCC may jointly develop. This would boost industry participation to expand the concept into many rural areas identified by the Government.
Appendix A
Configuration of the Proposed Interconnectivity
22 Peru

CARDIOCELL B138: Biomedical signal transmission via cellular mobile network

Background

Peru is situated in Western South America, bordering the South Pacific Ocean, between Chile and Ecuador. It has a population of 27,925,628 (July 2005 est.) and a total area of 1,285,220 sq km. Ancient Peru was the seat of several prominent Andean civilizations, most notably that of the Incas whose empire was captured by the Spanish conquistadors in 1532. Nowadays Peru is a republic with 24 departments and one constitutional province.

Brief history

The Santa Anita B138’s Firemen Company has developed many projects, one of them has been named “The Early External Disfibrillation program”, that requires a high-performance portable heart monitor, being able to support hard treatment, working with independent electric source and mainly having low cost.

“The Cardiocell B138” arises like a project by April, 2002 when this Firemen company contacted to the R&D team of the Development Technology Division in INICTEL.

Introduction

During the patients checking process that the Firemen Company’s health personnel used to carry out, it was frequently required to measure the corporal temperature level, blood pressure and heart rate as vital signals. This also was needed in every emergency help.

The Cardiocell B138 equipment allows us to obtain immediately those mentioned vital signals in a secure way, without requiring that the health personnel constantly measure the vital signals. In an emergency case, it is always possible to monitor a patient at the same time that the health personnel assist other patient’s needs that perhaps requires more dedication. In all cases, the system offers to the professional, simplicity and comfort in obtaining the patients vital signals.

The Cardiocell B138 equipment shows the vital signals on a liquid crystal display LCD, in which can be observed measures of heart rate, blood pressure and temperature level. Additionally, the equipment is able to transmit these signals through the cellular mobile phone network to a hospital (remote monitoring) where the vital signals can be visualized on a personal computer display; optionally the vital signals can also be observed locally (where patient is) by means of a local computer (local monitoring).

For both, local and remote monitoring, the vital signals are digitalized and processed in the equipment before being observed on a visual interface.

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This equipment has been developed to be used by mobile paramedic units of the Peruvian General Body of Voluntary Firemen; who requires the equipment for monitoring patients in a medical emergency. The paramedic personnel who assist patients in emergency cases will also have, as a monitoring help, acoustic signals according to the patient’s heart rate (considered the main signal) this will help the paramedic personnel, when necessary, to take the right treatment action in case of an abnormal heart behavior.

**Method**

The used methodology followed to achieve the equipment development included the following:

- **Information Compiling.** It was verified the existence of commercial systems similar to Cardiocell B138 equipment developed by specialized international companies, this comparisons allowed us to establish a reference for our equipment technical characteristics and also to estimate the limitations for the first prototype development. In this stage, the intensive use of INTERNET was made.

- **Functional blocks definition.** A preliminary design of equipment was made by defining functional blocks, which summarizes the main function of its parts. See Fig.2

- **Hardware development.** The selected microcontroller for the control stage is the PIC16F877A, which has incorporated A/D conversion channels and enough supported elements. The necessary hardware is limited to: a microcontroller PIC16F877A, levels converter TTL-EIA232C, a display LCD, buzzer (as a audible indicator). All the components were mounted in a single printed circuit board and accommodated in a box specially designed for the equipment.

- **Software development.** For the Cardiocell B138 was written a main program that works as an operating system, which is stored in the microcontroller program memory, it should contain the necessary code to manage the operation of the different tasks of the control stage such as: display LCD handling, connection establishment to a data terminal for transmitting information, A/D conversion control for input analog signals, calculation of heart rate, pressure and temperature level, transmission of digitalized samples. All developed programs were written in assembler language.

It was defined the internal functions that should execute the equipment:

- **Equipment control.** The fundamental function of the microcontroller included in the control stage is the total management of self-operation, where the principal performed tasks are: Initialization and system’s self-diagnosis, a display LCD Control, modem initialization and control, digitalization of 4 analog inputs channels, transmission of vital signals using cellular mobile phone network, establishment of communication protocols.

![Fig.2 Block Diagram of Cardiocell B138 Control stage](image-url)
• Visualization of messages and signals. A commercial display LCD is used to allow the message visualizations in ASCII format, with information about the system state or the request of information input from user. It has 2 lines of 16 alphanumeric characters each one, also has a buffer memory. This display is a low energy consumption type. The display control is managed by the microcontroller. In this display should be visualized the heart rate value (beats per minute), the patient’s corporal temperature and the high and low blood pressure calculated automatically.

• Biomedical digitalization signals. Here digital samples of 4 analog input channels are obtained, later they will be transmitted to be processed.

• Information transmission/reception. Here the digital samples of the 4 channels are transmitted to a computer terminal remote (remote or local monitoring) for its processing and evaluation. This task permits, in a remote way, to control some other tasks in the Cardiocell B138 equipment, before a communication is established. The Cardiocell B138 has 2 way of connection to a data terminal: the first way is a local connection that allows communication directly to a terminal by the use of a cable, and a second way is a remote connection that uses a cellular telephone modem to establish a communication. For any connection, after a valid communication is established between the Cardiocell B138 and a data terminal, the transmissions of the samples are controlled by the data terminal and by the communication protocols adjusted for this purpose, this is done for determining the beginning and end of each sample transmissions, selecting specific analog input channels of the microcontroller.

The previously aforementioned functions give origin to the functional units of the equipment that are described next.

**Biomedical signs acquisition unit**

It acquires the biomedical signals, amplifies, eliminates or reduces to the minimum the present noise in itself, it eliminates the signals of non desirable high frequencies, and adequate the signals inside to appropriate levels for its digital conversion.

In the Fig.3 it is observed the block diagram of this unit, the signals taken from the patient’s body are: temperature level, blood pressure and signal heart channel II [6], which originates the following blocks: acquisition and temperature conditioning, acquisition and blood pressure conditioning, acquisition and conditioning of the heart signal, power supply.

![Block diagrams of Cardiocell B138 Acquisition unit](image)

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258
**Signal controls unit**

It digitalizes the biomedical signals, and transmits them via cellular phone network to a computer for their processing and visualization.

In Fig.4 block diagrams of the control unit are appreciated.

The message visualizations are obtained on a LCD display, this offers low energy consumption and is controlled by the microcontroller; here it is visualized the heart rate’s value (beats per minute), the patient’s corporal temperature and the high or low blood pressure calculated automatically.

The biomedical signals digitalization is carried out itself by the microcontroller.

**Data transmission unit**

This unit establishes the communication between the Cardiocell B138 equipment and the remote computer by means of a phone call from the mobile telephone cellular network to the public switching telephone network PSTN which has an analog loop subscriber, the equipment operates a cellular phone modem to start the communication. The phone call is directed to a fixed number of the SPTN, where a computer is connected via modem, this computer has an specific purpose developed program that, after linked, will acquire the signals sent by Cardiocell B138. See Fig.5.
Specific purpose Application Program

This program receives the information coming from the Cardiocell B138 equipment using a modem, processes the biomedical signals and presents them in the computer display. This program was developed in Visual Basic.

This specific purpose program contains module routines whose main functions are:

• Local connection with the equipment for the computer port COM.

• Remote connection with the equipment through an internal or external modem.

• Visualization of biomedical signals in form known for the doctor. See Fig.6

• Possibility to record the signals for further analysis.

• Store patient’s basic data, such as: name, last names, age, sex, code, height, city origin, weight, hour and date of acquisition’s signals.

