

East Bhutan Tele-ECG Project

Muhammad A. Sadiq, Futoshi Ohyama, Hiroshi Juzoji, Isao Nakajima, Kinlay Penjor*

Tokai University Institute of Medical Sciences
Ministry of Health, Bhutan Government*

Nakajima lab. Tokai University Institute of Medical Sciences, Shimokasuya 143, Isehara, Kanagawa, 259-1143, Japan,
e-mail address: js2hb@is.icc.u-tokai.ac.jp

Abstract

The technology of Telemedicine and e-Health has now reached the stage awaiting wide scale application with promising potential benefits to many of the developing countries scourged persistently by the plague of resource constraints and harsh natural topography. The transmission of medical images from a remote understaffed health center to any bigger hospital for specialized and enhanced diagnosis is now a possibility through the use of Internet Protocol. This paper apart from looking at the state of telemedicine and its variety deals as a case study in the possibility of introducing tele-ECG over IP which can go a long way in enhancing the diagnosis of cardio-vascular diseases in the rural areas of Trashiyangtse and Lhuntse in east Bhutan.

Keywords: Internet Protocol (IP), Electrocardiography (ECG), Echocardiography

I. PURPOSE

The purpose of this paper is to analyze the current situation of the telemedicine project in Bhutan, which is now almost two years since its official launching. It also attempts to outline the best possible development to take advantage of the dynamic information technology using PSTN(Public Switched Telephone Network).

II. BACKGROUND

A. Bhutan

Location

A small mountainous kingdom located in the eastern Himalayas between the giants of China (Tibet) to the north and India to the east, south and west stretches from 150 km from north to south and 300 km from west to east, covering about 47,000 sq. km. With an estimated population of 658,000 in 2000, according to the Central Statistical Organization, the population density of Bhutan is among the lowest in Asia, and there still remain large tracts of unoccupied land.

Population

The population of Bhutan is estimated at 600,000. As in most developing countries, the proportion of the population under 15 is as high as 43%. As this age group enters the reproductive period, the population growth rate is likely to rise above the current 3.1%, unless family planning is more widely practiced. With this in view, various family planning options with the latest techniques are made freely available, accompanied by a family planning information campaign.

Bhutan has many different ethnic groups, the Ngalops, the Sharchops and the Lhotsams. The Ngalops and the Sharchops are mainly Buddhists and are concentrated to the

western and eastern Bhutan. The Lhotsams who are the Nepali-speakers and are comprised primarily of Hindus and animists are concentrated to the south of Bhutan. Bhutanese are friendly and hospitable people.

About 85% of the population lives in scattered rural villages homesteads and farms. Settlements have generally occurred in relatively flat areas, where climatic conditions are moderate. Migration from rural to urban centers, and the subsequent emergence of urban characteristics such as multi-storied buildings, restaurants, streets, shops, hotels and hospitals only began in the early 1960s. Today about 15% of the population dwells in urban townships like Thimphu, the capital, and Phuentsholing, a border town with India that is Bhutan's commercial hub.

Transport and Communications

Bhutan's total road network measures about 3,200 km and the main routes consist of an east-west highway (Root 1) and four north south highway. The road network connects all dzongkhags and 16 dungkhags. Major towns and villages are also connected by motor roads. However, some areas can only be reached by mule tracks, foot trails, and cantilever and suspension bridges. It takes over 20 hours by ambulance from east area to Thimphu, the capital city. Between east and west, there is one of the highest passes at a height of 3800m above sea level. Some cardiac patient cannot afford this transportation environment due to hypoxia.

Telecommunication services consisting of microwave (backbone), telephone, telegraph, telex, facsimile and E-Mail(Druknet), including the international telephone links are available to the dzongkha headquarters throughout the country except a few dzongkhags in western Bhutan. However, civil wireless facilities (VHF radio) are available in all the dzongkhags.

