Telehealth for Mountainous and Remote Areas of Northern Pakistan

Hameed A. Khan and Irfan Hayee

Introduction

Pakistan is ranked 124 out of 191 countries in terms of health care. About a third of the population lives below the poverty line, with unhygienic living conditions, poor health, and food and water insecurity. As a consequence, there is a high burden of infectious and chronic diseases among people in Pakistan, especially women and children. Poor nutrition and repeated infections have aggravated the situation. According to a health assessment conducted by the Aga Khan University, Pakistan ranks 157th in the world in terms of infant mortality, and 39th in child mortality. Moreover, with agriculture being the main occupation in the country, the majority of the population still live in rural and remote areas that are underprivileged in terms of access to basic health care services.

The northern area of Pakistan, comprising five districts (Gilgit, Skardu, Diamer, Ghizer and Ghanche), is one of the most remote and disadvantaged regions of Pakistan. The area has a population of around one million people, who live in more than 600 villages scattered over 72,000 km² of rugged terrain. Lack of communications is a major problem.

People in the northern area of Pakistan have long been poorly served in terms of access to health and education services. The area is known for its difficult terrain, extreme climate and geographical remoteness from large cities. Baltistan and Hunza, particularly, being remote and underdeveloped mountainous regions, do not have access to high-quality health care services. The health facilities do not have specialists, particularly for women’s health care. Major hospital and health facilities are a long way away. For instance, Gilgit is about 800 km away from a tertiary health care facility. Owing to the lack of satisfactory health services, people suffer as a result of late diagnosis and treatment. Furthermore, the rural health centres (most of which do not have doctors) are not linked to the hospitals in the main urban centres, resulting in avoidable mortality and morbidity, especially among women, children and the elderly. Lack of information and communication facilities and the absence of development networking compound the problems.

The Commission on Science and Technology for Sustainable Development in the South (COMSATS) was established in 1994 to promote science and technology in all spheres of life. It has 21 developing countries as its members and there are 16 centres
of excellence. In view of conditions in the northern parts of Pakistan, COMSATS launched a project on telehealth, which went into service in 2005. Its objective was to facilitate access to specialized health services and education, and thereby contribute towards raising the standard of living in the area. The Baltistan Health and Education Foundation, which was working to improve health care services for women in the remote and backward regions of Baltistan, collaborated with COMSATS on the project. The International Development Research Centre (IDRC), a Canadian government development organization, was the principal funding organization (see Chapter 7).

![Image of northern area of Pakistan](image)

**Figure 23.1 Northern area of Pakistan**

**Telemedicine in northern Pakistan**

Establishing a telehealth service in the mountainous and remote areas of northern Pakistan required not only having reliable technology but also matching the services to the socioeconomic and cultural environment of the area. This required cultural change, although, after three years, the telehealth service is now well established and accepted by the local communities.

In the rural areas of Pakistan, the lives of people are strongly governed by cultural and traditional norms, which makes introducing change difficult. Women are particularly marked by certain limitations as far as their mobility and interaction with the outside world are concerned. In such a situation, building a rapport with the local people, convincing them to adopt telehealth and interact with people who did not belong to their community, as well as disclosing personal information, especially in the case of women, was a formidable task. However, the COMSATS team was successful in bringing about change in the attitudes of the local people. This meant involving
members of the local community in delivering the services, so that patients coming in for consultation did not feel alienated.

The lack of telecommunication infrastructure in the region was a major problem. The government had installed landlines (digital telephone exchanges) to some villages, but these were of poor quality and also expensive for the users. On an experimental basis, the government introduced wireless local loop (WLL) in some villages, but this was not very successful. The only Internet service provider (ISP) in Gilgit was established by COMSATS.

The technology required for the project was installed by COMSATS Internet Services (CIS), the executive agency of COMSATS. The tasks included:

- establishing an ISP at Skardu
- capacity building at the Gilgit node
- training the project staff
- operating the ISP at Skardu
- assisting with procurement of equipment
- documenting the technical aspects of the project.

The equipment for the project is listed in Table 23.1. A major task was obtaining a licence to operate an ISP in Hunza.

Very-small-aperture terminal (VSAT) links between Skardu and Islamabad and between Hunza and Islamabad were established at an initial bandwidth of 128 kbit/s. Internet bandwidth was provided from Islamabad at subsidized rates. Once an ISP had been established at Skardu, surplus money being generated could be invested in the telehealth services.

**Project experience**

**Medical services**

During the first phase of the project, a needs assessment was carried out at Skardu. This showed the need for teleconsultations in five medical fields. In order to develop standard operating procedures and to synchronize the efforts of the Telehealth Centre (Skardu) and the Resource Centre (Islamabad), a study was made of various aspects:

- level and type of medical services
- availability of medical specialists
The three major areas of focus were:

1. designing and establishing a telehealth centre
2. identifying a suitable team of medical specialists
3. selecting and procuring appropriate medical equipment.

Teleconsultancy services were required in five specialties: general medicine, cardiology, gastroenterology, dermatology and nephrology. After three years of operation, services are now being provided in all fields except nephrology. Services in psychiatry are being considered. It was initially expected that asynchronous (store-and-forward) telehealth would be used most frequently, but later on, as telehealth came into routine use, the synchronous (real-time) method became common.

<table>
<thead>
<tr>
<th>Table 23.1 Project equipment</th>
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<td><strong>Equipment for the resource centre at Islamabad</strong></td>
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<tr>
<td>Ethernet switch</td>
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<tr>
<td>Videoconference equipment</td>
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<tr>
<td>Computer (P -IV, 850+)</td>
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<tr>
<td>Printer (HP Laser Jet)</td>
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<tr>
<td>Scanner</td>
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<tr>
<td>Uninterruptible power supply (3 kViA)</td>
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<tr>
<td>Webcam – high-resolution</td>
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<tr>
<td>Air conditioners</td>
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<tr>
<td>Dish/VSAT equipment</td>
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<td>Satellite receiver</td>
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<th><strong>Equipment for telehealth at Skardu</strong></th>
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<tr>
<td>Videoconference equipment</td>
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<td>Computers</td>
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<td>Laser printers</td>
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### Equipment for the ISP at Skardu

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Generator (25 kViA)</td>
<td>1</td>
</tr>
<tr>
<td>Uninterruptible power supply (3 kViA)</td>
<td>3</td>
</tr>
<tr>
<td>Server (for authentication, proxy and billing)</td>
<td>3</td>
</tr>
<tr>
<td>Networking (e.g. cables and connector)</td>
<td>16</td>
</tr>
<tr>
<td>Switch (24 ports)</td>
<td>1</td>
</tr>
<tr>
<td>Satellite receiver/modem</td>
<td>1</td>
</tr>
<tr>
<td>Dish/VSAT</td>
<td>1</td>
</tr>
<tr>
<td>Router</td>
<td>1</td>
</tr>
<tr>
<td>HDSL modems</td>
<td>2</td>
</tr>
<tr>
<td>Access server</td>
<td>1</td>
</tr>
<tr>
<td>Computers</td>
<td>14</td>
</tr>
</tbody>
</table>

### Medical equipment

After careful examination it was felt necessary to have similar videoconferencing equipment at both the Telehealth Centre (Skardu) and the Resource Centre (Islamabad). The equipment chosen (VSX 7000, Polycom) transmitted video calls over an IP connection. The Telehealth Centre was established in the premises of the Abdullah Hospital in Skardu and operated by the collaborating institution, the Baltistan Health and Education Foundation. The hospital is a secondary-level health care unit. The Telehealth Centre is located close to the ultrasound room, reception and the conference room, which makes patient care efficient and reduces teleconsultation times.

To reimburse medical specialists for teleconsultation, it was decided to pay them for each visit to the Resource Centre, and not on the basis of the number of patients seen. Reimbursement for delivering seminars was handled separately. To coordinate a team
of medical specialists, it was necessary to have a coordinator between the specialists and the people at the Resource Centre and the Telehealth Centre.

**Telehealth Centre at Skardu**

Five medical specialists and a telehealth consultant were employed at Islamabad. