



**ITU-D**

STUDY GROUP 2

4th STUDY PERIOD (2006-2010)

## QUESTION 14-2/2:

### *Mobile eHealth solutions for Developing Countries*



## THE STUDY GROUPS OF ITU-D

In accordance with Resolution 2 (Doha, 2006), WTDC-06 maintained two study groups and determined the Questions to be studied by them. The working procedures to be followed by the study groups are defined in Resolution 1 (Doha, 2006) adopted by WTDC-06. For the period 2006-2010, Study Group 1 was entrusted with the study of nine Questions in the field of telecommunication development strategies and policies. Study Group 2 was entrusted with the study of ten Questions in the field of development and management of telecommunication services and networks and ICT applications.

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## FOREWORD

For decades the Telecommunication Development Bureau of the International Telecommunication Union (ITU-BDT) is undertaking various activities related to the study of the potential benefit of eHealth and telemedicine solutions and services in the health care sector of developing countries as well as the demonstration of these applications by implementing pilot projects in different countries.

In accordance with the decisions made by the WTDC in Doha (Qatar) in 2006, BDT began to study Mobile eHealth. The main goal of ITU-D SG2, Question 14 was formulated as Mobile eHealth.

The Mobile health topic was also strongly supported at the Meeting of Question 14 in Japan in June 2008 as a service that will result in extraordinary benefits for the developing countries. The main goal was to assist developing countries in the introduction and widely spread of Mobile eHealth services using both – mobile phone and mobile centre/clinic connected via mobile network to nearby hospital. The number of mobile phones overtook the number of fixed lines. Africa was the first continent where it has happened.

Moreover the proposal to set up an initiative to support “Mobile eHealth” has been received from the BDT Programme 3 at the meeting of the Study Group 2, Question 14 presented in the Document 2/194-E, 09 September 2008. The idea was to speed up the introduction of eHealth services by using experience of all partners and benefit from their knowledge. The proposal has been discussed and unanimously supported by all participated countries.

This report highlighted the role of mobile telecommunication technology in health care by offering at a distance the medical consultation and administration of patient treatment.

The preparation of this report is one example of the experience of ITU experts in Mobile eHealth field and their ability to work successfully in cooperation with many other partners from all over the world.

I hope that this report will provide you useful information on various mobile Health solutions, on lessons learnt and thus will help those undertaking projects in this emerging eHealth needs of developing countries.

Mr. Sami Al Basheer Al Morshid  
Director, Telecommunication Development Bureau  
International Telecommunication Union  
Geneva, November 2009

## PREFACE

At the very beginning, the editors would like to clarify that:

- The present report does not represent a textbook on Mobile Health. A lot is written on the topic so far. To provide even a list of references on Mobile Health is a Sisyphean work and yet at the moment of publication the list will be already incomplete.
- The strategic goal of the report is to offer some practical information on successful or ongoing Mobile Health solutions and ready to implement decisions, some of them realized with the active support of ITU – financial, moral, scientific, etc.
- The common characteristic of all presented examples is a maximum achievement with a minimum funding. That is why the lessons learnt are applicable all over the world and especially for countries with restricted resources.
- As Mobile Health is inevitable part of the development and implementation of eHealth Master Plan, some examples of the latter are also provided.

The report consists of 3 parts:

- 1 Part 1 focuses on background matters – what is Mobile Health, how to use Clinical Decision Support Software and Traffic Control System for Medical Information Network in order to Telemedicine Services, Models of Wireless Access and Connectivity and the Structure of eHealth Master Plan;
- 2 Part 2 deals with some practical examples from different countries. “How”, “Where”, and if possible “When” – are only part of the questions that authors are trying to answer;
- 3 The Annex is Part 3.

Although the report is aimed at colleagues at developing countries, we think that anyone involved in Mobile Health will find it interesting. We are convinced that the report will provide useful information to everyone and especially to those who are preparing to introduce Mobile Health in their countries. Thus they may rely on experiences of others, will be aware of the benefits and problems that were encountered during or after implementation of Mobile systems or services, in order to avoid mistakes and to reduce potential problems. Due to the limitations of the size, just 50 pages, for additional details readers are kindly advised to follow the recommended references at the end of each paper.

Editors gratefully acknowledge the work of all contributors.

Enjoy your reading!

## ACKNOWLEDGEMENTS

The Telecommunication Development Bureau (BDT) of ITU would like to express its gratitude to the members of the group of experts on telemedicine/e-health for their excellent work and tireless efforts in preparing this report.

The text of the report was prepared by a group of experts: Prof. Leonid Androuchko (Rapporteur, Telemedicine Group, ITU-D Study Group 2 and International University Geneva, Switzerland) Dr Malina Jordanova (Solar-Terrestrial Influences Institute, Bulgaria Bulgarian Academy of Sciences) and Prof. Isao Nakajima (Institute of Medical Sciences, Tokai University, Japan).

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





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## QUESTION 14-2/2

## Mobile Health

**m-Health, mHealth, or Mobile Health – which one is correct?**

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In fact all terms are correct. mHealth is a short version of mobile health. The original concept behind it is to support healthcare delivery via wide application of all available mobile technologies – mobile phones, personal digital assistants (PDAs), monitoring devices, etc. Recently, the healthcare support of mobile citizens has also become part of the understanding of Mobile Health.

The interest towards Mobile Health is colossal and is facilitated by several factors:

- Cheap, widely available communications facilities and lower cost, higher performance computers;
- Increased public acceptance and confidence in the use of computer and communication technology;
- Up-and-coming global standards in communications, video conferencing, etc;
- Urgent necessity not to allow the healthcare budgets to rise plus;
- Necessity to ensure high quality medical care 24 hours a day, 7 days a week to all citizens, no matter where they are in a time of increasing globalization and mobility.

Let's clarify the last two points:

- 1 Demand to decrease or at least not to allow a sufficient increase of healthcare budgets. This is a strategic goal for all countries. If healthcare investments for a 6 year period (2000-2005) are analyzed, it is obvious that many countries were obliged to continually increase healthcare funds. The database of the WHO ([www.who.int](http://www.who.int)) clearly shows that for a period of 6 years from the beginning of this century, lots of countries have increased the health spending by >1%. If the trend continues, then governments would be forced to reduce other costs to ensure sustainability of healthcare budgets.
- 2 All countries are facing the problems of mobility and globalization (fig. 1). In brief: 898 millions have travelled in 2007; the number is expected to increase up to 1.56 billion in 2020. Data for 2007 also revealed that there were 36 million expatriates worldwide, 36% of them were ill or injured and at least 1-5% needed medical support.

**Figure 1: International Tourist Arrivals 1950-2020**



The above facts are more than enough to explain the extreme interest in Mobile Health. In addition, Mobile Health is part of eHealth and as such it carries all of its promises:

- Quick, timely high quality affordable healthcare for all, everywhere, at any time;
- Overcoming shortage of healthcare staff and funding and optimization of patient care;
- Enhancing preventive care;
- Protecting human rights;
- Educating and thus empowering citizens, etc.

No doubt the potential of mobile communications to radically improve healthcare services is enormous. The time has already proven this. Even in some of the most remote and resource-poor environments mobile health may drastically increase the quality and quantity of healthcare.

Mobile Health is applicable for collecting clinical data as well as for obtaining second opinion or organizing consiliums, for quick exchange of information back and forth to medical staff, patients and caregivers; for continuous education of healthcare providers, etc.

Mobile Health covers all medical fields – homecare, cardiology, pathology, surgery, emergency, mental health, rehabilitation, etc. The devices available also differ in size – from portable bracelets and suitcases developed for monitoring of vital physiology parameters to mobile hospitals installed in trains and specially equipped ships (Fig. 2)

It is impossible to cover all Mobile Health aspects in this short report. In addition to included papers, next paragraphs provide some extra examples in areas of pathology, nursing and SMS / MMS applications.

**Figure 2: Various devices**



(a) Israel – mobile monitoring, Schlisser (2007)



(b) «Nomad solutions» – Waterproof and secure equipment – ECG, SpO<sub>2</sub>, Spirometer, Glucometer, Rapid tests; autonomy : 3 hours, transmission: GSM/GPRS/3G satellite; weight: 3,9 Kg Petitet (2008)



(c) Board equipped for mobile surgery, Ecuador, Rodas et al. (2006)



(d) Argentina – secure, mobile phone service for message exchange, the SIM card is located inside the Micro-SIM Type card holder of the modem, Escobar (2009)

## Mobile pathology

Mobile pathology laboratory is developed in South Africa as a result of a contract from Armscor by TF Design and LTS Consulting. Its dimensions are 6m x 2,4m x 2,4m and it offers:

- Chemical pathology – electrolytes, liver functions, kidney functions, blood gases, cardiac functions....;
- Microbiology and microscopy (including searches of stool for ova and parasites), culture and sensitivity of blood, urine and stool, cerebro-spinal fluid studies, and general planting and incubation of bacterial samples; • Haematology;
- Dermatology – skin scrapings and punch biopsies;
- Rapid tests for pregnancy, hepatitis, HIV etc.

All the laboratory equipment gives results and images as digital electronic output, which is fed to the server computer. Satellite connection is also available. Thus data and images may be stored and forwarded to a pathologist at a remote location. Bar codes and scanners ensure security of data and samples (Molefi, 2004).

## Neurosurgery

Neurosurgery via mobile devices (Fig. 3) is rather new. But it is already a reality due to the efforts of Prof. Dr. K. Ganapathy, the former president of the Neurological Society of India and current president of the Apollo Telemedicine Networking Foundation, India (Ganapathy, 2007 a). Apart from tele-consultations that include clinical examination of pseudo seizures, involuntary movements, Parkinsonism, myopathy etc., already a number of several seriously ill head injured patients were managed by the local general surgeons, including evacuation of an acute sub dural hematoma, and excision of compound depressed fractures of the skull, with the confidence, that online neurosurgical video teleconsultation is available. With the help of Mobile Health, under the supervision of extremely qualified expert, family physician was able also to operate patients diagnosed for brain tuberculoma and brain cysticercosis (Ganapathy, 2007). These tele discussions are of considerable help for both local medical specialists and family members. Tele consultation was particularly useful in the follow up of already treated patients.

**Figure 3: Neurosurgery Anywhere! Anytime!**



Source: Ganapathy (2007)

## SMS and MMS

Mobile phones are one of the most exploited devices in Mobile Health.

Apart from consultations, appointment of meetings and physical examinations, exchange of consultations and information, vaccination alert systems, etc. it is worth mentioning the application of Short Messages Services (SMS) for management of chronic diseases. This emerging area is especially helpful in psychiatry, neurology and psychology. Most of the mental and behavioral disorders are associated with a considerable risk for relapse after reaching the state of recovery. Unfortunately, once finishing the inpatient treatment, most of the patients never seek after-hospital help. GSM and Internet offer easy and user-friendly ways to support these patients on their way back to everyday life.

A winning strategy was developed in the Centre for Psychotherapy Research Stuttgart, Germany, for after-treatment of patient with Bulimia Nervosa based on SMS. The intervention consists of weekly messages from the patients on their bulimic symptomatology and a corresponding weekly feedback that is a mixture of pre-programmed parts and individually tailored information. Results indicate that the program is technically feasible, well-accepted by patients and helpful for patients with bulimia nervosa to readjust to everyday life after finishing inpatient treatment (Bauer et al., 2004).

Another success story is the "On Cue" 2002 project in South Africa sending SMS reminders to patients with tuberculosis for drug regimen compliance. SMS were sent out every half hour within a chosen time-frame to remind patients to take medicine. As of January 2003, the city of Cape Town has paid only \$16/patient/year

for SMS reminders. In this pilot, only 1 patient out of 138 was non-compliant (99.3% compliance rate)! This is something that worth trying!

MMS is also used. Deserving attention is the example of Sweden, where a project was designed for continuous 24-hour anonymous and free consultations in the field of dermatology. The activity started in 2008 and allows those who want to advise a dermatologist by sending a photo with skin changes and short text to a fixed number. The results indicate that in ~ 77% of cases the appointment of treatment is possible from a distance within 24 hours of request (Börve and Molina-Martinez, 2009).

For those who are especially interested in this topic, the recommended resource is the report of United Nations foundation and Vodafone Foundation “mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World”. One of its most valuable parts is the short compendium of Mobile Health projects. Those who are interested may not only find brilliant ideas but also contact details. It is not necessary to discover the wheel again and again, let’s use the experience of the pioneers!

### **m-Nursing or Tele-nursing**

At the end, let’s mention one more aspect of Mobile Health – telenursing! This is the Mobile Health application to professional nursing practice. Tele-nursing has developed during last 10 years (Schlachta-Fairchild, 2008) and sufficient impact for this has various types of mobile devices for home / personal health monitoring. A very good example is USA. Despite of the fact that most health care services are reimbursed on a “per visit” basis and thus the use of tele care has not been heavily embraced, there is a 600% increase in tele-nursing in less than 5 years. It is expected that tele-nursing develops even more rapidly internationally, especially where socialized medicine provides a financial impetus for telecare. However, with the demanding requirement to deliver the best care at the least cost, the increase to tele-nursing applications will be even more evident in the years to come.

The International Tele-nursing Role Survey, performed in 2004-2005, gives more information on tele-nursing. The goals were to identify where tele-nursing is developed, whether tele-nursing is accepted, whether it is effective and whether tele-nurses are satisfied from their work. Results from 39 countries reveal that typical tele-nurse is white, female, married, with children, working full-time in telenursing. Telenurses experience less than average role stress, role ambiguity, and role conflict, and have the same work satisfaction as other hospital-based nurses. The most important factor contributing to telenurses’ work satisfaction are autonomy and interaction. Tele-nurses are happy with this less physically demanding situation and are sure that they are able to deliver, manage and provide better patient education, keep patients out of the hospital, provide better outcomes, decrease hospitalizations, save time, etc. 59% of telenurses stated that they are more satisfied with their telenursing position than “regular” nursing positions they had (Schlachta-Fairchild et al., 2008; Gundim, Padilha, 2008; Castelli et al., 2008).

Mobile Health is no more an optional choice. The service is more and more advancing and acceptable both by citizens and medical professionals. It is already proven that distant care management service can enhance self-care, change health-related behaviors and improve outcomes in patients with a number of long-term conditions (McNeil et al., 2008).

Mobile Health is already a must, a fantastic challenge for the future but it requires cooperation and coordination at all possible levels, it requires networking and planning, readiness to learn from the others and no efforts to re-invent the wheel. The main challenge is to be sure that available options are used optimally and in a coordinated manner to ascertain that the desired effects do come through and those resources are indeed not diverted away from basic needs.

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# Clinical Decision Support Software

*Vijayabhaskar Reddy Kandula<sup>1</sup>, Sanjay Deodhar<sup>2</sup>*

## Introduction

Majority of the people in the developing world do not have access to basic medical care. The International community is working to bridge this gap for many years without uniform, replicable success. Some inroads have been made but have not derived any system which could make a massive impact in the delivery of primary care. Medical Science is changing at rapid pace which has made health care delivery more complex, costlier and at times inaccessible to major population. However, the rapid advancement in information and communication technology and its universal reach provide new opportunity to bridge this gap. Information technology has improved access to services transforming them universally, though the impact in healthcare is not felt at all levels.

Primarily the purpose of Medical Science is to alleviate the sufferings of human beings; the rapid advancement of medical technology has not lived up to meet these expectations. Worse still, one of the undesirable consequences has been the increasing distance and loss of communication between the patient and the doctor. Information technology can be one of the several newer tools that could help to bridge this gap. Health industry can learn from experience from other sectors like microfinance and businesses to reach out to the people at the grass roots level.

There has been an explosion in the outreach of mobile communication in the last decade benefitting the poorest communities in the developing world. Increasing access to mobile phones and availability of Internet access on mobile platforms is fast bridging the digital divide as well. It seems logical to use this trend to bridge the large gap in access to basic health services. IT and related technologies can be the catalysts that can usher in changes in health care to bring basic health services to the door steps to the hitherto inaccessible areas.

It is wise to be cautious in embracing these new technologies and emphasize on building multidisciplinary teams represented by health, IT and management experts so that standard medical care can be developed on IT platforms in a way that is not only cost effective but also user friendly.

## Methods

eClinician CDSS (Clinical Decision Support System) is the outcome of an ambitious project conceived 9 years ago. It is developed over the years by physicians and software developers who have successfully integrated information from standard medical text books and literature systematically. The working medical team consists of 24 medical specialists, many of whom are academic faculty members including professors in reputed Medical Colleges and Hospitals throughout the world. In addition to these experts, the team has general physicians who ensure that the software is user friendly for general physicians. Medical information is simplified such that it is ready to use at point of care and incorporates the latest guidelines recommended by professional medical bodies. For example, HIV and AIDS information is listed as separate module and incorporates WHO guidelines, which includes extensive literature review and treatment guidelines. International Classification of Diseases (ICD 10) codes are incorporated and updated constantly to avoid nomenclature disparities which helps in data mining and to monitor standards across health care delivery sites.

The software has been refined over several years now and is seen as an innovative tool that can improve the quality of care and decision at the point of care. The program is tailored to be used by health workers with

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minimum or no computer expertise and is flexible enough to be adapted to suit the needs of different levels of practitioners- from general practitioners to specialist.

eClinician Clinical Decision Support System has a data bank of more than 4500 diseases, 1300+ lab investigations with normal values, ICD-10 cross references, drug interactions, HIV and AIDS treatment guidelines, clinical examination methods and notes on various topics like immunoprophylaxis, vitamin deficiency etc.

The unique value of eClinician is the differential diagnosis module, which is a logical system developed by utilizing thousands of signs and symptoms. This system is capable of generating all probable differential diagnoses from signs and symptoms of the patient, which includes common and uncommon probabilities in clinical diagnosis. The system helps physicians to avoid overlooking uncommon conditions and provide decision support in difficult cases.

eClinician is tailor made fundamentally focusing on Physicians who provide clinical services in rural, semi-urban and even urban areas of developing countries. eClinician is an aid to medical practitioners as it is simple to use, add value to practice and provide immediate access to the most relevant medical knowledge at the point of care.

We did a pilot study to access the accuracy and utility of the software. Four doctors working in both hospital and clinic environments were selected using convenient sampling methods. Two are General Physicians, one Paediatrician and Orthopaedic surgeon.

Forty clinical cases- real clinical encounters by these doctors were selected- 10 cases per doctor. The presenting signs and symptoms of these patients were entered into the software and the list of differential diagnoses generated was documented and compared with actual final diagnosis made by the doctors after investigations.

The clinical diagnosis by the doctor in all the cases (100%) showed up in the list of differential diagnosis generated by eClinician CDSS. In 35 cases, the final diagnoses made by the doctors were first among the list of differential diagnosis. For three cases the final diagnosis matched with the second among the list and for the remaining two it matched with third among the list of differential diagnosis generated by eClinician (Table 1 and Figure 1).

**Table 1: Accuracy of eClinician in Generating Differential Diagnosis**

	Final diagnosis in list of eClinician generated diagnosis	Differential Diagnosis Generated by eClinician	
		Where Actual Diagnosis was first in the list	Where Actual Diagnosis was 2nd or 3rd in the list of Diff. Diagnosis
No	40	35	5
%	100%	88%	12%

## Discussion

eClinician CDSS software is fairly accurate, user friendly and has high potential to not only improve efficiency in providing clinical care but also to improve quality of health care. The program is developed in flexible computing platform that can be migrated to mobile technology. Since mobile communication technology is becoming universal, eClinician system can be made available to the doctors and health practitioners anywhere in the world.

In addition, eClinician can be linked to any electronic medical records so that it can be integrated into the normal patient flow stages- history taking, vitals signs, examination and lab test- and the data entered can be used as inputs for the program based on which differential diagnosis is generated. This will increase the

possibility of making a more accurate diagnosis. Equally important is the ability of the software to provide instant access (with one or two clicks) to relevant medical literature which would normally require 15-20 minutes of extra time and disruption of work flow and possibly patient dissatisfaction.

Other potential benefits include the possibility for general practitioners to diagnose and better manage more severe clinical conditions, which they would normally either refer to a specialist or completely miss the diagnosis. This in turn benefits the patients by healthier outcomes and reduced health care costs.

Use of eClinician CDSS will facilitate wider clinical judgment and faster diagnosis; save costs by accurate and timely diagnosis; avoid unnecessary lab tests; educate and update doctors continuously; help to avoid medication errors with drug information; provide drug interactions within seconds

### **Conclusion**

Modern health care scenario is a unique synthesis of technology, doctor and patient. The availability and use of medical software technology in clinical decision support was inadequate. However, the latest development in technology including mobile communication and high speed internet connectivity opens up a golden opportunity. Proper integration of these technologies with appropriate medical software can revolutionize the health care delivery models globally. The ultimate beneficiaries will be the under privileged and rural population in developing countries.

# Basic Requirements of Mobile Device Assistance with GIS/GPS to Improve the Quality of Life for the Disabled – Toward Society that Supports the Potential of Ostomates

Masato TAKAHASHI<sup>1, 2</sup>

## Introduction

After a medical surgery, some patients are supposed to keep medical treatment for themselves in daily life. This is not always considered as a part pure medical treatment area, or as a nursing area. Such activity is thought as a region where the patient should treat for himself. In this background, some mobile assistance using information and communications technology can have great possibility to support the self treatment in their daily life. In this paper, focused especially on ostomates' daily life, the possibility and perspective of this kind of support by mobile devices are discussed to improve their quality. The legislation aspect and the history in Japan to support ostomates' daily life are also introduced when necessary and significant for making the discussion understood easier.

## Ostomy

An ostomy is a temporary or permanent surgical opening made in the abdominal wall due to disease of or injury to the rectum or bladder. The opening created on the skin is called a stoma and serves as an exit for urine or stool or both.

The word "ostomate" refers to people who have had this surgery.

Because conscious control over urination or excretion is lost, an external pouching system (called an appliance) is worn to collect body wastes.

### A. Colostomy

A colostomy indicates that the opening is from the colon. A colostomy is created when a portion of the colon or the rectum is removed and the remaining colon is brought to the abdominal wall. It may further be defined by the portion of the colon involved and/or its permanence. When the colostomy is in the left colon, only a pad may be needed to cover the opening. When the opening is in the right side of the colon, some type of appliance or bag is required. There are various types of colostomies. The physician and surgeon recommend the appropriate one for each patient.

### B. Ileostomy

An ileostomy is created by bringing a portion of the ileum (small intestine) through an opening in the abdomen. Discharge is fairly constant and watery and contains large amounts of salts and digestive enzymes.

### C. Urostomy

This is a general term for a surgical procedure which diverts urine away from a diseased or defective bladder. The ileal or cecal conduit procedures are the most common urostomies. Either a section at the end of the small bowel (ileum) or at the beginning of the large intestine (cecum) is surgically removed and relocated as a passageway (conduit) for urine to pass from the kidneys to the outside of the body through a stoma. It may include removal of the diseased bladder.

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### Investigation into the actual condition of ostomates-member of the joa

Japan Ostomate Association is a volunteer-based, non-profit corporation approved by the Ministry of Health, Labor and Welfare of Japan, and contributing internationally as an affiliation of IOA (International Ostomy Association) and its regional association, AOA (Asian Ostomy Association). JOA is also a member association of various coalitions of domestic organizations for disabled.

Every three years, JOA has conducted a member survey with the goal of using the resulting data to fulfill its strategic plan. Results of the 2005 survey follow.

1003 respondents were randomly chosen from 12,000 members of JOA.

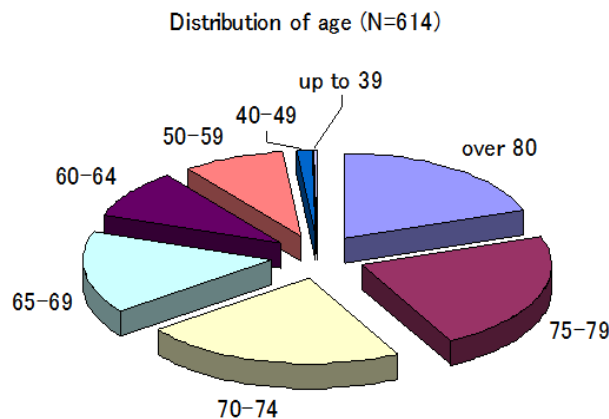
#### *Ostomates' Demographics (Figure 1)*

Senior ostomates such as over 65 years old are increasing every year.

Especially, the age of ostomates is most highly distributed on over 70 years old.

Distribution of period after surgery is most largely on 10-20 years.

**Figure 1: Distribution of age of ostomates (redrawn with the data in [2])**



#### *Anxieties of ostomates in future old age*

Ostomates have various anxieties (Figure 2) as follows:

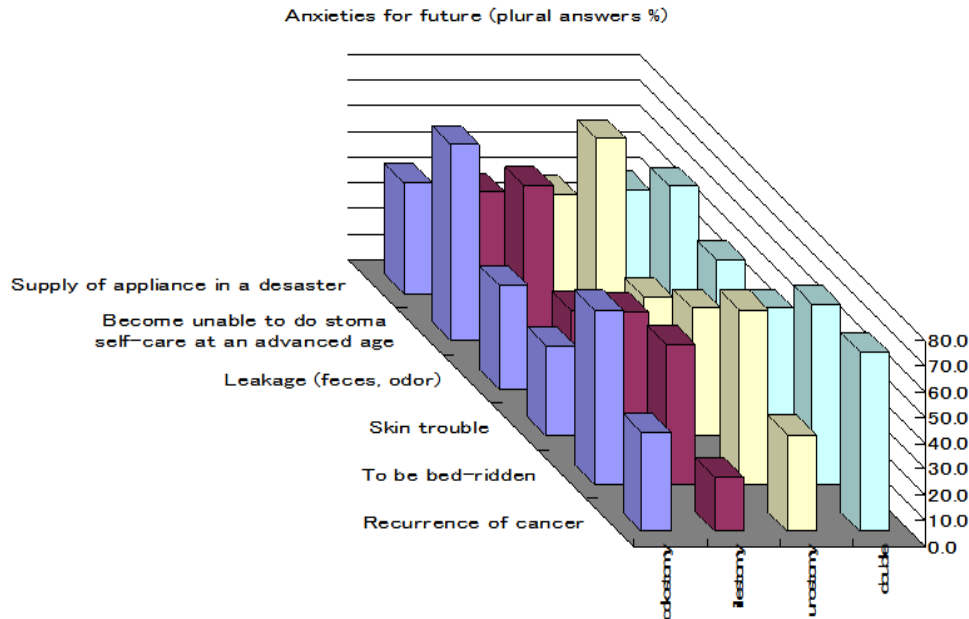
The anxieties are to become impossible to perform stoma self-care and to become bed ridden in future.

Due to the anxiety of leakage (feces, odor) makes ostomate tend not to be away from home. This lowers the quality of life.

However, such a life often makes ostomates becoming bed-ridden, which is another real anxiety for bed-ridden.

Therefore, active going out as they please is a key for making their quality of life.

In order them to do that, toilet facility information provision is essential because they need periodic exchange their pouches and quick wash of pouch and the stoma is adequately possible only at the toilet facility for ostomates.

**Figure 2: Anxieties for future of ostomates (redrawn based on a table in [2])**

### *Toilets Facility for Ostomates*

Many Japanese ostomates are hesitant to leave home and have active lives in the community because they worry about how they will empty their pouches or handle leakage problems should they occur away from home. It is particularly stressful and instills panic to deal with leakage of stool or urine while in public. In a JOA survey, 50% of ostomates reported these helpless feelings.

Therefore, it can be said that the availability of public toilet facilities to meet ostomates' needs is the key to their sense of well-being and rehabilitation in the community.

### *Installation in Buildings of Local Authorities*

Realizing the unique need for toilets to help ostomates trying to solve the above-mentioned problems while away from home, JOA appealed to passers-by on the streets and to the prefecture officials. Fellow ostomates of JOA in her district joined and cooperated with her efforts.

As a result, the first toilet for ostomates was installed in Narashino Prefecture Office in Japan in 1998.

This accomplishment encouraged similar activities in other JOA branches, and the installation of toilets for ostomates was gradually expanded to various city offices, public halls, and other buildings of local governments in Chiba and other prefectures. JOA reported that installation of 70 of these toilets has been achieved with an additional 120 under planning or under application by the middle of 2000.

Though these installations are not numerous enough to cover entire areas where ostomates often frequent, they stimulate the establishment of additional installations in private buildings, and further arouse public awareness of ostomates' unique needs.

### *Installation at Transportation Terminals*

The Japanese Government enacted the "Transportation Barrier Free Law" in April 2000, aimed at creating a smoother and more comfortable transportation system for the aged and disabled. The specifications for toilets for disabled persons were also revised under this law. It is the first time that the requirements of ostomates were incorporated into law as a result of discussions within the planning committee of MLIT (the

Ministry of Land, Infrastructure and Transportation). Additionally, signage (a pictograph) (Figure 3 (a)) was developed to indicate the presence of special toilet facilities for ostomates to be displayed at the entrance of each toilet room.

**Figure 3:**



(a) Signage of special toilet facilities for ostomates to be displayed at the entrance (designed by Ministry of Land, Infrastructure and Transportation)



(b) An example for special toilet facility for ostomates (from [1])

In line with this legislative movement, JR (the Japan Railways-former National Railways) installed prototype toilets at 3 major stations in the Tokyo area in September 2000 that were open for ostomates' use. Collection and analysis of ostomates' opinions in the field are ongoing and will be reflected in future installations.

Toilets at transportation terminals need to cope with heavy and complicated use (for instance, frequent use by people of various ages and medical needs), space restrictions, and severe cost requirements to make wide and numerous distributions feasible.

On the other hand, it is believed that the establishment of the toilets over most transportation terminals will greatly contribute to the active lives of ostomates. An example of special toilet facility for stomates is shown in Figure 3 (b).

This trial is being extended to the private railways and trial installations are already in place at some stations in major cities.

### ***Current Status of Toilet for Ostomates***

The installation and practical use of toilets for ostomates in Japan is just beginning, and we are in the process of trial and error to establish an optimum facility. To attain this goal, ostomates must be responsible for cooperating with the related authorities, owner organizations, and facility developers on all stages from planning to use and improvement.

It is expected that with increased availability of toilets for ostomates throughout the country, the rehabilitation of ostomates into the community will be accelerated, providing a better Quality of Life for Japanese ostomates.

It is also hoped that through this initiative, public awareness of ostomates' problems will be enhanced. The pictograph illustrated in Fig.5 is expected to be a mediator for this purpose as is the case of wheelchair signage.

### **Mobile device support**

#### **Stomates to Search and Reach toilet facilities**

Ostomate JP <http://www.ostomate.jp/> or mobile Ostomate JP <http://m.ostomate.jp/> is a search site for the location and available time about toilet facilities for Ostomates when they are away from home.

As of January of 2009, 8075 toilet facilities for Ostomates can be retrieved. Information of 1605 facilities was added in the period of just 9 months after its inauguration with corporation of the users.

Currently, this site returns a search result as simple text information of its address and facility, sometimes including a rough map.

The author considers that it is much desirable if the user's current position and the distance to the nearest facility would be desirable for mobile users.

Such kind of system can be installed on i-mode cell phone in Japan.

**Table 1: Information of toilet facility for ostomates**

<b>Facility overview</b>	multipurpose toilet facility in the Ground floor
<b>Phone Number</b>	+81-3-5340-****
<b>Available time</b>	Should be confirmed to the building owner (local authority)
<b>Limit for user</b>	none
<b>equipment</b>	Small sink for pouch exchange with a shower nozzle
<b>Warm water</b>	available
<b>Note</b>	none
<b>Informant</b>	Foo

### *A Municipal Office's Annex nicknamed "Zero"*

Address: 1-2-3, Nakano, Nakano-ku, Tokyo

Table 1 shows an example of the information of toilet facility for ostomates (usually a map is provided at the same time).

For pedestrian ostomates, the orientation to the nearest facility is also important. Economical GPS receiving unit can not directly provide the user the orientation in body coordination.

If it should contain magnetic sensor, the geomagnetism is often contaminated by the local magnetism, declination and deviation [Takahashi2009].

This site is voluntarily run by a private company. This site is developed as an information exchange and mutual support site by patients who have cancer and his/her families.

Currently, the site offers information shown at Table 1 with a map. However, there is no current point of the user and the orientation to the toilet facility on use-center user-fixed coordinate. Therefore, the author think the orientation information, in user-center user-fixed coordinate, should be provided by a new device suitable for portable device for pedestrian in land, in order to make it easy to reach the facility and heighten the quality of life.

Ostomate JP is a search site of toilet facilities for ostomates for free.

### **Requirements for the toilet facilities**

In the Cabinet office of Japan, "the central council for promotion of measurements for the disable", which states its own opinions directly to the prime minister of Japan every year, was established.

This establishment was based on the FY2004's minor revise of "the basic law for the disable" which was originally passed through the Diet of Japan in 2003, in order to promote the disable to participate in all the

social, economical and cultural activities, as a result of the major reform of “basic law for the measurements for the disable” which was passed through the diet in 1970.