• Digital signal filter to eliminate the noise of 60 Hz. See Fig.7.

• To display the heart rate applying digital processing to heart signal. See Fig.8.

Heart rate module has been tested in adults from different ages and anatomic constitutions, with almost no distortion. This module works along with a sensor of good sensibility and easy to locate this allows to use it in emergencies where the collision and the rescue maneuvers are very hard. The heart frequency is shown with digits and audible sounds above 80 dB.

The pressure module was built based on a hybrid that allows monitoring the patient’s blood pressure by means of manual insufflations, the pressure spikes are shown with numbers in the LCD.

Fig.6 Heart sign presentation, channel II

Fig.7 Acquired heart sign without filter and filtered sign
The temperature module executes readings in 30 second cycles; works along with an easy location sensor, is armpit type and has an independent liquid crystal display.

In general the approximate weight of equipment is 900 grams, it has independent power supply based on rechargeable batteries of 9V that give autonomy up to 8 continuous working hours.

**Results**

In January, 2004 starts the first tests in real emergencies; moreover it was tested the sensibility and precision of the equipment and also mechanical tests such as impact and vibration were proved; all tests were passed without any problem. The first completely functional prototype was given to Firemen Company in March, 2004.

Actually, there are similar equipments to Cardiocell B138 whose specific application makes them suitable for certain heart illnesses but would be of limited use due to high costs.

So far, people who suffered lesions due to an accident or illness should be evaluated by appropriate professionals after being admitted in emergency rooms; that happened after the evaluation for paramedic personal in the accident place and later evacuation to a hospital. The use of Cardiocell B138 allows the victim to be monitored from a hospital, while the paramedics work to rescue him or her; this will reduce the time of advanced attention, prepares for emergencies room personnel and allows the first answer personnel to receive precise indications to save the patient’s life before being moved from the accident scene.

The use of the equipment covers a wide spectrum of applications, from the use in emergency ambulances, sport applications as a biometer tool, or sending signals to another side of the world in the way of tele-consult. In the private sector, it will help to increase the attention health efficiency, since the emergency mobile units could be equipped at a significantly more reduced cost that would redound in better attention to the patient.

The average costs of a commercial heart monitor for use in vehicular rescue lies among US $2,000 and US $3,000. On the contrary the Cardiocell B138 has been designed to match our real economic limitations, its price oscillates among US $400 and US $600. The Cardiocell B-138 has a power supply with a 9 volts battery and has been designed in a modular way, so that in the malfunction event their components can be replaced in a simple way.

The medical care of emergency increased during the years; the statistics say that this continuous tendency will increase. The Firemen Body has increased its exits because of medical emergencies, being among 60% and 70% from the total attended emergencies to national level. See Table 1.

Comparing medical emergencies from 2001 with 2000 they increased in 16%. In the period 2001–
Table 1 Statistic of attended emergencies in Lima, Callao and Ica
(Source : General Voluntary Firemen Body from Peru)

<table>
<thead>
<tr>
<th>Type of emergency</th>
<th>2000</th>
<th></th>
<th>2001</th>
<th></th>
<th>2002</th>
<th></th>
<th>2003</th>
<th></th>
<th>2004 (to August)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL</td>
<td>%</td>
<td>TOTAL</td>
<td>%</td>
<td>TOTAL</td>
<td>%</td>
<td>TOTAL</td>
<td>%</td>
<td>TOTAL</td>
<td>%</td>
</tr>
<tr>
<td>Fire</td>
<td>3607</td>
<td>9%</td>
<td>3713</td>
<td>8%</td>
<td>4295</td>
<td>8%</td>
<td>4475</td>
<td>7%</td>
<td>3605</td>
<td>7%</td>
</tr>
<tr>
<td>Gas leak</td>
<td>1577</td>
<td>4%</td>
<td>1437</td>
<td>3%</td>
<td>1638</td>
<td>3%</td>
<td>1538</td>
<td>2%</td>
<td>1183</td>
<td>2%</td>
</tr>
<tr>
<td>Medical emergencies</td>
<td>25542</td>
<td>63%</td>
<td>29712</td>
<td>66%</td>
<td>39117</td>
<td>70%</td>
<td>50862</td>
<td>75%</td>
<td>39897</td>
<td>78%</td>
</tr>
<tr>
<td>Rescue</td>
<td>964</td>
<td>2%</td>
<td>763</td>
<td>2%</td>
<td>796</td>
<td>1%</td>
<td>706</td>
<td>1%</td>
<td>450</td>
<td>1%</td>
</tr>
<tr>
<td>Products spill</td>
<td>74</td>
<td>0%</td>
<td>50</td>
<td>0%</td>
<td>45</td>
<td>0%</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short circuit</td>
<td>760</td>
<td>1%</td>
<td>624</td>
<td>1%</td>
<td>193</td>
<td>0%</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special services</td>
<td>3755</td>
<td>9%</td>
<td>4160</td>
<td>9%</td>
<td>3998</td>
<td>7%</td>
<td>3865</td>
<td>6%</td>
<td>1738</td>
<td>3%</td>
</tr>
<tr>
<td>Vehicular accident</td>
<td>4129</td>
<td>10%</td>
<td>4365</td>
<td>10%</td>
<td>4712</td>
<td>8%</td>
<td>4639</td>
<td>7%</td>
<td>3492</td>
<td>7%</td>
</tr>
<tr>
<td>False alarm</td>
<td>359</td>
<td>1%</td>
<td>346</td>
<td>1%</td>
<td>597</td>
<td>1%</td>
<td>627</td>
<td>1%</td>
<td>329</td>
<td>1%</td>
</tr>
<tr>
<td>Others</td>
<td>63</td>
<td>0%</td>
<td>68</td>
<td>0%</td>
<td>67</td>
<td>0%</td>
<td>67</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural disaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td>0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>40813</td>
<td>100%</td>
<td>45294</td>
<td>100%</td>
<td>56054</td>
<td>100%</td>
<td>67453</td>
<td>100%</td>
<td>50953</td>
<td>100%</td>
</tr>
</tbody>
</table>

2002 medical emergencies increased in 32%. During 2002–2003 medical emergencies increased in 30%. While in 2003 and August, 2004 medical emergencies increased in 22%.

In Table 1 it is shown the urgent necessity that rely on the described equipment. In this way the patient is “assisted professionally” from ambulance arrival on, the emergencies room doctor can observe the patient’s state, to indicate (for an appropriate channel) some procedure that paramedics should accomplish, and to wait the patient with the appropriate equipment for his/her treatment. This means to make more professional the daily of medical emergency attentions.

Taking as a indicator the delay time the patient begins to be assisted by a doctor, the impact of the Cardiocell is tested:

The time is the main restriction in a medical emergency event; so that, serves as a impact indicator of Cardiocell B138. From the ambulance arrival to the accident scene, starts the evaluation, preparation of the emergency room, and the medical team in the hospital; which impacts directly in the life average percentage as soon as the patient gets better.

From the economic perspective, the Cardiocell B138 is a way to reduce cost in an ambulance, since the equipment budget of similar functions would exceed US $3,000:

- Heart monitoring equipment: heart beats per minute, and blood oxygen.
- Thermometers to measure the corporal temperature manually.
- Pressure meter to measure the blood pressure.
- Communication dedicated equipments for the readings transmission in real time.

Discussions and commentaries

- We took advantage of previous experience in the development of biomedical signals monitoring equipment.
Table 2  CASE: A vehicular accident with caught patient in the vehicle

<table>
<thead>
<tr>
<th>Time average:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency answer</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Assessment by the paramedic personnel</td>
<td>1.5 minutes</td>
</tr>
<tr>
<td>Victim rescue (until 40 minutes)</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Take to the nearest hospital</td>
<td>8 minutes</td>
</tr>
</tbody>
</table>

Table 3  Comparative

<table>
<thead>
<tr>
<th>Comparative table</th>
<th>Without Cardiocell</th>
<th>With Cardiocell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total time without attention (Time from the accident until the ambulance arrival)</td>
<td>5 to 10 minutes</td>
<td>5 to 10 minutes</td>
</tr>
<tr>
<td>Total time with basic attention (It includes an exposed paramedic to lesions inside the vehicle during the victim's rescue)</td>
<td>29.5 minutes</td>
<td>0 minutes</td>
</tr>
<tr>
<td>Total time with professional attention (It begins when arriving at urgencies room for a doctor's attention)</td>
<td>0 minutes</td>
<td>29.5 minutes</td>
</tr>
</tbody>
</table>

- To improve the heart signal acquisition and filtering (it was not necessary an immobile patient during the acquisition).
- It is useful in first diagnosis medical emergencies (irregular beats, heart attack symptoms, fibrillation, hypothermia, fever, gets off pressure, intern hemorrhages, etc.), further advanced diagnosis may be completed with specialized equipments.
- The electrodes and probes must be placed in the patient correctly, to avoid an inadequate form acquisitions of the signals.
- The Cardiocell B138 signals transmission (from the emergency place) to a hospital center, is limited by the telephone line bandwidth, whose minimum transmission recommended is 19,200 bps.
- A notch filter of 60 Hz. was implemented in the applicative computer software which eliminates the line noise properly without distorting the signal. It proves the algorithms usefulness of signal processing.
- The pressure sensing takes place in a continuous way, is difficult and complicated. However it is proposed to continue studying the problem of automatic pressure reading.
- There are several forms to measure temperature; therefore more methods should be tested to see which is better.
- The applicative program was structured with procedures and functions that facilitates the correct data transmission and reception.
- The applicative program runs in any compatible computer that has a serial port and Windows 98 or higher software installed as operating system.
• It can be made changes in the software for new applications according to interest.

• The microcontroller programs were written in a modular form and they can be used for many other applications.

• The Internet use facilitated the information access for the biomedical part. It also facilitated the direct contact with specialists.

**Acknowledgements**

We appreciated the support of the Firemen Company of Santa Anita B138, that brought us the idea which we work on.

Acknowledgments to Telefonica Mobiles Company who has facilitated the telephone line at the hospital center and the cellular telephone for the equipment.
23 Russian federation

A complex telemedicine system of the disasters medicine survey to provide medical relief to the population during the elimination of consequences of emergency situations

Introduction

The latter part of the twentieth century was marked by the rapid development of two modern technologies, namely computing and telecommunications. Their development is closely linked, and has given rise to totally new forms of telecommunication, including the Internet. At the same time, the rapid development of computer technology is resulting in a whole series of new approaches in the most varied spheres of human activity, including medicine. The medical industry has begun to produce diagnostic apparatus capable of displaying results of medical examinations in digital form, and this is opening up totally new opportunities for the processing and storage of diagnostic data, it having become possible, among other things, to transmit such data over any distance via telecommunication channels. This has given rise to e-health/Telemedicine.

The awful tragedy that happened recently in the coastal areas of South-East Asia: Indonesia, Thailand, Sri-Lanka, and India shocked all humanity. There were a lot of victims of the tsunami waves and consequent disruptions amount to hundreds of thousands of people. Countries of the region have suffered enormous material losses. The international community has provided humanitarian aid to the population of the disaster areas.

The scale of the catastrophe of 26. 12. 2004 demonstrated to the whole world the need for new approaches in the field of organization of medical relief to population during the elimination of consequences of emergency situations. Russian specialists have proposed the use of unique systems on the basis of ICT with capabilities that meet the scale of the challenge. If such systems were at the disposal of governments of the Indian Ocean area that suffered as a result of catastrophic events of 26. 12. 2004, the number of victims could have been much less. The lack of means of efficient communication lowered the effectiveness of the organization and coordination of rescue operations, leaving many victims without timely help.

Complex Telemedicine System

Russia proposes to use a complex telemedicine system (CTS) to provide medical relief to the population during elimination of consequences of emergency situations. CTS includes mobile and air-mobile telemedicine means of diagnostics, control and informational support of rescuers and medical units. Because catastrophes of such scale are practically inevitably followed by epidemics of infectious diseases causing losses comparable to that of the catastrophe itself, the CTS includes a SCAESNet system for mass screening of the population and fighting infections diseases in remote areas and areas out of reach.

SCAESNet is Satellite Communication AntiEpidemic Screening Network.

Accordingly, CTS consists of:

- Mobile control station coordinating the work of all system and services;
- Mobile telemedicine station of emergency assistance in the immediate surroundings of the catastrophe zone equipped with a special database for identification of the victims according

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to results of a genetic express-examination;

- Small mobile telemedicine units to organize temporary telemedicine points in regional and local medical institutions receiving evacuees from emergency situation zones;

- Mobile telemedicine laboratories to fight epidemics of infectious diseases.

In actual conditions characterized by significantly growing number of natural and technological disasters, terrorist attacks and local armed conflicts, the role of specialized medical units capable to provide rapid and highly professional medical care to civilians in suffered areas sharply increases. In Russian Federation the function of such units play All-Russian Disaster Medicine Center called “Zaschita” and its divisions in Federal districts and territories. The Russian Disasters Medicine Survey on the basis of the All-Russian Disasters Medicine Center “Zashita” is to be created in 2005. The pilot phase of the project was already started in the Urals Federal Region.

Development of complex telemedicine system for the relief actions in a course of elimination of emergency situation consequences will allow enhancing efficiency and rapid functioning of Disasters Medicine Survey (DMS) owing to:

- Fast receiving of maximum complete reliable information from disaster zone;

- Efficient and accurate estimate of scale and complexity of emergency situation’

- Effective decision making on the actions for elimination of emergency situation consequences, control and co-ordination of relief operations’

- Organization of qualified medical care for civilians in disaster conditions and during elimination of their consequences.

Geographical peculiarities of many countries and lack of advanced and highly reliable communications infrastructure in some regions negatively influence on the capability of DMS units to produce effective estimate of emergency situation consequences, to develop and implement the coordinated complex of organizational and medical measures on their elimination. In Russian Federation mobile medical system is using satellite communication.

**Peculiarities of the System Functioning**

Generally the technological process of staff and DMS units responding on emergency situation (ES) is as follows. In the event of ES the corresponding information arrives to DMS staff, where it is analyzed and then the decision on sending the medical team to disaster area is made. If necessary the mobile multi-profile DMS hospital is deployed in this area. Regional and territorial disaster medicine centers direct their specialized medical teams to ES zone.

At this stage the rapidity, accuracy and adequacy of the decisions on determination of number and profile of medical personal in the team depends mainly on speed and accuracy of the information delivery on location, type and scale of ES, the number of victims, the level and features of damage, availability of local hospitals and their specialization, etc. The mobile multi-profile DMS hospital deployment time is about 1 day.

An average time of functioning in the ES zone is 7 to 10 days that can be prolonged up to 30 days. In the conditions of high loading, geographical remoteness from the medical centers, lack or destruction of communication infrastructure in the disaster zone and need to make vital decisions within the short time, the quality of medical assistance can be improved owing to wide application of advanced information, communication and telemedicine technologies.

Mobile and fixed telemedicine complexes as parts of the system provide efficient 24 hours
communications for consultancy with specialized clinics and scientific centers of the state. This communication is needed during the nearest time interval (10 to 30 days), when rapid diagnosis, ways for further medical treatment, places of hospitalization and necessity of surgical operations should be determined. It is also important on a longer time scale (above 2–6 months) when doctors can receive necessary information and consultations of leading specialists on further treatment and rehabilitation of injured.

The mobile telemedicine station is equipped with the complex of diagnostic and therapeutic medical equipment. There are autonomous system for satellite communication, autonomous power supply systems and “life-support system” providing comfortable working conditions for personal in any climate. The station provided efficient diagnostics of injured, information support and consultations for medical personal.

Taking into account the critical importance of applying the abilities of telemedicine to systems of elimination of emergency situation consequences, in order to form an appropriate social demand in Russia, as well as in other countries, mobile telemedicine systems and technologies are being demonstrated and popularized at many exhibitions, forums and conferences. Among some of the most important events of this kind, one should mention the largest infocommunication exhibition of the year in Russia: “InfoCom-2004”, held by the Russian Administration of Communications and during which the telemedicine project and the Mobile Telemedicine Unit (MTU) were demonstrated to the leaders of the State, and the exhibition “Rescue Means-2004” of the Russian Ministry for Emergency Situations, where the project received a gold medal. In March 2004 the SCAESNet system and the MTU were demonstrated at the International Salon of Inventions in Geneva and were honored with a gold medal. The German Inventors’ Society awarded system with its Special Prize.

The Mobile Telemedicine Unit was also successfully demonstrated during the World Summit on the Information Society in Geneva, 10–12 December 2003.
MTU INTERIOR ARRANGEMENT

Microscope
Air-conditioner
X-ray assistant’s workplace

Workplace with air cleansing system
Workplace for digitalization of rest results
Heater system, water dispenser

— 268 —
24 Tanzania

Muhimbili Health Exchange Forum (MuHEF)

The United Republic of Tanzania or Tanzania, is a country on the east coast of east Africa. It is bordered by Kenya and Uganda on the north, Rwanda, Burundi and the Democratic Republic of the Congo on the west, and Zambia, Malawi and Mozambique on the south. Tanzania has a population of 36,588,225 (2004 est.) and a total area of 945,090 km².

Tanzania is currently experiencing a crisis in the availability of health staff. Given the shortages, staffs in rural areas often work in isolation with no possibility of accessing health information and sustaining dialogue with their colleagues in specialized hospitals. Running libraries in Muhimbili University College of Health Sciences (MUCHS) has proven to be costly and ineffective, yet the School of Public Health &Social Sciences generates a lot of research and papers which could serve as a life-line to their colleagues in the periphery.

To improve information sharing with various health staff within and outside the country, a website, www.muhef.or.tz, known as the Muhimbili Health Exchange Forum (MUHEF) was established at the Muhimbili University College of Health Sciences, Dar es Salaam, Tanzania in October 2003. MuHEF’s central goal is to promote improved health care practices and behaviors by increasing access to health information. Its’ mission is to facilitate exchange of online communication and the flow of current health information to and from districts, regions and health experts within and outside the country so as to improve quality in health.

What to do?

The background is that in 2002 the School of Public Health and Social Sciences and the German Technical Assistance, GTZ decided to assess the extent to which this situation can be improved by means of Information and Communication Technology. Initially a questionnaire was piloted among CHMT members and health staff in six districts of Tanga Region, thereafter 230 questionnaires were sent to CHMT members in the other 20 regions of mainland Tanzania. The aims were to:

- Assess computer availability and usage
- Examine knowledge of how to use the computer
- Assess access to Internet
- Identify the scientific journals read regularly
- Identify the information that will be helpful to CHMT members for MuHEF

The response rate was 55% and the results were more than just intriguing:

- The majority (86%) of the district hospitals had computers available, but not all CHMT members had access to a computer
- Less than half (48%) of the district hospitals had access to Internet
- There was a low level of basic computer literacy (37%) at the district level
- Access to scientific journals was very limited (28%).

Some of the CHMT members received an average of two to three copies of a certain journal

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per year. The number of copies that reached them was small compared to the number of health staff.

Based on the above mentioned surveys, the decision for development and wide distribution of of MuHEF was taken; with the firm believe that MuHEF would help in the distribution of healthcare information such as :

- Articles from International Journals
- National Health Statistics
- Healthcare Guidelines (Training, Policy & Treatment)
- Latest or updated health news
- Possibility to put questions to Health experts
- Articles from local experts

Discussions between Dean of School of Public Health and Social Sciences and a wide spectrum of health specialists from MUCHS, Muhimbili Orthopedic Institute, and Muhimbili National Hospital were held. Given modest funding available it was decided to try to answer the needs via a website and CD.

Steps towards bringing to life MuHEF www.muhef.or.tz

- Identification of useful articles and discussions with Ministry of Health to obtain guidelines
- Categorization of documents
- Copyright obtained, articles converted into PDF and security features added
- Hosting options in Tanzania are limited so RSA was preferred
- MuHEF was launched October 2003.

At the moment MuHEF website offers :

✔ 400 Articles from local experts and International Journals covering 32 topics
✔ National Health Statistics
✔ Guidelines (Policy, Treatment & Training) from Ministry of Health and WHO
✔ IEC information (leaflets, fliers, booklets) for download
✔ Discussion Forum (Question & Answers)
✔ Important websites (related to health)
✔ Basic computer information
✔ News & Events (Fig.2–5).

**MuHEF on CD Rom**

Given that there is limited internet access/slow connection speed, a total of 400 CD-Rom versions was produced and distributed at one of the District Medical Officer’s conference, and others were through the Christian Social Sciences Commission. The question and answer facility is not lost, as the question sheet can be printed from the CD and faxed to Muhimbili. CD is now
updated and mailed to districts twice a year.

In sum:

Up to day (September 2005), the overall number of distributed visitors is over 8,000. A total of 100 online questions have been received — covering mainly research, with a few questions regarding clinical work. The use of the question and answer facility is limited. Possible reasons for this might be: (a) the website is not sufficiently marketed, (b) a slow connection speed, (c) the website is difficult to use by some inexperienced end users, and (d) probably lack of sufficient culture of asking questions and seeking help.

Next steps

The plan is to continuously update the information on the website; upload new tools, for example we have recently put a Comprehensive Council Health Plan tool which is a computer based planning tool linked to the Tanzania Essential Health Intervention Program (TEHIP) also to share information on short course offered by the School of Public Health and Social Sciences at MUCHS. In November 2005, an evaluation questionnaire will be distributed at a DMO’s conference to assess the extent to which members of CHMT have accessed the website and the CD Rom and identify potential problems they may have encountered and whether they had any questions pertaining to the information that has been shared.

At a meeting of the experts at the end of 2004 and recently in August 2005, it was decided to seek clinical questions more actively and shorten the response period to at least two days. A pilot is being undertaken with Mnero hospital, Nachingwea district, Lindi Region. This is a church hospital in one of the poorest areas of Tanzania which recently gained internet access. The results are being monitored but it is still very for final conclusions. In addition, it is foreseen to widen the circle of experts to include zonal training centre staff as these are now gaining better internet access as well as to become more involved in continued education with distance learning possibilities via online courses in RH, STDs, HIV/AIDS. Some courses on HIV/AIDS from Engenderhealth have recently been translated into Kiswahili and are available upon MuHEF.
25 Turkey

Background

Turkey is a developing country located on the southeastern part of Europe and bridges over to western end of continental Asia (Fig.1). It has a total area of 780,580 km² and population of 69,660,559 (2005).

The country is divided into seven regions with rather different climatic, populational and economic characteristics: Marmara, Aegean, Mediterranean, and Black Sea regions have fairly dense population with higher socio-economic status, while Central, Eastern and Southeastern Anatolian regions have sparse population and underdeveloped economy (Picture 2).

Turkey has about 80,000 medical doctors, 45,000 of them are general practitioners. Healthcare facilities are unevenly distributed over the country. Most of the highly specialized medical centers as well as top-level physicians are concentrated in metropolitan areas. All these makes Turkey ideal candidate to immensely benefit from telemedicine services.

As other developing countries, Turkey suffers from lack of funding to establish state of the art healthcare services through out the country. Citizens in rural areas suffer both from lack of adequately developed health care facilities and from inadequate quality of medical care. This, creates socio-economic problem: affordability and distance to the closest medical center. Patients seeking quality health care are being forced to travel to distant medical facilities or alternately having the desire to live closer to adequately-equipped medical center. As a result involuntary internal immigration to big cities starts, causing unbalanced growth and unplanned expansion of bigger cities, resulting in overcrowd the medical centers, even in big metropolitan areas. Telemedicine can possibly stop and reverse this trend by giving physicians the latest advancements in medicine, readily, easily and at minimal cost. This would allow the doctors to advance

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60 Cavit Avci, M.D., Levent Aytan, M.D., Yavuz Ozdogu
themselves while providing quality medical care where adequate health care is needed the most, even in rural areas. The global vision, ideology and humanistic ideas can easily reduce cost of health care, pave the way to highly advanced hospitals to flourish in every region, upgrade the medical know how of physicians to even higher levels and allow every citizen to receive better health care in their own community. For these reasons all Telemedicine related Projects are of vital importance to all developing countries and particularly to Turkey.

The Telemedicine Projects along with advanced telecommunication technology; medical knowledge and resources of participants, will help facilitate the financial, technical and administrative aspects of quality health care for everyone. We could bring telemedicine to all doctors, everywhere, without having them to leave their workplace, their patients, eliminating enormous transportation and lodging expenses. The vision of all people involved in telemedicine today, should be to tell all physicians no matter where they practice, that telemedicine is available, tele-assist is available, tele-mentoring is available, teleconsultation is available and robotic telesurgery will follow soon. Every practicing doctor should know that there is a more experienced specialist available to help; technological and medical advancements are available for them to further their post medical training or simply participate in interactive professional forums, without leaving their place of practice. This would also yield the opportunity to for physicians to serve even in remote areas without feeling totally isolated. Let us give them the confidence they need by assisting them provide quality health care. The only benefactors will be the citizens in general, regardless of their wealth or location.

Compared to other developing countries, the telecommunication infrastructure of Turkey is quite good. There is wide usage of Internet, cable TV, satellite broadcast, and other electronic communication services by the general public. Steadily increasing number of service providers in the field of electronic communication as well as increasing number of everyday users is positive indicators of progress. Based on this, if telemedicine is widely introduced and enormous benefits of telemedicine explained properly in Turkey, it could definitely generate interest and find full acceptance readily.

However, at this moment, telemedicine usage and application is not yet fully developed. This is a result of economics as well as lack of administrative and informative presence. Low national income per capita plus country’s economic status, coupled with extreme cost of implementing high tech telemedicine services, appears to have curtailed the rapid expansion of telemedicine. Initial investment and operating cost may be considered as excessive in countries with actual mediocre economies. Once set up and starts operating smoothly, telemedicine will provide better benefits and more economical advantages compared to classic medical and health care services with equal value. In order to attempt to achieve this, initial start up cost should not be considered as classic investment that should be amortized within a certain time frame. Taking state of Turkey’s current economy into consideration, this is not an easy task.

Another difficulty usually encountered in countries where capital investment in telemedicine is needed the most, is being able to show the immense benefits of telemedicine and argue the advantages, prove the long term advantageous economics, both to government officials and to private sector investors. Currently, the national personal income per capita and funds set aside for classic health care maintenance in Turkey is far below global standards. In view of this fact, it is hard to transfer additional funds from the national budget for a new venture like telemedicine.

Ministry of Health is expected to support a nation wide telemedicine project that can provide higher quality service to all citizens in every region of the country. From time to time, we
come across theoretical telemedicine project studies within the Health Ministry however there has not been anything tangible until now.

In Turkey, currently, there are basically two types of established institutions that are focused on telemedicine, the universities and private health providers.

In Istanbul, there are several private hospitals that have an internal inter-departmental communications system via local area network (LAN) with adequate capacity to have interactive audio and video imaging communications. But even this service is limited to a few departments within the hospital, such as radiology and pathology.

Istanbul University is the only institution in Turkey that has started meaningful work and limited application of telemedicine. ISTEM (Istanbul University Continuing Medical Education and Research Center) currently carries out telemedicine work at the University (Fig.3). It has years of experience in Telemedicine. This experience coupled with an ambitious Turkish National Telemedicine Project (TNTP), can achieve this objective. Administrative staff of ISTEM continuously monitors and actively participates in international telemedicine developments. They are always open for more cooperation with other institutions. ISTEM is a member of IET (Institut European de Telemedicine), ISFT (The International Society for Telemedicine), SET (Société Europeennne de Télémedicine), TELEMEDIANA (Virtual Academy of the ART Science of Healthcare), IFTRE (International Forum for Telesurgical Research and Education) and EITS (European Institute of Telesurgery). In 2002 ISTEM participated in ITU-WHU meeting in Geneva and became involved in “Telemedicine for Developing Countries” study group (Development Sector Study Group 2, Question 14-1/2). Additionally, ISTEM is also a founding consortium member of EMISPHER (Euro-Mediterranean Internet Satellite-Platform for Health, Medical Education and Research) sponsored by European Commission. EMISPHER work commenced in September of 2002 and it will conclude the first phase by October 30, 2004. ISTEM have participated in this project for the past two years and they are organizing the “Best Practice of Real Time Telemedicine” conference scheduled to take place September 15-19, 2004 in Istanbul.

During this conference another European Commission sponsored project has been discussed and debated to commence work on VEMH (Virtual Euro-Mediterranean Hospital). ISTEM is ready to participate in this venture, too. ISTEM wishes to continue the relationship with ITU (International Telecommunication Union), WHU (World Health Union) and further its cooperation with Development Sector Study Group 2, Question 14-1/2. By doing this, ISTEM will help enhance further the Turkish National Telemedicine Project (TNTP) which is a major new contributor to Turkey’s national health policy and it will continue its participation in the international telemedicine platforms. ISTEM, also plans to strengthen its relations and telemedicine cooperation with the former Soviet Union countries like Azerbaijan, Turkmenistan and other countries that share the same cultural Turkic roots and commonly used dialects of Turkic languages. We believe, the close relationship and better cooperation among Turkic countries will also contribute to importance and rapid expansion of the Turkish National Telemedicine Project.
Turkish National Telemedicine Project (TNTP)

Purpose, operational process, current applications and future expectations:

The main goal is to establish a National Telemedicine Study Group under the leadership of ISTEM, Istanbul University Continuing Medical Education and Research Center. This group’s main objective will be to launch, enlighten, and define telemedicine concept nationwide. Initiate wider realization of telemedicine nationally and ensure that enormous benefits of telemedicine reach every corner of the country. At the same time achieve wider cooperation with foreign organizations and participate in international projects to keep abreast of global medical and technological advancements.

Strategy and charting a course:

There are number of preparatory studies that need to be carried out. We need to research suitability of telemedicine with existing healthcare system in Turkey and determine its overall benefits as well as:

— to try to pin point possible difficulties/problem areas and find solutions,
— to determine the appropriate telecommunication system and its suitability with the existing telecommunication infrastructure,
— to make a list possible private and government agencies that can provide resources and determine the prospect of their close cooperation.

We need to determine probable institutions qualified to join the system and open dialog with their administrative bodies. We have to introduce, portray the great benefits and explain the mechanics of telemedicine to their governing bodies. We need to confer what they have to do and discuss the responsibilities. We need to outline the extent of investment in equipment and deployment of technical staff. In addition to internal resources, external resources should be explored to determine possibility and extent of cooperation that can be expected.

Once these issues are completely addressed and resolved the project should commence under the stewardship of ISTEM.

Structure of TNTP:

ISTEM (Istanbul University Continuing Medical Education and Research Center) is responsible for initiating, developing and administering the Turkish National Telemedicine Project. ISTEM, the driving force of TNTP, is an academic institution of Istanbul University. Administratively it is tied to Rectorship of Istanbul University. Administrative body of ISTEM consists of a chairman, a vice chairman, board of directors, and an advisory board.

Permanent Administrative Body consists of Director, Assistant Director, two secretaries and three technical staff members. Additional personnel are deployed as needed, usually employed as consulting contractors. In the future, when it is completely operational, representatives of other universities and institutions will be invited to join the administrative board.

ISTEM is located at the Istanbul University Medical Faculty Capa Campus. They have 600 square meters of office space for Director, assistant director; secretarial staff and they have their own production and post-production shop. There is a 120-seat amphitheater, two meeting rooms—one with a capacity of 80 persons and a smaller one for 30 persons (Fig.4).

Infrastructure and equipment: ISTEM uses terrestrial connections and satellite links for telecommunications and utilizes Internet, ADSL, Radio Link, ISDN, Satellite and UlakNet...
(Turkish National Inter University Academic Network)

Internet: Utilizes Internet connection provided by Istanbul University and Turkish Telecom to communicate with local, national and international terminals. The service provided by Turkish Telecom is neither sufficient in speed nor adequate in capacity to serve the communication needs of ISTEM. Although service seems to be satisfactory for data transfer, it is inadequate for quality image transfers. For the time being, only data and still images (photos, radiology images, and pathologic images) are being transmitted. By using web camera connection, low quality live images are transmitted when desperately needed. ADSL and similar systems provide sufficient speed and better quality. We expect Turkish Telecom to upgrade their current infrastructure in the near future. Once upgrading process is complete, we may be in a position to better utilize line connection service in Telemedicine.

Currently Istanbul University has a frame-relay connection to Harran University in Urfa approximately 2000 kilometers southeast of Istanbul. With a point-to-point connection, interactive math, physics courses are offered to students at Harran University.

Radio Link Connections: Istanbul University has two medical faculties, Capa and Cerrahpasa, approximately 13 km apart. Since 1996, Cerrahpasa Medical Faculty has had a radio link with Capa Medical Faculty, where ISTEM is located. Both faculties have been utilizing this radio link to have joint scientific meetings, discussions, debates and teleconferences on various subjects such as surgery, gynecology and others. Real time, interactive telecommunications via radio link yields very good quality audio and visual imagery. It is available 24 hours a day, basically free, without any roaming charges. Biggest disadvantages of radio link communication are distortion during bad weather conditions and ineffective transmission to more distant points.

ISDN Connections: In 1996 when ISTEM decided to implement distant medical education, it consulted Turkish Telecom (TT) administrators, to evaluate and help select a suitable telecommunication system. Turkish Telecom's evaluation resulted in suggesting ISDN-PRI or ISDN-BRI to be the most suitable system for TNTP at the time and consideration of IP based network at a later date. Based on this finding, we initially subscribed for ISDN-PRI (2 MB) and later changed our subscription to ISDN-BRI (3x128 kb/s). We currently use one ISDN-BRI (384 kb/s) line actively and we keep two other lines inactive. For the past seven years we actively implemented telemedicine with several centers within Turkey and even with more centers outside Turkey. Based on our seven years of experience, we have established that ISDN connection with minimum 384 Kb/s yields acceptable quality of audio and visual imagery transmission. ISDN lines are more readily used in other countries and easily obtainable. However there are several disadvantages as well: frequent disconnections, image freezing, difficulties of 3x128 connection, poor quality with 256 and 128 Kb/s connection. The lines need to be kept under constant and careful surveillance, roaming charges are expensive and making multi conference connection is not easy (need MCU).

Satellite: It is well known that satellite system is the best choice for teleconferences and similar
interactive transmissions. However initial investment to set up this system is quite high. Due to very high start up cost, this system was not an option for TNTP.

On the other hand, ISTEM is the Turkish representative and founding member of EMISPER (Euro-Mediterranean Internet-Satellite Platform for Health, Medical Education and Research) Project that was sponsored mostly by the European Commission. Due to this relationship, now there is a 2.5 m diameter parabolic satellite antenna set up on the roof of ISTEM building (Fig.5). By utilizing the satellite capacity of Eutelsat which is a technical partner of EMISPER, Mediterranean basin countries are now able carry out telemedicine related work among themselves as well as their European partners. In the future TNTP will be able to use the ISTEM antenna for similar telemedicine related work and education.

Ulak Net : Ulak Net is the name of a system called National Inter University Network set up to provide better communication service among universities. It is a broad band and IP based, communication network. This system was set up and is currently operated by TUBITAK (Turkish National Science and Research Center), a government agency. All 47 medical faculties of numerous universities in the country are connected to each other using this system. Universities are able utilize this system for data transfer and Internet connection service without any charge. Cost of operating the system is covered by TUBITAK.

ISTEM have been studying the possibility and feasibility of using Ulak Net to enhance TNTP. There is also a study group in place to analyze how 47 medical faculties can carry out telemedicine work among themselves as well as medical centers in Euro-Mediterranean countries through Ulak net with the assistance of ISTEM satellite link. Currently university medical centers are able make point-to-point teleconferences with fairly good reception. We are in the process of trying out multi cast applications.

Ulak Net will add important and valuable advantages to TNTP when it is fully utilized. Through proper deployment of existing system, 47 university medical centers and their LAN (Local Area Network) will enable every computer terminal to reach or connect to telemedicine work being conducted at a distant point. A physician sitting in an office, using a personal computer will be able to receive and share medical information or participate in medical forums. All of this will come without any cost to campus users, since Tubitak has set aside funds to cover the cost of this operation.

**Teleconference Equipment and System at ISTEM**

Currently, Istem uses the following equipment:

- 1 Sony 5100-P teleconference unit, ISDN compatible, on screen multi conference capability at 4 (3+1) x128 kb/s.

- 1 Ezenia MCU unit, ISDN compatible, 12x384 kb/s multi conference capabilities.

- 1 Polycom teleconference Unit, ISDN and IP compatible.
• Analog and digital camcorders, document cameras, video projection equipments, and suitable audio system, montage (assembly) and postproduction equipments.

ISTEM also has an extensive video archive of over 1000 medical and surgical cases/procedures recorded on video cassettes in different formats (VHS, 8, Hi-8, Dig) and work is underway to convert the complete archive into digital format for use by TNTP.

**Past, Present and Future of Telemedicine Project of Istanbul University**

Istanbul University is the oldest educational institution in Turkey. It has pioneered many innovations in numerous fields over the years. Now, Istanbul University has keen interest in what the latest information and communication technology has brought to us: Telemedicine.

Istanbul University has been vanguard of medicine and medical education during the past 550 years, not only by using cutting edge of technology but also by helping the evolution of medicine in terms equipment and techniques. In 1992, two medical faculties of Istanbul University established the Audio Visual Medical Education and Research Center (ODVIM) to provide more up to date medical education. In 1996 ODVIM started “Distant Education” and “Telemedicine” implementation. In 1997, the name and structure was changed to ISTEM-Istanbul University Continuing Medical Education and Research Center. Between 1997 and 2000 using radio link and ISDN connection, ISTEM commenced distant medical education, though limited in scope. ISTEM center progressively started to gain experience and recognition in telemedicine.

On April 3, 2000 ISTEM organized the First National Telemedicine Symposium that was the foundation of TNTP (Fig.6). This symposium brought together Ministers of Health, Education and Transportation along with top officials of universities and medical faculties as well as high ranking representatives of Turkish Telecom, TUBITAK and other communication officials to present their views and opinions on TNTP.

Ever since 2001, six Medical Faculties in different regions of Turkey have been making telemedicine conferences over ISDN 384 Kbit/s line connection at ISTEM. Additionally, from time to time, we have meetings/conferences with numerous medical centers in France, Belgium, Germany, Austria, Italy, Sweden, Israel and U.S.A. We plan to increase telemedicine activities in the future and make them more effective (Fig.7).

We plan to use the existing Ulak Net communication network that links 47 medical faculties. This broad band IP based network appears to be more advantages than ISDN connection. Existing Ulak Net System is operated by Tubitak, a government agency, therefore all operating costs and expenses are covered as part of their annual budget.

Our future plan is also to link non-university medical centers, medical clinics even individual practices with medical centers around the world via satellite, internet and terrestrial lines so that they will share their medical experiences with their peers in the medical field and keep themselves up to date with developments and advancements in medicine (Picture 7).
Fig. 7 Future plan of TNTP

References


26 Ukraine

Experience and results of teleconsultations in daily clinical practice

Background

This Eastern European country is situated between Poland, Romania, and Moldova in the west and Russia in the east and is bordering the also Black Sea on the south. Ukraine has a population of 50,447,719 (1997) and a total area of 603,700 sq km. This is the second largest country in Europe.

Teleconsultations

Beginning

In 2000–2005 Donetsk Research and Technical Institute of Traumatology and Orthopaedics, Department of Informatics and Telemedicine, carried out over 300 teleconsultations in 15 different fields. The very first one was provided by Professor M. Nerlich from Regensburg (Germany) on 25.01.2000, who consulted a patient with serious pelvic trauma in Donetsk. More information is available at www.telemed.org.ua. The well developed teleconsultations network was also used to consult patients after the terrible earthquake in India in 2001.

As a prerequisites of teleconsultations success a list of main indices were developed and followed.

Indices

- Determination of diagnosis and treatment tactics in cases of infrequent, serious or atypically flowing diseases;
- Necessity to perform new and/or infrequent surgical (medical or diagnostic), procedure etc.;
- Lack of immediate experts in the given medical establishment or lack of sufficient clinical experience for diagnostics or treatment of diseases;
- Confirmation of the elected tactics of treatment;
- Search of alternative solutions of a clinical problem;
- Geographical distance preventing the e-health provider from providing attending urgently to the patient;
- Cost lowering for the diagnostics and treatment without the loss in their quality and efficacy;
- Features of surgery and medicamentous therapy;
- Disputable clinical situation;
- Independent opinion for patients’ complaint.

Devices

Teleconsultations were realized via work stations for daily clinical use: PC/notebook (500

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MHz and more) with the set of multimedia equipment, digital camera (1.3 mpx and more), Internet line (56K and more), scanner (any), printer (any), film-viewer (Fig.2).

**Technologies**

Asynchronously and synchronously teleconsultations at the base of the Internet technologies were applied-mailing lists, medical off-line forums, e-mail, ICQ, system “ICQ + e-mail”, also MMS Internet connections depended on the distance-dial-up-for small hospitals and rural areas, leased line connection-for big regional hospitals and GPRS/Mobile-for urgent cases.

To ensure data security, the following topics were always concerned and taken into consideration: *patients consent, anonymity, login/password* for all telemmedicine work stations and *digital signature* system for regional e-health care.

**Areas for teleconsultations** : trauma—57.5%, orthopaedic surgery—21.5%, neurosurgery—4.9%, oncology—4.2%, teratology—3.5%, rheumatology—2.8%, hematology—2.1%, other (plastic surgery, endocrinology, ophthalmology)—2.1%. Table 1 provide detailed information for the period 2000–2004, while Table 2 described data transmitted through different telecommunication systems during teleconsultations.

**Results**

The reliability of the diagnostics of different traumas and diseases using digitized data is quite high and makes up 72.8% (p<0.05) and more.

Recommended schemes for treatment were used in 88% of the clinical cases.

Clinical results:

- 16% reduction of the terms of in-patient treatment;
- 9.2% reduction of the frequency of complications (moreover, there is statistical evidence that the structure of complications changed a lot so that the mild forms prevailed);
Table 1

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Absolute numbers</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traumatology and orthopaedics</td>
<td>147</td>
<td>70</td>
</tr>
<tr>
<td>Neurosurgery and neurology</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>Oncology</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Congenital abnormalities</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Other (e.g. plastic surgery, endocrinology, dermatology, dentistry, neonatology)</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Internal diseases</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Rheumatology</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Haematology</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Cardiology/cardiac surgery</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>210</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Medical Data</th>
<th>Absolute numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital case histories</td>
<td>210</td>
</tr>
<tr>
<td>Digital clinical photographs</td>
<td>64</td>
</tr>
<tr>
<td>X-ray images</td>
<td>461</td>
</tr>
<tr>
<td>Tomography images</td>
<td>106</td>
</tr>
<tr>
<td>MRI images</td>
<td>541</td>
</tr>
<tr>
<td>Ultrasound images</td>
<td>4</td>
</tr>
<tr>
<td>Graphical images</td>
<td>15</td>
</tr>
<tr>
<td>Digital cytological micrographs</td>
<td>5</td>
</tr>
<tr>
<td>3-D tomography scans</td>
<td>14</td>
</tr>
</tbody>
</table>

- 10% reduction of the relative risk of development of complications;
- 0.4% reduction of re-hospitalization rate.

Thus, we recommend wide use of technically simple telemedical systems for asynchronously and synchronously teleconsultations.

Our results in “second opinion” consulting are also worth mentioning. Our site “Telemedicine in Ukraine” (Fig.4) provides a special web-page for patients, we also have a special mail-box (consalt@telemed.org.ua). 8,3% of teleconsultations were carried out using this method. The areas of medicine in which distant consulting were used are traumatology and orthopedics (50,0%), in-born pathology (33,4%), neurosurgery (8,3%), plastic surgery (8,3%). It is expedient to mention that 50% of all the “second opinion” teleconsultations concerned traumas, acquired diseases and in-born pathologies of hands. After this kind of teleconsultations about 30% of
the patients were treated in our clinic.
27 Zambia

The Republic of Zambia is a landlocked country in southern Africa. It borders the Democratic Republic of the Congo to the north, Tanzania on the north-east, Malawi on the east, Mozambique, Zimbabwe, Botswana, and Namibia to the south, and Angola on the west. Formerly Northern Rhodesia, the country is named after the Zambezi river. Zambia has a population of over 10,462,436 (1977) and a total area of 752,614 km².

Background

The life expectancy in the country is about 40 yrs. Most of the population is clustered along the line of rail that is highly urbanized due to economic activities. Dispersal of population with high rates of urbanization has made it difficult to deliver health care services across the country (Fig.2–3).

The last decade has witnessed a major re-organization in Zambian health services. Government has dedicated lots of efforts to improve quality of life. One of the steps was the health reforms that started in 1999. The strategic goal was and still is, to transform the healthcare sector into an efficient health care system that is able to guarantee equity of access to cost effective healthcare as close to the family as possible use the available facilities (Table 1).

Despite of the efforts so far, the limited financial resources have seriously constrained the governmental efforts in achieving desired objectives. Scarcity of specialized health staff and its skewed distribution plus the significant brain drain has made difficult the effective delivery of healthcare services. In addition, the high cost of referrals and difficult terrains create major problems for an equitable healthcare delivery. All these forced the government to consider implementation of telemedicine the only possible solution.

Telemedicine Program

Telemedicine has been identified as an innovation for bridging the gap in many areas of

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| Health Facilities                      | No | Central hospitals | 3 | General hospitals | 18 | District hospitals, including mission hospitals | 72 | Rural health centers | 899 | Urban health centers | 187 | Military hospitals | 1 | Industrial hospitals | 8 | Private hospitals | Many |

intervention. Telemedicine in short can be described as “practical medicine from a distance” which can be done by linking experts as the centre of excellence with distantly located patients and primary healthcare providers. Telehealth is a technology that if implemented with an equity focus could promote health even in underprivileged are remote settings.

In 2003 the Government of Zambia through Ministry of Health appointed members from various institutions to set up the National telemedicine Steering Committee. The mandate of this committee is to establish Telehealth activities in the country and integrate it into the general health policy of Zambia.

The starting point in the work of the committee was the selection of six pilot sites under a phased implementation system. The selected site were Mumbwa, Kabwe, Chainama, Chipata, Chongwe and UTH (University Teaching Hospital). The selection was based on the following criteria:
- Availability of technology
- For reaching Areas
- Hospitals with very complicated cases and
- Higher catchments
- Population-decongestion

Various technologies were recommended for each of the selected sites based on their role in the network. For example, UTH as major receiving centre have 15 points LAN, DSL, wi Fi and dial up service as a back up. Chainama is the main training centre and should have LAN (3 points), DSL, wiFi and dial up as a back up. The same refers to Mumbwa, Lundadzi (additionally added) and Kabwe, which is situated 150 km from the main center. Chipata is situated 500 km from UTH and has to have 4 points LAN, DSL, wiFi and dial up as a back up.

Achievements so far

The four sites have been assessed for installation of the system and sensitization of the staff on the program has been conducted. The personnel that have to undergo training were chosen. Recommendations have been made to connect the four sites for tele-consultations on complicated cases and tele-radiology and tele-dermatology cases. In addition, in order to gain more experience on recent development in telemedicine, an extensive study tour was made to South Africa in February 2005. Visits were made to the Department of Health, central governmental agencies (SITA, MRC, etc.) to universities, local, provincial and tertiary hospitals and private enterprises. Lots of commitments for extensive collaborations were achieved as results of the study tour. Example is the agreement with MRC that will help in providing technology, standards, protocols, research results, etc. South Africa network would
and tele-consultations on various radiology cases.

**Coming soon**

The plans for further development of telemedicine implementation include:
- Transmission of live, video and voice fails;
- Data transmission;
- Real time remote consultations;
- Real time remote examination of patients;
- Transmission of images and X-rays as well as distant highly specialized lectures as extension to e-learning courses.

Despite of the achievements so far and our optimism and enthusiasm, the main constraints for telemedicine development in Zambia that cannot be easily overcome are:
- Funding-most of the equipment that can be used in our telecom infrastructure is expensive;
- Training-very few medical personnel have computer competence;
- Too many competing health demands: HIV/AID;
- Uneven distribution of telecommunications infrastructure.

That’s why we appeal to everybody for help. Zambia needs telemedicine much more than other countries because of the numerous health challenges. We appeal for support and funding to further develop this noble project.
Annex 1

Resolution 41 (ISTANBUL, 2002)

E-health (including telehealth/telemedicine)

The World Telecommunication Development Conference (Istanbul, 2002),

considering

a) that the World Telecommunication Development Conference (Valletta, 1998) recommended that ITU continue to study the potential of using telecommunications for e-health in order to meet some of the needs of developing countries, and as a result adopted Question 14/2 “Fostering the application of telecommunications in health care”;

b) that the ITU-D has produced a report on “Telemedicine and developing countries-Lessons learned” which was approved by ITU-D Study Group 2 in September 2000, and a telemedicine directory which was approved in September 2001;

c) that the second World Telemedicine Symposium for developing countries convened by the Telecommunication Development Bureau (BDT) in Buenos Aires, 1998, recommended that BDT set aside a specific budgetary allocation from ITU TELECOM surpluses and from the BDT budget for supporting the telecommunication component of e-health pilot projects, e-health training, and missions by telemedicine experts to assist developing countries in the formulation of proposals, and that ITU-D continue its studies of telecommunication needs for e-health and, in particular, to identify pilot projects, provide an analysis of project results, and assist countries to define a policy and strategy towards telemedicine implementation,

considering further

a) the potential benefits identified in the report on “Telemedicine and developing countries-Lessons learned”;

b) the new Question on what measures should be taken to facilitate the introduction of e-health applications in developing countries,

recognizing

a) that the possibility of undertaking e-health applications will be enhanced if appropriate regulatory, legal and policy frameworks exist in the telecommunication and health sectors;

b) that sharing expensive communication infrastructures with other applications such as e-commerce, distance education and so on can improve the availability and sustainability of e-health applications;

c) that in order to deploy these applications, it is necessary to adopt a multidisciplinary approach and bring together expertise from the information and telecommunication technology and health sectors,

resolves that BDT

1 continue its efforts to raise the awareness of decision-makers, health professionals, partners, beneficiaries and other key players about the benefits of telecommunications for the e-health applications;

2 continue to support e-health projects in collaboration with government, public, private, national and international partners-in particular with the World Health Organization (WHO);

3 collaborate with international and national initiatives in e-health, such as the UN
Millennium Project: Health InterNetwork, led by WHO;
4 encourage collaboration, and provide support using TELECOM surplus funds and other
resources, on e-health projects on the national and regional level;
5 set up, within existing budgetary resources, a fund for telecommunication facilities for
e-health, and introduce e-health training in the centres of excellence;
6 promote, facilitate and provide technical support and training in information and
communication technologies for e-health;
7 work with the health sector to identify models for sustainability of e-health applications,
particularly in remote and rural areas of developing countries, exploring possibilities for
sharing infrastructure with other services and applications,

invites

1 Member States to consider the establishment of a national committee/task force comprising
representatives from the telecommunication and health care sectors in order to assist with
awareness-raising at national level and with the formulation of feasible telemedicine
projects;
2 the international financial institutions and donor agencies to assist in developing
telemedicine/telehealth applications, projects and programmes in developing countries.
Making better access to healthcare services

ITU-D Study Groups
Report on Question 14 1/2

Kyodo Bunkasha Co, Ltd