Healthcare Services

Healthcare in Bhutan is delivered in an integrated system through a four-tiered network consisting of the National Referral Hospital in the capital city, Thimphu, two regional referral hospitals (Mongar and Yebilabcha), and smaller district hospitals in the centers of each district. Rural healthcare is provided through a network of Basic Health Units (BHUs) staffed by a health assistant, nurse, midwife and a basic health worker. These medical practitioners also provide services to more distant villages through a system of outreach clinics that they visit on a regular schedule. In total, there are 28 hospitals (Fig. 1), 149 Basic Health Units (BHUs), and 426 outreach clinics located at strategic points across the country. The total hospital beds amount to 1023 and the population per bed is 622, which is still quite low

[illegible]

Figure 1 Existing Health Facilities

B. Tele-ECG

The transmission of ECG image has been very successful largely due to the small size of the transmitted images. In the Bhutanese experience also, Tele-ECG has been one of the most successful applications. The transmission of echocardiography needs higher bandwidth. However, still images of lesser size can be transmitted for expert consultation. Internet Protocol (IP) is one of the medium through which the transmission or teleconsultations are conducted. In this section, the East Bhutan. An electrocardiogram (ECG / EKG) is graphical recording of the electrical activity of the heart and is used in the investigation of heart disease. Electrocardiograms are generally of two types: a 12-lead ECG for use in diagnosing heart disease, and portable ECGs for monitoring patients at bedside. On the other hand, Echocardiography is the technique of examining the heart by use of ultrasound.

Internet Protocol (IP), the medium for the transmission of data and images, can be described as the common thread

that holds the entire Internet together (19). It is responsible for moving data from one host to another, using various cost-based techniques (or 'routing' algorithms). In other words, IP is the standard that defines the manner in which the network layers of two hosts interact. These hosts may be on the same network or reside on physically distinct heterogeneous networks (19, 20).

III. PROJECT

In collaboration with the Tokai University, Japan, two Tele-ECG projects through Japan's Grant Assistance for Grassroots Project (GGP) has been approved. Though delayed due to some logistic problem, it will be implemented within the first quarter of this year (2003). Under these projects, the two hospitals in Lhuntse and Trashiyangtse will be both equipped not only to conduct tele-ECG consultation but also Echocardiography in addition to making accessible to worldwide webs (21, 2). The consultation will be done with the specialist of the Jigmi Dorji Wangchuk National Referral Hospital (JDWNRH) through ordinary dial-up Internet connection. Both the Hospitals are amongst the most remote in the eastern part of the country. Lhuntse Hospital is located at about 541 km and Trashiyangtse Hospital at about 600 km from Thimphu and it takes more than three days by ambulance to reach Thimphu for both hospitals. The regional referral Hospital at Mongar can be reached in a day from both the hospital. Both the hospital doesn't have an ECG machine and is staffed with only one physician each. In view of the remoteness, human resources shortages and the potential of the telemedicine, the two hospitals are ideal and stand to benefit the most.

A. Project components

The two hospitals will be connected with JDWNRH through Dial-up type workstation linking with PSTN and Internet. The connection will be through Druknet the only Internet service provider (ISP) in the country, which provides 33.6 kbps of dialup connectivity.

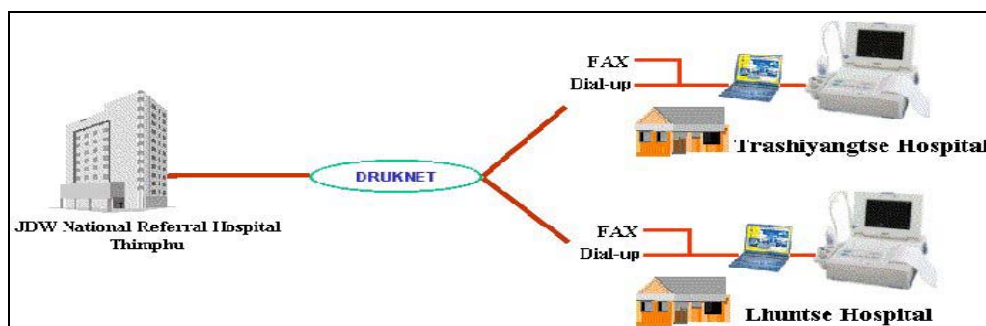


Figure 2 The concept of this project Tele-ECG and cardio echogram via PSTN linking with Internet
Equipment ECG equipment from the Fukuda D

Both the hospitals under the project will be equipped with a laptop computer and multi-purpose ECG equipment. The

ECG equipment from the Fukuda Denshi, a Japanese company, has an 12-lead ECG, Cardio echogram, Phonocardiogram, and computer aided analyzer software.