In the 2006FY white paper of the disable, published by the Cabinet Office, the facts (message to the normal) which the disable would like the normal people to know are stated based on questionnaire results.

As to the internal organ disable, which ostomates are categorized, the message which gained the highest percentage was as follows:

- The disability itself can not be observed by the outlook. Therefore, it is hard to get people’s understanding on the disability itself. (93% of the answers to the questionnaires from the internally disabled);
- More specifically, the problem is not only on the function of the disabled organ (heart, lung, etc), but also often on the whole body malfunction, including chronic fatigue and lack of concentration and perseverance the due to the disability of the organ. When others misunderstand this characteristic, it may leads to a trouble.

The white paper for the disabled published the cabinet office of Japan, deals with the categories of the disable as follows: (1) visionary (2) auditory/verbal (3) limb (3) internal organ (4) intellectual (5) mental (6) development.

#### ***The act on friendly buildings (1994)***

“The act to promote the construction of buildings for person advanced in years and the disabled to be able to use comfortably” was passed through the Diet of Japan, on 29th June 1994 as the Law Number 44 in the Fiscal Year 1994.

This act was often referred to as the act on friendly buildings.

According to the article one of the act, this act to improve public welfare through make the quality of buildings higher by taking measures required to promote the construction of buildings for person advanced in years and the disabled to be able to use comfortably.

In other words, this act obliged the owners of public buildings such as railway stations, department stores and hotels to make facilities, including toilets for the wheelchair users, guiding blocks for the visually impaired, required to persons advanced in years and the disabled such as the visually, auditory impaired and the like.

This act was abolished at the enforcement of “The act to promote the smooth movement of person advanced in years and the disabled” (as known as the new act on barrier free society) on 20<sup>th</sup> December in 2006 as described later.

#### ***The act on barrier free transportation systems (2000)***

“The act to promote the smooth movement of persons advanced in years and the disabled with effective utilization of public transportation systems” was passed through the Diet of Japan, on 17th May 2000 as the Law Number 68 in the Fiscal Year 1990.

This act was often referred to as the act on barrier free transportation systems.

The act was enforced on 15th November 2000.

According to the article one of the act, this act to improve public welfare by taking measures necessary to promote to make the quality higher on (1) passenger facilities (2) vehicle designs of public transportation and (3) roads, squares and passages within a certain radius from a passenger facility, considering the growing demands to ensure daily and social life of persons advanced in years and the disabled, in a safe and secure style in self-sufficient fashion.

Articulating more specifically, (1) Promotion of measurements on bumps, such as introducing elevator, escalator and slope facilities, (2) Toilet facilities available comfortably for the wheel chair uses and ostomates (who has ileostomy, colostomy or urostomy), (3) Point system, such as Braille, for the blind in the display of fare and guide system, (4) Installment of space for wheelchairs, display system on the name of the



next station and so on in a car of railway system, (5) Introduction of non-step bus, one-step bus, lower floored road train system, (6) Installment of voice guided go-stops around cross road points, (7) installment of point systems around a platform in a station or a pavement and others.

This act was abolished at the enforcement of “The act to promote the smooth movement of person advanced in years and the disabled” (as known as the new act on barrier free society) on 20th December in 2006 as described later.

**The new act on barrier free systems (2006)**

“The act to promote the smooth movement of persons advanced in years, the disabled and the like” was passed through the Diet of Japan, on 21st June 2006 as the Law Number 91 in the Fiscal Year 2006.

This act was often referred to as the new act on barrier free systems.

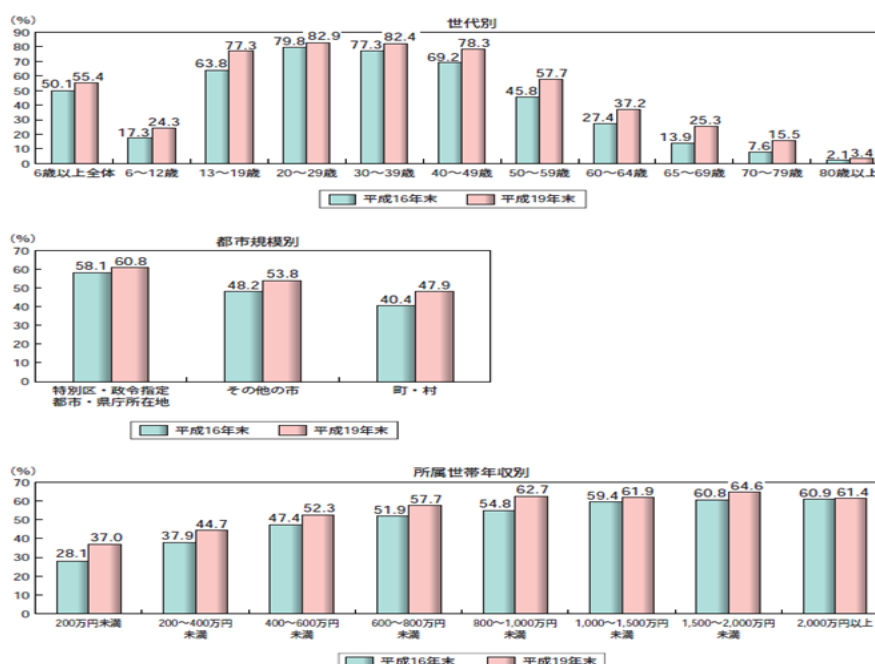
The act was enforced in December 2006.

According to the article one of the act, this act to improve public welfare through enhancing the convenience and safety at the movement and at the facility utilization of persons advanced in years, the disabled and the like, by taking measures necessary to improve the quality of (1) passenger facilities, (2) vehicles of public transportations, (3) roads, parking areas, parks and buildings related to the above mentioned facilities and (4) passenger facilities and buildings, pathways connected to them, squares around a station and the like, considering the growing demands to ensure daily and social life of persons advanced in years and the disabled, in a safe and secure style in self-sufficient fashion.

**Mobile telecommunication network**

The Internet utilization from mobile device or cell phone is illustrated in Fig.5 in attribute based styles. The top graph is in generation (year old) base style. The middle graph is in city size base style. The bottom graph is in annual income (ten thousand yen) of the household the user belongs to.

**Figure 5: Internet utilization from mobile device or cell phone in Japan ([7])**



### Items for Research and Development

On one hand, according to the graph of the delivery of age of stoma, most ostomates are persons advanced in years. On the other hand, shown at the graph of the Internet utilization from mobile device or cell phone in Japan, major users are young generation.

There seem to be plural reasoning for this discrepancy. However, one reason should be the lack of orientation provision method in the current mobile device and cell phone, except for the L1 GPS differentiation method or magnetism sensor, both of which have trouble some characteristics within their use.

The rest of this chapter explain those method's deficits for pedestrian, and especially persons advanced in years or persons with disabilities.

#### A) *L1 GPS difference of Position calculation*

This method requires for pedestrian to walk by 30 meters or more just for acquire for a pedestrian. According to the questionnaire statistics by the cabinet office, the patient suffers from the whole body chronic fatigue of whole body.

Therefore it is hard to be the main bearing device for a pedestrian.

#### B) *Magnetic compass ([5])*

Magnetic compass is erroneous in the three aspects [5] as follows: (1) local magnetism (2) declination (3) deviation. The domestic magnetic compass direction used by a pedestrian in land often is contaminated by (1). Special equipment of the pedestrian often affects the value by (3). When at oversea location, the value is contaminated by (2). Therefore the magnetic compass value should be corrected by other adequate method if any.

#### C) *Gyroscope ([6])*

A Gyroscope uses preservative characteristic of the rotational momentum of heavy rotator. Therefore the heavy and large rotator gives a precise value. In other words, the light and thin device tends to be erroneous. Besides, the gyroscope requires initialization process where a direction should be matched to the true north. It requires some other bearing method, such as (A), (B) or visual pattern match between environmental viewed scenery and preceding knowledge.

Therefore it is hard to be the main bearing device for a pedestrian.

Therefore, the adequate orientation device should be designed for pedestrian in land. The author began such kind of research and development. The basic requirements will be:

- Light weight, low volume, low cost (unlike gyro);
- No periodical calibration (unlike gyro);
- No geographically specific error (unlike magnetic compass);
- No major physical task required (unlike GPS position difference, i.e. walking 30 meters or more);
- To propose a novel orientation device with these requirements satisfied, the author began a research.

### Conclusion

In order to improve QOL of ostomates, mobile digital device or cell phone with GPS, GIS with toilet facility for ostomates would play an important role to search toilet facilities suitable for them in Japan.

Many Japanese ostomates are hesitant to leave home and have active lives in the community because they worry about how they will empty their pouches or handle leakage problems should they occur away from home. It is particularly stressful and instills panic to deal with leakage of stool or urine while in public. In a JOA survey, 50% of ostomates reported these helpless feelings.

In such a situation, personal mobile phone assistance to retrieve an adequate toilet facility near to the current user position. In addition, the orientation for the facility should be provided to the user. However, the economical GPS receiving unit can not provide the user the orientation unless the user move as much as more than 30 meters. In this background, a novel GPS orientation provision method is required. The author began to research and development on the novel GPS orientation provision unit which can effectively work even in an environment where magnetic sensor can not provide the user geomagnetism correctly due to a strong local magnetism and so on. Support by a mobile device with GPS/GIS for Ostomates to make utilize toilet facilities available to them is very serious one for them to continue to engagement in social activities. Therefore this application might have a much far serious meaning than usual entertainment application for normal persons to be given some kind of restaurant, gas stand or sightseeing information.

From this viewpoint, novel orientation information in user centric user fixed coordinate is strongly desired. It is partly because under a situation where normal people have an enough time or resource to make a trial walk in order to just get the course azimuth by GPS positioning difference, the disable, including ostomates, can not have enough time or resource to do so.

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## Traffic Control System for Medical Information Network to Promote Telemedicine Services

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### Introduction

A telemedicine service is a form of health and medical service using information and communication technologies (ICT). This service is expected to alleviate regional disparities regarding access to medical services anywhere and at any time. Promoting telemedicine services is an important political issue in the New IT Reform Strategy announced by the Japanese government in January 2006.

The Internet has helped in promoting telemedicine services, but there have been concerns about the quality of service (QOS) and security. Therefore, NICT has studied and developed a system to control network traffic for medical information network in order to improve the QOS.

### Background

Our research base is located in Asahikawa city, Hokkaido, which has the largest geographic area and the lowest population density of all areas of Japan. 60% or more of the population are concentrated on the city of 100,000 people or more. The half the number of the doctor vicinity lives in the Sapporo city. The shortage of doctors has become a serious problem in rural or remote areas in Hokkaido. Patients in rural areas must travel to hospitals in large cities for specialized medical services. As a result, patients spend a considerable amount of time and money travelling between rural or remote areas and large cities. In 1994, Asahikawa Medical College Hospital, a major hospital in Hokkaido, started telemedicine to supplement the shortage of doctors and to reduce the amount of time and money spent on travel between rural or remote areas and large cities. The first telemedicine service center in Japan was founded in July 1999, and since then, it has been providing telemedicine for radiology, ophthalmology, and pathology, among other specialities, on a daily basis. The telemedicine service was used approximately 400 times in the 2005 fiscal year.

### Forecast for telemedicine services

According to medical service records for the 2005 fiscal year, about 100,000 people (or 30%) of the outpatients at Asahikawa Medical College Hospital came from areas of Hokkaido outside the Asahikawa city limits. Therefore, if a medical information network were introduced throughout Hokkaido, we forecast that the frequency of use of the telemedicine service center would be 30 times greater than it was in 2005.

Telemedicine can provide advanced and efficient medical services for uses such as:

- Remote diagnosing and consulting using teleconferencing (1–2 Mbit/s) with high-quality video real time transmission before or after operations (40–60 Mbit/s);
- Reading electronic clinical records, such as photomicrographs of tissue samples taken at rural or remote hospitals, before operations (1–5 Mbit/s);
- Telepathology (Remote diagnosing for pathology);
- Transmitting photomicrographs of tissue samples for diagnosis (1–5 Mbit/s);
- Receiving diagnostic results using photomicrographs of tissue samples (1–5 Mbit/s);
- Explaining diagnostic results using teleconferencing (1–2 Mbit/s);
- Teleradiology (Remote diagnosing for radiology);
- Transmitting CT/MRI tomography, etc., for diagnostic imaging (5–10 Mbit/s);
- Receiving diagnostic results with CT/MRI tomography, etc.
- Explaining diagnostic results using teleconferencing (1–2 Mbit/s);
- Electronic clinical records of other hospitals;

- Reading electronic clinical records of other hospitals in rural or remote areas about outpatients' initial visits (1–5 Mbit/s);
- Medical image database construction in major hospitals;
- Storing static images with diagnostic results for pathology and radiology (1–10 Mbit/s);
- Recording and storing high-quality videos of operations (40–60 Mbit/s);
- Distributing contents to doctors in rural or remote areas for training and educational purposes.

### **Project definition**

The telemedicine service center in Asahikawa Medical College Hospital has been using ISDN or Best-Effort (IP network) service to connect to remote hospitals. Unfortunately, these services provided by telecommunication operators have limited bandwidth or do not guarantee the transmission quality. Therefore, introducing a medical information network in Hokkaido would greatly enhance telemedicine.

Since June 2005, the Hokkaido Research Center of the National Institute of Information and Communications Technology (NICT) and Asahikawa Medical College Hospital have jointly studied how to control traffic of a medical information network based on the requirements of telemedicine services.

An IP network is generally based on a best-effort service like the Internet. However, telemedicine services require a certain level of communication quality to operate efficiently and to enable medical information to be prioritized in an emergency. This would be similar to how ordinary cars move aside to offer an open road for approaching emergency vehicles.

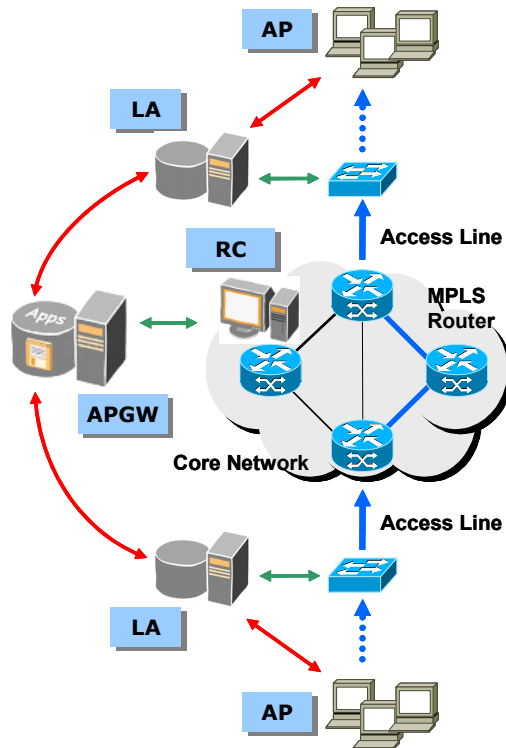
To meet these requirements, we have studied and developed an on-demand medical information network system (platform) that controls traffic by prioritizing user requests on a multi-protocol label switching (MPLS) network.

An on-demand medical information network system enables the flexible control of network traffic according to applications and user requests, and secures smooth data transmission even on a congested communication network or even under limited network resource conditions.

### **System description**

Figure 1 shows the overall structure of the system. To control the network bandwidth, the data transmission on user access lines must be adjusted with the data transmission on the core network that links the MPLS routers. The local administrator (LA) manages user applications and access lines, which exist between users and the core network, as a local resource. The application gateway (APGW) controls the requests from each LA and forwards the requests to the MPLS routers via the router controller (RC) to secure the resource of the core network.

**Figure 1: On-demand Medical Information Network System**



In response to user requests, the LA and APGW determine the applications to be prioritized and pass the results to the network control. At that time, they consider a priority policy based on the network operation and the priority level specified by the users using the analytic hierarchy process (AHP) method (see Table 1). Users specify the priority level according to the guidelines for the emergency level (urgent or normal, shown in Table 2) and the necessity level (V to I, shown in Table 3). The network is controlled so that high priority applications can preferentially secure the bandwidth, and routes are arranged appropriately.

**Table 1: weighting of parameters for calculating priority**

Emergency		Necessity		Application type		Transmission type		Medical department	
40		30		15		10		5	
Urgent	65	V	45	Clinical record	26	Streaming	68	Ophthalmology	27
Normal	35	IV	34	Static image	14	File transfer	32	Internal medicine	42
		III	12	Video	41			Pathology	7
		II	7	Teleconference	19			Radiology	24
		I	2						

- Weighting of each parameter by a priority policy based on network operation
- Weighting of each item of each parameter by analytic hierarchy process (AHP)
- Calculating priority for cases by combining parameters and items:  
 (Ex.) [Urgent] [Necessity V] [Video] [Streaming] [Internal medicine]  
 $(40 \times 65) + (30 \times 45) + (15 \times 41) + (10 \times 68) + (5 \times 42) = 5455$

**Table 2: Guidelines for emergency levels**

Level	Definition	Example
<b>Urgent</b>	Medical information is needed immediately	Cases when time delays could severely impair body functions and jeopardize life
<b>Normal</b>	Medical information is not needed immediately	Electronic clinical records for usual outpatient exams Remote diagnosis planned beforehand

**Table 3: Guidelines for necessity levels**

Level	Definition	Example
<b>V</b>	Medical information transfer is indispensable to medical practice and data transmission is needed immediately	Remote instruction from specialist for treatment and operation performed by rural or remote doctor Request for telepathology during an operation
<b>IV</b>	Medical information transfer is indispensable to medical practice and data transmission must be completed by a designated time	Request for remote diagnosis for teleradiology and telepathology
<b>III</b>	Medical practice can be executed but information transfer would be helpful	Remote advice from a specialist during an operation; Remote hospital also has a specialist
<b>II</b>	Diagnosis and treatment can be executed but information transfer is desired	Background information usually acquired during initial outpatient exams (case histories, notes from initial exams at rural or remote hospitals)
<b>I</b>	For uses excluding diagnosis and treatment	Acquisition of data for research; Distribution of videos of operations recorded for educational purposes

## Conclusion

A network traffic control based on user requests would be an important factor for the development of a medical information network to promote telemedicine services. Our proposed on-demand medical information network system ensure improved access to quality telemedicine services even under limited network resource conditions in rural or remote areas around the world.

# Wireless Access and Connectivity for Community Based Health Workers in Developing Countries: Models

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## Introduction

Health systems in developing countries face an uphill task in combating the double burden of chronic and infectious diseases facing their populations. Scarce financial resources [1] coupled with the massive brain drain that has led to the loss of mostly high and medium level health workers [2] has further worsened this situation. The Millennium Development Goals (MDGs) have been set by the United Nations as a driver for tackling these disease burdens in developing countries. MDGs are a set of eight goals that were adopted by the United Nations (UN) in September 2000 [3]. This includes calling on countries to carry out more collaborative activities against poverty, illiteracy, hunger, lack of education, gender inequality, child and maternal mortality, disease, and environmental degradation.

MDGs-related diseases account for the majority of morbidity and mortality in most developing countries. However, there have been concerns raised about lack of direction and resources in meeting the defined targets by the set date of 2015 [1]. A major contribution of MDGs is that they have helped in situating these major health burdens within the global development agenda and discourse [4]. Rapid achievement of the health related-MDGs can be effectively attained by adopting the principles of the Alma Ata Declaration of Primary Health Care (PHC) [5]. Of particular importance to this present discussion is the principle of community participation in delivering essential health services.

The principle of community participation makes the case for using health workers drawn from within the community for primary healthcare delivery. The shortage of adequate human resources to tackle public health problems has also been identified as a major impediment in many developing countries [2].

Recently, there have been calls to focus strategies on the development of substitute health workers for the provision of health services in developing countries [6]. Community Based Health Workers (CBHWs), as long standing providers of primary healthcare in many developing countries [7], can henceforth be regarded as such. The World Health Report 2006 [8] was focused on highlighting and addressing the global shortage of health workers but with a special focus on developing regions. The critical roles of CBHWs in delivering essential health services in these regions were emphasized. Their importance to health service delivery is further underlined by the fact that they constitute about one third of the health workforce on global average [9]. However this ratio might be higher in developing countries where there is evidence to show that the increase in immunization coverage was accountable to the use of CBHWs.

Employing mobile/wireless information and telecommunication technologies [(m)ITTs] to support their healthcare activities was a notable recommendation of this report [8]. Therefore supporting CBHWs with mITTs should henceforth be considered as a top priority.

Using ITTs as enablers is integral to the MDG agenda [3]. As a response, the WHO has also proposed using eHealth (ICTs in health) for enabling effective health services especially in developing countries [10]. Also, the ITU has continuously made a case for the use of "broadband" mITTs for bridging the digital gap between developed and/within developing countries[11]. The reduced implementation time, lower maintenance costs and high network adaptability of wireless over wired connectivity networks was ITU's rationale for this proposition. In developing countries, the relatively low cost and affordability of mobile-user devices in comparison with fixed computers [12] also deepens this rationale. Therefore, this paper proposes using mITTs for supporting CBHWs' healthcare activities in developing countries. mITTs in this paper are taken to include wireless connectivity and mobile access devices.



eHealth is the use in the health sector of digital data transmitted, stored and retrieved electronically in support of health care both at the local site and at a distance [10]. Therefore, mITTs are just platforms or scaffolds for eHealth applications [13]. The major difference is that it is wireless instead of wired, or it is mobile instead of fixed and it is scalable instead of rigid.

As the internet provides a global and a distributed platform for accessing online services and information, its use for bridging digital divide has been documented in many developing countries with positive impacts. Enabling developmental activities within the educational, health and agricultural sectors are examples of these impacts. Internet applications such as web services, e-mail and instant messaging (IM) can provide access to health information and services through mITT connectivity. These applications have been demonstrated to provide eHealth services in developing countries. For example, the RAFT programme is an open source web-based telemedicine network from Mali [14]. The network gives health workers' collaborative eLearning and teleconsultation access over local and almost continental-wide distributed network through terrestrial and satellite wireless connectivity.

The rationale for providing developing countries' CBHWs with connectivity and access through mITT-enabled eHealth networks will further be developed below.

### **Community Based Health workers**

CBHWs comprise the variety of health workers that are selected, trained, and work within the communities. They should be accountable to their communities, and be enabled and empowered by the health system, but may not be part of it and they normally have shorter education than professional workers [7]. In the context of Africa's health system, they are regarded as a broad group of low-level health workers, located in rural, urban, semi urban settings [7]. They carry out health organisational tasks such as home-based patient care, environmental health improvement, supporting health programmes such as large-scale immunizations, and diagnosis and/or treatment of diseases such as pneumonia, TB, HIV/AIDS, malaria, maternal and childhood diseases. Their activities can henceforth be supported with organisational support systems such as electronic health records (EHR), decision support systems (DSS) and teleconsultation to mention a few. Aside from delivering essential health services, they are also social change agents within their community.

Henceforth, supporting CBHWs with a mITT infrastructure to enable their health and social activities could have a positive impact on their performance. For example, on a home visit to a HIV/AIDS sufferer, a CBHW with access to the patient's medical records through a PDA can effectively track compliance to medication such as ART drugs and also to monitor their health status and progress. This has potential for ensuring better patient outcomes with an eventual improvement of the health system's performance as a whole. CBHWs as presented above in this section are very important to the delivering of essential health services to citizens in developing countries. Therefore, the use of mITTs for eHealth purposes will be discussed in the succeeding sections. The use of mITTs for developmental purposes like health services in developing countries have long been promoted by ITU [11]. However, at the moment their use (mostly GSM/GPRS, WiFi) in most developing countries is limited to voice communication with little use for data transmission. This is despite the emerging availability of broadband mITTs such as WiMAX and 3G in these regions. Broadband mITTs are frequently required for communication and data transmission within health systems, as they are process and information intensive organizations. In addition, the need to provide access and connectivity to health information systems (HIS) to health workers for effective patient care and health system performance further reinforces this notion.

### **mITTs Access and Connectivity models for CBHWs in Developing Countries**

CBHWs working within the community can be provided Internet access through different type of fixed or mobile access points. These can be used to provide either voice or data transmission in either store and forward or real-time modes.

Proposed models for fixed wireless access include the use of Public or Private Call Offices (PCO) [15], the Green Bank Village Pay Phone (VPP) [16], and the Community Telecenters, DakNet model of Community Information Kiosks [17] connected through broadband mITTs. For example, low-cost, store and forward data access platforms like SMS, MMS, and voice access through voicemails can be provided

through GSM-based public or private shared access points. These can be provided through the GSM enabled “Shared Access to Data” concept, a system of providing internet access to multiple users from a single point. The “Shared Access to Voice” scheme, the deployment of a portable GSM-wireless box-phone complete with solar charging accessories, an attempt to imitate a commercial public phone booth, can be adopted for voice communication [18]. These two “shared access models” could also be employed for use by a team of CBHWs working together within a health post or centre.

The deployment of these concepts through the Grameen Bank -VPP model or Community Information Centres (CICs) could provide an appropriate connectivity means for CBHWs in rural and urban regions of developing countries. E-mails and web services can then be accessed through shared desktop PCs located in the CIC such as in the Nakaseke MTC model in Uganda [19]. In addition, real-time voice communication for CBHWs can be provided through “Shared Access To Voice” model or through VOIP in CICs. A mobile-fixed or semi-mobile concept could be equipping CBHWs with mobile devices such as mobile phones, PDAs and wireless smart cards or USB memory sticks. These can be asynchronously connected to wireless access points (WAPs), or with wired or wirelessly connected desktop PCs through infrared, Bluetooth and WiFi either within CAPs as in the UHIN, Uganda concept [20] or as in DakNet model in India [17].

Real-time multimedia and near real-time applications such as videoconferencing and instant messaging (IM) through the web can also be provided through wirelessly connected PCs within CICs for teleconsultation or interactive e-Learning sessions as demonstrated in the iPath project [14]. Public access points through community digital screens, as in the Mindset Health programme [21], can also be employed. The proposed FonePlus concept from Microsoft can also be used. This aims to make mobile phones to provide internet access through televisions that are widely available in most developing countries.

A fully mobile community internet access for a CBHW could be provided with WiFi enabled mobile devices that are in turn connected directly to community WAPs on a real-time basis [22] or ad-hoc basis through mobile access points (MAPs) on bicycles or public buses, as in the DakNet project in India [17]. These mobile devices could then provide data and voice access through packet-access wireless networks. The use of low-cost mobile end user devices such as the One Laptop per Child project (OLPC) and its imitator such as the Intel Classmate could make this approach economically and technically feasible in developing countries. For example, a team of CBHWs on a community immunization programme could employ the “Shared Access to Data” model with an OLPC device for entering or accessing vaccination information of patients on the field. These are suggested approaches that could make use of the already existing CAPs in developing countries for supporting CBHWs health working activities. However, a fully mobile wireless connectivity and access that will support the nature of CBHWs activities could be through GPRS and WiFi networks.

## Conclusion

The importance of CBHWs to the healthcare delivery in developing countries has been presented.

Providing access and connectivity to CBHWs through mITTs has the potential to contribute to the health human resource capacity building objective of the WHO. Access to organisational knowledge systems such as DSS, CME and EHR through these models could enhance the achievement of better health outcomes for patients and effective health care services delivery. However, the successful adoption and diffusion of the technologies will require issues of organisational, technological, cultural and end-users to be put into a synergistic perspective. Organisational issues such as a change in work pattern of the CBHWs, negotiation of access with CICs, or fees agreement with private providers will have to be sorted out. The reorganization of the health systems to accommodate these changes will also need to be put into perspective. A major extra-organizational issue is how to make mITTs financially accessible at low cost for CBHWs. Technological issues like design of mobile devices for portable and seamless connectivity and access within the community, design and configuration of wireless networks for optimization are also important. Our research work is presently exploring how these issues can be understood through proposed evaluations of mITTs usage by CBHWs within health systems in developing countries.

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## How to Speed up the Introduction of eHealth Services

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### Introduction

The World Health Report 2006 “Working together for Health” presented an estimated shortage of almost 4.3 million doctors, midwives, nurses and support workers worldwide. Today the situation has not changed much. The poorest countries are worst hit, especially those in the Africa region with 24% of the global burden of diseases but only 3% of health workers commanding less than 1% of world health expenditure. The dramatic shortage of health workers is resulting from years of chronic under-investment in health services and training of personnel. Let’s take India as an example. A recent survey by the Indian Medical Society has found 75% of qualified consulting doctors practice in urban centres and 23% in semi urban areas and only 2% from rural areas where majority of the population live.

Today there is no doubt that eHealth services are useful to all countries and in particular developing countries. They are important for many medical specialties and with the help of modern information and communication technology the people in developing countries will have better access to medical services and there will be also improvement in the quality of services as well.

Recently the WHO collected the opinion about eHealth from the Ministry of Health of all Member States and published the report of the WHO Global Observatory for eHealth under the title “Building Foundations for eHealth” [1]. Nearly 60% of the 192 WHO Member States provided the information to this survey. Overall opinion about eHealth is positive. On the other side the implementation of eHealth services in developing countries is still very slow. There are some reasons behind that and it is important to understand where main obstacles are. To start with we would like to study only one important aspect – the awareness of medical staff in developing countries about eHealth.

### Opinion of developing countries

Three countries were selected for this study, namely Uganda, Pakistan and Bhutan. The questionnaire has been developed and distributed. Taking into account that some of medical staff will be not aware about eHealth, a short introduction this new technology was included in the beginning of the questionnaire. In order to collect information, the interview method was used.

In the questionnaire there were the following questions:

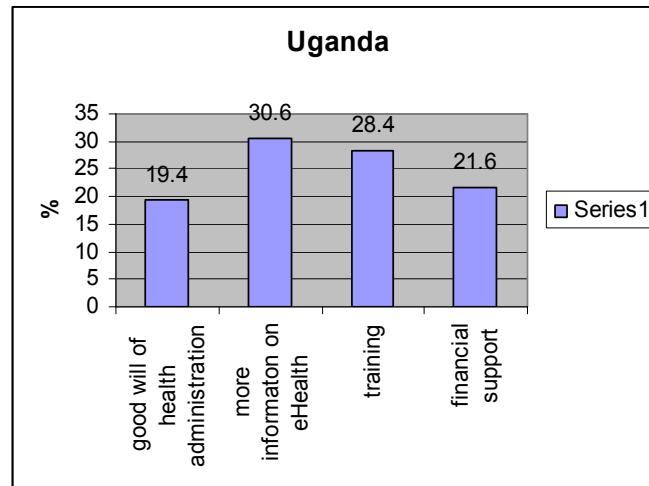
- 1 Have you heard of eHealth prior to this survey?
- 2 Where have you heard about eHealth?
- 3 What is your own opinion about eHealth services for developing countries?
- 4 What would be necessary to do in order to introduce eHealth services in medical practice in developing countries?

### *Uganda*

The chairperson of Telemedicine Association in Uganda, Dr. Catherine Omaswa has managed the distribution of the questionnaire and the organization of interviews. The questionnaire was distributed among the medical staff in the main hospitals in Kampala. 58 persons were interviewed. There were 37 doctors, 13 nurses and 8 from the health administration. The first question has been answered by 73% positively. This is because one of the first telemedicine pilot projects of the International Telecommunication Union was implemented in Uganda in the year 2000. The two big state hospitals in Kampala were connected together by a telemedicine link for transmission of X-ray images and medical consultation. This project gave a chance to the medical staff in Uganda to understand better the potential benefit of information technology in health care. Therefore 56 from 58 respondents (96.6%) were in favor of eHealth services for developing countries.

There is no one who was against eHealth. Two persons did not provide any answer. The answer on the fourth question is presented below in Figure 1.

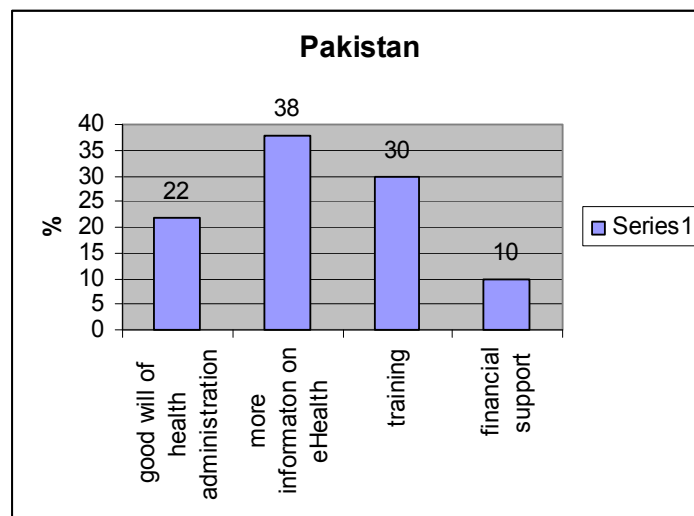
**Figure 1:**



**Pakistan**

Pakistan is the 6<sup>th</sup> most populous country in the world with a population of 150 million. 65% of the population is living in rural areas. The survey in Pakistan was implemented under the supervision of Professor Asif Zafar Malik, the chairman of the Telemedicine Association. The questionnaire was distributed among medical staff in two main cities in Pakistan – Rawalpindi and Islamabad. There were received 111 answers. In this case, 61% of the respondents have mentioned that they knew eHealth. The results for the third question are the following: 86.5% supported the introduction of eHealth services, 6.3% were against and 7.2% did not provide the answer. Below in Figure 2 there is the answer to the last question – What would be necessary to do in order to introduce eHealth services in medical practice in developing countries?

**Figure 2:**

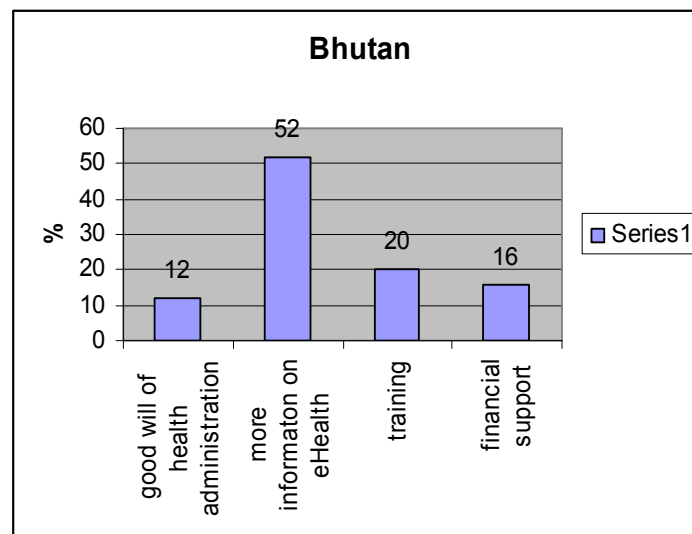


It is also interested to know how medical staff in Pakistan has received the information about eHealth. This information is presented in the Table below. The role of medical education training is still very low. It is only 23.42%. The continuous medical educational programme (CME) is not providing training in eHealth field. The ability of eHealth/telemedicine to facilitate health-care irrespective of distance and availability of personnel on the site, make it attractive to developing countries.

### ***Bhutan***

Bhutan is a small country. The total population is only 0.8 million and about 80% of the people live in sparsely populated rural villages. The number of doctors is only 122 and doctor/population ratio is about 1 to 6667, which by any standard is very low. The primary health care system is operated by nationally trained paramedics. The Ministry of Health is aware about usefulness of eHealth and considers it as an effective strategy to meet the health care needs of population living in rural and remote areas, and improve the quality and sustainability of services. The country has already benefited from several small pilot telemedicine projects implemented with support from international organizations such as the International Telecommunication Union and the World Health Organization. The interview with the medical staff in Bhutan was done by Ms Lungten, ICT Officer in the Ministry of Health. She asked opinion about eHealth from 16 members of medical staff including doctors and paramedics. They were from the hospital in Thimphu and five regional hospitals from Lhuntse, Trashi Yangtee, Trongse, Bumthang and Gelephung. The positive answer to the first question was received only from 31% of respondents. It means that only 31% of the medical staff knows what eHealth is. Then after the short briefing about eHealth, 87.5% of medical staff was agreed that it is useful for Bhutan. The answer on the fourth question is presented below in Figure 3.

**Figure 3:**



The expert group has already experience in the preparation of eHealth Master Plan in some developing countries and they are ready to share their knowledge with other countries. Based on the existed telecommunications infrastructure, eHealth Master Plan will prove the advice what type of medical services could be possible to organize. Then the medical authority will select the service according to the local needs and priorities. There are several common steps which are necessary to implement by doing such strategic planning. The general structure of eHealth Master Plan is presented below in Table 1.

**Table 1:**

	Frequency	%	Cumulative %
During medical training	26	23.42	23.42
CME	3	2.70	26.12
Medical journals	10	9	35.12
Newspapers	6	5.4	40.52
TV	8	7.2	47.72
Conferences/seminars	7	6.31	54.03
Colleagues	16	14.42	68.45
From this survey	22	19.82	88.27
Others	3	2.7	90.97
Internet	1	9	91.87
No response	9	8.13	100
Total	111	100	

The results achieved indicate clearly that developing countries need more information on eHealth services. They understand that the introduction of eHealth services is important for developing countries but they need to learn more about it in order to speed up the implementation. The respondents strongly highlighted that education will play the crucial role in the adoption and wide implementation of eHealth services. The main obstacle today is not a lack of funds. eHealth services could be implemented gradually in line with available resources. The problem is that the decision makers in a health sector are also not very well informed about the benefits of the application of modern information technology into medical practice. In order to get support from the Government and other decision makers it is necessary to develop a National eHealth Master Plan.

### **Solution – National eHealth Master Plan**

In May 2005 the World Health Organization in its Resolution WHA58.28 recognized officially eHealth and recommended to all countries “to consider drawing up a long-term strategic plan for developing and implementing eHealth services in the various areas of health sectors”. Due to the fact that the technical platform for any eHealth services is the telecommunication network, the strategic planning is required the good cooperation between healthcare and telecommunications authorities. This is a particular important for developing countries because telecommunications specialists will be able to provide a good advice on how best to use the existed network.

The expert group on Question 14 “Telecommunication for eHealth”, which belongs to the ITU-D Study Group 2 of the International Telecommunication Union, has developed a special training course for participants from developing countries “How to implement eHealth solution”. The training course was successfully implemented for the first time during the International Educational and Networking Forum for eHealth, Telemedicine and Health ICT (MedeTel) in Luxembourg at 16-18 April 2008.

Based on the existed telecommunications infrastructure, eHealth Master Plan will prove the advice what type of medical services could be possible to organize. Then the medical authority will select the service according to the local needs and priorities. There are several common steps which are necessary to implement by doing such strategic planning. The general recommendations with regard to the structure of eHealth Master Plan is presented below.

The local eHealth policy must be in agreement with any overall informatics policies in force in a country as well as with its overall health sector policy. It is important to develop “eHealth Master Plan” for each country. This is a national eHealth policy document which will guide and coordinate all eHealth projects and activities helping to eliminate interoperability problems between different telemedicine systems.

## **Executive Summary**

Overview of the main issues in the eHealth Master Plan

### **1.1 Introduction**

- Purpose and Scope (Brief description of the reason behind the development of eHealth Master Plan).
- Vision, Mission & Objective of the Ministry of Health.
- Meeting eGovernment objectives.

### **1.2 International Best Practices**

- Overview of similar eHealth systems and services that have been successfully implemented in other countries and they could be of interest to your country.
- Legal and security issues.

### **1.3 Current Status of the Health Care Sector**

- Organization structure (Present overall structure of the Ministry. Public and private hospital and clinics).
- Services offered & delivery channels used by the Ministry.
- Customer analysis (General information on those who use the services offered by public and private sectors).
- Level of computerization of health care organizations.
- Details of existing Hospital Information Systems.
- Block diagram of information flow in the provision of each particular medical service including links with other departments and organizations.

### **1.4 Problems of Health Care**

- Shortage of medical staff?
- Lack of facilities?
- Analysis of the gap between the current state and desired state of medical services, and elaboration of the approach and solutions to reach the desired state.

### **1.5 The Role of eHealth –Global Vision**

- Improve access to health care services for people living in rural and remote areas.
- Improve cooperation between medical organizations with a goal to get more efficient provision of services.
- Tangible & intangible benefits.
- Cost-effective solution when a paramedical staff can get an expert advice instantly from a remotely located doctor and a patient is treated locally.
- For a patient, it is saving of the vital and crucial time and cost of diagnosis.
- Continuous Medical Education (CME) for medical staff can be organizing much less expensive using partly eLearning method.



- Medical error reduction by ability via telemedicine network to get second opinion of another doctor or specialist.
- Increased efficiency of existing medical staff.
- Wide introduction of Electronic Health Records.

#### **1.6 Current Telecommunication Infrastructure**

- Level of network digitalization.
- Optical fiber transmission network.
- Digital microwave network.
- Internet network and how many medical organizations have been connected to Internet.
- Accessibility to Internet in rural areas.
- Mobile network.

#### **1.7 eHealth Network**

- Proposed global structure of eHealth network based on existing telecommunication infrastructure.
- Proposed eHealth network for the capital city.
- Proposed eHealth solution for rural areas.

#### **1.8 eHealth services**

- List of proposed eHealth services for each level of health care and each medical organization.
- Customer analysis (Who are the current and new customers and what are their expectations).
- Desired information flow for each proposed service (Block diagram of desired processes, time taken for each process and the delivery channels used).
- Proposed system architecture (A block diagram of the main physical components of the systems: Pcs, server, router, modem, and communication links).
- Interfaces with medical diagnostic equipment.
- Interoperability of eHealth systems located in different medical organizations.
- eHealth technical standardization.
- International telecommunication if it is necessary.

#### **1.9 eHealth Training**

- Preparation of the code of practice related to eHealth services.
- Training of medical and technical staff.
- Define indicators with expected and actual values to measure the success of implementation.
- Legal and Security issues.

#### **1.10 Marketing**

- To ensure that each eHealth service is positively received by customers and to ensure buy in at the level of the Government or users at the Ministry of Health.
- A practical marketing plan to ensure acceptance at citizen level and buy in at Government level has to be develop.

#### **1.11 Cooperation with other Organizations**

- Working with private sector & NGO/voluntary organizations.
- What type of collaboration can be developed with these organizations as strategic partners and as clients in the provision of the services?

- Project Budget – depends on the selection of medical services to be introduced into the eHealth network.
- Implementation.
- A senior responsible owner (e.g. Chief Information Officer) for overall project with heads for each services and their committed management teams have to be nominated.
- Monitoring and review mechanism has to be proposed.
- Based on the eHealth Master Plan approved by the Government, it is important to provide the strategic planning for the implementation of eHealth services and solutions at the level of each hospital and any other medical institutions. These documents will guide the health administration to organize the implementation of eHealth in well coordinated manner.
- Gaps in legislation and the uncertainty of rules applying eHealth services pose a legal risk for both the doctors and their patients. The code of conduct for the practice of eHealth has to be urgently developed.
- In a broader sense, eHealth characterizes not only a technical development, but also a new way of working, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology. ICT can build the know-do bridge by removing distance and time barriers to the flow of information and knowledge for health, and providing just-in-time, high quality, relevant information to health professionals.

### **Conclusion**

- Developing countries can not speed up the implementation of badly needed eHealth services without close cooperation with telecom sector.
- Developing countries urgently need a strategic document – eHealth Master Plan in order to informed decision-makers in health care sector about benefits of eHealth technology.
- Developing countries heed technical guidelines on how to use mobile and fixed telecommunication infrastructure for the introduction of eHealth services.
- Developing countries need more training and capacity building in this field.

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# Algeria: Innovative Health Care Solutions Enabled By Technology Development to Meet Critical Needs in Remote Areas

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## Introduction

For several years, we have been conducting an experimental project, reported previously [1], of giving specialized care on interventional digestive endoscopy throughout Algeria on freelance basis.

This project, allows specialists to provide medical service to patients living in remote areas, thus avoiding the need to travel to the hospitals situated in the north of the country. It has proven to be cost-effective as it saves time and money of the patients who had to spend on costly trips and accommodations for themselves and accompanying members of their family. In our initial phase, we have set a mobile digestive endoscopy unit and focused our expertise towards three objectives 1 – emergency management; 2 – routine diagnostic and operative digestive endoscopies and 3 – monitoring of patients with digestive chronic diseases. In addition to providing operative endoscopic digestive procedures we have had to examine a large number of patients with medically acute, benign and chronic digestive diseases. A large proportion with the first two conditions have been addressed by referral to local General practitioners with recommendations. A special attention has been given to patients with chronic diseases. These patients with chronic diseases were inadequately followed up for reasons ranging from a lack of local medical expertise to poor social and economic conditions. These chronic conditions included a large spectrum of digestive diseases like inflammatory bowel disease (IBD) celiac disease, chronic diseases of the liver and pancreas and digestive neoplasias. It is well known that these conditions like IBD carry a heavy financial burden [2]. Efforts are made by our Public Health to give facilities to patients with chronic diseases. Drugs are given freely to these patients who are registered regularly to public insurance but poverty, unemployment, lack of medical expertise in remote areas undermine all these efforts. The purpose of this project is to monitor at distance the clinical parameters and evolution of these patients. It permits them to live at home with the active collaboration of the locally nurse and GP who keep an eye on their health status. This follow up will prevent or diagnose a flare up of the disease or drug side effects without a need for a hospitalization when it is not necessary.

## Materials and methods

Due to inadequate care, most of these patients with chronic diseases presented at consultation with some degree of severity. This necessitates a short admission to undertake a work up and to start medications including a large spectrum of drugs. A large proportion of these patients, were illiterate which requires more time to inform them and explain the course of the disease. Additionally, a diary card completed by the patients and /or the nurses according to clinical parameters of follow up, were provided to them along with referral letters to their local GP and local nurse that included our contact coordinates (mobile telephone number and e-mail address). Typically, treatment is started and a daily enquiry is made by telephone or email, when the patient has access to this latter. Patients were invited to feel free to call us at any time if needed. Regular work up was made according to our traveling planner. Patients included and spectrum of diseases is reported in a table:

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## Results and Discussion

Most of the patients were motivated and closely followed the advice and recommendations given to them. The mean time of follow up has been about 24 months (36 to 06 months). Telemonitoring with the active collaboration of local GPs and nurses have prevented many potential complications due to side effects of drugs taken or to the natural history of the disease. All the telephone calls from patients or GP's or nurses seeking medical advice or treatment were answered. Short Message Service (SMS) was also used to provide correct prescription to get to the pharmacist. Almost all the patients included in this study were living in remote areas. The bothering of the telephone calls was dealt with according to our commitment and willingness to conduct such a project. Charges were so thought about to minimize them to the least possible.

This work reports on our experience is aimed at providing health care locally through an organization of freelancing –traveling professionals and by leveraging the recent technological developments in mobile telephony and improvements in domestic air and land travel infrastructure. Part of it is an open study to ascertain the acceptability and feasibility of telemonitoring of chronic digestive diseases by mobile phone in remote areas. Relevant data were taken retrospectively and accounts for obvious bias. Unlike S. Bali [3] number of parameters were not taken into account like number of telephone calls, liability, mean duration time of a call, cost. Sustainability of this system depends on our commitment and willingness to conduct this study in spite of some bothering telephone calls. Central to this success, has been the widespread availability and use of mobile phone (more than 27 millions units) enabling communications with various parties at all time. This domestication of mobile phone for health professionals including patient monitoring, disease surveillance and prevention is becoming of paramount importance for a large country as Algeria with 36 millions of inhabitants, which suffers a lack of balanced distribution of its healthcare infrastructure and personnel. As a by product of our experience has been to educate the physicians and the nursing staff working at remote areas raising their level of competence. The experience taken from this ongoing study let us to agree with Dr. Howard Zucker, Assistant Director-General of the World Health Organization, who said: "The explosive spread of mobile phone networks across the developing world has created a unique opportunity to significantly transform how countries can tackle global health challenges," [4]. However, in a large systemic review of the nature and magnitude of outcomes associated with telemonitoring of four types of chronic diseases G. Pare et al conclude that future studies need to build evidence related to its clinical effects, cost effectiveness, impacts on services utilization, and acceptance by health care providers [5].

The distribution of Chronic diseases with respect to age, sex and localization is given below in Table 1.

**Table 1:**

	<b>IBD n=95 Crohn disease 43 ulcerative colitis 52</b>	<b>Celiac disease n=12</b>	<b>Liver diseases n=36</b>	<b>Chronic pancreatitis n=2</b>	<b>Endoscopic follow up n=60</b>
Mean Age (y)	31	32	39	44	53
Range (y)	18-53	27-38	27-58	42-46	34-74
Sex ratio M/F	1,5/1	1/3	1/3	2/0	2/1
Localizations and other aspects of diseases	LB 29; Proctitis 25; SB 07; LB, SB 18; Perianal 07; Pancolitis 09	GFD Alone 08 Resistant 04	Compensated PBC 2, AIH 2; Decompensated 32		Metachronous neoplastic lesions:LB polyps 56; Familial polyposis 04

**Abbreviations:** IBD: inflammatory bowel disease; M: male; F: female; y: year; LB: large bowel; SB: small bowel; GFD: gluten free diet; PBC: Primary Biliary Cirrhosis – AIH: Autoimmune Hepatitis

## Conclusion

The result of this study suggests that regardless of their illiteracy condition, socioeconomic status and age, patients comply with the telemonitoring through the use of telephone mobile. Telemonitoring of chronic diseases seems to be a promising patient management approach, which may reduce the financial burden of the raise of their health care costs.

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## New Telecommunication Technology for eHealth Applications

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### Introduction

In both developing and mature nations, at the local, state, and national levels, governments are challenged to contain rising healthcare costs, enhance quality of care, and increase access to healthcare services. They also must provide traditional functions such as monitoring public health and minimizing the spread of communicable diseases.

Meeting these goals requires intensive communication as well as collection and analysis of information – and in some cases, collaboration across political and physical boundaries. Intel technology-based solutions help public healthcare systems meet their objectives of providing better care to citizens. Intel consults with governments and healthcare systems around the world to understand their unique challenges so that we can address them together. We bring technology leadership, a unique, independent perspective, a strong commitment to open standards, and deep experience in helping nations and industries use digital technologies to improve health and healthcare.

### Solutions, technologies, and expertise help governments to:

- Accelerate clinician adoption of digital technologies that improve productivity and enhance healthcare quality;
- Increase opportunities for citizens to access high-quality, cost-effective healthcare services;
- Improve efficiencies and costs by deploying scarce resources more effectively, optimizing workflows, and delivering up-to-date information where it is needed;
- Optimize use of healthcare information technologies to impact clinical and policy objectives.

For example, we have assisted governments in creating practical programs that help physicians, district nurses, and other healthcare workers enter data electronically, access clinical data when and where they need it, and collaborate with other providers in real time. These government-assisted purchase programs, including employee purchase programs, can help improve healthcare quality, control rising healthcare costs, and enhance the productivity and job satisfaction of highly skilled workers.

Intel is passionate about technology's ability to improve health and healthcare worldwide. Around the world, healthcare costs are rising. Too many people lack access to high-quality healthcare services. Paper-based workflows introduce errors and hamper productivity. Aging populations and swelling rates of chronic disease threaten to overwhelm even the most efficient healthcare systems. Intel is delivering innovative leaps in digital technologies to help address those challenges. We share the vision of healthcare leaders who recognize technology's potential to evolve healthcare toward more proactive, consumer-centric models of care as well as the potential to improve the quality, cost, and accessibility of healthcare services. In homes and hospitals, clinics and pharmacies, we collaborate with healthcare leaders to better connect people and information, and enable new models of care.

By helping individuals, families, and the extended healthcare community connect to the right information at the right time, we empower them to make better, more informed decisions – and accelerate the ability to radically improve health and healthcare.

### *IT in Healthcare*

Intel's innovations helps enterprises more efficiently and effectively – whether that enterprise is a healthcare system, hospital, clinic, biopharma company, payor, government agency, or ministry of health.

We are working with healthcare leaders around the world to integrate the healthcare information environment. Our solutions, technologies, and collaborative expertise enable healthcare organizations to

better manage healthcare information – and make it possible for people to enhance health and wellness throughout their lives.

By connecting people and information in new and important ways, we enable healthcare organizations to deliver higher quality, more accessible, and more economical care and meet their clinical and business objectives.

See below how our work benefits all stakeholders in the healthcare enterprise.

- Healthcare providers can improve quality of care, workflow, costs, and accessibility.
- Biopharma companies can accelerate drug discovery and optimize e-Clinical trials.
- Payers can improve healthcare's quality and cost while evolving to become health services.
- Governments and ministries of health can deliver better care to more people at lower cost.

### ***Healthcare Providers (Enabling the integrated digital hospital)***

Healthcare providers are challenged every day to enhance quality of care, optimize workflows, and improve access to services. IT can play a significant role in reaching these goals, including empowering providers with real-time access to digitized information to improve clinical decision making.

Digital technologies are proving to be essential tools for improving access to information – current orders, medical images, patient histories, prescriptions, physician orders, and other vital data – across the healthcare system. But deploying electronic medical records and other digital health technologies requires much more than just hardware and software. Transitioning to an integrated digital hospital requires interoperable, standards-based digital technologies, comprehensive solutions, careful planning, and significant culture change. Intel works with healthcare providers worldwide to meet these challenges. We drive standards and interoperability, and we design technologies for the secure and timely exchange of healthcare information. We enable digital information to be shared securely across the healthcare ecosystem: hospitals and clinics, patients, payors, biopharma companies, and other members of the healthcare community.

Collaborating with healthcare leaders and clinicians around the world, we listen to understand unmet IT needs, match information systems to business objectives, and customize solutions and platforms for healthcare's unique needs. What we've learned helps our healthcare customers more effectively link people, processes, and information to:

- Improve clinical decision-making and quality of care;
- Increase patient safety;
- Reduce costs;
- Improve access to healthcare;
- Enhance workflow, productivity, and operational efficiencies.

### ***Personal Telehealth***

Overview around the world, people are living longer and striving to lead independent, happy, and healthy lives. At the same time, we are seeing a dramatic rise in the number of people with chronic conditions such as diabetes and congestive heart failure – and high costs associated with managing and treating these conditions.

The healthcare community is looking for new approaches to meet these challenges. Clinicians, payors, and others are seeking approaches where:

- Patients remain at home;
- Patients and clinicians work together to achieve the best outcomes;
- Patients are viewed in their totality, including their health status, as well as their social network and their individual capabilities and preferences.

Backed by nearly a decade of ethnographic and health research, Intel believes innovations in personal telehealth technology will help usher in an era of patient management marked by new ways of envisioning the delivery of care. To realize this vision, we are committed to developing technology to better care for aging and chronically ill individuals – personal health solutions that are based on the specific needs of these populations and designed to allow people to age in place and take a more active role in their health management. Our hope – and our expectation – is that these telehealth advances will allow people to harness the true power of information from the comfort of their own homes – turning that information into action and better health outcomes. Disease management entered the healthcare scene with the promise of helping physicians, patients, and managed care organizations improve outcomes and control costs through coordinated and proactive interventions. That promise is still to be realized, as the challenges of our complex healthcare system have proven difficult to overcome.

Disease management professionals deal with several core issues:

- Engaging patients in their health management;
- Handling multiple and coexisting chronic disease states;
- Supporting physician decision making;
- Using data to identify early and appropriate interventions.

The goal is clear: healthier patients and more efficient use of resources, resulting in system-wide cost benefits. What has been missing is a way for data to be more easily shared and used so the right people have the right information at the right time to improve outcomes and reduce costs.

Technological advances are helping make the disease management promise more achievable. New personal health system technology will allow the real possibility of easy, interactive, up-to-the-minute, and even real-time links between doctor, patient, care manager, and family caregiver. By bringing user-friendly technology that engages the patient right in the home and allows for timely medical and educational interventions, personal health system technology can help move disease management closer to the ideal upon which it was founded.

### ***Evolution of Remote Patient Monitoring***

Remote patient monitoring technology devices have been around for years. They perform simple and important tasks, such as recording and sending a patient's vital signs, sharing educational content, and providing helpful reminders.

But the expectations of patients and healthcare professionals have changed considerably since these devices were first introduced. Today, people expect more from technology than the simple ability to monitor standard vital signs. Fortunately, telehealth technology is evolving to provide both patients and healthcare professionals with real-time, interactive, data-rich health management systems that can engage both patients and their care management teams more fully in the treatment of chronic illness. This new generation of personal telehealth technology is designed to fit in with current models of care, whose goals are to provide a more proactive and continuous approach to working with patients. To help achieve this important goal, the next generation of personal telehealth technology must be an integrated health management system that:

- Is specifically designed based on the needs of patients and clinicians.
- Provides self management tools for patients to take a more active role in their own care.
- Offers communication tools that connect the patient's entire care team for better coordination.

New personal telehealth technologies, such as personal health systems, hold the promise of providing real-time communications and integrated data reporting that keeps "informed and activated patients" in touch with their healthcare providers. Personal health systems can support the care team by providing a powerful and flexible tool that is compatible with current systems and approaches. Personal health systems are continuously available to both patients and healthcare professionals in the home, so they also provide a more complete picture of a patient's health.



## Telehealth Case Studies

### *Mobile Ambulance – Turkey (WiMAX-Triple Play service)*

Intel Turkey and Turk Telekom successfully demonstrated how mobile WiMAX could be used to send information in real time from an ambulance carrying a patient to a hospital's emergency room. Intel set up the demo at Numune Hospital in the Turkish capital of Ankara. Communication between ambulance and hospital established with Mobile WiMAX wireless access technology. On the way to the hospital, live video of the patient, the patient's demographic information and vital signs, and 12-lead electrocardiogram data were transferred from the ambulance to the hospital over WiMAX.

### *China (Healthcare)*

Located on the southern coast of PRC, Guangdong province is 65 percent farmland, with the majority of its farming villages in mountainous areas. Although Guangdong has the highest total GDP of all Chinese provinces, its rural areas, which represent 40 percent of its total population, contribute only 22 percent. The remoteness and inaccessibility of their villages is often cited as one of the reasons farmers can't keep up with the rest of the province. Another factor inhibiting development is the lower level of IT usage and competency compared to the cities. Guangdong is not alone in its rural challenges. China's national government has launched the New Countryside Initiative to improve infrastructure, education, and medical care systems for the country's 800 million farmers. IT will play a key role in China's educational and healthcare commitments.

Conveniently located e-community centres have been set up throughout Guangdong's rural areas. The provincial government sponsored the centre locations. Intel provided the design and setup and oversaw the IT vendors. Service providers such as China Telecom supplied Internet connectivity. And local PC manufacturers provided the systems and labour. By Q1 2007, 1100 centres had been set up, with 9000 more to deploy by the end of 2007. These government-monitored centres provide broadband Internet access to the community via ADSL. PC platforms designed by Intel for developing countries (like the Rural PC created in conjunction with China's Ministry of Information Industry for rural farmers) provide computing power and access even in areas with unreliable power supplies. Training is available on-site for the centres' visitors, many of whom are first-time PC users. Locally relevant content – such as agricultural trading information and farming techniques, and e-government services for land registration and policies – is provided via a Rural Information portal specifically developed by Intel for use in the e-community centres.

The first two digital healthcare clinics have been established in the city of Zhanjiang. Intel brought together hardware and software vendors to develop a system that brings all the key elements of a clinic together on a network, including patient registration, pharmacy, outpatient doctors' station, nurses' station, laboratory system, mini-PACS, and more. Electronic Medical Records (EMR) enables a seamless transition and secure transmission as patients receive treatment. EMR also enables vital information to be uploaded from clinic to ambulance as critical cases are rushed to the hospital. And a telemedicine component gives local residents access to specialists in urban hospitals, including low-cost remote diagnosis.

### *Lebanon (Telemedicine-WiMAX)*

WiMAX networks accelerate the use of technology and high-speed computer connections to access the vast knowledge resources of the Internet. WiMAX systems deployed at two hospitals, one school and two community centres in Burj Al Barajneh, Nabatiyeh, and Beirut. The longer-range wireless technology is considered a more efficient way to bring connectivity to rugged and remote areas less suited for installing cable or phone wires.

Intel is also increasing technical and doctor training support for a Telemedicine Program at one of Lebanon's top hospitals, American University of Beirut Medical Centre (AUBMC) and the Nabatiyeh Governmental Hospital in Nabatiyeh. The Telemedicine systems provide the hospitals with real-time video consultation between physician's kilometres apart, the ability to share data and to diagnose patients from afar. Without Telemedicine, Nabatiyeh citizens needing a specialist would have to travel to Beirut, a trip that can be long and arduous. The innovation gives local doctors the ability to access the latest medical data and get second opinions from specialists and medical centres hundreds of kilometres away.

***Egypt (Telemedicine-WiMAX)***

A remote city near the Nile River Valley, Oseem is home to about 200,000 citizens. Just an hour's drive from Cairo, this agricultural community of ancient traditions is a world away. Cattle, goats, sheep, and camels compete with vehicles on the unpaved roads. And although the rooflines are dotted with satellite TV dishes, lack of PC technology was holding the community back. Simple government transactions could take many months. Illiteracy was a concern, as it is nationwide. In addition, much of rural Oseem was without access to medical care.

The city was chosen to be a model "digital village," to showcase how cost effective basic information communication technologies can improve development and quality of life. Intel has been working with the government and a variety of private and public partners focusing on three key areas: e-government, education, and healthcare. Using WiMAX connectivity, IT was successfully introduced into the community. The Oseem digital village was designed and deployed within a matter of weeks.

WiMAX solution was piloted in Oseem. Government and local distributors worked closely to set up a cost-effective solution that could serve as a blueprint for future WiMAX stations. This new connectivity enabled installation of an e-government kiosk, giving Oseem residents and businesses easy access to more than 700 government services.

As a result of being digitally enabled, an existing medical convoy was used to set up a cost-effective mobile telemedicine solution. This allows residents access to specialized care without having to make the expensive and time-consuming trip to Cairo. Similar setups can be used in rural clinics to supplement the very basic medical care now available.

***Brazil (Telemedicine-WiMAX)***

Parintins – population 100,000 – is an “island city” in the middle of the Amazon jungle. Accessible only by airplane or a 12-hour boat ride, it's a perfect example of the challenges posed by very remote locations. With no roads and limited infrastructure, education and healthcare were suffering. Only 61 schools of the region's 190 public schools and community centers had access to a power line. Only one school had computer access and that was just one PC with a 64K connection. There is only one hospital – a difficult, costly journey away for many people – and the city's physicians were finding it difficult to provide affordable, quality care.

In a public-private partnership with Brazilian government, business, and education officials, Intel planned and led the effort to install a state-of-the-art WiMAX network for a primary healthcare centre, two public schools, and a community centre. Companies making key contributions to the project included CPqD (PC labs and network installation), Embratel (provided satellite link services and the WiMAX network operation), Proxim (donated WiMAX CPEs and base stations), and Cisco (donated Wi-Fi access points).

In healthcare, Parintins is benefiting from a Telemedicine Clinic in Manaus that will be a first point of contact resource for Parintins doctors. It was formed by the State University of Amazonas and Federal University of Amazon. Brazil's telemedicine leader, University of São Paulo (USP), provided software tools and the use of “virtual man,” a computer graphics representation of the human body. USP is also providing continuing education and refresher courses. The doctors now have video conferencing capability, giving them faster, and better access to the latest medical data to help combat diseases that plague the region. Dr. Gregorz Maciejewski, (Physician) says: “It takes two months for skin biopsy results to be received. With the image I'm sending now, today, on the wireless system with this camera, the diagnosis could be done within an hour. I think this is a quantum leap, something out of this world.”

***India (Telemedicine – WiMAX)***

Located about 120 kilometers from Pune, Baramati is a Tehsil, or administration centre, for a group of villages. Its economy is primarily agricultural. Baramati has a well-built infrastructure, with roads, water, and utilities—due in large part to native son Mr. Sharad Pawar, the Union Minister for Agriculture, Consumer Affairs, Food, and Public Distribution. The small town also boasts India's largest dairy, capable of processing one million liters of milk per day.

A new Community Service Centre features kiosks that provide Internet access and services. WiMAX enables broadband speeds in a wireless environment, while Intel-powered PCs provide computing power and access,

even in areas with unreliable power supplies. One beneficiary of the town's new PC access is the network of more than 100 women's vocational self-help groups.

A digital community health center was implemented, with remote diagnostics in ophthalmology and cardiology. The center delivers specialized care in areas like cardiology and eye care at dramatically lower costs than in urban areas – sometimes as much as 25 times less expensive. The initiative involved healthcare partners SN Informatics and Schiller Healthcare, along with tertiary care providers Narayana Hrudyalaya and Aravind Eye Hospital, and supported by the leading local institute at Baramati, Vidya Prathisthan's Institute of Information Technology (VIIT). The community health center is making a dramatic difference, with 11,000 outpatients served in just its first four months of operation.

### *Nigeria (Telemedicine – WiMAX)*

Intel announced a comprehensive set of digital inclusion projects aimed at improving education, healthcare and economic development for Nigeria's 140 million people in 2007.

With the support of the Federal Ministry of Health, Intel launched a pilot telemedicine project that brings critical pediatric care to a rural hospital serving a region of 4.5 million people. With Intel's support, doctors in Bida are now able to consult in real time with pediatric and surgical specialists in Abuja through the new telemedicine system, which features video conferencing and high-speed broadband connections through WiMAX, a long-range wireless technology. The pilot makes it possible for physicians to shorten both time and distance in getting to patients to treat them. The system connects one of Nigeria's flagship medical institutions, the National Hospital in Abuja, with the Federal Medical Centre in Bida, a rural 200-bed medical facility that's a four-hour drive away. Up to now, patients who needed referrals from Bida were forced to travel at least 250 kilometres to reach specialists – a trip most could not afford.

Bida has an acute need for care from paediatric medical specialists. In the project's first phase, a fetal-monitoring capability will permit baby doctors to remotely – and more quickly – consult with medical staff and examine expectant mothers to monitor the progress of their pregnancies. Intel is also training medical practitioners and technical specialists at both hospitals to use the new technology tools.

## **India: Current Telemedicine Infrastructure, Network, Applications in India**

*S K Mishra <sup>1</sup>, L S Sathyamurthy <sup>2</sup>*

### **Introduction**

India is a vast country with more than one billion population still struggling to improve its poor health parameters. With a huge disparity between urban and rural infrastructure telemedicine enable health services holds a great promise. Over last eight years several initiatives have been taking place to adopt various e health services. Those initiatives are given below.

### **Hospital Information and Management System (HIMS) in India**

Majority of the hospitals in the country are rooted in manual processes, which are difficult to access. The insurance sector demands for more efficient information storage and retrieval. Automation alone can help hospitals to meet these challenges. Many sturdy, standard HIMS solutions have been developed by the major IT companies e.g. Centre for Development of Advanced Computing (CDAC), Wipro GE Healthcare, Tata Consultancy Services (TCS) and Siemens Information Systems Ltd (SISL) etc. Currently most of the corporate and some government hospitals are deploying HIMS. CDAC, an autonomous government IT organization developed and deployed the first total HIS software in collaboration with Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), Lucknow in 1998.

### **Tele-health Care Services**

Healthcare is a state subject which follows a three tier system – primary health centres catering a group of villages, secondary level health care located at district level and medical college hospitals constituting the tertiary level healthcare located in the big cities. Besides, there are few advanced medical institutes of national importance having clinical, teaching and research facilities in various super-specialties. In addition to government run health system, same hierarchical healthcare service exists in private sector also. In spite of well planned public health care system in place, access to healthcare in rural areas is far from satisfactory. Several case studies in country and abroad have proved the technical capabilities of telemedicine in satisfactory transfer of knowledge and information pertaining to patient care, professional and skill development of healthcare providers and administrators from tertiary level through secondary to primary level. This will not only educate the doctors but also improve the quality of patient care at these levels. Both government and private agencies are venturing into Tele-healthcare by providing communication link, Hardware and software solutions for telehealth care. Some of these activities are summarized below.

### **Indian Space Research Organization (ISRO)**

ISRO is deploying telemedicine nodes under GRAMSAT (rural satellite) programme. In collaboration with state governments it has established a Telemedicine Network consisting of 225 Hospitals-185 Remote/Rural. District Hospital / Health Centers connected to 40 super specialty hospitals located in the major states. The state wise distribution of 225 telemedicine nodes are as follows: Andhra Pradesh (13), A & N Islands(4), Bihar (1), West Bengal (6), Chattisgarh (16), Gujarat (1), Himachal Pradesh (1), Haryana (2), Jharkhand (1), Jammu & Kashmir (12), Karnataka (25), Kerala (26), Lakshadweep Islands (5), Madhya Pradesh (1), Maharashtra (4), NE States (21), New Delhi (4), Orissa (3), Punjab (4), Pondicherry (5) Rajasthan (32) Tamilnadu (13), Uttar Pradesh (3), Uttaranchal (1) and Others (21). More than 225000 patients have been provided with tele-consultation and treatment under ISRO project.

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## **Department of Information Technology (DIT) Ministry of Communication and IT (MCIT), Government of India**

DIT has established more than 75 nodes all over India and support Research and Development as Under;

Development of telemedicine software systems by C-DAC and validation for three premier medical institutions- viz. SGPGIMS, Lucknow, All India Institute of Medical Sciences (AIIMS), New Delhi and Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh using ISDN & Satellite connectivity.

For diagnosis & monitoring of tropical diseases in West Bengal using Wide Area Network (WAN), developed by Weibel (Kolkata), Indian Institute of Technology, Kharagpur and School of Tropical Medicine (2 nodes)

Kerala Oncology Network for providing services for cancer detection, treatment pain relief, patient follow-up and continuity of care in peripheral hospitals of regional Cancer Center, (RCC), Trivendrum (5 nodes).

A Telemedicine solution to provide specialty health services to remote areas of north-eastern states of India at Naga Hospital Kohima and remote states of Mizoram and Sikkim with support from Marubeni India Ltd., Govt. of Nagaland and Apollo Hospital, Delhi.

Undertook initiative, in a project mode, for defining "[The framework for Information Technology Infrastructure for Health \(ITIHI\)](#)" to efficiently address information needs of different stakeholders in the healthcare sector.

To standardise services of different Telemedicine centres a document, "*Recommended Guidelines & Standards for Practice of Telemedicine in India*", has been prepared by DIT<sup>2</sup> which is aimed at enhancing interoperability among the various Telemedicine systems being set-up in the country. These standards will assist the DIT and state governments and healthcare providers in planning and implementation of operational telemedicine networks. To establish a telemedicine center standard should be set for telemedicine system, software, connectivity, data exchange, security and privacy issue etc. Guidelines should be made to conduct the telemedicine interaction.

In collaboration with National Informatics Center (NIC), Community Information Centres (CICs) were setup initially in 30 blocks of the North Eastern states and Sikkim using NICNET.

## **Ministry of Health and Family Welfare (MoH&FW)**

Has set up a National Task Force on Telemedicine in 2005 is addressing various issues in telemedicine. Sub-committees are working to develop a national policy document and has implemented integrated Disease Surveillance Programme network with the help of ISRO.

Under the National Cancer Control Program MoH&FW establishing OncoNET India, a network connecting 25 Regional Cancer Centres and 100 peripheral centres to provide comprehensive cancer treatment facilities and carry out cancer prevention and research activities.

Approved tele-ophthalmology project to provide eye care specialty services to the patients of rural and remote areas of Punjab, Uttar Pradesh, West Bengal states of India through tele-ophthalmology mobile van.

Draft proposal for National Telemedicine Grid has also been prepared by ISRO and submitted to MoH&FW.

Apart from this some telemedicine programme are also supported by some super specialty hospitals in government and corporate sectors and state governments (Table 1).

## **Distant Medical Education**

Imparting quality medical education in all the medical colleges and maintaining a uniform standard across the country is not only dependant on adopting an uniform curriculum prescribed by a regulatory body but also requires availability of excellent infrastructure such as qualified teachers, knowledge resources, learning materials and teaching technology. Though all these measures are ensured and followed in developed countries it is not so in developing countries due to financial and logistic constraints. Advancement in

Telecommunication and Information technology provides an opportunity to bridge the knowledge gap by networking academic medical centers of excellence with peripheral medical colleges to practice distance learning in the form of interactive virtual class room, teleconference of operative procedures, accessing library, and web enabled teaching activities etc. The scenario in India is no different from any developing country. Considering the recent availability of enormous bandwidth from existing space and terrestrial telecommunication infrastructure, Information technology professionals, necessary hardware and software, and the emerging technology of grid computing, the country is now in a position to afford such kind of network. Over last five years few tertiary academic medical centers are engaged in such activities with encouraging results (Table. 1).

**Table 1: Super Specialty Hospital Telemedicine Network (Public & Corporate Sector)**

Sl. No	Super specialty Hospital	Telemedicine nodes linked with	Funding & Implementing Agencies
1	SGPGIMS Lucknow	Orissa, Uttaranchal State network, District Hospital, Raibareli, AIIMS, PGIME, Eight states of North East, AIMS, Kochi, SRMC, Chennai, CMC, Vellore, Rohtak Medical College, Rohtak, Haryana	ISRO, KIT, Govt. of Orissa Uttaranchal, Gas Authority India Limited, CDAC Mohali, NIC
2	AIIMS, New Delhi	J & K network, Haryana (Rohtak Medical College, Ballabhgarh Community Centre), Cuttack, Guwahati, Chennai, Kochi	DIT, ISRO, C-DAC, Mohali
3	PGIMER, Chandigarh	Punjab and Himachal network, SGPGIMS Lucknow, AIIMS New Delhi	ISRO, DIT and Govt, of Punjab and Himachal
4	Amrita Institute Medical Sciences (AIMS), Kochi	34 nodes	ISRO
5	Tata Memorial Hospital, Mumbai	9 NODES AND Regional Cancer Centres	
6	Asia Heart Foundation, Bangalore	Rabindranath Tagore International Institute of Cardiac Sciences (RTIICS) Calcutta, Narayana Hrudayalaya, Bangalore	ISRO
7	Shankar Nethralaya, Chennai, Meenakshi Eye mission & Arvinda Eyecare Center, Madurai	Mobile tele-ophthalmology	ISRO
8	Apollo Hospital Group	64 nodes in India & abroad	ISRO, Apollo Telemedicine Network Foundation (ATNF)
9	Fortis Hospital	12 nodes	

Though telemedicine application projects have been undertaken in many states in the country, research and development has not grown in that proportion. Research projects carried out / under development till date are summarized in Table.2.

**Table 2: Summary of the Research Projects**

	<b>Organization</b>	<b>Project title</b>	<b>Objective</b>	<b>Funding Agency</b>
1	SGPGDMS <sup>9</sup> (June 1990)	Telemedicine – in extremes of environment	Telehealth care for the Kailash Mansarovar Pilgrims	Kumaon Mandal Vikas, Nigam SGPGDMS
2	SGPGIMS (January 2001)	Application of the Telemedicine Technology to provide Telehealth Care during Mela Festival and Disaster	Tele-healthcare – in festivals and Disaster situations	DIT. Ministry of Communication & IT. Govt. of India
3	AIIMS SGPGIMS PGIMER C-DAC Mohali (2001-05)	Development of Telemedicine technology and it's implementation towards optimization of medical resources	Development of telemedicine software (Mercury & Sanjeevani)	- Do -
4	SGPGIMS (Year 2002)	Development of Mobile Telemedicine Units	Mobile health care for remote areas emergencies & disaster management	OTRI, Ahmedabad
5	SGPGIMS (Year 2002)	Development of Portable Telemedicine Units in suitcase	Emergencies & disaster management	OTRI
6	Indian Institute of Technology (IIT). Kanpur	Development of Portable Mobile Rural Healthcare Module (Sehat Sthi)	Dissemination of information diagnosis & treatment on health & disease	Media Lab Asia
7	IIT. Kanpur	A mobile platform (Infothela)	Designed to accommodate diagnostic equipments	- do -
8	IIT. Kharagpur	Augmentative Communication System for the speech impaired & people affected with cerebral palsy (Sanyog)	Natural Language Sentence Generator	- do -
9	IIT. Kharagpur	An Embedded Indian Language Text to Speech System (Shruti)	Provides a speech based communication interface for speech impairments talking web browser for visually challenged	- do -
10	AIIMS. New Delhi	A replicable model for IT based health system at grass root level (Ca:sh)	Digital updation of data at PHCs & CHCs. Management of childhood diseased on handheld devices	- do -
11	IIT. Delhi	Zero Configuration wireless mesh network (802.11b)	Disaster mitigation & management	- do -
12	Byrraju Foundation	32 Ashwinwi centers in 84 villages of Andhra Pradesh	Specialist consultation health education and promotion and continuous medical education	Byrraju. Foundation

### Capacity Building

Apollo telemedicine network foundation in collaboration with Anna University, Chennai has started a 15 days certificate course in Telehealth Technology which is a blend of technical, medical and managerial skills. SGPGIMS, Lucknow in collaboration with the State and Central Governments and Ministry of Information Technology has taken up the initiative and set up a School of Telemedicine and Biomedical Informatics in its campus. This 2500 sq. metre building will house different laboratories in the field of e health such as Telemedicine, Hospital Information System, Biomedical informatics, and medical multimedia and image management, Medical Knowledge Management, Artificial Intelligence, Virtual Reality and Robotics. The objectives of the school are creation of various resource facilities, structured training programme, research and development, providing consultancy to government and private healthcare

organizations, collaboration with technological and medical universities in the country and abroad. Currently SGPGIMS is providing training in networking, technical, managerial aspects and application of telemedicine to man power involved in Orissa, Uttaranchal and Raibareli telemedicine projects. SGPGIMS has also submitted a project to the DIT to support creation of laboratory infrastructure to carry out inter-disciplinary research in the field of Health IT. This project is aiming at creation of a resource center at national level to attract researchers from various fields of science related to health information science and technology to develop research collaboration. This National Resource Center is going to function in the School of Telemedicine and Biomedical Informatics.

### **Conclusion**

Telemedicine technology is getting familiar with healthcare providers in India. Some states have started adopting it but most of the applications are in project modes. It will take quite some time for diffusion of this technology into health delivery system. Technically the country has all the resources to face the need of the users. Broadband connectivity is widely available and the cost is coming down fast. Besides tele-healthcare this technology is used for distance education and soon all the medical colleges may be linked which can bridge the deficiency of teachers and medical library facility. Most of the telemedicine projects are driven by the doctors and the success is entirely dependant on human rather than technical factors. Awareness among patients and health administrators is essential to accept this emerging technology as a facilitator for quality healthcare delivery in remote areas. There is a need to address policy issues like standardization, legal, ethical and social factors besides developing revenue models and creating infrastructure for meeting the need of training manpower and carrying out research and development. Though start-up projects are successful, models should be developed to sustain it.



## India: Ready to Implement Mobile e-Telemedicine

Two excellent devices are developed in India – Disaster Management System “DISAMED 2000” and Mobile Van. Both are results of the efforts of Infocom Private Limited (OIPL) and its Research wing Online Telemedicine Research Institute (OTRI).

**Disaster Management System “DISAMED 2000”** helped take healthcare initiatives to distant locations to support prompt medical assistance and services at the site of natural calamities like earthquakes, floods, typhoons, stampedes, etc. The system is ‘detachable’ and can be created in the form of a telemedicine kit which can be taken to remotest and non-commutable places using horses, camels etc. or can be airdropped at the affected areas at the time of severe calamities to provide primary medic care. (Figure 1)

**Figure 1:**



Natural calamities strike without any prior warning, amongst that too floods and earthquakes are the worst conditions with virtually no communication possible in the initial stages. The gravity increases as the patient cannot approach the doctors nor doctors can reach the patients. In this situation the “Disamed 2000” a Disaster Management System can be proved as boon to the people. Carry healthcare in the bag “Disamed 2000” is a portable waterproof; shockproof, dropdown kit meets all possible requirements of healthcare in isolation. These mobile kits facilitate transmitting of data of health care, research and survey through videoconferencing at control center through space. This system has been used in mass gathering and earth quake relief.

Disamed 2000 is very easy to function, Easy to operate. It does not require any technically or medically skilled person to operate the system. The information/images are collected by the Disaster Management Cell and transmitted to the Disaster Management Controlling Unit (DMCU) from the received data a diagnosis/ Consultation is done. Online consultation from DMCU to Disaster management Cell makes the system most effective to work in disaster situations.

The **Tele-mobile van** is designed to reach the site in the shortest possible time for maximum services to be offered on such occasions. It is able to provide a full-fledged facility to hospital, housing the features given in below Table 1:

**Table 1:**

<b>Attachment Facility:</b>	<b>Optional Attachments:</b>	<b>Communication media:</b>
1.Microscope	1.Ultra Sound	1.VSAT
2.PTZ camera	2.Echo Doppler	2.Mobile Phone
3.12 lead ECG	3.PFT	3.Blue tooth
4.Mobile X-ray Machine	4.Pulse Oxymeter	4.INMARSAT
5.Dark Room		
6.X-ray Scanner		

### **Disaster Medicine Mobile Van**

Works on VSAT, PSTN, ISDN, Web/ Internet, Mobile/WILL, Satellite phone for Medical Image & Data transfer with Live Video Conferencing.

Transfers Live Ultra Sonography, Blood Slides, 12 Lead ECG, X-Ray, MRI, CT Scan, Live Video/ Audio clipping, cath lab, live video/medical image conferencing, Angiogram, Color Doppler.

Functions with different branches: Radiology, Cardiology, Pediatric, OB Gynecology, Pathology, Dermatology, Oncology Surgery, Psychiatry, Ophthalmology and as many as desired.

OIPL has designed also developed a Rural Telemedicine system to provide healthcare requirements at the rural area. The system also provides, education (tele-education is part of the system), entertainment and brings to the doorstep the developments happening at the other 'end of the world' on time.

This system is going to revolutionize the system of providing education, which could be a boon to poor countries like those in Africa, a boon in terms of low project cost. At the same time, highly effective method, and for a developed country or a developing country, it would be a 'switch over' from a conventional, confined and ineffective method to a highly efficient, result oriented and cost effective method which ensures speedy reach to the level at the bottom.

## Nepal: ITU Assistance for e-Health in Nepal and Future Planning Issues

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### Introduction

Nepal is a least developed country with diverse land topography mostly hilly and mountainous. It has been facing a difficult economic situation though the recent political development has been propelling the country towards a public democratic economy. The economic crisis has led to decrease in the government expenditure in health and telecommunications sector. There is no telemedicine policy and health insurance policy in place.

The promotion of healthcare is in the hands of the state, being regulated by the Ministry of Health and Population (MOHP). The private sector is also involved in provision of healthcare services but it is expensive and not affordable to the general people. No strategy of telemedicine initiatives have been adopted at the government level yet though a few private health institution and health practitioners have set up a telemedicine network for teleconsultation. Recently, International Telecommunication Union (ITU) has assisted Nepal in preparing an e-Health Master Plan and it is in progress.

**General statistics:** Nepal is a landlocked country situated between two giant countries, China and India, in southern Asia. Its total population is 25,665, 9599as per projection from 2001 census. The Himalayan country elongates within 80-88 degrees East and 26-30 degrees north. In total it occupies 147, 181 sq. km. with 3 main geographical regions: flat land in the south (17%), hilly region in the central part (68%) and Himalayas in the north (15%). Nepal is administratively divided into five development regions with total of 75 districts. The capital is Katmandu.

**Health Statistics:** basic health services during the last fiscal year (2005-06) was provided by 89 hospitals, 186 Primary health Care Centers(PHCCs), 697 Health Posts(HPs) and 3129 sub Health Posts(SHPs). Primary health care was also provided by 14,710 primary Health Care Outreach Clinic (PHC/ORC) sites. These services were further supported by 48,164 Female Community Health Volunteers (FCHVs).

Thus, the total health institutions owned by the government are 4100 in these 3914 VDCs and 58 municipalities throughout the country. Out of the 25, 377 staff of the Department of Health Services over 60 percent works in rural areas. A total of 1,000 doctors and 4, 199 public health staff are employed in different regions. Nursing personnel comprise 20% of the total health personnel. The budget allocated to health programmers under the DOHS was Rs. 4509 million (about \$60million) out of the total health sector budget of Rs. 6553 million (about \$90 million). The external Development Partner's contributions comprised 44.9 percent of the total budget under DOHS. The fact sheet in the annual report of Department of Health Services(DOHS) shows high coverage of health services by different programmer such as gradually increasing CPR every year, expansion and strengthening of safe motherhood services, decreasing OPD visits, gradual Declining of reporting from hospitals. However significant problems and constraints are identified by these health centres so that MOHP and DOHS jointly have to take appropriate actions to solve these issues to improve the healthcare system for quality care.

**Telecom statistics:** The number of telecommunication service providers, as of April 2006, are basic Telephone(2), Cellular Mobile Telephone(2), Rural Telecom(1), Limited Mobility(1) and Internet with email(38).

Nepal's incumbent telecommunications operator, Nepal Doorsanchar Company Limited (NDCL or Nepal Telecom in short), has rolled out its expansion project with the distribution lines about 500,000(fixed line) and in total approximately 1.2 million lines including mobile, CDMA & WLL phones. It has achieved the telephone penetration of around 4.64 as of Aug, 2006. With fully digital network offering national and international direct dialing services, the national trunk network is equipped with 1762 Mbps, out of which

788 Mbps broadband microwave system is being used to link Katmandu with the rest of the country. About 1250 optical SDH E-1 links have already been installed around the country for broadband connections. For rural connectivity, NDCL uses technology such as Digital C-DOT, MARTS, VHF/UHF radio, Digital microwave, HF radio, VSAT. The rural service penetration level is 50.4% of VDCs served with at least one PCO. Another Rural Telecom service provider, STM telecom, has been licensed exclusively to provide at least two telephone lines in each VDC in the Eastern side. So, the total VDC penetration is 2387 out of 3914 VDCs.

The private sector basic telecom operator, united telecom Limited (UTL), has subscriber base of around 45000 WLL phones and around 3000 limited mobility phones. Another Private sector mobile operator, Spice Nepal Pvt. Ltd. (SNPL) has the total subscriber penetration of around 110,000 lines.

## **National Policy and Importance of e-Health**

### ***Health Policy***

The national health policy of Nepal was adopted in 1991 to bring about improvements in the health conditions of the people. Its primary objective 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. It focuses on the following areas of health services:

- Preventive health Services (to reduce infant & child mortality);
- Primitive Health Services (for healthy living of the population);
- Curative Health Services (available thro' PHCC, HP, SHPs, mobile teams);
- Basic Primary Health Services (thro' SHPs in each VDCs and HPs in each constituencies);
- Ayurvedic and other traditional health services;
- Organization and management (for integration of district hospitals to health offices);
- Community Participation in health services (at all levels thro' FCHV, TBA and local leaders);
- Human Resource for health development (strengthening training and academic centre);
- Resource mobilization (e.g. Health insurance, user charges, drug schemes);
- Co-ordination with private sectors, NGOs and non-health sectors;
- Decentralization and Regionalization (more autonomous DHOs and DPHOs);
- Blood transfusion services & Drug supply (increasing domestic production & quality);
- Health Research.

Likewise, the ministry of health and Population has developed a 20-year Second Long Term Health Plan (SLTHP) for FY 1997-2017). It aims to guide health sector development for the improvement of the health of the population; particularly those whose health needs are often not met. It guides framework to develop appropriate strategies, programs and action plans and to establish co-ordination among public, private, NGO sectors and development partners.

The main targets of the SLTHP are as follows:

- To reduce the infant mortality rate from 64 to 34.4 per 1000 live births.
- To increase life expectancy from 61.9 to 68.7 years.
- To reduce the crude birth rate from 34 to 26.6 per 1000 population.
- To reduce the crude death rate from 10 to 6 per 1000 population.
- To increase the contraceptive prevalence rate from 39 to 58.2%.
- To extend EHCS available from 70% to 90% of the population living within 30 minutes' travel time to health facility.
- To increase total health expenditures to 10% of the total government expenditures.

The government has prioritized following clinical and curative services as EHCS:

- Appropriate treatment of common diseases and injuries.
- Reproductive health, Condom promotion and distribution.
- EPI and Hepatitis B vaccine.
- Leprosy and TB control.
- Integrated Management of Childhood Illness (ARI, PEM, Measles etc).
- School health, Mental health & Occupational health.
- Emergency preparedness and management.

Moreover, the government has carried out National Health Sector Program (NHSP-IP) activities in two components that focus on performance results and health policy reforms implemented under a Sector Wide Approach (SWAp) namely a) Strengthened Service Delivery and b) Institutional Capacity and Management Development. Likewise, the government of Nepal endorsed the Millennium Declaration and has been committed to achieving the MDGs. The country's tenth five year plan (2002-2007) has incorporated the MDGs into its strategic framework, and has highlighted the importance of improving the monitoring mechanism. Out of different 18 targets, it aims to extend cooperation with the private sector to make available the benefits of new technologies, especially information and communications (ICTs).

The government of Nepal has started few initiatives for the development of ICT infrastructure and its applications around the country. Multi purpose telecentres (MCTs) are being established with a view of providing communication technology to the people of urban and rural areas. Its main objective is to provide computer, internet, and email technology facilities to the people of underprivileged society. Currently, 21 telecentres around the country have already been in operation with other specific objectives of accessing & distribution of agricultural information, distance learning, Telemedicine, productive economic activities and employment opportunities. The government has already started e-Governance initiatives with the joint effort of Ministry of Environment, Science & Technology (MOEST) and High Level Commission for Information Technology (HLCIT). The telemedicine is the use of information and communication technologies to provide and support healthcare services when distance separates the participants. It is used for the investigation, monitoring and management of patients and staff using system which allow ready access to expert advice and patient information. In Nepal, Telehealth can help in the domain of Distant Medical Education, tele-healthcare (e.g. Tele consultation, telefollow-up, pre-referral screening, and tele-mentoring) and telehealth care in disaster period. The essential healthcare services identified by Government of Nepal such as reproductive health, immunization, integrated management of Childhood Illness, school health services can be achieved through telemedicine.

In the context of Nepal, it has been observed that there is a great deal of disparity in quality and access to healthcare between urban and rural regions. Almost 80% of the total population live in the rural areas and ironically, majority of the doctors and trained medical workers & technicians live in the urban areas. For mountainous country like Nepal where accessibility by transportation is the main hindrance for reaching a nearest medical centre, it takes around three days of walk to arrive at some district level hospitals, telemedicine seems to be vital. It avoids travel time, cost of traveling, burden to patient's relatives and their household works. In such situations telemedicine definitely can help overcome geographical, time, social, and cultural barriers.

### ***ITU Assistance for Nepal***

The government of Nepal has felt the utmost need for developing policy and plan in institutionalizing eHealth practices and tele-education. The Ministry of Information & Communications (MOIC) and Ministry of Health & Population have started to address the issues with the help of external Development partners. The administration plans to design and formulate e-Health Master Plan for provision of quality health services in the semi urban and rural areas through the deployment of existing telecom infrastructure's, the ITU assistance has been requested for developing the extensive master plan that guides the strategic and operational procedures in setting up eHealth network in Nepal. The eHealth plan is aimed to be submitted to relevant government authorities for action and possibly for enactment and amendment of relevant regulations in its implementation. Accordingly, ITU sent Prof. Saroj Kant Mishra, the Nodal Officer for Telemedicine

program, SGPGIMS, India to Katmandu from 11 to 22 September on a mission in Nepal. As per the Terms of Reference identified jointly by ITU and Nepal Government, Dr. Mishra met and discussed with government senior officials at departments of Health, Telecommunication and Information technology, Nepal telecom and Medical University. Through his final Report, the expert has recommended to the Nepal government to constitute a National Task Force on e-Health to bring in all the stakeholders to a single platform, develop concrete policy and roadmap for e-Health integration into healthcare and medical educational system. He further advises to develop projects to prove some of the concepts like rural healthcare access through wireless telecommunication media, e-CMEs through virtual private network.

### ***Future Planning Issues***

The eHealth master plan could be a milestone guiding framework for the initiation of telemedicine activities. It could suggest the different issues such as policy formulation, enactment of e-Health act, integration of current health care facilities with e-health network, implementation issues, setting up countrywide hospital network for improved and integrated Hospital Information System (HIS), possible expansion of the network and link with other tertiary care hospitals in India & abroad. The infrastructure development relating to teleconnectivity around the country, Availing the local/nodal hospitals and referral hospitals with telemedicine equipments will be other issues for smooth implementation of such initiatives.

The expert suggests that having a national task force in place is a must in dealing with the above issues. The composition of the task force should include members from each of the stakeholders accompanying officials from MOHP, MOIC, Nepal Telecom Authority, and High Level Commission for Information technology, Nepal telecom, and Private players in the health and telecom sector, Consumer society. The high level task force must be empowered with the following responsibilities such as:

- Prepare e-Health Strategy, Plan and Implementation activities for Nepal.
- Providing consistent suggestions to the Government on the policy plan and programme to be adopted for the development of tele-healthcare services.
- Assessing the status of connectivity and Suggest the government for making necessary arrangements to avail basic telecom service preferably for high speed connectivity and facilities to the prescribed areas.
- Identifying the different types of healthcare services to be provided through telemedicine in different regions of the country.
- Identify the PHCs or SHPs in each district, regional hospitals thereby and a tertiary level central university hospitals to be connected to the telemedicine network.
- Making strategic and operational guidelines in the provision of such services.
- Carrying out cost calculation for setting up such a network and making cost benefit analysis.
- Conceive few pilot projects at least, to start with, after assessing the available health and telecom facilities.
- To estimate the budgeting requirements and, if required, to look for prospective donor agencies such as WHO, ITU, UNDP, APT, UNESCO, ADB etc.
- Preparing a global vision of eHealth network for Nepal based on the existing ICT infrastructure and healthcare needs of the country and setting up the priority for the step by step introduction of eHealth services.
- Identify the implementing agency for the project and Identify the role of the Ministry of Information & Communications (MOIC), Ministry of health (MOH), Telecom regulator (NTA), the telecommunication service providers etc. in the implementation of the project.
- Provide guidelines for the system requirements and standardization of Telemedicine equipments, software, security etc.
- Form separate sub committees as required for the facilitation and speedy work as per the area of expertise such as Policy formulation, Project implementation & monitoring, Budget control, Infrastructure development, User group, Public awareness, Human Resource Development and National & International coordination committees.

For carrying the pilot projects, the government must evaluate, make specifications and develop database (HIS/MIS) on the recommendation of the National task force immediately in the following domains.

- Availability of Broadband connectivity and communication media.
- Availability of video conferencing equipment, high end video cameras and high resolution display devices.
- User friendly applications and non-proprietary hardware & software.
- Trained medical workers and technicians.
- Public awareness to the applicability of telemedicine.
- Affinity of doctors and medical workers towards information technology.

### **Conclusion**

From the WTDC held in Buenos Aires in 1994 to the recent WTDC event in Doha, the ITU-D Study Group on Question 14-2 has been dealing with the needs of developing countries in raising the awareness of regulators, telecom operators, donors & customers about the role of ICT in supporting better care and healthy life in these countries. It has been publicly accepted that eHealth solutions and applications can play very important role in health care delivery and, in particular in developing countries, where the acute shortage of doctors, nurses and paramedics exists.

In a least developed country like Nepal, few pilot projects for simple low cost applications using existing ICT facilities would help to overcome the task of specialty & quality care, limited healthcare training, limited communications & transportation opportunities, surveillance of outbreak of communicable diseases and for continuing medical education. Thus, the national task force has tremendous challenge ahead to make the most out of ITU assistance and generous contributions of other international agencies for reaping the potential benefits of IT enabled healthcare services.

## **Russia: New Generation of Mobile Telemedicine Complexes Creates New Possibilities for Health Services to the Population in the Remote and Hard-To-Reach Regions**

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### **Introduction**

Wide interest to the telemedicine developments now is quite natural taking into consideration the general aspiration and practical steps for improvement of quality of people's life on our planet. Being entered into era of information technologies, medicine has reached big progress, but, at the same time, more brightly highlighted some problems which were less appreciable earlier in the prevail system of stationary medical institutions. First of all it concerns the problem of maintenance of qualitative and timely medical services to the population in the remote and hard-to-reach areas. The overwhelming number of medical points in such areas is capable practically only for rendering of primary medical aid, but can absolutely powerless in cases when urgent consultation of the highly skilled doctor was required, of the expert in the given kind of disease. Moreover, in a number of areas, for example in the Far North, there are Indigenous and Communities till now, which have a nomadic way of life. Being in conditions of constant migration, these communities practically are cut off from modern medical aid. As result, the increased level of diseases and death rate are observed in this areas, the infectious diseases are springing up more often, that creates the real threat of its extend not only on other territory of the country, but also on nearby countries. The given problem actively discussed at various levels both in the separate countries and in the international organizations in particular in the frame of «Northern Dimension» policy.

The Russia is not aside of this problem. In conditions that considerable part of population lives in countryside, in the remote and hard-to-reach areas, including at Far North, the problem of maintenance of the population with qualitative medical aid has special sharpness. The «National Telemedicine Agency» Research-and-Production Union in 2003 made an attempt to solve the problem and developed telemedicine project based on use of information and telecommunication technologies and Mobile Telemedicine Units (MTU). The results of this system's operation in Ural Federal District of Russia, in Ekaterinburg city, then in Perm have shown its exclusively high not functional only, but economic characteristics too, that have been a basis for further perfection of Mobile Telemedicine Units complexes (MTU).

### **Principles of Construction and Architecture of Telemedicine System**

The following principles have been put into a basis of construction of new mobile telemedicine complexes:

- 1 Possibility of reception of the objective medical information in the digital form about the patient even in case of use of the non-numerical medical equipment.
- 2 Possibility to carry out the storage, viewing, processing and preparation of the patient medical data for carrying out of telemedicine consultations.



- 3 Possibility to transmit collected and prepared medical data to the distance in the shortest time. Possibility of discussion of these data with the remote adviser and possibility of reception of the conclusion.

It is possible to disjoint all MTU facilities for three basis parts: medical, telemedicine and telecommunication.

Medical facilities concern: digital and non-numerical medical diagnostic equipment; devices for carrying out of diagnostic researches for various clinical cases;

*Telemedicine* facilities include devices for gathering, processing and storage of medical data; for preparation of data and carrying out of telemedicine consultations; for registration of telemedicine consultations and mobile facilities for delivery of equipment and medical personnel to patients.

*Telecommunication* facilities consist of all variety of data transmission systems. On their basis the specially allocated "telemedicine channels", corporate networks can be organized or existing networks of data exchange, such as the Internet, can be used. The choice of channel for medical data transmitting, its capacity, is defined by tasks of telemedicine system.

### Structure of Telemedicine System

*The National Telemedicine System can be organized as hierarchical four-level system.*

At the first, *local* level, (in a countryside, in the remote and hard-to-reach areas, in territories with low population density), the continuous medical monitoring of the population (prophylactic medical examination and primary health services) is carried out with use of telemedicine points equipped in local stationary medical institutions, connected with independently working Mobile Clinical and Diagnostic Units.

At the second, *regional* level the qualified experts of medical institutions (as a rule, the leading experts of the central regional clinics), provide the experts of regional hospitals, medical help stations and personnel MTU with telemedicine consultations on the basis of data received from MTU. On the other hand, the regional telemedicine centers are connected with federal medical institutions that allow to regional experts to receive highly skilled consultations in the most difficult clinical cases. Beside this, the possibility of the regular control over the patients, received medical help in the federal centres is besides, is provided too.



At the third, *national* level the medical institutions carry out the telemedicine consultations in difficult cases, general methodical supervision of telemedicine sector, training and education of personnel. The national telemedicine centers provide also the control over disease level in concrete region on the basis of operative information. At the fourth, *international* level the exchange of telemedicine consultations in especially difficult cases between physicians in Russia and abroad is carried out. Especially it is necessary to note the active connections between physicians of the CIS countries, also an abundant quantity of Russian-speaking doctors in many countries of the world have learned in former USSR and Russia, which would like to receive the consultations of their teachers and colleagues. The telemedicine system formed with stationary telemedicine stations and mobile laboratories connected among themselves on vertical and across, easily adapt for conditions of concrete territory, and are scaled depending on the sizes of this territory, quantity of the population and epidemiological conditions.

The key element of the system is Mobile Telemedicine Units (MTU). Depending on medical tasks, the MTU can be provided with various medical and telecommunication equipment. According to geographical and climatic features of territory, the MTU can be mounted on the car of the out-of road lorry, on air- or floating carrier. By reason of presence of communication with the qualified medical personnel of higher medical institutions, the MTU's medical personnel can consist the specialists of average qualification that is very important in conditions of shortage of highly skilled doctors, at the same time the price of health services reduce practically without loss of quality. MTU have life-support systems of crew and independent operating equipment. These systems include, in particular, own diesel-generators, solar batteries (for southern areas), equipment amortization systems for journey out of roads, refrigerators for medicines and food stuffs, systems of satellite navigation, toilet, shower, a washstand, medical scrap tank, stocks of pure water, etc. MTU equipped by all communication facility, including satellite stations of for transmit and receiving of medical data via geostationary satellites.

Results of medical and other inspections, lead by MTU personnel, in digital form are transmitted via communication channels to the stationary telemedicine points of local or regional levels which can be relayed to the leading medical institutions in the country or abroad. Highly skilled experts of these clinics analyze this information and inform the personnel of MTU about results of diagnostics and the recommendations for treatment. MTU of "Tobol", "Kama" and "Terek" types, developed by "TANA" Group of Companies, successfully operate in Russia. MTU "Tobol" is intended for rendering primary medical aid, routine and prophylactic medical examination of the population and allows making various inspections, including thorax radiological researches, morphological and biochemical analyses, also functional diagnostics. The main component of this MTU is the low-dose digital X-ray diagnostic unit (Figure 1).

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**Figure 1:**



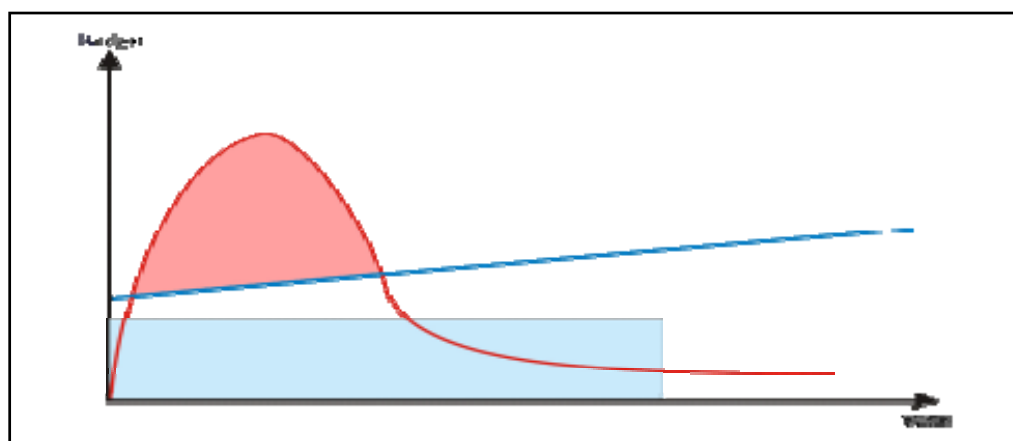
MTU “Kama” it is intended for inspections and prophylactic medical examination of women and allows making various examinations, including gynecologic surveys, radiological researches of mammary gland (mammography), morphological and biochemical analyses, also functional diagnostics and other researches necessary for effective mass screening of women health. The main component MTU “Kama” is digital mammograph, intended, at the same time, for early diagnostics of a cancer of mammary gland. MTU “Terek” is intended for diagnostics of infectious agents: zoonosis feral herd infection (bird flu, leptospirosis, rabbit-fever, tick-borne encephalitis, tick-borne borreliosis, etc.) and anthropologies infections (poliomyelitis, a virus hepatite, a belly typhus, etc.). The base technology of diagnostics is the method of polymerase chain reaction (PCR) in a real time mode (Real Time PCR). This technology provides quantitative definition DNA /RNA of infectious agents in the investigated material, the automated registration and interpretation of received results, and reduces number false-positive results. MTU “Terek” can be armed also with equipment and materials for indication and identification of corresponding pathogenic organisms. The main component of MTU is PCR – laboratory. The special MTU intended for liquidation of consequences of emergence situations have been developed also.

The decision on the basis of satellite communication technologies has a line of advantages compared to ground communication system. Such decision provides the globalism of telemedicine network due to use of geostationary communication satellites which cover the significant territories, including some nearby states. The basic advantage of this decision is full independence of a satellite network from a regional ground telecommunication infrastructure which can be absent in the given region or not corresponding with modern technical and technological requirements. By virtue of this circumstance for creation of telecommunication center for telemedicine purposes the decision can be using of satellite VSAT (Very Small Aperture Terminal) system. The additional benefit of use of the VSAT-technology is the short time for expansion of mobile telemedicine complexes and satellite netting.

#### *Economic Maintenance of Creation of National Telemedicine System*

The successful three-year operation of telemedicine system in Ural Federal district and the Perm region of the Russian Federation allow representing economic indicators of this system as shown on this graph below in Figure 2.

**Figure 2:**



The public health budget, based on traditional method of development of stationary medical institution system, increases with time (dark-blue straight line). Moreover, in conditions of stationary public health system and, in a number of cases, absence of scale prophylactic medical examination, the patients, as a rule, get to medical institutions in neglected state that distinctly increases the cost of treatment and rehabilitation.

The indirect costs also are great. The solving of this economic and social problem is possible by full-scale prophylactic medical examination of population. In this case charges for public health are described by other line (red curve). On the other hand the application of the regular prophylactic medical examination of population system, demands increased investment as shown by red «filling» between red and dark-blue curves in the left part of figure. These charges, (as a rule very large) always are the barrier to transition to mass prophylactic medical examination. In case of implementation of telemedicine technologies this problem has the effective economic decision. That have been successfully realized in practice by Russian «National Telemedicine Agency». As the statistics shows, the cost of treatment in case of regular prophylactic medical examination of population due to early diagnostics of diseases and, accordingly, on the stage of earlier treatment, decrease approximately on the order. Efficiency of this scheme is achieved due to use of resource-saving telemedicine technologies for the organization of health services; high throughput of the telemedicine system as the system for mass service. The statistics gives following figures of telemedicine system exploitation in Ural Federal district and the Perm region of the Russian Federation:

- Increase of kinds of the out-patient and polyclinic help rendered to the population in countryside;
- Improvement of an epidemiological situation, especially with tuberculosis and HIV/AIDS due to detection of primary patients at an early stage of diseases;
- Increase in revealing of oncological patients at an early stage from 10 % up to 20 %;
- Decrease of temporal disability on 20 %;
- Decrease of death rate on 5%.

Mentioned indicators are attained with expenses essentially smaller, than it would be required for achievement of the same results by traditional methods without use of telemedicine technologies.

### **Conclusion**

The use of telemedicine systems in combination with technologies of mobility was rather fruitful. For today more than 15 variants of mobile telemedicine complexes are developed in Russia and the works in this field are continuing.

## **Uganda: Mobile Phone Technology, Whose Rapid Growth in Uganda Provides an Avenue to Reach Millions with HIV/ AIDS Messages in a Relatively Easy, Practical and Cost Effective Way**

*Hajo Van Beijma <sup>1</sup>, Bas Hoefman <sup>2</sup>, Sentamu Phillip Sparks <sup>2</sup>*

### **Background of the use of mobile phones to fight HIV/AIDS in Uganda**

Despite all efforts, comprehensive knowledge about HIV/ AIDS, other Sexual transmitted infections (STI's) and health issues in general, in Uganda are still low. While it is assumed that almost everyone has heard about HIV/AIDS, only 30% of women and 40% of men had comprehensive knowledge (2006 Uganda demographic and health survey, UDHS) The HIV incidence rate of 370 people per day and 137,000 people per annum in Uganda is also unacceptably high.

Mobile phone technology, whose rapid growth in Uganda provides an avenue to reach millions with HIV/AIDS messages in a relatively easy, practical and cost effective way and as such is the new tool for HIV prevention and awareness campaigns.

The Text to Change project which was first pioneered in Mbarara-Uganda and Africa in general is an initiative aimed at increasing awareness on HIV/AIDS through information giving by use of mobile phone SMS quiz, with the desire that this will increase HIV/AIDS awareness and encourage and motivate participants to access HIV Counselling and Testing (HCT) services. The SMS platform can be designed for general health awareness communication as well such as announcements on immunization and also for surveys which would later be used for planning purposes. Text to Change (TTC) is a Dutch organization which is dedicated to support health education via mobile telephones in Africa.

This report provides an account of the activities, approaches, achievements and challenges met in the implementation of the Text to change project from 28th January– 28<sup>th</sup> February 2009” at AIC Arua Branch.

### **Major Intervention activities**

AIC Arua Branch with financial, logistical and technical support from AIC headquarters and Text to Change employed the following interventions to make the Text to Change program a success.

The preparation for the Text to Change started with consultative and planning Meetings held between AIC senior management at headquarters and Text to Change and later at AIC Arua Branch. On December 07, 2008, Mr. Daniel Lukenge (AIC Public Relations and Advocacy Manager) and Mr. Bas Hoefman (Chairman Text to Change, Amsterdam), held a consultative meeting with the Branch Advisory Committee Chairperson, the Arua BOT representative, Heads of Departments and Counsellors from AIC Arua branch on rolling the Mbarara experience to Arua Branch. Arua staff was informed that the TTC project would run for six weeks targeting Ten Thousand (10,000) MTN subscribers from the West Nile Region with AIC Arua Branch being the HCT service provider. Participants were to receive interactive text messages in form of multiple choice questions on their mobile phones. When answered correctly, would automatically guarantee a participant free HCT services and at the same time qualify to enter into weekly draws to win various prizes including mobile phones and airtime. During the meeting the service providers were oriented on the data tool to be used and inputs were given to the quiz based on issues surrounding HIV/AIDS in West Nile and Arua district.

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<sup>1</sup> Text to Change, Netherlands.

<sup>2</sup> Text to Change, Uganda.

## Publicity

In order to sensitize the general public and create awareness about the Text to Change program, over 100 posters and flyers were posted at strategic locations in Arua town and others distributed to the community by PTC members 60 radio announcements, DJ mentions and spot messages were aired on four FM stations namely radio Pacis, 90.9 FM, Arua One, 88.7 FM, Voice of life 100.9 FM and 94.2 Nile FM. This was aimed at preparing the ground for the mobile text messages and differentiating the program from the usual promotions by fake and unlicensed companies that send unsolicited text messages on people's mobile phones. (Refer to appendix 1 for radio spot message the script). One talk show was conducted on Radio Pacis to sensitize the listeners about the program and address potential challenges that may hinder the successful implementation of the program. An estimated total of 5 Million people were reached. The talk show was conducted by the Branch Manager – Lumu Henry Leku, The AIC BOT member – Hon Dick Nyai, the BAC Chairperson – Mr Opima Dan, Mr. Daniel Lukenge (AIC Public relations and Advocacy manager) and Mr. Bas Hoefman (Text to Change, Amsterdam). The Moderator of the show was Flexie.

## Results

Ten Thousand (10,000) MTN subscribers in Arua and West Nile were reached with HIV/AIDS messages. Two thousand one hundred (2, 100) people were directly involved in the HIV SMS quiz. The number of people accessing HCT services at the branch, other HCT sites in west Nile region and outreaches greatly increased during the project period. A total of 677 (376 Males and 301 Females) people accessed HCT at AIC Arua branch from 28th January – 28th February 2009. This was one of the highest numbers of people served in a space of one month as a result of the program and the various interventions employed. The total includes 131 Couples (262 individuals) and 102 individuals who presented the Text to change SMS text messages before accessing HCT services (Table 1). This is a 33% increase on the average n° of visitors.

**Table1:**

<b>Summary of results at a glance:</b>	
Subscribers reached With SMS messages:	10,000
No. involved in quiz:	2100
Number of people who accessed HCT:	677(M=376 F=301)
Number of couples served:	131 (262 Indiv)

Many prizes in form of airtime and mobile hand sets were given to the winners of the HIV quiz. The winners of mobile hand sets were invited for a prize giving ceremony on February 27, 2009 at AIC Arua branch premises. The function was attended by Arua branch staff, the Chairman Text to Change and Branch Manager who handed over the prizes. The event was witnessed by representatives from the local radio stations and BBC journalist Mr. Joshua Mali who interviewed the winners and members of AIC Arua post test club. Dialogue on HIV/ AIDS increased in Arua as those who received the quiz questions shared them with their relatives and friends. The complementary responses received emphasized the correct answers. The program has helped to remind people about HIV/AIDS and the need to know one's status. This was evidenced in the open discussion on the streets of Arua town and public gatherings as people reach for their mobile phones to retrieve the correct answers received and then share them with friends. The program helped reach more than ten thousand Ugandans with HIV/AIDS messages and inform them of where to access quality HCT services in the region including making services available to the hard to reach populations. Many scholars and other HIV/AIDS partners in the HIV/AIDS arena have applauded the innovative approach to the fight against HIV/AIDS after listening to the BBC program.

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*“This program has helped me and my family to know more about HIV/AIDS because each time I got the message, I called my children to help me read and translate the message in lugbara so that we get the correct answer and win prizes. I am happy that I managed to win air time worth ten thousand shillings and as well know my HIV status at Kuluva Hospital.” (A watch man at Kuluva hospital sharing testimony)*

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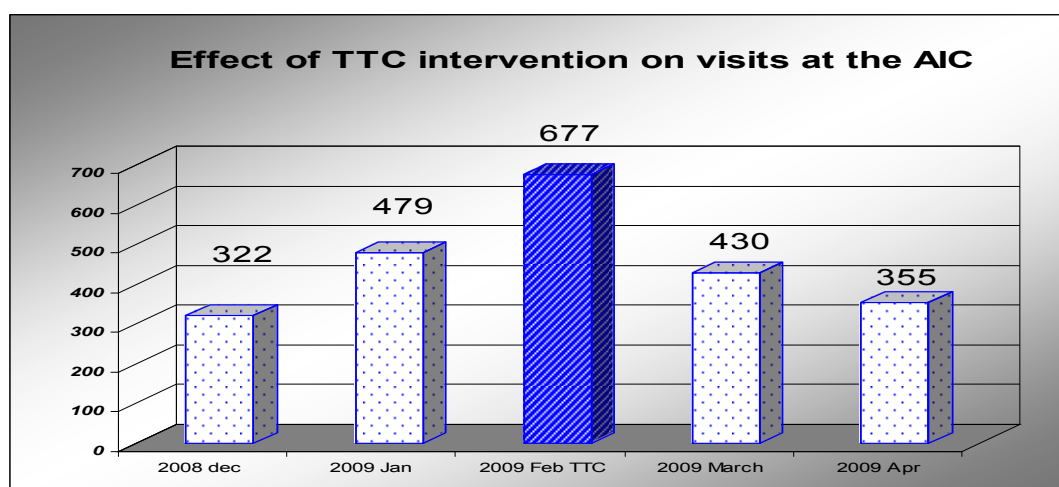
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### Pilot study in Mbarara 2008

From February 14th 2008 until April 8th 2008 there were 15,000 Zain mobile phone users targeted of the Greater Mbarara region. The duration of the program was 8 weeks.

There were 2610 (17,4%) people who responded on 1  $\geq$  sms question. Age was available for n=807/2610 (30.9%) respondents; mean age (95% CI) was 29.2 (28.5-29.8) years. Median age was 26.0 years. Of the n=801 respondents with known sex, n=567 (70.8%) were male and n= 234 (29.2%) were female. The response rate declined throughout the first phase of the quiz and subsequently stabilized. The least missing answers were given for question 3 (“HIV is not present in a) semen; b) sweat; or c) blood”), whereas question 11 (“Is the HIV test accurate?”) had the most missing answers. Correct answers for the question regarding

rapid testing were provided by n=317 (95.8% of respondents for this question); for the question on the 'window period' a correct answer was provided by n=142 (80.7% of respondents for this question). On the question whether other people would know their test result, 33,8% answered 'yes' (N=118), and on the question whether the test is accurate, 99,3% (N=138) answered no. At AIC Mbarara 255 individuals went for VCT through as a result of our program. Of those, 71.7% were male (N=183) and 28.3% were female (N=72). HIV prevalence among those who were tested through the TTC program is 7%, which is slightly higher than the prevalence rate of the South West region of Uganda (5.9%).

## Future

In collaboration with the UN's department of Economic and Social Affairs(UN-DESA) under the texting4health initiative, Text to Change will in July 2009 engage residents in Jinja District in a 10 day short health quiz using text messages which will serve as a public health information campaign, mainly-malaria, HIV/AIDS and Child health. The Text to Change objective of this short campaign is:

- 1 To draw attention to the potential of mHealth.
- 2 To create awareness and interest by demonstrating the possibilities to collect information in real time.
- 3 To show the ease of outreach to citizens with mobile phones.

The results of the demonstration will be shared with Ministers of UN member states at the Annual Ministerial review session of the UN Economic and Social Council (ECOSOC) in Geneva in July 2009.

Text to Change enjoys full support of the Ministry of Health, UN and WHO in Uganda as they see it as a very innovative initiative.

Health Initiatives for the Private Sector (HIPS) which is supported by United status Agency for internacional Development (USAID) is in the process of strengthening integration of medical male circumcision (MMC) and Multiple Sexual Partners (MSP) in the existing Behaviour Change Communication (BCC) approaches and interventions. In order to determine best mechanisms for the integration and be able to assess (BCC) results, it is necessary to establish current empirical evidence of levels of knowledge, direction of attitudes and levels of practices among the target audiences. As part of the efforts, HIPS will work with Text to Change to conduct the baseline among 300 male and female employees from three companies namely; Kakira Sugar Works in Jinja, Kinyara Sugar Works in Masindi and Kasese Cobalt Company Limited in Kasese. In order to supplement and confirm data from the SMS messages, 6 focus group discussions (FGDS) will be conducted by HIPS BCC staff and peer educators using available opportunities which include Health Fairs, Community video shows, men only seminars and peer educators trainings.

## Lessons learned

- The Text to Change program is feasible. Many people felt recognized after receiving invitation to take an HIV test on their phones.
- There is still high unmet demand for HCT.
- The uses of SMS/text messages help reach many at a relatively lower cost within a shorter time.
- The program helps to deliver messages without distortion and makes the fight against sexually transmitted diseases such as HIV/AIDS and other communicable diseases participatory and sustainable as text messages can be stored for a long time and referred to from time to time.
- The program has a long term effect of increasing knowledge about HIV, addressing myths, misconceptions and taboos surrounding HIV/AIDS and stimulating demand for HIV/AIDS services.
- The program needs to be complemented with other media approaches such as radio announcements, DJ mentions, posters, testimonies, Focus Group Discussions and experiences from those who have accessed services to realize its full potential. The persistent reminders of people through the text messages compel them to test.



**Recommendations**

- Adequate publicity needs to be done using the appropriate media approaches before and during the program. Due to limitation of resources, Spot messages were aired for one week only.
- Need to target all mobile networks.
- Develop and print IEC materials about the program in most of the local languages including the text messages.
- Adequate pre-testing of the messages needs to be done.



# **Annexes**



## Annex 1

### Armenia: Development of eHealth Master Plan

#### Background

Major progress in the field of Information and Communication Technologies (ICT), including wider availability of telecommunications, modern videoconferencing equipment, software developments and multiple Internet-based solutions, opens completely new opportunities in the provision of healthcare. That, together with a need to organize more effectively delivery of health services, in terms of time and distance, and to contain health care costs, resulted in recent decade in a sharp increase in the use of ICT applications in health care, collectively known as eHealth. "eHealth is the use, in the health sector, of digital data – transmitted, stored and retrieved electronically – in support of health care, both at the local site and at a distance." Major international structures (such as the United Nations, European Commission, World Health Organization, and International Telecommunications Union) have officially prioritized development and wider use of eHealth applications and services. E.g., the World Health Assembly's eHealth Resolution of 2005 (WHA58/28) underscored WHO's commitment to advancing eHealth and recommended to all member states "to consider drawing up a long-term strategic plan for developing and implementing eHealth services in the various areas of health sector".

The introduction of eHealth applications requires multidisciplinary collaboration, with active participation of ICT and healthcare professionals.

Armenia was one of the most industrialized republics of the former Soviet Union with a sophisticated high technology sector. Nowadays ICT domain is one of the most successful and fastest growing industries in Armenia. During the last 10 years, the ICT industry saw a sharp increase in the number of newly formed companies, both local start-ups and branches of foreign companies. More than 90% of the foreign companies were established in 1998-2008. The number of operating IT companies in 2008 reached 175 representing nearly 17% growth from 1998 to 2008. On average 17 IT businesses were launched annually in 2000-2008. This is in sharp contrast to 1990s when only 5 companies were formed each year. In 2008, Armenian ICT sector generated around \$111 million (\$38 million in 2003), which constitutes around 1.2% of GDP.

However, penetration of ICT applications in health care sector remains remarkably low, which reflects absence of national strategy and sustained policy in eHealth. The vast majority of country's 140 secondary care institutions and almost all primary care facilities do not have sustainable access to high-speed Internet, as well as other modern telecommunication routes. Even major multi-disciplinary tertiary care institutions in the capital of Armenia, city of Yerevan, are lacking necessary IT equipment and communications. Major eHealth tools, such as electronic Hospital Information Systems, Electronic Health Records, Picture Archiving and Communication Systems, e-prescription and e-referral, are not installed. Local web-based activities are as yet sporadic, so those health specialists (and lay public alike) regularly using on-line health related resources rely heavily on access to international health information portals.

eHealth Master Plan will allow coordinated efforts by all interested parties in developing and implementing mentioned eHealth applications in Armenia. That will ultimately benefit all interested parties:

- Patients (in terms of universal equitable access to quality care and cost reduction);
- Health care professionals (in terms of productivity, competencies);
- Community (in terms of public health efficiency and cost containment).

### The purpose of the project

It is to develop a long-term strategic plan for developing and implementing eHealth services in various areas of health sector (eHealth Master Plan). This will include the following aspects:

- Detailed analysis of the current state of healthcare sector in the country;
- Research of international experience in eHealth development;
- Define the role of telecommunication and information technologies in supporting healthcare;
- Find country specific aspects in health policies; define how eHealth will influence existing medical practice, education and research in Armenia;
- Social-economic evaluation of eHealth project for the country;
- Define national eHealth priorities, strategies and roadmaps for coming 5-10 years;
- Define relationship between national healthcare reforms and eHealth;
- Define eHealth services in the various areas of health sector. Propose list of possible eHealth services based on existing telecommunication infrastructure for main hospitals;
- Propose model structure of Hospital Information System (HIS);
- Determine provisional cost of the installation of eHealth infrastructure in one hospital as a model; draw eHealth business plan for one hospital as a model;
- Prepare budget for each stage of development;
- Define national strategy for eHealth – National Program for eHealth, example: “eHealth Foundation Armenia”;
- Define the stakeholders and those responsible and authorized for deployment of eHealth infrastructure and components;
- Find optimal balance between legislative measures, consensus based decisions and selection of pilot cases supported by believers;
- Propose structure of national telemedicine network;
- Propose network structure for the capital – Yerevan city;
- Propose list of eHealth services for the region;
- Define national standards for: Core data set, Demographic Data, Health profile, Insurance plans;
- Define national standards for: Authorization, Authentication, and Privacy;
- Define national standards for: minimal functional and data requirements of IT solutions for providers (hospitals, primary care doctors,...);
- Instead of revising current resource allocation to national institutions such as MOH, health insurance, medical universities and schools, consider creation of an agency (or institution) with relevant name like Electronic Health Center.

### Participants

#### *Armenian Association of Telemedicine (AATM):*

AATM is a non-governmental, non-profit organization founded in December 2008 having the *mission* to bring the health ICT field in Armenia to existing international standards, while at the same time participating in further evolution, expansion and progress in the field worldwide.

The *major goal of AATM* is to assist in increasing quality and accessibility of health care in Armenia via exploration, establishment and development of various health ICT applications and services in the local health care system.

#### *Main Objectives / Directions of Activities are the following:*

- Centralized coordination and support for Telemedicine and eHealth activities in Armenia;

- Cooperation between various institutions and Telemedicine services providers locally;
- Cooperation with major international associations, agencies and industry groups in the field;
- Development of educational activities and assisting in staff management;
- Cooperation with central and local governmental structures; working in legislature area;
- Expansion and further development of the Association.

***AATM has by now completed the following tasks:***

- Defined structure of the organization, general vision and strategy of development;
- Established contacts and developed agreement on partnership with leading local ICT structures and companies (UITE, Nork IAC, Microsoft RA, Synopsis, Sourcio, D-Link, Macadamian RA, among others);
- Established contacts with leading international structures in the field (World Health Organization, International Telecommunication Union, International Society for Telemedicine and eHealth, American Telemedicine Association, European Health Telematics Association, among others);
- Applied for and obtained status of National Member of ISfTeH from Armenia;
- Held consultations and established cooperation with leading specialists in the field related to forthcoming projects.

***Macadamian AR CJSC:***

Founded in 1997 “Macadamian Technologies” headquartering in Canada provides a complete range of user experience design and software development services to clients throughout North America, including Ottawa, Toronto, Montreal, Boston, Dallas and San Jose. In 2007, “Macadamian Technologies” opened a subsidiary called “Macadamian AR” in Armenia. Armenia branch has grown up to 35 people in one year, inheriting processes and expertises of the Canadian headquarter.

Macadamian has worked with a number of medical device and healthcare companies to develop the control and measurement software for mass spectrometers, build single-sign-on software for hospitals, and develop patient-nurse collaboration systems for remote healthcare. Some of our work has included:

- Designing and developing a web-based software application that controls and collects data from a [sleep monitoring device](#);
- Improving the instrumentation control system of a [mass spectrometer](#), using National Instruments’ LabVIEW instrumentation software;
- Designing a [telehealth application interface](#) easy enough for senior citizens to use;
- Conducting a usability requirements and re-design project for a simple, [mail-able DNA collection device](#).

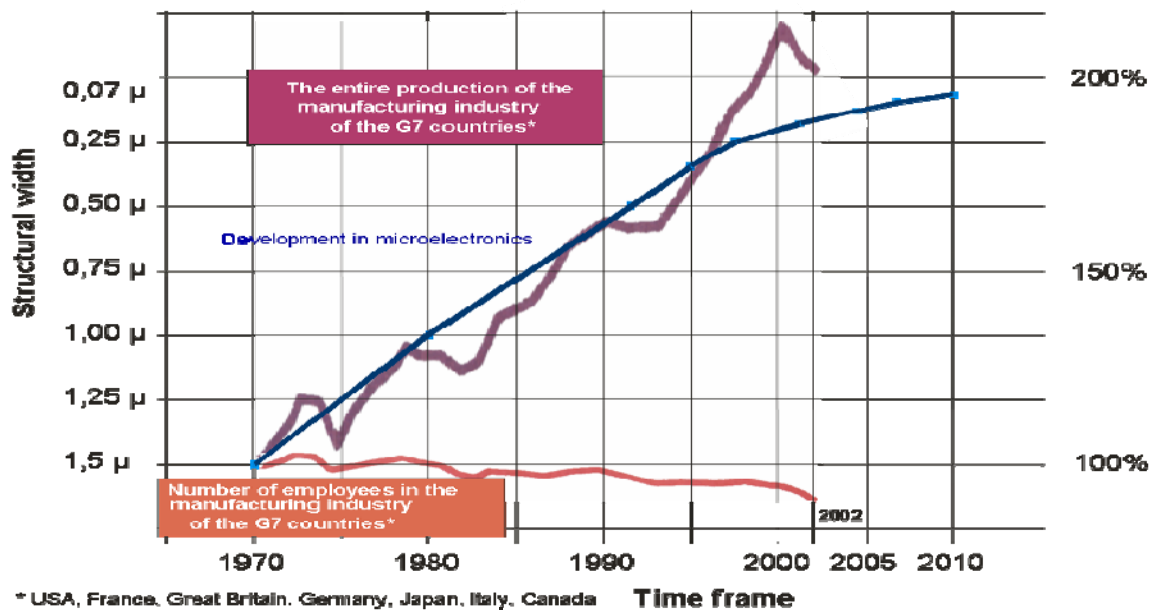
## Annex 2

## Germany: Ambient Medicine<sup>®</sup> – Telematic Medical Systems for Individualized and Personalized Assistance

*P. Friedrich<sup>1</sup>, J. Clauss<sup>2</sup>, A. Scholz<sup>3</sup>, B. Wolf<sup>1,4</sup>*

Mobility and information technology have become normal part of our lives and have emancipated the average citizen in the process. The best example is the pervasive use of the mobile phone. The areas of health care and consumer protection, however, are still lagging far behind as a survey conducted by the VDE (Association for Electrical, Electronic & Information Technologies) recently showed [1]. 77% of the German population stated that in their opinion much more needs to be done in medical technology. More than half said they were interested in telemedicine. Lying dormant in the clever combination of modern sensors and modern information and communication technologies, which have demonstrated enormous efficiency potential in the rest of the technical world, are also considerable cost savings and quality potential in the field of medicine. This relationship is shown in figure 1.

**Figure 1: Efficiency potential due to the development in microelectronics**



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<sup>2</sup> Sense Inside GmbH in Innovationszentrum Medizinische Elektronik, München.

<sup>3</sup> Sensor GmbH in Innovationszentrum Medizinische Elektronik, Kirchweidach.

<sup>4</sup> Zentralinstitut für Medizintechnik der Technischen Universität München (IMETUM) Germany, [friedrich@tum.de](mailto:friedrich@tum.de)



For this reason, a number of years ago we started to develop sensor-based strategies, which permit realization of individualized and personalized diagnosis and therapy concepts combined with telematically oriented data bases to complement our developments in medical sensor concepts [2,3,4]. If, for example, the high hopes placed in the health card will ever be fulfilled also depends on the proper anamnesis and protocoling of the respective, treating physician. In view of standard office procedures, it is doubtful if this will ever really be the case in doctors' practices because for various reasons billing data and treatment data do not have to be identical.

Moreover, it has been proven that measurements carried out by the patients themselves in their home or their work environment is essentially more authentic and provides more reliable data [5]. Individualized and personalized sensor-based diagnosis can provide realistic imaging of many symptoms and even be developed to such an extent that the patient can be helped directly via evidence-based and personalized data base structures. Already today medical care in rural regions is not immediately ensured at all times. Here telematic diagnosis and therapy systems can be of great assistance and can permit organizing more efficient treatment structures. In many cases, it suffices the patient to receive advice on how to behave based on acute data which will allow the patient to cope adequately with feeling unwell. This information can also be provided by health care providers which have the necessary patient data at disposal and, if need be, can have a long-term care relationship with the patient.

The most important criteria for acute unwellness are immediate access to medical knowledge and the corresponding advice. In order for the physician who is not on site to be able to judge the situation, he needs reliable basic data, such as for example heart rate, blood pressure, temperature, weight or metabolic values such as for example glucose and, if need be, seeing the patient. It also makes economic sense to use sensor-based telematic systems to allow the continuously aging population to age "healthily" [6]. The systems can ensure regular intake of medication or on a need-by-need basis as well as concrete changes in behavior.

In the following, the results from many years of working on developing such systems are described including the possible risks linked with their use and first attempts at telematic therapy concepts.

### **General Observations on Telemonitoring**

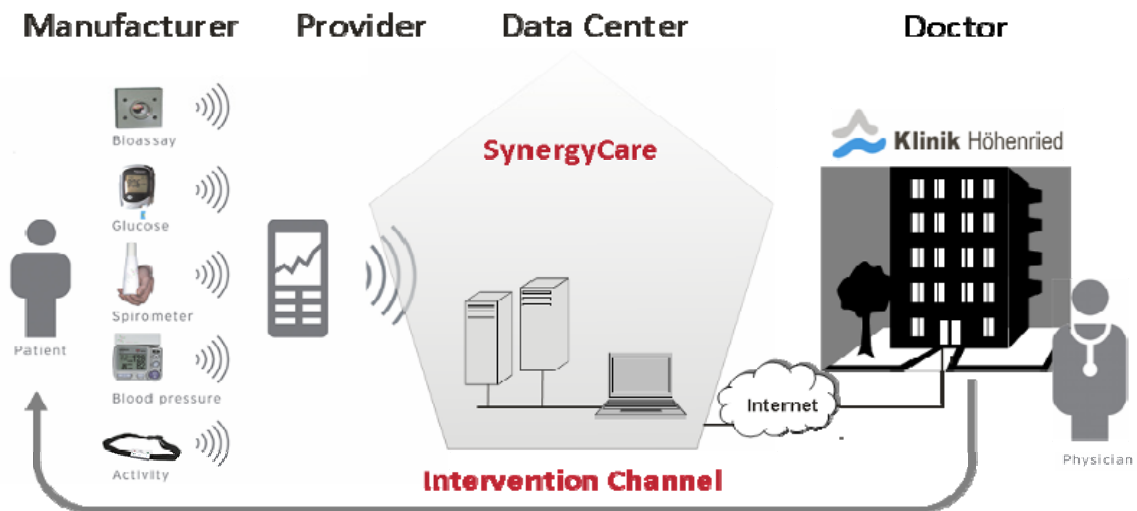
Telemonitoring or home monitoring is a modern component of the care of chronically ill patients which takes into account the entire treatment of the patient from prevention to diagnosis and therapy to rehabilitation. The fundamental idea is to bridge the spatial gap between the patient and the treating doctor for a certain period to prevent a care gap from occurring. This care concept should not be confined only to the chronically ill, but also presents an ideal aid for all health-conscious people, especially for the aging population.

At the beginning, such a system was intended for extreme situations in which patients or the to-be-observed person, for example members of an exhibition or military staff located at some distance from any medical institution. Meanwhile, this is the case for many parts of the population simply due to the increasing sparsity of doctors in many regions of Germany. The purpose of such telematic medical systems is to record using sensor-based aids the health-relevant data about the condition of a person under observation and to transmit this data to a counterpart, where specialists study it.

With time the single specific solutions became a complete platform, the telemetric personal health monitoring system. Its setup is shown in figure 2. The name "TPHM" came from, on the one hand, from personalization of medical devices, and, on the other hand, from telemetric transmission of medical relevant parameters.

Due to technical developments and the consequent cost reduction in manufacturing small and thus mobile medical measuring devices, for some years it has been possible to also take up a large number of patients with a variety of ailments in a telemonitoring system. One such "target" group may be patients who need to consult a doctor frequently just to determine a physiological parameter, such as for example blood pressure or blood sugar concentration.

**Figure 2: The Ambient Medicine® platform with the data base connection SynergyCare**



Telemedical technology is used as a central component that combined with easily accessible and widespread communication networks permits providing care for patients mobility – i.e. independent of where they are. The patients measure their indication-based values regularly themselves to obtain information about their momentary condition. Upon request or if treatment is necessary, this information can automatically be conveyed to the treating doctor.

This type of time and place independent treatment corresponds to the increasing trend toward mobility and pressure to reduce costs in health care. Implementing a telemonitoring system allows realization of not only financial but also medical advantages for the patient. Continuous observation of the patient permits detecting changes in disease dynamics quicker and, in particular, detecting deterioration early and in the best case ward it off. In many cases, a patient's quality of life is improved.

The sensor-based telematic solutions described here are an extension of the TPHM system with technical devices. Here, telemedical care is based on integration of a mobile phone as an interface between the patient's measuring device and the treating doctor's server. Owing to the omnipresence of mobile phones in general today and to those with bluetooth technology in particular, the user usually does not need to purchase additional devices. The respective medical devices have been extended by a bluetooth-transmission and reception module or if need be one newly developed by us. An essential feature is simple operation of the measuring devices and the mobile phones. Our solutions require no action on the patient's part to transmit the measured data. Transmission via email or data SMS by the mobile phone is triggered automatically after successful measurement.

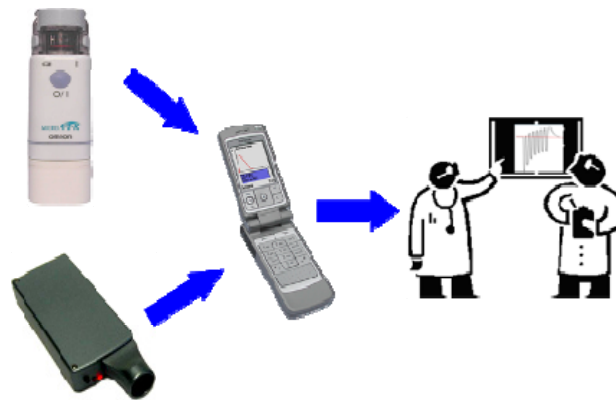
## **Examples of Realized Electronic Assistance Systems for Selected Indications**

### ***Respiratory Disorders***

Chronic respiratory disorders are among the most widespread common disorders. The most frequent indications are asthma and chronic obstructive pulmonary disease (COPD) and strike approximately 150 million people, tendency rising. Observation, respectively monitoring afflicted patients is a decisive factor in medical treatment. The well-being of a patient relating to his/her respiratory disorder is determined by a spirometer which measures the lung-function values. However, to assess the course of the treatment requires protocolling additional therapeutic measures. The time point of medicine intake, of pollen warnings in various regions and the outdoor weather conditions may decisively influence the success of a treatment. The relationship between weather conditions and the frequency of asthma attacks and allergy attacks has been

proven in a scientific study [7]. Home Monitoring which enables observing a patient in his daily surroundings has attracted much attention. These systems must be comfortable and easy to use, in addition small and handy [8]. For this purpose, we developed the first telemedical spirometer for measuring lung function parameters and extended it into a mobile, patient-based diagnostic and therapy system [9]. A conventional spirometer equipped with a bluetooth communication unit automatically transmits the values determined by the peak-flow measurement to a corresponding mobile phone which then conveys the data to the central data base. In order to make best possible medical use, the spirometer is combined with an inhaler, figure 3. Thus lung-function values and medication intake are documented and observed simultaneously. These data permit drawing conclusions on the effectiveness and the dosage of the given medication and responding with immediate corrective measures. Such a medical assistance system can also be used to observe patient compliance. As a result of this feedback, the mobile measuring devices are also at disposal for individualized motivation and training measures, promoting in this way active patient involvement in the therapy process and thus increasing patient responsibility.

**Figure 3: Combination of spirometer and inhaler**



### ***Cardiovascular Diseases***

Half of all deaths in Germany are caused by cardiovascular disorders. One of the main risk factors of cardiovascular diseases is arterial hypertension. About 40% of the German population has high blood pressure. Compared to the role that high blood pressure plays in causing fatal “heart attacks”, the extent it finds treatment in Germany is still negligible. Moreover, single blood-pressure measurements do not always provide reliable information: blood pressure is subject to natural fluctuations during the course of the day. Physical examinations in the doctor's office or in the hospital may falsify results, because stress causes the blood pressure to raise – a phenomenon known as the “white-coat effect”. An effective way to avoid this effect is regular self-measurement of the blood pressure using a system like the one shown in figure 4. To record the measured values, we use conventional blood-pressure-measuring devices. These measuring devices are equipped with a bluetooth interface via which the detected blood-pressure values are transmitted to an allocated mobile phone. Software is installed on this mobile phone which packages the received measured values in an email and stores them in a mail server. From there, the measured values can be retrieved at any time and further processed. This occurs via a data base which provides statistical processing in addition to graphic representation.

**Figure 4: Telemedical, mobile blood-pressure-measuring system of the Heinz Nixdorf-Lehrstuhl für Medizinische Elektronik in cooperation with Sendor GmbH**



In such a personalized therapy, patient compliance is much better than is the case with conventional methods of treatment. Apart from the growing frequency of hypertension, there are an increasing number of other diseases among them diabetes mellitus or adiposity that demand reliable and intensive care. If these three disorders occur in combination with a fat metabolism disorder, it is called a metabolic syndrome, which increases the risk of cardiovascular disease further. The Ambient Medicine® platform developed by us offers an ideal basis for monitoring the parameters linked with these diseases. Consequently, we extended it with devices such as weighing scales, blood-sugar and ECG measuring devices for such telemetric use. Figure 5 shows as an example the ECG open.

**Figure 5: Mobile ECG measuring device open of the Telmed Medizintechnik GmbH [10]**



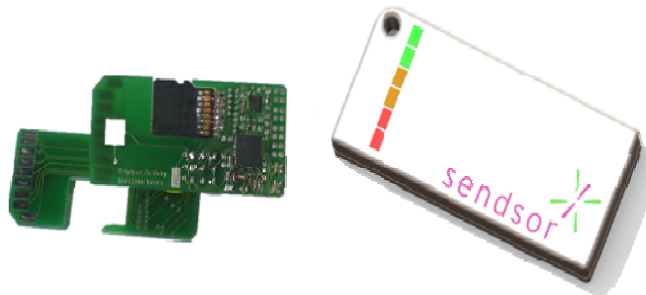
### Activity Monitoring

In most cases of feeling unwell and the previously mentioned typical symptoms, suited moderate corporal activity plays a significant role in recovery. Consequently, recording patient-specific physical activity data is gaining in importance. Defined training programs can help patients reach their goals. An activity monitor for self-monitoring may be helpful. A high-resolution activity sensor worn by a patient on a key chain, on a chain around the neck or as a band around the arm or leg measures the continuous acceleration and/or the inclined profile of a patient. The data are sent (e.g. one a day, incident-based) to a medical center. The activity values are compared there with other disease-relevant values. The activity sensor comprises a three-

dimensional acceleration sensor, an internal storage (microSD card) for the gathered data, a battery for portable use, a display to allow self-monitoring and a SD-card-compatible interface for simple, convenient readout of the data on a PC by the physician, figure 6. In addition to this, in the device software is installed, which upon insertion of the device into the card reader (SD-card-compatible interface of the device) starts automatically, evaluates the stored physical activity profile of the patient on the PC and shows it at a glance. This simplifies analysis and how to proceed in the therapy for the physician. Activity monitoring should be a component in overall home therapy. It makes no difference whether the data are transmitted telemedically via a “telemetric personal health monitoring system” or whether the physician reads the data from the activity monitor whenever the patient comes to the office.

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**Figure 6: Miniaturized activity sensor for a vest pocket developed by Sendor GmbH**




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The overall system is a small desktop station or a portable handset. It can also gather process and transmit additional data, for example, from a spirometer or a blood-pressure measuring device. The station's complete set of parameters is written on the memory card of the activity monitor and is immediately transmitted to the treating physician via available telecommunication channels permitting subsequent evaluation of the data as well as immediate intervention by the physician. Furthermore, the patient is advised to keep a diary to compare the measured values online or later with the current state.

### ***Virtual Lab***

The virtual telemedical laboratory presented here, also called virtual lab, and offers a solution that meets the requirements of both the increased mobility of a patient and of the medical staff as well as the increasing expectations of ubiquitous and best possible prevention and therapy. Set up and operation correspond to the previously expounded principles.

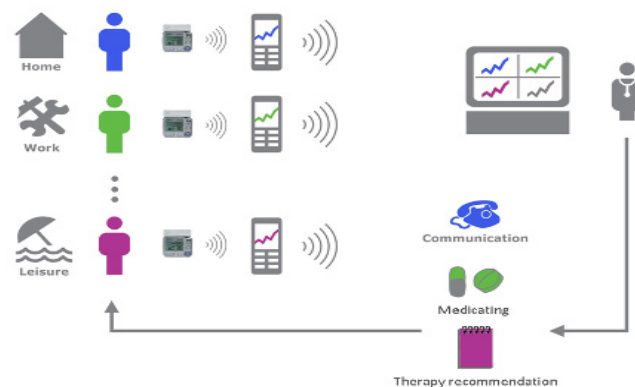
Particularly in the case of diseases with a patient-specific cause or patient-influenced diseases it is indispensable to obtain as authentic as possible parameters that record both the current situation in the patient's routine day as well as document the course of a disease over a longer period of time. This means that the patient measures himself in his accustomed surroundings. He can do this at home, at the work, on the way or anywhere and everywhere a current, individual vital parameter is always being recorded. A further advantage, apart from being location-independent, the patient can measure at own-selected times or at times prescribed by medical specialists. Automatic transmission of the measured values to a data base ensures uninterrupted recording, which is indispensable for individual and personalized therapy. Besides being able to determine just the course of the measured values, which alone already document improvement or deterioration of the patient's health, highly individual conditions can be detected.

### ***Data base***

A data base accessible via the internet at any time for respective authentication was implemented to store data independent of place and doctor. Both the patient and medical staff can enter this data base as registered

users with certain user rights and read these self-measured and graphically processed values on a display. For patients, it offers active involvement in the course of their disease or therapy, for doctors it offers simple and inexpensive support in their intensive care of their numerous patients. Depending on the indications, patient-specific borderline values that can be set and if exceeded or fallen below trigger definable actions such as calling or informing the patient or the doctor. In a next step, the data base is extended to an evidence-based specialist system, which can give in consultation with the doctor medication or therapy advices. Figure 7 shows the already realized virtual lab.

**Figure 7: Overview of the virtual lab system from the Heinz Nixdorf – Lehrstuhl für Medizinische Elektronik of the Technical University Munich**



### ***Feedback and Intervention***

Medical assistance systems are of great significance in particular in long-term monitoring both in primary and in secondary prevention. In order to prevent artefacts, measurements should be carried out regularly in the accustomed surroundings. Ideally, the patient measures, for example, his/her blood pressure at home, at work or on the way. However, timely “feedback” is a necessity for reliable, self-determined handling of the self-measured data by the patient. Only then, does the patient receive the required certainty for action and decisions, respectively a virtual therapy guided by the treating doctor are possible. Via the mobile phone, the feedback system becomes a closed circuit. In addition to the measured values and other text information, audio and image data can also be sent to the doctor over this bidirectional link between doctor and patient. Thus, data is not just transmitted from the patient to the data base, respectively to the treating doctor, but rather medical staff, respectively a system of specialists behind the data base, can influence the course of the therapy directly over an intervention path and individualize it. This principle is shown in figures 2 and 7.

Non-medicative therapies, for example acoustic biofeedback including circadian or gender-specific influences can be examined for the influence of blood pressure respectively the course of the therapy. In all these applications, the virtual laboratory permits obtaining authentic vital parameters in real time.

The telematic sensor-based therapy concept in dentistry realized in collaboration with Sense inside GmbH described in the following combines the requirements of individuality and feedback. For the first time, a real therapy is possible with this individualized and personalized assistance system.

### ***Bruxism***

Teeth-grinding or teeth-pressing, referred to as bruxism, is the source of enormous suffering for 8.2% of the adult German population. The consequences of teeth-grinding range from enormous muscle tension accompanied by headaches to major damage to the teeth and the jaw joints. Up to now bruxism patients were given a retainer to protect their teeth and jaw joints although it was difficult to determine which patients needed which treatment and when or whether the treatment was actually successful.

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**Figure 8: The SensoBite System for measuring jaw forces, [www.senseinside.com](http://www.senseinside.com)**




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The symptoms of bruxism are tense facial muscles, muscle pain and headaches. In an advanced stage, the chewing muscles grow together the crowns of the teeth are ground down. Tension of the neck muscles extending down the entire back and even tinnitus may be the consequence. In addition to this, the partner's sleep is also often considerably disturbed. Early diagnosis and fighting the causes should stand in the foreground of treatment and not treating the resulting symptoms. The SensoBite Systems showed in figure 8 makes this possible by combining analyses of the grinding behavior with a biofeedback system. The SensoBite System developed by us permits comfortable, reliable measurement of the jaw forces (clamping down forces and times). The system supports bruxism patients with effective and cause-based healing of the disorder with precise diagnosis and individually adapted therapy. Such an aid contributes actively to adaptation of therapies to the individual and to developing new therapies. By being able for the first time to check the individual effectiveness of known therapies, the system is also of great use for clinical research. The SensorBite System comprises measuring electronics and transmission electronics, a receiver, which is located outside the body, and software for data analysis. The miniaturized, flexible sensor electronics measure the pressing forces on the retainer and can be placed in a conventional retainer. The data are transmitted wirelessly from the body via an integrated radio transmitter and in real time. Included is a receiver, which records the data, transmitted from the mouth. Having the size of a matchbox, it fits easily in the patient's trouser pocket. In addition, the receiver offers a biofeedback function via a vibration alarm to inform the patient when bruxism occurs. With the software, the treating doctor, respectively the patient can graphically display and analyze the recorded Bruxism events. In this manner, diagnosis as well as observation of the course is possible in the patient's customary home environment without influencing the quality of the patient's sleep or thus the measuring result. Worn day and night, the system records all bruxism events and using the obtained data, seeks and evaluates the best form of retainer and of therapy for the patient. Bruxism analysis has up to now been inadequately possible as it is either dependent on the subjective perception of the patient or long-term changing symptoms such as abrasion and muscle pain. SensoBite System makes it possible to detect a change in grinding behavior after just a few nights allowing to check the success of the selected therapy immediately and, if necessary, adapt it accordingly without having to wait six to eight weeks for the results.

### ***Biofeedback (Therapy)***

The SensoBite Biofeedback offers effective, novel support for curing the cause of bruxism. A small device that informs the patient during the day by means of biofeedback (vibration) that tension is manifest can effectively mitigate the tension without any negative effect on the patient's quality of life. Informed about the tension in the jaw region, the patient can find relief by means of special relaxation [11, 12]. The SensoBite-Biofeedback System enables patients to fight manifest bruxism effectively during the day. In this way, they are able to contribute to clarifying peculiarities and to contribute to a useful therapy.

### **Prospects**

As the retainer is well-suited as a trial instrument for implantations, it follows to utilize the obtained know-how and information for intelligent implantations, which due to increasing miniaturization are gaining in significance for solving complicated medical problems. We are presently doing research on a system platform with the help of which sensor data can be transmitted wirelessly from implanted systems in the patient's body. First results from a research project for monitoring osteoneogenesis (curing bone disease) are very promising.

### **Conclusions**

Linking electronic media and systems with medical sensors opens the path for individualized and personalized telematic medicine. Like in the environment of other specialist systems, individual medical data can be collected with data of superordinate data bases to provide, when needed, personalized information. This is particularly helpful in an aging, mobile society which in future will face decreasing doctor density and which already is dependent on the presence of such systems especially in the rural areas. People's self-determination regarding information, largely realized in other realms of their lives is now extended to the area of medical information and permits, in addition to a healthier lifestyle, greater mobility in old age. Various systems and concepts for diagnostic and therapeutic medical assistance in the areas of asthma, chronic obstructive lung disorders (COPD), cardiovascular disorders and bruxism are described as examples.

### **Acknowledgement**

We are deeply indebted to the Heinz Nixdorf Foundation, Synergy Systems, the Klinik Höhenried and T-Mobile for their generous support. Ambient Medicine® is a registered trademark belonging to the Heinz Nixdorf – Lehrstuhl für Medizinische Elektronik of the Technische Universität München.

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### Annex 3

## Italy: Deaths on Board Ships Assisted by Centro Internazionale Radio Medico (CIRM), The Italian Telemedical Maritime Assistance Service (TMAS) from 1984 To 2006

*I. Grappasonni<sup>1</sup>, A. Di Donna<sup>2</sup>, C. Pascucci<sup>1</sup>, F. Petrelli<sup>1</sup>, F. Sibilio<sup>1</sup> and F. Amenta<sup>1,2\*</sup>*

### Introduction

The majority of people on board ships are in a disadvantaged situation in comparison with ashore-living people which, if necessary, may have medical services available within a short time. Only a few ships carry a doctor or adequately trained paramedic personnel on board and the majority of vessels are at sea for days or weeks before they can reach a port. Hence, the most reliable possibility of treating diseases or accidents on board is to provide medical advice via telecommunication systems. At the present, several organizations world-wide give medical assistance to ships without a doctor on board [1, 2].

The Italian experience in the field of medical advice to ships started on April 1935, with the activity of Centro Internazionale Radio Medico (CIRM). CIRM was established with the purpose of providing free medical assistance to ships without a doctor on board of any nationality and navigating on all seas of the world [1,2]. CIRM, recognized by the Italian government as the national Telemedical Maritime Assistance Service (TMAS) has assisted more than 60,000 patients, mainly on board ships, being the organization with probably the largest experience in the world in the field of maritime telemedicine. CIRM medical assistance is provided in Italian or English for 24 hours a day. The doctor on duty receives the request of assistance and gives instructions for the case, establishing the dates of appointments according to the gravity of diseases under treatment.

Seafaring represents a hazardous occupation when compared with shore-based activities and seafarers may be exposed to risks rarely encountered by workers in other occupations. Unfortunately only sparse epidemiological data are available on the reasons for the death of seamen during their career [4,7,10,11,13,14]. The present study has analyzed causes of deaths on board ships assisted by CIRM from 1984 to 2006.

### Epidemiological analysis

Retrospective analysis embraced all deaths among seafarers assisted by CIRM between 1st January 1984 to 31st December 2006. For each patient assisted, a digitalized medical file is established and updated following every contact with the ship. These files did establish the basis for the present study.

Analysis was made by reviewing 21,869 files of patients assisted by CIRM during the time chosen. Files of cases in which patient death occurred were extrapolated and analyzed. Presumptive diagnosis of CIRM physicians was classified according to the International Classification of Diseases (ICD)-10 [6]. The ICD is the international standard diagnostic classification for all general epidemiological, health management purposes and clinical use. When possible, causes of deaths were referred to the age of individuals, their rank on board, to the circumstances and to the number of crew members in the ship where it occurred.

Death data were then analyzed statistically by assessing cause and specific mortality rates.

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## Results

As mentioned above, during the period considered CIRM has assisted 21,869 patients on board ships. Figure 1 summarizes the total number of patients assisted by CIRM in the 22 years considered. As shown, compared with the past, the number of patients assisted by the Centre is increasing significantly in the last 4 years. The increase in maritime traffic worldwide, the improvement of telecommunication systems allowing an easier contact in case of diseases or accidents on board and the augmented sensitivity to health protection in seafarers is the most probable reasons for the increase in medical assistance cases recently observed. Deaths occurred were 339 (1.55%). Excluding fatalities involving passengers or other transported people, deaths were 300 (1.37%). Specific causes of deaths are summarized in Table I.

**Table I – Causes of deaths among patients assisted by CIRM in 1984-2006**

Cause	Deaths total		Deaths excluding transported people	
	No.	%	No.	%
Diseases of the circulatory system (I00-I99)				
– Ischaemic heart diseases (I20-I25)	138	40.7	116	38.7
– Hypertensive diseases (I10-I15)	6	1.8	5	1.7
– Cerebrovascular diseases (I60-I69)	5	1.5	5	1.7
Diseases of the respiratory system (J00-J99)	11	3.2	9	3.0
Mental and behavioural disorders due to psychoactive substance use (F10-F19)	12	3.5	11	3.7
Certain infectious and parasitic diseases (A00-B99)	17	5.0	17	5.7
Endocrine, nutritional and metabolic diseases (E00-E90)	6	1.8	5	1.7
External causes of morbidity and mortality (V01-Y98)				
Accidental poisoning by and exposure to noxious substances (X40-X49)	12	3.5	12	4.0
Water transport accidents (V90-V94)	2	0.6	2	0.8
Exposure to electric current, radiation and extreme ambient air temperature and pressure (W85-W99)	14	4.1	14	4.8
Falls (W00-X19)	18	5.3	18	6.0
Other external causes of accidental injury (W00-X59)	25	7.8	25	8.3
Burns and corrosions (T20-T32)	4	1.2	4	1.3
Intentional self-harm (X60-X84) / Assault (X85-Y09)	7	2.1	6	2.0
Other	38	11.2	27	9.0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	24	7.9	24	8.0
<b>TOTAL</b>	<b>339</b>	<b>100</b>	<b>300</b>	<b>100</b>

Sequence of the distribution of causes of death showed that cardiovascular diseases were on the first place, followed by accidents and violence, infectious and parasitic diseases, alcohol and drug addiction and respiratory system diseases. In approximately 8% of cases, cause of death was not established. Pathologies affecting cardiovascular system were the most represented among either crew-members and other transported people (passengers, stowaways...).

Analysis of causes of deaths per different ranks of seafarers is summarized in Figure 2. Deck crews were the manpower with the highest rate of mortality. This is probably due to the larger number of deck crews on board compared to other workers. In deck crews the main cause of losses was represented by cardiovascular diseases, followed by external causes of death (poisoning, accidents, exposure to electric current, burns and corrosions...).

Figure 1: Total number of patients assisted by C.I.R.M. from 1984 to 2006

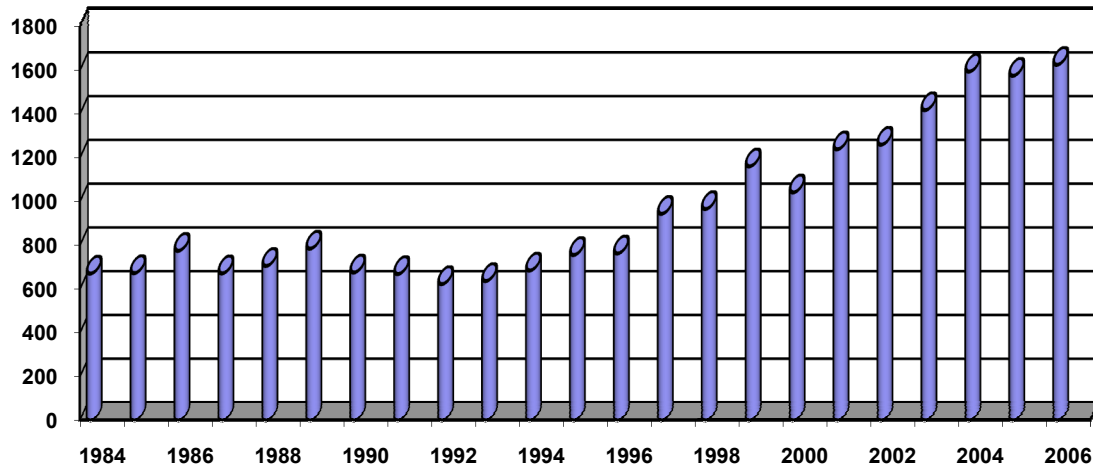
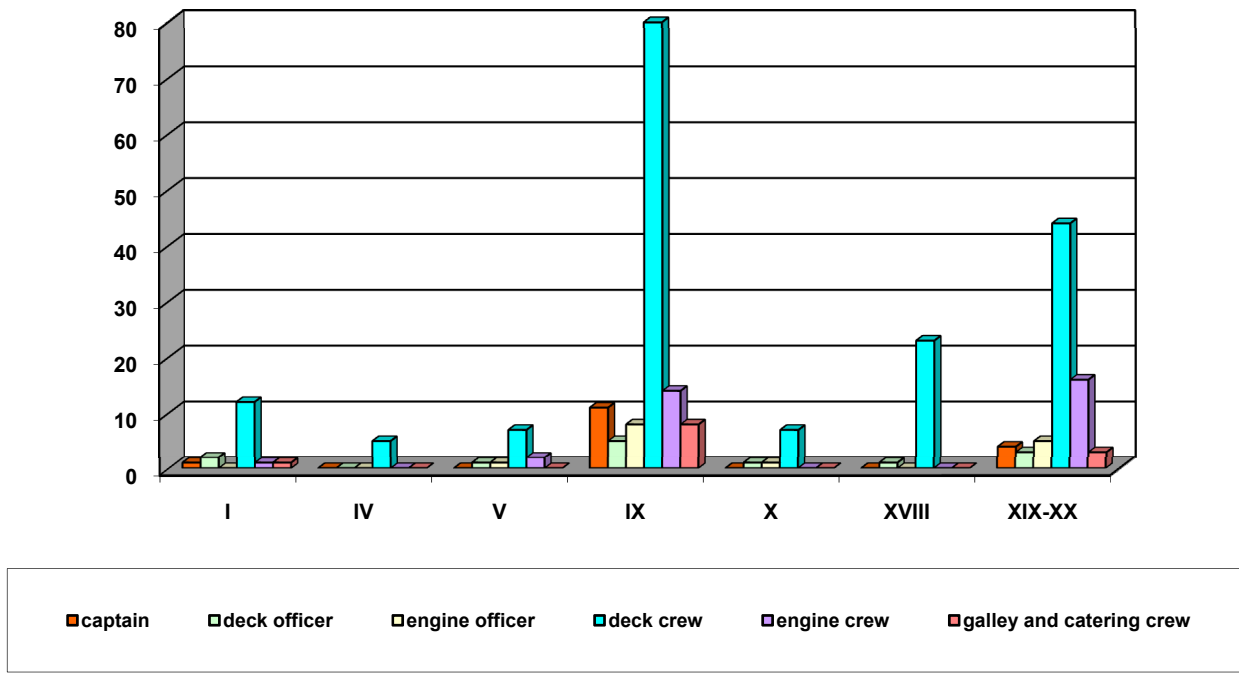


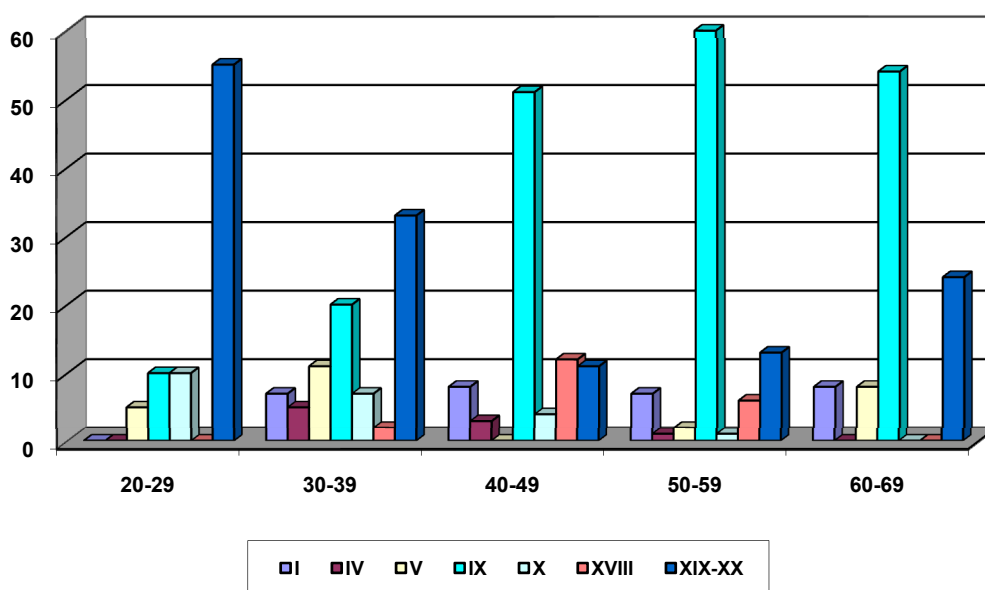
Figure 2: Deaths on board ships assisted by C.I.R.M. from 1984 to 2006 divided per rank of the crew members and per (ICD)-10 [6] class



(I-infectious diseases; IV-endocrine, nutritional and metabolic diseases; V-Mental and behavioural disorders; IX-Diseases of the circulatory system; X-Diseases of the respiratory system; XVIII-Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified; XIX-XX- Injury, poisoning and certain other consequences of external causes-External causes of morbidity and mortality).

Evaluation of death cases by class of age revealed that deaths due to injuries decreased with age, whereas those caused by diseases of the circulatory system did increase (Figure 3). Manpower losses for injuries and accidents affected to greater extent youngest crew members aged between 20 and 29 years (Figure 3). Losses for cardiovascular diseases were on the first place as causes of deaths in the age groups between 40 to 69 years, with a peak in people aged 50-59 years (Figure 3).

**Figure 3: Deaths on board ships assisted by C.I.R.M. from 1984 to 2006 divided per age and per (ICD)-10 [6] class**



## Discussion

Deaths in shipping are in general not registered with the local registrars of deaths, and are not considered in routine national mortality statistics. These losses are included in separated registrars depending on the flag of the ship or on the country of the port where the corpse landed. The present investigation is the first study on the causes of death on board ships obtained from data of a maritime telemedical centre. Our analysis therefore derives not from a post event evaluation of mortality reports, but from actual data of the reasons for mortality when patients were still alive or immediately after the event. In spite of the limits in assessing causes of death from a remote physician and without patient's direct examination, this kind of evaluation has the advantage of being undertaken very close to the moment of death and therefore may be relevant for the identification of situations of high risk of death for seafarers and for establishing possible prevention measures.

Among the causes of deaths, diseases of the circulatory system were at the first place, followed by the so-called external causes. Comparative analysis of our data with those of recent studies on causes of deaths on board ships [4,7,-14] confirmed that cardiovascular causes represent indeed the first cause of mortality in sailing seafarers. These most recent data are not consistent with the view dominant around the last quarter of past century that cardiac and cardiovascular disorders were less prevalent in seamen compared to populations on the land [3]. The less favourable age structure among seafarers at the present, the lack of adequate prevention measures and of technical facilities (e.g. systems for transmitting via telecommunication systems basic cardiovascular and blood chemistry parameters) are the most probable cause of the increased risk of mortality for cardiovascular causes reported by the majority of recent investigations on the topic [4,7,10,13].

The prevalence of cardiovascular diseases as cause of deaths on board ships deserves particular attention for developing preventive measures including intensive campaigns for adequate lifestyles and the availability on ships of digital electrocardiographs and automated external defibrillators. These may have a real utility for diagnostic purposes, resuscitation as well as for verification of death.

Accidents represented the second cause of deaths among seafarers assisted by CIRM. Different from other reports [1,2,6], the percentage of manpower losses due to external causes was less than the 25% of total deaths. The observation that the majority of deaths affected deck crews is probably related to the greater number of these workers compared to others. An interesting finding in terms of epidemiological analysis is the observation that deaths referable to accidents affected to the greatest extent younger people. It is largely reported that injuries occur most often in young seamen probably due to their lack of enough experience and to a yet limited adaptation to the life and work on board [3]. The fact that the youngest age group is mainly affected by external causes of mortality indicates the need of more adequate training of seafarers of this class of age as a main preventive measure.

To sum-up, cardiovascular and external causes represented the main reasons of deaths among seafarers assisted by CIRM in the last 22 years. These main causes of mortality may be sensitive to preventive measures, which would be appropriate to increase for augmenting standards of human life safeguard at sea.

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## Annex 4

### Japanese Telemedical Concept of Ambulatory Application

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#### Objectives

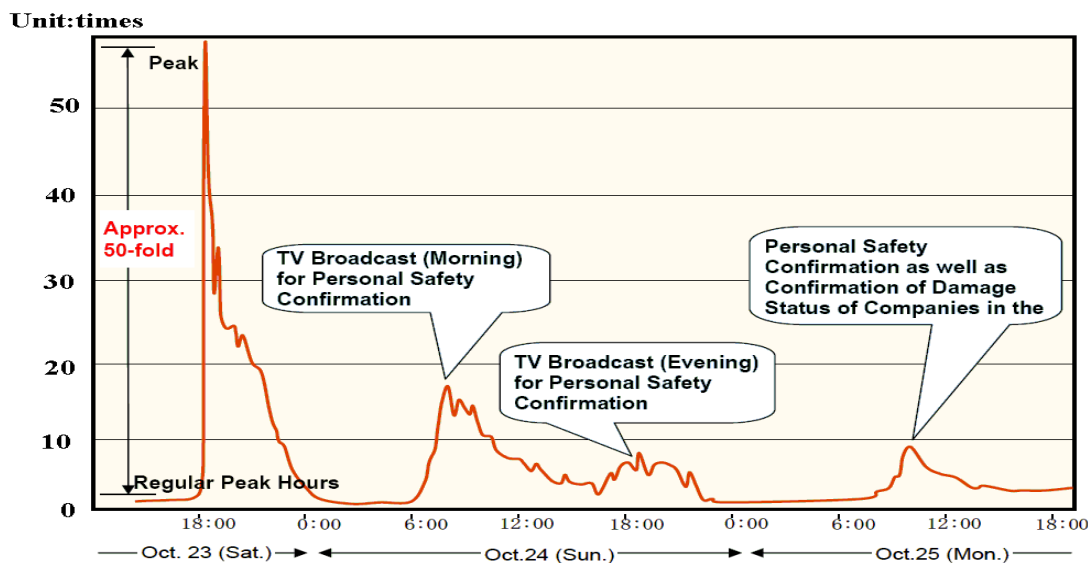
Transmission of in-ambulance data without inconveniencing or undue effort on the part of the rescue crew – in other words, automation of in-ambulance activities (measurement/analysis, activity recording, message transmission) – is essential in implementing uniform medical control standards across the nation. One of key elements for this automation is communications technology (CT). Its development is a must for emergency transportation for the near-future. Currently, no country has succeeded in supporting patients through CT on board ambulances. As an ER doctor, I strongly believe the need to do so will grow in the near future. This paper describes our basic concept of CT to support ambulatory application.

#### Technical Communication Background

##### *What is CT?*

The purpose of in-ambulance CT is to improve emergency rescue quality by transmitting patient data and ambulance GPS data to the triage center automatically, with no inconvenience to or undue effort by the crew. Ideally, CT would connect the patient monitor online with TCP/IP and record crew activities automatically and electronically. In reality, time standards for the ambulance clock, cardiograph, and communication devices are not synchronized in Japan, and rescue crews must match these manually every morning. Synchronizing these devices would be a simple matter if the devices were linked via TCP/IP connections.

**Figure 1: Calls to Niigata over the public phone network during the Niigata Earthquake from nationwide. October 2004, over 50 times higher than normal**



reported by NTT East Co.  
[http://www.aptscc.org/meetings/2005/apg07-2/APT\\_ITU\\_DIS2005\(10\)NTTE-1.pdf](http://www.aptscc.org/meetings/2005/apg07-2/APT_ITU_DIS2005(10)NTTE-1.pdf)

### ***The third Generation (3G)-Mobile phone***

Some believe communications with moving ambulances should be based on the 3G mobile phone network. Is this correct? Is the 3G mobile phone network good enough to ensure multi-path high-speed transmission from fast-moving ambulances? The answer is no, even in Japan, where a 3G network is established nationwide.

#### *Multi-path communication:*

This technology is not yet established. If the base station antenna is located very close to the mobile terminal and communication occurs in line-of-sight mode (Nakagami-Rice fading), communications will be reliable and stable and throughput close to nominal values. But in non-line-of-sight mode (Rayleigh fading), communication is not reliable under multi-path conditions, resulting in inadequate throughput. Maintaining a 384kbps connection rate (the FOMA uplink standard) during transmission from a moving car is quite difficult. None of the various studies involving transmissions from ambulances using the 3G network have led to introduction of a practical system.

#### *Service area problems:*

The number of base stations for the NTT DoCoMo 3G FOMA Service is now at around 3,200 in the Kanto-Koshinetsu area and 10,700 across the nation, with service areas expanding. The population coverage is about 98% nationwide as of the end of December 2007. This coverage, however, counts all city/village citizens when their local administration office exists in a service area. Undoubtedly, this approach counts mountainous areas and remote islands that are actually located outside service areas. Since mobile phone carriers follow profit-oriented market dynamics with the cream-skimming policy (shedding unprofitable areas), they will not invest money to construct base stations in these areas. Even with the advent of the 4G network, they will likely focus on urban areas while shortchanging rural populations.

### ***Public wireless LANs***

Are public wireless LANs useful? Wireless LANs are already in service at railway stations, airports, and main streets. If this system is deployed everywhere, broadband communications will be possible for public rescue vehicles such as patrol cars and ambulances. In an experiment, a Gifu (Japan) national road was equipped with a wireless LAN (Route-make terminals) by the Takayama National Road Office of the Land and Transportation Ministry. Since this assumes line-of-sight communications, transponders connected to NTT networks must be placed at every 0.5 to 1.0 km. Adopting this system for roads across the nation would involve exorbitant cost and infrastructure demands.

### ***Geostationary satellites***

“Geostationary satellite” is the term for a communication/broadcasting satellite that remains at a certain orbital altitude above a specific point on the Earth at all times. They orbit in synchronization with the surface of the Earth at approximately 36,000 km above the equator. They are called geostationary because they appear fixed in the sky when viewed from the ground. One geostationary satellite can cover the whole nation. However, there are two technological issues posed by the limited transmission power of the ambulance and antenna gain when sending data at a high speed from a moving mobile terminal.

- Blocking by buildings (communication interruptions);
- Gain-to-noise temperature ratio (G/T) of the satellite receiver antenna.

Problem 1 occurs because Japan is located at mid-latitude, not at the equator. G/T in 2) expresses sensitivity on the satellite side – a ratio of front gain G to overall noise temperature T on the receiver side. A common way to increase gain is to use higher frequencies and increase area antennas with fine mirrored surfaces.

### ***Quasi-zenith satellite (HEOs)***

As required by Kepler’s second law, sweeps across equal areas of an ellipse take the same amount of time. If there are three satellites and each of them appears over Japan at zenith every 8 hours, this is the same as one satellite being present 24 hours. Such systems have already entered practical use in Russia and the USA. These satellites can avoid propagation blockings caused by buildings and can be used efficiently when

combined with a geostationary satellite that provides another line-of-sight propagation (directional diversity). The successful development of a large expandable antenna of spacecraft also makes this system more feasible. This system is now expected to be used for disaster prevention and emergency rescue. Japan will launch GP-use quasi-zenith satellites incorporating Ku-band transponders in 2012.

### *Current status of the public phone network (immediately after a disaster)*

Immediately after a disaster, the number of calls placed over the public phone network increases sharply. The resulting congestion can make connections highly unreliable. For example, immediately after the Niigata earthquake, as shown in the figure, the number of calls increased by a factor of 50. The Erlang-base call loss ratio (connection failure probability) rises to 0.99 or above. This means that even 100 calls will fail to ensure a single successful connection. In short, public networks are of limited use during times of disaster. A disaster/emergency rescue-dedicated network is needed, independent of the public network and capable of nationwide coverage.

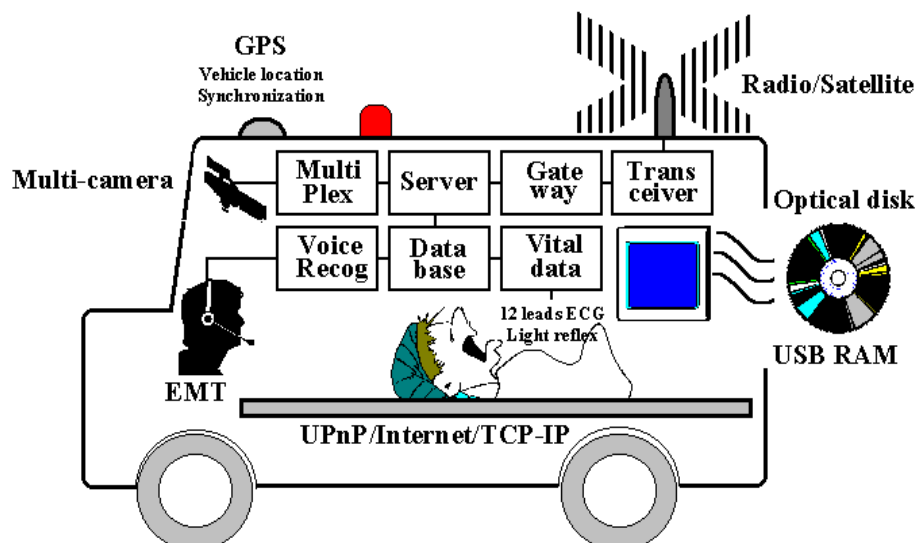
### *Universal Service Fund*

Carriers competing in the free market are free to shed services for emergency rescue, for the disadvantaged, and for people living in remote areas. A universal service fund which is possible in stable economies, aids in such situations. The International Telecommunication Union (ITU) recommends the deployment of this system in many countries, based on a WSIS (World Summit on the Information Society) action plan for resolving digital-divide issues.

In Japan, an extra charge of 7.35 yen/month has been imposed on each call across the board since March 2007. This fee is used to support services in high-cost remote areas in Japan; in other developed countries, a similar fee is used to fund communication applications related to medical care and education. In the United States, \$50 million was paid out in 2007 for medical services for telemedicine to help those living in remote areas.

A 100% cash back or tax relief measure should be considered as part of a universal service policy to support wireless and satellite networks for emergency rescue-dedicated purposes.

**Figure 2: Telemedicine supported system Real time clock on each device to synchronize the computer time setting with Universal Plug and Play**





## **CT assisted Treatment Technology**

### ***Emergency rescue activity record***

Electronization is the key for quickly creating accurate activity records. Providing accurate information to the destination hospital is crucial, as is transmitting data back to a PC at the station automatically to minimize inconvenience. For this purpose, a system of handy PDA-like terminals must be provided to rescue crews, and a gateway system deployed to send PDA data to the network from the ambulance.

Voice recognition (particularly dispersion-type voice recognition) to eliminate the inconvenience of character input for busy rescue crews represents a challenge in innovation that Japan, as a leader in the development and international standardization, should be fully equal to. Other electronic tools will be needed to assist rescue crews improve their skills in providing medical treatment in an ambulance, as well in searching for hospitals. Additionally, electronic support is an essential element of a safe first-aid system capable of reliably identifying serious hidden symptoms.

### ***Medical control via communications circuit***

In Japan, the medical treatment of patients in the ambulance poses difficult issues because it falls under the purview of two different ministries – the Ministry of Public Management, Home Affairs, Posts and Telecommunications and the Ministry of Health, Labor and Welfare. Medical control based on a Notification by the Fire-Defense Agency Emergency Rescue Manager involves 1) early instructions to the rescue crew; 2) doctor's post-verification of the treatment provided; and 3) continuing education and training of rescue crew.

The restrictions imposed by Article 20 (which requires a face-to-face diagnosis) under Medical Law can be lifted when a reliable communication network is used, according to Notification No.1075 of the Health Policy Bureau, Ministry of Health, Labour and Welfare, issued December 24, 1997. A revised Notification further permits so-called telemedicine via networks for patients in ambulances.

In short, Japanese law permits medical control of rescue crews (for basic treatment and care) and higher-level treatment by the triage doctor located at the triage center. However, a high-quality communication path is the minimal condition necessary.

### ***Specific diseases***

Successful treatment of coronary clogging is known to be highly likely if an acute heart attack patient receives medical treatment in the ambulance and a thrombolytic agent is administered within 60 minutes of identification of a vein route by the rescue crew. This treatment, however, may cause bleeding in the skull, making it necessary to monitor blood pressure constantly. An echocardiogram and a 12-lead electrocardiogram are essential for correct diagnosis of a heart attack, whereas the position of certain clots is easily detected by heart auscultation based on independent element analysis. This technology has been considered in certain countries where the patient must remain for relatively long periods in an ambulance, and related papers have been published by IEEE and APT.

The CT-based medical control will be effective with various patients suffering from cardiac or respiratory arrest and external injuries, as well as acute heart attacks. While not a magic bullet, this technology will enter actual use in the near future. CT offers high potential for improving prognoses and eventually reducing medical costs.

### **Networking in-ambulance devices**

At present, the measurement devices in ambulances are not connected to any networks. They are not even synchronized automatically. At present, the best solution appears to be to network them and to transmit data via a TCP/IP intranet on board the ambulance. Listed below are the parameters that must be monitored.

#### ***A: Macintosh with integrated type of CCD camera (Pharyngoscope)***

With the hard type of the pharyngoscope, we can extend a larynx and observe the whole larynx under the line of sight. With the integrated type of the small CCD (Charge Coupled Device) camera, we can monitor and

record the process electronically, and transmits image data via telecommunication circuit. Especially, it supports a procedure of an endotracheal tube insertion and/or removal of a foreign body in trachea. Without this monitor, a 20 % of patients will be misplaced tube and will become severe hypoxia during transportation.

### ***B: Light reflex image (Pupillometer)***

Conventional methods of analog papillary light reflex examination performed inside emergency vehicles tend to be associated with significant amounts of error that impede precise quantification of changes in pupil size. To establish a simple method for quantifying nervous function in prehospital care, we applied a technique for processing video images captured by a CCD camera to enable accurate measurements of the rate of change in pupil size. While this method can be used to assess either direct or consensual light reflexes, we focused in this study on an ipsilateral (direct light) reflex pupillometer, since this choice raises technically more challenging issues and is expected to result in significantly smaller design [09]. Based on this image, it should be possible to diagnose not just brainstem problems, but dementia and peripheral nerve disorders. The shrinkage speed of the pupil declines in Alzheimer disease and the diabetes.

### ***C: 12-lead electrocardiogram***

The 3-lead ECG that we all use with our monitors on a regular basis can only detect an arrhythmia. Because the 3 leads placed in the anterior thoracic monitor myocardial electric activities with hexaxial view. While the 12 lead ECG shows not only hexaxial view, but also the cross section view, for example in a transverse horizontal plane with V1-6. So we can make a diagnosis of acute myocardial infarction with reciprocal changes of ST elevations.

Europe is the leader in this field, while in Japan Yokohama City has just introduced the technology. It provides information on ischemic heart disease during transportation and enables early aid for improved prognosis and reduced medical cost. This should prove useful if it can be automated and network connections made easier.

### ***D: Automated ultrasonic measurements***

A serious blunt thoracic injury has to be treated within 60 minutes after an accident. There is a strong possibility of heart injury and/or of great-vessel-injury that shown fluid collection in a thoracic cavity. In the same way, the abdominal blunt trauma has a risk of hepatic injury and/or injury of inferior vena cava. So EMTs have to rule out the fluid collection in the peritoneal cavity with ultrasonic tomography.

With robotic arm holding curved array scan probe, the US army continues to issue academic reports on automated measurement of heart wall movements for ischemic heart disease or trauma victim to check the absence/presence of thoracic fluid collection [10].

## **Discussion**

### ***Vision of medical controls for the near future***

Emergency transport and medical care are intertwined. The extension of medical control is based on telemedicine and care by triage doctors located at medical control or triage centers. The ultimate goal is to improve prognoses and extend patient life expectancy. While ambulances are operated by the Fire Defense Agency, patients require prompt medical care. There is no question concerning the importance of prehospital care in reducing medical costs, which amount to 30 trillion yen annually in Japan.

Each prefecture currently operates a medical control center. However, assuming that the medical control center is only necessary for patients in serious condition (approximately 10%), one center should suffice for each Dou or Shu (state: 6–10 in total). Another important goal is nationwide equality in such services. The former or prefectural-based medical control center service aims to provide a service based on local conditions, while the latter, or Dou/Shu-based medical center service, places the priority on economy and equality. In either case, there will be no progress in medical control without the development of CT that can be effectively used in emergency transport.

### ***Case of cardiac infarction***

In Japan, heart attacks rank second as a cause of death; in FY2006, 172,875 died of heart attacks. Annually in Japan, 49,000 people experience acute cardiac infarction. According to nationwide statistics for emergency transport for FY2006, heart disease patients accounted for 9.3%, or 271,943, of all those transported. It appears that close to half the patients struck by acute cardiac infarction die within one hour. The causes of death are cardiac arrest due to Ventricular Tachycardia, Ventricular Flutter, and Ventricular Fibrillation. A significant number of patients may be saved if they receive proper treatment within one hour after the attack. The patients who are lucky enough to be transported to a CCU in emergency centers are in most cases given thrombolytic agents while undergoing PTC (Percutaneous Transluminal Coronary) operations to remove the coronary thrombus. Thrombolytic agents are reportedly effective even when injected into a vein, if injected in the early stages (within one hour after the attack). In fact, some trials of thrombolytic doses in ambulances have been initiated. However, it is known that all thrombolytics pose the possible risk of cerebral hemorrhage. For example, a thrombolytic thrombolyse, now used in the emergency rescue center, resulted in cerebral hemorrhages among three patients, two of whom eventually died in Japan, although the number of such incidents was relatively low. Thus, the use of such thrombolytics without question requires continuous monitoring of blood pressure and blood pressure control by medical experts. In case of remote medical observation in the ambulance during transport, a patient struck by an acute cardiac infarction will be performed suitable triage by specialist at Triage Center with transmitting 12-lead ECG, and Echography. After suitable diagnosis by specialist, a shot of a thrombolytic agent PTCA should be administered into vein. Assuming that early-stage treatment is successfully performed by administering thrombolytic agent into the patient's vein in the ambulance, we estimate a reduction in medical costs for the treatment of acute cardiac infarction, based on the following assumptions:

- Ten percent of the 271,943 heart disease patients transported in emergencies have just been struck by acute cardiac infarction (equal to 41% of patients struck by acute cardiac infarction are transported to hospitals via ambulance).
- It is possible to use telemedicine during emergency transport to isolate the cause of the problem as acute cardiac infarction, based on data provided by a 12-lead electrocardiogram and cardiac ultrasonic imaging.
- If an ambulance technician administers a vein dose of a thrombolytic to the patient under the instruction of doctors, the rate of improvement appears to be around 60%.
- A patient whose condition improves thanks to early intervention will return home after a 7-day hospital stay, while a patient for whom the intervention has no effect is hospitalized 21 days on average.
- The medical cost per hospitalized patient per is US\$1,200 per day.

Reduction in medical cost during 10-year implementation = US\$ 2 Billion. This is the amount of reductions in medical costs made possible by pre-hospital care in the event of acute cardiac infarction, based on assumptions 1) to 5). If the calculation is expanded to include cost reductions in other acute diseases and injury, medical expenses can be expected to be reduced even more dramatically. One solution for curbing medical expenses in Japan, which is currently growing 5% annually, is improving pre-hospital care. Proper implementation of this project requires high-speed data channels, since these will enable doctors to see the conditions of the patient in an ambulance as if the patient were in the next room. The communications channel is one of most promising solutions.

### ***Momentum for international standardization***

ITU-T (International telecommunication Union, Division of Telecommunication) SG16 Q28 is currently boosting the standardization of telemedicine technologies. Tasks related to this standardization effort are currently underway in each member nation. Now is the time for member nations to propose PDA specifications for use by rescue crews and procedures for emergency rescue wireless communications.

## Conclusions

High automation (automation of measurement, recording, analysis and transmission) of ambulance-borne devices is the goal of CT. Emergency transportation for the near future is expected to enable data transmission from ambulances automatically, without inconvenience to rescue crews, resulting in high-quality services available uniformly across the nation.

As of May 2009, no country had succeeded in deploying a high quality communication path for mobile terminals, although this remains essential for the smooth implementation of medical controls.

We are certain medical controls will be much improved in the near future both in quality and content as CT integration proceeds and that such CT will significantly improve patient prognoses.

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## Annex 5

### Oman: eHealth Plan – Key Issues

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#### Geographical Features

Sultanate of Oman is located in the south eastern corner of the Arabian Peninsula. Its coastal line extends 3,165 kilometers from the Strait of Hormuz in the North to the borders of the Republic of Yemen, overlooking three seas: the Arabian Gulf, Gulf of Oman and the Arabian Sea. It borders Kingdom of Saudi Arabia and United Arab Emirates in the West, the Republic of Yemen in the South, and the Strait of Hormuz in the North and the Arabian Sea in the East. The total area of the Sultanate of Oman is approximately 309.5 thousands square kilometers. The Sultanate is composed of varying topographic areas consisting of plains, wadis (dry river beds) and mountains. It is administratively divided into 5 Regions and three governorates with 59 Wilayats.

#### Demographic Features

The first General Census of Population was carried out in Sultanate of Oman in December 1993. The census reference night was 30/11-1/12, 1993. According to the census, the population of Oman was about two million of which about 27% were non-Omanis. According to mid year population for 2005 the Omani population shows a sex ratio of 102.1 males per 100 females. It is a young population, about 38.9% of the population is under-15 years old, and only 3.5% are 60 years and over. About one quarter (26.9%) of the total Omani population is females in the reproductive age group (15-49 years). They represent nearly 54.4% of all females and about 50.2% of them are expected to be married.

#### Organization and Health Policy of the Ministry of Health

The Ministry of Health (MOH) is responsible for ensuring the availability of health care to the people of Oman. In course of implementing its health development plans, the Ministry's organization had to be adapted in tune with the strategies and objectives that were crystallized during 1990. These can be summarized broadly as:

- 1 Regionalization of health services and decentralization of decision making in specified technical, administrative and financial affairs.
- 2 Emphasizing the role and importance of planning.
- 3 Development of Education and Training in health.
- 4 Emphasizing the importance of health systems research.
- 5 Emphasizing the importance of regional and international relations.

In 1990, MOH adopted decentralization policy, the Directorates-General of Health Services and the Directorates of Health Services at Health Regions are vested with the responsibility for the delivery of comprehensive health care through a network of hospitals, health centres and mobile units.

The decentralization policy of MOH and the setting up of multi-speciality regional hospitals, supported by a strong apex hospital (the Royal Hospital), together with effective planning and management at national, regional and wilayat level and the emphasis on health care human resources planning and development of health management information system, etc. have helped to achieve higher efficiency and effectiveness of the health care system. As an immediate outcome of the improved health care, the Sultanate has achieved increased self-reliance in the treatment of most diseases which helped in saving enormous expenses of treatment abroad. Later, Ministry of Health has adopted a policy of hospitals autonomy. It is expected that

hospitals will be able to adopt their decisions according to their own performance indicators and their resources which is expected to be reflected on the health status of the people.

Other organizations also provide health care for their employees and dependents. These include the Ministry of Defence, the Royal Oman Police and the Petroleum Development Oman. In addition, there is the Sultan Qaboos University (SQU) Hospital that serves as a teaching hospital and provides tertiary care. The private sector has also been playing an increasingly important role in providing health care over the past few years.

### Telecommunication Services

There are three telecommunication service providers, as of June 2007; Omantel, which is the only service provider for the wired telecommunication services, including Internet, fixed phone service, and digital links. Last year (2006), it signed an agreement with the government of Oman for providing broadband connectivity and communication media to all government entities over the country.

Omantel has few running projects such as laying optical fiber for information superhighway, ADSL, and MPLS which is approved technology for the e-government portal.

Other telecommunication services providers are Oman Mobile and Nawras. They provide wireless services such as cellular mobile telephone and other wireless communication.

### e-Health Strategy

The computerization in the ministry of health started in 1987, in a National Referral Hospital called "The Royal Hospital", which was the first hospital in Oman opened with computerization.

In 1990, a specialized dedicated Unit for IT was created in the Ministry. In 1997, the first Computerized Health Centre was implanted after the decision of building an indoor system was considered. In 2004, the Information Technology (Computer Department) was upgraded to the level of Directorate General with 4 departments and 15 sections, and it is called Directorate General of Information Technology (DGIT).

MOH has a comprehensive computer system automating all the processes of healthcare delivery institutions to almost making them paperless. There are **over 140** computerized health institutions across the Sultanate, including all the major institutions.

The electronic system covers all parts of the patient file. All processes in the health institutions have been computerized, including PACS system in some hospitals.

Drug Information System (DIS), which is software used to help doctors to have wide idea about any medicine and review side effects and interaction with other medicine, has been integrated to the clinical system. The system is also integrated with SMS to inform and remind patients about their appointments, and to remind people to donate blood. Research, Statistics and Administrative Reports are automatically created by the system.

The e-health strategy states that the usage of ICT in **ALL processes** of the Healthcare Delivery System in order to streamline and make them cost-effective and to make ICT applications **tailored** to all requirements of Health Institutions, and also providing necessary information for planning and other research purposes.

There are two objectives behind this strategy to improve the Healthcare Delivery System, increase efficiency level, and to contain the Healthcare costs.

To sum up, Ministry of Health has been requested to plan for a National **e-Health** Portal to be used by other government s and non-government organizations. The 58<sup>th</sup> World Health Assembly Resolution on **e-Health** *has* requested MOH to build a National **e-Health** Strategy and to create a National **e-Health** Committee, including all concerned governmental and the private sectors.

Electronic Medical Record (EMR) has been created using international standards to automate all processes including referral system, which automates request for Appointment, Consultation feedback, and Request for Second opinion.

## Tele Education in MOH

Feasibility of tele-education project has been discussed since 2002. The main goals are to:

- Exchange the medical knowledge among medical staff in the different institutions around the country.
- Conduct technical meetings and conferences.
- Broad second opinion and consultation.
- Reduce the doctors' internship duration, by having part of the internship locally using videoconferencing facility to interact with universities.
- Create an electronic medical library as a reference to the medical staff.

Professor L. Androuchko, Consultant in International University in Geneva, and Rapporteur of Telemedicine Group (ITU) was invited twice by MOH.

The following points were listed in his report on the last visit, which took place in Muscat from 10 till 19 April 2004.

The Ministry of Health does not need the "classical" videoconference solution. It is necessary a videoconference system for medical education which has to be also integrated with the existing HIS (Hospital Information System) and PACS (picture archive communication system), and meet the requirement of medical provincials, doctors and other medical staff.

There is one very important point which distinguishes the videoconference system for the Ministry of health from many other videoconference systems. The medical conference or any type of medical training requires transmission of many medical images (X-ray, Ultrasound MRI, etc) with very good quality which has to be checked and approved by doctors. It is not enough to see the face of a lecturer and hear his voice (as it is for any business meeting), it is much important to provide transmission of different medical images with a required quality.

It is necessary to establish a videoconference network for the Ministry of health. From the angle of network design has to be done taking into account the global goal of the Ministry – gradually provide videoconference facilities to all regional hospitals and other important medical institutions for medical education and then use them as a platform for introduction of other e-health services when and where they are required.

Medical education needs a good medical library. It is important to have an electronic library based on modern web technology and it has to be design taking into account the necessary requirement for reliability and security.

## Conclusion

To sum up, MOH has started e-health project and there are many health institutions which belong to MOH has been computerized. However, there is always a room for improvement; Firstly, to complete e-links connectivity among all health institutions, and create national repository of the e-Health Record, where a summary of all health transactions be collected at a centralized database.

It is also very important to create *e-Health* Legislation and obtain information security Accreditation.

The National ID Number is also considered to work with or replace the existing patient ID. Last and not least, Tele-Education and Disaster Recovery Systems are at the top of the future plan.

## Annex 6

### Philippines: A Telemedicine Program Utilizing Short Message Service (SMS) for Remote Village Doctors

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#### Introduction

The Philippines is faced by an immense public health crisis as a result of the migration of health professionals to foreign countries due to economic reasons. Furthermore, majority of health providers who opt to stay in the country, particularly the specialists, situate themselves in urban areas for better professional practice [1]. This brings about a disparity in health care delivery especially in the remote and underserved areas of the archipelago.

The government made steps to augment this phenomenon through the Doctors-to-the-Barrios (DttB) Program of the Department of Health (DOH). The DttB Program aims to deploy doctors, mostly general practitioners, to “depressed, unserved/underserved, hard to reach and critical fifth and sixth class municipalities without doctors for at least two years [2].” With its sixteen years of implementation by the Health Human Resource Development Bureau of DOH, the program has deployed hundreds of medical doctors in various rural communities across the country [1]. However, since majority of these doctors are general practitioners, some even fresh from medical school, there may be a need to provide them with vital health information coming from trained specialists in order to better manage their patients in the community.

Given these realities, the University of the Philippines Manila – National Telehealth Center (UPM-NThC), being the “premier center for information and communications technology (ICT) applications in health” [3] in the Philippines, explored ways on how to enhance access to health information and services between remote doctors and clinical specialists. Conscious of the available resources in remote areas, the UPM-NThC utilized the Short Message Service (SMS) or “text messaging” so that general practitioners in these rural communities can refer problematic cases to domain experts (DE) from the University of the Philippines – Philippine General Hospital (UP-PGH). Key to this program is the delivery of specialized health information that may translate to better patient care.

#### Review of literature

##### *Short Message Service (SMS)*

SMS, or text messaging, is a communications protocol that allows users to send and receive short text messages using mobile devices such as cellular phones, smartphones or personal digital assistant (PDA) [4,5]. The message can be composed of a combination of alphanumeric characters that form words or meaningful truncation of words. However, SMS has a limitation of being able to transmit only a maximum of 160 characters, including spaces [6].

SMS delivers messages in a store and forward manner, essentially similar to paging. Instead of being sent directly to the receiving mobile device, a text message is temporarily stored in a central short message center (SMC), which then forwards the message to the intended recipient. This is useful since a message can still be received at a later time even if the recipient phone is turned off or out of coverage during the time of sending [5,6].

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The intense development and widespread use of SMS worldwide has broadened the possible applications of this service. From a simple medium that can convey short communications between two or more persons, SMS is used nowadays for information dissemination services (i.e. news, weather, stock market, and entertainment), mobile banking, internet/email notifications, mobile chatting, and even catechism [5,6,7].

Despite the limitations of size and a not so easy input mechanism through the phone keypad, SMS is still a very popular technology that has a lot of promising applications that are waiting to be developed and deployed.

### ***Text Messaging and the Philippines***

Text messaging in the Philippines has been phenomenal and its use is exponentially increasing over the years [8]. “Filipino cell phone users have truly developed a culture of texting after the Philippines retained its title as the ‘text- messaging-capital-of-the-world’ – sending a remarkable 1.39 billion text messages from a subscriber base of just 50 million [9].”

The appeal of the SMS technology to Filipinos may be attributed to the economic state of most mobile phone users. In the Philippines, a text message would cost only Php 1.00 (approximately US\$0.02) while a 1-minute prepaid voice call costs around Php 8.00 (approximately US\$0.16). Because of this, “more than 90 per cent of the country’s thirty-five million subscribers” resort to SMS as a primary means of communicating with others. It is estimated that a subscriber sends about seven text messages per day. [10]

Historically, text messaging was a free service from its inception in 1994 until 2000 [9]. Despite the current low rate of a mere peso for every text message, mobile networks devise promotional offers wherein subscribers will only spend Php 30.00 (approximately US\$0.62) to be able to send unlimited text messages for one to two days. Due to the affordability of text messaging, “the Philippines has become the first country in the world where mobile users spend more on data services than on voice, according to a leading research company [11].”

### ***SMS and Health***

The widespread use of text messaging in various financial and entertainment applications triggered the health care community to take advantage of this technology for health services delivery. In recent years, various SMS applications for health have been utilized both by health practitioners and their patients.

Most SMS health applications focus on health information dissemination. In England, text message reminders are sent to women to prompt them to take their oral contraceptive pills. A SMS reminder system for AIDS patients in Australia was shown to improve patient compliance to the complex combination of drugs. Supportive text messages that supplement smoking cessation programs in New Zealand were found to be valuable in encouraging smokers to quit. Finally, the Health Department of San Francisco, California use text messaging to disseminate sexual-health information to adolescents and young adults. [12,13]

Despite the potential applications of text messaging in health, there are some instances wherein it may not be a suitable medium for delivering messages, such as when disclosing to a patient a critical diagnosis like cancer or AIDS [12]. In these cases, a face to face encounter with the patient is the most appropriate and ethical way of conveying the message.

## **Methodology**

### ***Program Coverage***

The SMS Telemedicine Program was formally launched last 15 October 2007 through a Memorandum of Agreement signed between the UPM-NThC and the DOH during the Continuing Medical Education (CME) Conference of the DttB Program at Cagayan de Oro City, Philippines. A total of 34 DttBs from various remote villages of the Philippines participated in this program. The DttBs were asked to sign an agreement that the information which they will receive are opinions of the DEs and that the final diagnosis and management for the patient shall remain their responsibility. To remove the financial barrier for these doctors, the UPM-NThC gave each doctor a monthly Php100.00 (approximately US\$2.00) credit load in order to refer their cases to the Center.

The doctors were encouraged to refer at least one case per week regarding any domain. The Center gave them the option to send their clinical referrals via text message to any of the two network mobile numbers (Globe and Smart). In instances where they do not have any problematic cases to refer, they were asked to send a census of all the cases they saw during the previous week. Only non-emergency cases were to be accepted since the Center can only guarantee a turn-around time of up to 48 hours.

During the May 2008 CME Conference of the DttBs, an additional 21 doctors signed up, making a total of 55 DttBs included in the pilot program.

### ***Central Operations Procedure***

The SMS Telemedicine Program is managed by a Telehealth Physician, two Telehealth Nurses, and seventeen DEs from various specialties.

The text messages were received by the Telehealth Nurses who triaged the cases to the appropriate DEs. In cases where they have difficulty in classifying the referral, they elevate it to the Telehealth Physician. The text messages were sent to the DEs through the modality that they chose. Some preferred to receive text messages through their cellular phones, while others opted to receive an email containing all the referrals for the day. All the DEs were alerted via SMS for any incoming referrals addressed to them. Once the referrals were answered by the DEs, the Telehealth Nurse forwarded the replies to the inquiring DttB.

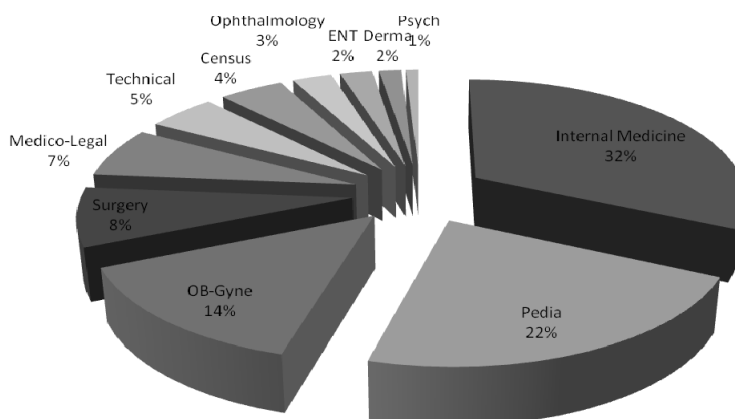
### ***Technological Aspect***

Initially, the Center used two SMS-capable cellular phones to receive the text messages. The Telehealth Nurses manually encoded the referrals from the phones to a spreadsheet database. All SMS transactions (receiving from the DttB, sending to the DE, and vice versa) were done using the two mobile phones. After two months of this process, the SIM cards were then connected to a GSM modem so that incoming text messages were readily available in a computer interface. The Center utilized playSMS, “a flexible Web-based mobile portal system” [14], to manage all the incoming and outgoing SMS transactions. The shift in the technology to automate the various transactions improved the workflow and minimized the possible errors in encoding.

### **Results**

Over a period of one year (15 October 2007 to 15 October 2008), UPM-NThC received a total of 577 telehealth referrals via SMS. Among domains, Internal Medicine had the most referrals (185) followed by Pediatrics (128). Other referrals were from: Obstetrics and Gynecology (82), Surgery (46), Medico-Legal (39), Technical procedure questions (28), Census reports (26), Ophthalmology (16), Otorhinolaryngology (11), Dermatology (9), and Psychiatry (1). Figure 1 shows the distribution of referrals by domain.

**Figure 1: Total SMS Referrals from 15 October 2007 to 15 October 2008 (n=577).**



The UPM-NThC was able to respond to 518 out of the 577 referrals, yielding a response rate of 89.77%. Of the 59 unanswered referrals, majority were Medico-legal (15) and Internal Medicine (14) cases.

## **Discussion**

The geographic configuration of the Philippines, being an archipelago of 7,107 islands, has made it impossible to physically station a medical practitioner in all its municipalities. Furthermore, the handful of doctors deployed in rural villages may lack certain clinical expertise in order to resolve problematic cases in the field. These general practitioners may need the assistance of a trained specialist who on the other hand, usually practices in urban areas.

With the availability of the SMS technology across the country, reaching even the far-flung regions, the geographic barrier to dissemination of specialized health information has been removed. Exchange of data between a central health facility and a remote village doctor is now possible and even crucial to the management of patients in the rural setting.

The familiarity of rural doctors with the use of cellular phones makes it a better communication tool compared to Internet-based solutions. The accessibility of SMS at the point of care, as well as its economical rates adds to its advantages of being used in the rural setting.

In this program, DttBs made use of SMS to refer the challenging cases that they encountered in the community. Despite the 160-character limitation of the SMS technology, the ability of most cellular phones to compose multiple short messages into one message made it possible for the referring doctor to provide more clinical information for review by the DE. However, for earlier models of cellular phones without such capability, the character limitation may pose some difficulties in sending and retrieving lengthy messages.

The limitations in allowable characters of a text message was further shun from through the use of a text vocabulary or 'text speak' [13]. This made use of truncated or abbreviated words to keep the messages brief and concise. It is worth mentioning that despite the use of such language, the DEs were still able to understand the intended message of the DttBs.

Based on the domain analysis of the telehealth referrals, the DttBs referred mostly Internal Medicine and Pediatrics cases probably since majority of the outpatient consults in the provinces are in the domains of general adult and child medicine. In most cases, the health information given by experts helped the rural physician in managing the case.

The UPM-NThC was able to answer 89.77% of all the referrals received. The unavailability of some DEs during a few periods of time made it difficult to answer the cases within the allotted time frame. Furthermore, since the University does not have a full-time Medicolegal Expert, a number of medicolegal referrals remained unanswered. In certain instances, the referrals were forwarded to agencies outside the University.

## **Conclusion**

SMS seems to be a viable telemedicine application in the Philippine setting due to its accessibility, availability, affordability and mobility. There is a need to support village doctors who are frontliners in the remote communities of the country. The extensive use of cellular phones and SMS technology nationwide provide a lifelink for general practitioners to refer their challenging cases to a specialist.

There is a need to assess the satisfaction of both the remote doctors and DEs with regards to the implementation of the SMS Telemedicine Program so that modifications can be done to improve the service for both stakeholders. Aware of the great potentials of SMS as an application for health, there is a need to develop standards and guidelines for this emerging field.

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## Annex 7

### Thailand: Next-Generation Healthcare

*Adnon Dow  
Motorola Limited, USA*

#### **Bumrungrad International Hospital**

Bumrungrad International is the largest private hospital in Southeast Asia and one of the world's most popular destinations for medical tourism. It offers state-of-the-art diagnostic, therapeutic and intensive care facilities in a multi-specialty medical center located in Bangkok, Thailand. Opened in 1980, the hospital was Asia's first to pass the demanding review of the Joint Commission International, the highest US standard for hospital accreditation. Newsweek recently included Bumrungrad on its list of 10 leading international hospitals, calling it "one of the most modern and efficient medical facilities in the world."

#### **The challenge: Real-Time access to patient information and improving hospital staff efficiency and response time**

Over a million patients are provided patient-care facilities annually at Thailand's Bumrungrad International hospital, across its 90,000 m<sup>2</sup> campus. The hospital staff needs to have up-to-the minute information about the patients, medical records and medication schedules, regardless of where they are working across the campus.

Being the largest private hospital in Southeast Asia, Bumrungrad has built a strong reputation as a leading medical tourism destination providing world-class healthcare service to its patients. "Bumrungrad's long-term vision is to provide information and internet access to every patient throughout the hospital. Hospital staff must have access to real-time patient information which enables them to provide improved healthcare services and advice to their patients," said Mr. Chang Foo, Chief Technology Officer of Bumrungrad International.

Another key challenge was to have a robust system that maintains the confidentiality and security of patient information across the network.

#### **The solution: Implementation of a state-of-the-art wireless infrastructure**

Bumrungrad initiated implementation of a state-of-the-art wireless infrastructure project that will provide the backbone for delivering world-class healthcare services to its patients. Bumrungrad selected an enterprise mobility solution that includes wireless switching and over 300 access points.

Hospital staff will be equipped with mobile computing devices through which they can access hospital information and patient records on Hospital 2000, Bumrungrad's hospital information management system provided by Global Care Solutions.

The network topology will include wireless switch as the core backbone. By allowing mobile users to maintain a persistent connection to high-bandwidth applications as they roam throughout the wireless coverage area, the switch will provide the foundation for Bumrungrad's long term vision to expand and deploy other WiFi services both indoors and outdoors.

Bumrungrad plans to upgrade the core switching platform to the Wireless Next Generation Switch which is the industry's first radio frequency (RF) wireless switch that bridges the gap between Wi-Fi, RFID and other key RF technologies, and is designed to support value-add, optional add-on modules such as fixed-mobile convergence to provide seamless persistent connectivity for mobile and fixed devices.

Furthermore, to ensure patient information remains confidential and known only to authorized personnel, the wireless network is also protected. The system will notify Bumrungrad's IT staff when network vulnerabilities or attacks occur, enabling an immediate response. The software architecture is scalable, simple to deploy and easy to upgrade.

Bumrungrad plans to take its vision of next-generation healthcare one step further through the implementation of RFID technology for staff, patient and asset tracking.

**The benefits: Improve the quality and efficiency of patient care, helping to reduce risk and save lives**

The solution allowed the hospital staff to access real-time information and data messaging capabilities while on the hospital's 90,000 m<sup>2</sup> campus. It allowed the medical staff to review patients' medical histories, update patient information, check for drug interactions, and look at lab results and x-rays – all from the point of activity: the bedside, the front office, in surgery or on the go.

The patients could also enjoy seamless mobility across the campus. The wireless network will also enable Bumrungrad's long-term vision to provide information and internet access to every patient throughout the hospital.

The solution is also designed for scalability and will allow Bumrungrad Hospital to deploy Wi-Fi and RFID services through one switching platform. This will reduce the total cost of ownership and simplify management of multiple wireless infrastructure technologies.

## Annex 8

### Russia: Mobile Telemedicine – Solutions for Russian Vast Territories

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#### Introduction

Long-term experience of adoption and development of telemedicine technologies in Health Service practice of Russia with its vast territories that have different level of development and organizational resources of qualified health care delivery gives the opportunity to authors to suggest their own view of practical projects realization within the bounds of conception of World Health Organization (WHO) “Health for everybody”: “...when innovative telemedicine technologies become the instrument for providing of available aid of the best doctors to any citizen of the farthest regions of the country and the world, and it gives to general practitioners the access to advanced training at the best specialists of the country (the world), even if they have no opportunity to leave that far away region of their professional activity”[1, 5].

We have to mention, that besides historic hard-to-reach areas where people are void of access to the latest advances in medicine, the needs of modern economy produce new islands of high-risk – offshore drilling platforms and camp of oil and gas industry workers in Polar Regions and in deserts, where the health and safety of specialists who temporarily go to these objects, have to be under special supervision, and today’s technologies of telemedicine on the basis of videoconference communication system make it possible to solve these problems on the new level. Telemedicine technologies let us to open, for given category of specialists through satellite communication, the remote access to modern medical resources and services including international resources and services. Meanwhile considerably increases the safety of people who are far from stationary medical aid, the possibility to receive competent medical consultations promptly appears.

#### Mobile Solutions for Telemedicine-First Steps

The beginning of active work in the realization of telemedicine projects is closely connected with the availability of fast-acting channels of communication that can cast big scope of static information, for example X-ray photographs and also wideband dynamic signals – television signals and analogous.

The practice proves that if there is a usual telephone channel with bandwidth of 64 kilobit per second, or lower-bit-rate Internet with the same bandwidth in a village hospital, then it is possible to start telemedicine project giving the opportunity to consult on the base of beforehand transferred static information that is prepared with the help of scanner, documentary camera and photographic camera. Transferred through this channel of communication medical information is quite enough for urgent consultation or prior subspecialty consultation that gave the opportunity not only to consult thousand of patients but also to reduce costs for such help considerably. Publications of our foreign colleagues in applied problems of telemedicine use in different spheres of modern medicine confirm the given conclusion of Russian specialists. [2, 3].

As soon as the possibility of wideband communication channels use (such as high-speed Internet or channels like ISDN that provide change of information between consultant and consulting person with the speed higher then 128 kilobit per second) becomes available, the telemedicine project rises to the new level when in a real-time mode practically all existing tool methods of patients diagnostics becomes accessible

Experience of organization of mobile telemedicine units shows that at the current rates of development and improvement of digital diagnostic units it is rather hard to predict how soon the whole set of the existing

devices will be affordable for any clinic with a lean budget. Whatever seems fantastic today, tomorrow may prove to be outdated.

By the very end of 1990s, the industry offered to the market videoconferencing mobile units (the so-called “yellow suitcases”). This equipment allowed physicians from the mobile emergency medicine units to get in touch with consultants at diagnostic centers right from the site of accident or disaster, demonstrating the patients via AudioVideo (AV) channels and feeding audio data on examination results acquired with the help of a standard set of devices, which physicians brought to the disaster area. Despite insignificant (by modern standards) volume of data provided this way, it allowed to reduce the losses among patients at the cost of increasing the quality of solutions and prioritizing the emergency aid to the big groups of patients. Looking back now, one should consider it as a huge step ahead [3, 4].

### **Modern Mobile Solutions for Telemedicine**

Modern mobile telemedicine complexes are specialized portable systems that provide remote medical consulting, execution of basic diagnostic examinations, as well as urgent, computer processing and data transfer for consultation. These complexes use telecommunication as well as satellite for address exchange of medical information between diagnostic specialists and give the opportunity to doctors and patients to have remote access to modern medical resources and services including international resources and services practically from any place of the planet.

Technical decision for mobile telemedicine complex provided by Russian specialist includes:

- Module of data processing and videocommunications.
- Informational and diagnostic module for urgent medicine.
- Module for connection with satellite or mobile communications.
- Module for protection and biometric identification.

Approximate architecture of the decision (one of possible variants) is shown on figure 1.

Module of data processing and transfer of videoinformation includes personal portative computer (laptop) with a screen and installed medical software and portative system of video conferencing for videoinformation transfer (teleconsulting). Both systems are connected through digital interface and have possibility for connection to wire communication (ISDN or IP). Computer has programs of input, processing and storage of images, ECG curve, and also the program of database with patients’ notes maintenance.

Laptop has the full complement of interfaces for external device connection, and also controllers Bluetooth and WiFi for external connection. Hardware system complex of videoconference as polyethylene waterproof case with integrated videocode, built-in camera, LCD screen, microphone, loudspeakers, headset with a microphone, control console and power module.

This decision integrates the best Russian and foreign decisions and guaranty simultaneous connection of 4 video and 3 audio abonents, transmission speed up to 384 kilobit per second – 2 megabit per second through ISDN channels or 768 kilobit per second – 3 megabit per second through protocol IP, protocols H.323, H.320 and SIP.

Distinctive feature of mobile telemedicine complex is existence of informational and diagnostic module for urgent medicine that gives possibility to implement express-monitoring of patients condition and data transfer for consultations and hospital preparation for the reception of patients. The Module includes different medical equipment that is possible to connect to digital interface to other modules of the complex. It consists of diagnostic system of functional diagnostics doctor. This system includes electrocardiograph, spiograph, and phonocardiograph. Besides, the module is completed with glucometer/ cholesterolmeter for measure of blood sugar and blood cholesterol, measuring instrument for blood pressure and extra laboratory equipment. The content of the module can also differ depending on demands.

If this complex is also used for express-examination, it following devices can be connected to it extra:

- Ultrasonic portable scanner;
- Electrocardiogram plus spirometric sensor;



- Haematological analyzer (about 20 characteristics);
- Portable urine analyzer;
- Mobile X-ray apparatus (in the suitcase);
- Without X-rays microanalyser of general blood bilirubin;
- Complex for dermatoglyphics examination.

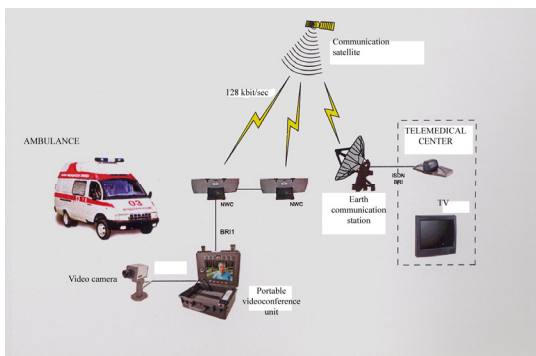
The content of informational and diagnostic module can be changed that is there are separate kitting for diagnostic of heart and circulatory system, the system can be changed or added kitting of daily patients monitoring, neurologic equipment [4, 6].

To the content of the complex the module for connection with different channels of communication and biometrical control system and system of access control for securing of equipment and information from unauthorized use.

Mobile telemedicine complex can be hand transported in the forests, fields, tundra and also it is established on special off-highway vehicle that serves polar nomad camp of reindeer breeder (Fig.2-3).

**Figure 1, 2 & 3**

**Approximate architecture of the decision for mobile telemedicine complex**



**Mobile telemedicine complex: Teleconsultation at the reindeer-breeder stop on the Arctic ocean coast (Russian tundra zone)**



**Mobile telemedicine complex in tundra (transported by special cross-country vehicle)**



Similar system on the base of Mercedes Sprinter cars (resuscitation ambulance) was adapted to the departmental system of health care of “Rossiyskie zheleznye dorogi” Ltd. (Russian railways) (Fig.4). Similar system is functioning in five medical special trains (movable diagnostic centers), named after well-known Russian specialists: physician “Matvey Mudrov”, surgeon “Nikolay Pirogov”, and so on, that work in northwest, south and in the Far East of the Russia. The cost of medical equipment installed in each train is close to € 2,500,000 (Fig.5-6).

**Figure 4, 5 & 6**

**Ambulance (during teleconsultation)**



**Hospital train (outward) JSC Russian railways has now five hospital trains (modern Mobile diagnostic centers with teleconsultation center in the compartment and satellite antenna on the roof)**



**Hospital train (teleconsultation center in the compartment)**



According to a newspaper printed in the Far East, each train "...consists of nine cars: No. 1 – diesel generator car with a constant voltage regulator to feed digital medical equipment and computers; No. 2 – X-ray car; five diagnostic and treatment cars housing offices of a cardiologist, professional pathologist, ENT specialist, endoscopy and colonoscopy room, sterilization room, and two administration cars. Special attention should be paid to the functional diagnostics car. In addition to offices of a neurologist, neuro-physiologist and psycho-physiologist, it has a telemedicine office. It has a satellite communications system for videoconferences and consulting with experts of the relevant regional hospital and the leading national clinics. On January 25, 2006 test teleconference bridge successfully connected the medical train to Strasbourg where O.Y. Atkov, Vice-President of the OJSC "Russian Railways", President of the Russian Telemedicine Association, Astronaut, M.D., lectured about the opportunities of telemedicine. Satellite communication with Khabarovsk served as a demonstration... In fact, not every clinic in Khabarovsk can boast the same hardware as this train. It is not a polyclinic on wheels as some journalists dubbed it. It is a fully functional mobile clinical diagnostic center. Overall staff of the train is 55 persons..."

For Russia with its territory covering ten time zones, emergence of mobile clinics and clinical diagnostic centers means an important stage of national projects in the sphere of health care system, which serve to equalize quality medical services all around this huge country.

All this hereinbefore mentioned solutions are not cheap and can not be recommended for almost 50000 medical stations where frequently alone nurses work in small remote villages.

But formation of telemedicine consulting and training system for this class of medial units will ensure solution of the most vital social and economic objectives for those rural inhabitants – make sure that the best physicians are readily available to assist every resident of the most remote regions of Russia. Now inhabitants of remote villages can get qualified help only if they have visit district or regional hospital – average distance in East regions of Russia about two – three hundred kilometers or even more.

The situation can be change-over if the work of each medical station will be organized on the basis of digital platform (not very expensive) and minimal set different medical equipment that are possible to connect to digital interface of the platform.

Modern Russian mobile complex (Prototype on the bases of notebook see Fig.7) gives as a good sample of such equipment. These complexes use telecommunication as well as satellite for address exchange of

medical information. It includes the above mentioned diagnostic system of functional diagnostics doctor. So such mobile complex includes the set of diagnostic equipment that is beyond the dreams of the municipal medical station now.

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**Figure 7: Inexpensive mobile telemedicine unit (in compare with standard equipment)**



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The level of the cost of such equipment will be equal the price of notebook. That is why creation of cheap mobile telemedicine complexes appeared to be a natural extension of previously performed work. It means that the system of telemedicine consulting centers evolved into a major factor enhancing the quality medical aid in remote districts of Russia.

As we can see modern mobile telemedicine unit, in addition to videoconferencing facilities, comprises of digital diagnostic units capable of transmitting to the consultant a fairly big volume of measurement data in the course of examination and it should be noted that functionality of this unit tends to expand [6].

### Summary

Decade of development of telemedicine projects in rural regions allows for a number of optimistic conclusions, including the one that Russia has laid foundation for its national telemedicine network based on innovative technologies, which will define scientific and engineering development of any country caring for health of its citizens.

The task for the nearest future is to expand the use of telemedicine technologies by physicians in all regions of Russia without exception, as well as to support the emergency medicine personnel, render assistance to residents of remote settlements and detached communities (vessels, offshore drilling rigs, etc.).

According to this analysis, experience of the national telemedicine may be vastly used in the course of profound technical upgrading of medical institutions in the regions and communities, as well as during the creation of integrated system to ensure quality medical assistance to the citizens of each country, based on the approved innovative mobile telemedicine technologies. This will ensure substantially more efficient and economically feasible use of budgetary assets.

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## Annex 9

### USA: The Role of Telemedicine in Long Term Care Facilities

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#### Introduction

Long Term Acute Care Hospitals (LTACH) have the ability to provide care to medically complex patients. However, LTACH's are faced with many of the same challenges that exist internationally with the decreased supply and high demand for Intensivist's and the nursing shortage [1]-[2]. An e-ICU® program provided an opportunity to optimize the clinical arena with telemedicine as the practical solution for an LTACH population. Integrating the e-ICU® program into the LTACH presented several benefits as well as unique challenges.

#### e-ICU®

Historically telemedicine has been used in a variety of ways to offer support, medical consults, and to provide a continuum of care for patients and medical staff. Once such use of telemedicine is the eICU® which is a safeguard or an additional layer of protection for Intensive Care Units (ICU). The e-ICU® concept was originally developed to combat the Intensivist physician shortage in ICU's but has been adopted in other care environments such as Post Anesthesia Care Units (PACU), LTACH's, and Emergency [3-5].

The e-ICU's® is emerging as a viable solution to aid in safety and quality of care for intensive care patients. An eICU® telemedicine system allows physicians and nurses to closely monitor patients from a remote location. The e-ICU's® use data streams from physiologic systems, ancillary systems, intelligent decision support and data mining tools integrated with an electronic medical record to permit coverage of large numbers of geographically remote patients from a central physical location. The technology leverages nurses and Intensivist's around a designated set of work hours strategically defined to support hospitals during hours of vulnerability [3]. These intelligent technologies channel critical care and hemodynamic data to the appropriate clinicians at the appropriate time to proactively impact patient care. The immediate benefit to using this innovative and effective technology is that critical care units are improving patient care in the face of an increasing Intensivist and nursing shortages [1]-[2].

The e-ICU® has the distinct advantage much like that of a panoptical where the flow of historic and real time data continually flows. The ability to have data and patient information centrally located through the eICU's® electronic data system, coupled with interfaces allows physicians and nurses to intelligently intercede for the patients benefit using smart alert systems [4]. The benefit of transparent data flow allows for the entire care team, whether physically located on site or remotely, to improve communications that positively impact on the patients care [3].

#### Long Term Acute Care

LTACH's evolved in the 1980s in response to an increased demand for ICU beds and an inability or lack of step down units to care for these patient populations. There are approximately 385 LTACH's in the United States [6]-[7]. Typical conditions or diagnoses for LTACH admission include but are not limited to ventilator weaning, skin ulcers or wounds, long-term antibiotic therapy, and stable but complex medical conditions. Historically these patients's are ICU outliers with an increased length of stay. Medicare rules for LTACH's

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indicate that the average length of stay must be greater than 25 days [6]-[7]. Acute care facilities often do not have the multidisciplinary teams and resources to optimally provide care for these types of patients whereas in an LTACH resources are optimized.

### **Challenges in LTACH**

Some of the most pressing challenges impacting patient care aside from the above mentioned human factor shortages is ensuring the transparency of data flow, it was reported [3] that the eICU® impacted positively on decreasing patient length of stay and infection rates. Decrease in these measures increases the return on investment in an ICU setting but these outcome measures remain to be seen in the LTACH environment. One documented eICU® impact on the LTACH has been the ability of the eICU® to provide oversight in the management of patients without needlessly transporting patients to a higher level of care. LTACH's operate under stringent guidelines around patient length of stay that impact payment structures to the LTACH's. The financial implications to send a patient to a higher level of care has a significant impact on the return on investment compared to the costs to institute an Intensivist led telemedicine program that can effectively manage patients within the LTACH structure [6]-[7].

A number of approaches have been employed to combat the Intensivist shortage. To date, efforts to decrease the Intensivist shortage, primarily with ICU support in mind, has lost ground in terms of supply and demand with some estimates indicate a 48% shortage by the year 2020 [1]-[2]. This reduction in physician workforce has allowed for one such LTACH to creatively utilize the eICU® telemedicine services and institute teleconsulting as a means to provide consultation for the unit's medically complex patients.

Another challenge within the LTACH was how the e-ICU could have an impact on the patients that were not being monitored. The e-Care Mobile® is a state portable electronic telemedicine device. It enables the e-ICU to provide expert medical care and nursing support to critically ill or deteriorating patients. The device is brought to the patient's bedside during all rapid response calls as a critical part of the care the response team. The device can be used to provide supervision or consultation by the providers in the e-ICU. In addition, the device has been placed into patients rooms that are confused or agitated to provide supervision.

### **Benefits of Integrating an e-ICU® Program in an LTACH**

Integrating an eICU into a LTACH enhances a culture of safety within the hospital. Clinicians in the Clinical Operations Room (COR) track compliance with evidence based practice for stress ulcers, ventilator bundle, sepsis bundle, low tidal volume ventilation, deep vein thrombosis prophylaxis, transfusions parameters, glycemic control and beta blocker usage. Processing large volumes of information in real time allows both the eICU® clinicians located in the COR and bedside clinicians to identify harmful trends in a patients' status. Recommendations are made by the critical care nurse or the Intensivist in the COR to the bedside nurse that initiates a proactive intervention. The COR team may be consulted by the bedside nurse or a hospitalist to discuss any complex LTACH patient from the room or in a designated consult area. The LTACH is meeting or exceeding national benchmarks in infections rates, falls, and response to alarms.

A mobile e-ICU® unit was integrated into the hospitals' Rapid Response Team (RRT). The e-ICU® mobile unit is used with all patients housed in the building and not a part of the LTACH. Patient rooms throughout the building can be connected via a landline port to the eICU® mobile unit allowing other patients access to the clinical expertise of the Intensives and critical care nurses working in the COR. Safety promotion, service excellence and evidence based practice were deciding factors in developing this model of care.

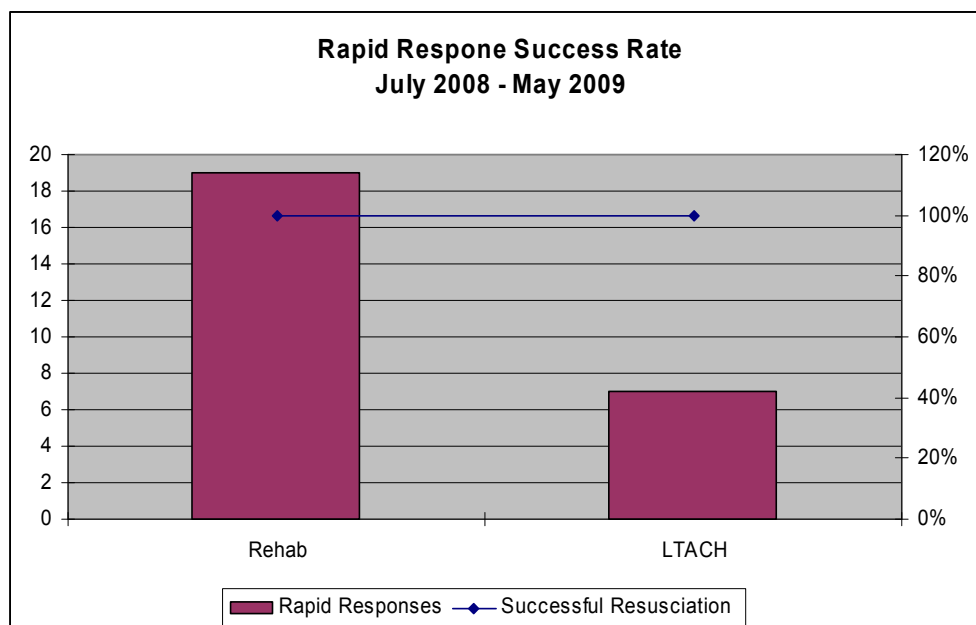
Hospitalists and a Critical Care Pulmonologist cover the LTACH seven days a week during the day for twelve hour shifts while night time coverage is provided by the e-ICU® Intensivist. Research demonstrates the strength of the Intensivist model in optimizing and improving patient outcomes [1]-[2].

Consults with a specialist or the patient's primary physician using the eICU® mobile unit in a patient's room promotes communication across the healthcare continuum. The consultant or primary care physician at the acute care hospital or from their personal computer can communicate with the patient by way of a bidirectional AV feed and patient's can converse and see the consultant. Physicians across the health system

have the ability to follow a patient from preadmission, hospitalization, discharge and rehabilitation which increased patient, family and physician satisfaction.

The benefits of these innovative pieces of technology to the LTACH impact both the patient and the staff. The LTACH and rehab units have a 100% success resuscitation rate in all rapid response. These devices have also led to high staff satisfaction due to the additional support systems created. The graph of rapid response success rate is given below in Figure 1.

**Figure 1:**



### Comment

A night time Intensivist model of care is not feasible for most LTACH's due to scarcity of the resource and expense of this care model. However, this LTACH found this model cost effective because of the reduction of inappropriate transfers, improved outcomes, healthcare providers, and patient/family satisfaction. The e-ICU® model of care in a LTACH is a viable solution that can provide a second layer of protection during the day while protecting the patient's during the most vulnerable time period at night. An e-ICU® can assist a LTACH in ensuring safety standards, service excellence while maintaining research based practices and processes.

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