Figure 3: Lavie Laptop from NEC



Figure 4: FF Cardio FCU-2000 from Fukuda Denshi

Service to be provided

With the multi-purpose ECG machine connected through a dial-up workstation (laptop) linkage with *Druknet*, following teleconsultation services will be provided from the two hospitals;

- Tele-ECG
- Tele-Cardiology
- Tele-Phonocardiogram
- CME through access to www
- Other general teleconsultations through email

The Tokai University will conduct a weeklong voluntary training and tutorials for the users of the two hospitals and also undertake the installation of the equipments in the respective hospitals. A follow up visit to review the progress and experience will be made after six months.

B. Operation

Via PSTN, teleconsultations (over 20 cases at the first 3 months) were performed successfully from two hospitals. Transmitted data were shown in the figure 5, 6, 7.



Figure 5 An examination at Yangtse hospital, Bhutan



Figure 6 Transmitted Echography

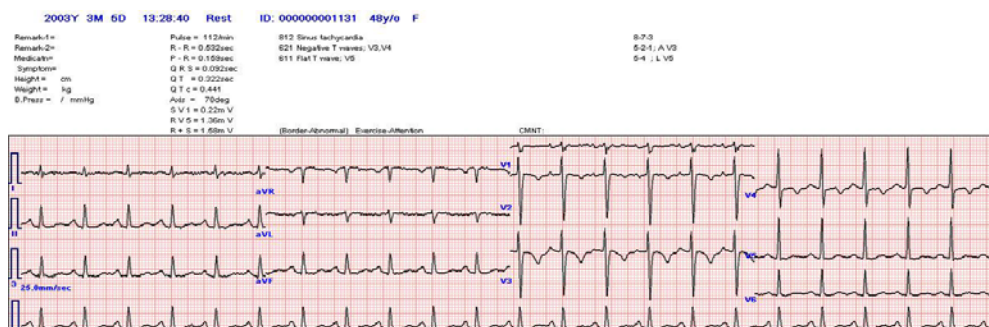


Figure 7 Teleconsultated ECG data from Yangtse hopsital

C.Second Opinion Center

APT (Asia –Pacific Telecommunity) second opinion center hosted at Tokai University.

From March to July 2003 thirty cases were (consultation) were performed. Consultation was obtained mainly for diagnosis and treatment purposes. Rheumatic heart disease is quiet common in developing countries as 10 percent cases were diagnosed to have rheumatic fever and appropriate consultation was given We also diagnosed cases of valsalva rupture (figure 7), aortic root dilatation (figure 8) and VSD (figure 9). One of the consultation seek from one of the hospital is exempld:

dear sir,

This is a case of Ms Dema 19 yr old student who is having persistant hemoptysis and giddiness for the last two years. She has no other complaints.

O/E she is avg built. General examination is WNL. She has a weak pulse in the left side and a good volume pulse on the right. BP is 140/90 in the right and only 100/70 in the left. There is no radiofemoral delay. She has a very prominent suprastenal pulsatile swelling which on palpation is likely to be arterial the suprasternal hollow is is full with the swelling Chest exam is normal clinically and so is the heart except the slightly loud second sound. No clinical evidence of heart failure.

Blood esr-75, ASO negative, Chest xray shows promonent aorta. I am sending her 2 D echo, PSL view please advise.

*Dr. P.Bhandari, DMO
Trashiyangtse Hospita*

The echo image (figure 8) showed aortic root dilatation and we advised the physician to refer the patient to India (as there is no cardiac surgery facilities in Bhutan) where she underwent ortic valve replacement. She was having grade 4 AR causing aortic root dilatation.

So this system proved to be very useful and excellent advises were given. This not only helped a lot in the better management of patients but also helped to improve the doctors, their cardiology knowledge as both the doctors had a very limited experience of working in cardiology. Here is a part of acknowledgment letter from one of the doctor.

Dear Dr. Sadiq,

Thanks for the advise. I am very happy and comfortable with all your opinions. this is largely improving my cardiology knowledge and also patient care.

Regards,

Dr. Bhandari

Now after four months of tele-consultation, the physicians are have been able to diagnose and manage cases of ischemic heart disease, rheumatic heart disease, heart failure and valular heart disease with confidence.

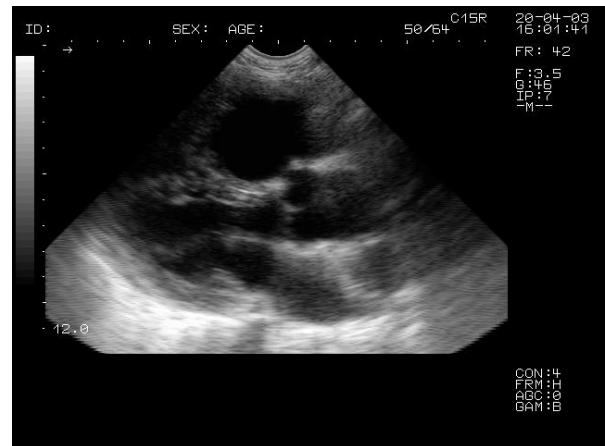


Figure 7 Valsalva Rupture



Figure 8 Aortic Root Dilatation



Figure 9 VSD

IV. CONSIDERATIONS

A. Benefits

The benefit to the two hospitals will be quite enormous. Some of the perceived benefits are outlined below;

1. Through *Teleconsultations*, some specialized services will be made available to the two remote hospitals. This will directly either reduce the number of expensive patient referral, which is a minimum of two days travel by ambulances, or save enormous cost through timely diagnosis of potentially life threatening diseases.
2. Prevention of Heart diseases is foreseen to be one of the greatest benefit targeting specially children in the two remote districts. Like in any other developing country many infectious diseases are rampant which most often eventually leads to heart valvular diseases. A juvenile patient of Mitral Valve stenosis if not treated will usually not survive more than 30 years. As such the early detection of heart problem especially in juvenile cases will go a long way in containing expensive medical treatment (which government have to bear).
3. The ultimate benefit to the government will be in containing or even reducing the medical expenditure on transportation of patients and avoidance of costly patient referrals to expensive bigger hospitals outside the country.

In addition a lot of other benefits can be perceived. The shortage of human resource to certain extent can be eased in addition to the accessibility of the hospital staff to the Worldwide web (WWW).

B. Universal Service Policy

Health care service is now becoming more information driven and the Royal Government through its multi-faceted program is committed to the Universal health care by being signatory to the WHO's *Health for all in 21st Century* and the UNDP's *Millennium Development Goal* towards improvement of quality of human life. WHO has already resolved Telemedicine to be a part of the strategy for *Health For All*. The ITU has also recognized the importance of Telemedicine and has now included it in the BDT Programme on E-Strategies and Application. However, the universal coverage or the drive for wide spread implementation of e-Health has been greatly hindered by not only initial capital intensive investment but also by high running cost especially in developing economies like Bhutan. Towards this end, complete or a great amount of concession for running expenses like telecommunication charges for such social service would go a long way in not only

encouraging new projects but also in sustaining the already established projects.

IV. CONCLUSION

E-Health or telemedicine is said to be a technology that is no more awaiting application as there is quite a substantial implementation experiences. Through continuous evolution telemedicine is now recognized as a powerful tool, which can be used for in actual patient care. The magnitude of its application is quite vast and as such even ITU has proposed that e-Health will be used as the correct terminology to reflect a much more broader definition. Even in case of Bhutan, the JDWNRH – Mongar Health Telematics has proved to be quite useful despite numerous logistic problems. The East Bhutan Tele-ECG project will also not only expand the telemedicine activity but also benefit the targeted communities of the two most remote locations.

In order to facilitate wider coverage the management at the central level needs to step up its expansion drive by approaching the government and various potential donors. Further to ensure the sustainability of the e-Health activities, human resource strengthening through periodic trainings for both the staffs and target users needs to be initiated quite vigorously. To reduce running cost of the e-Health activities and also to facilitate expansion, *Druknet* and *Bhutan Telecom* should help the Health Sector by either granting some concession on the monthly charges or by making available other cheaper modes of services like wireless options.

Acknowledgement

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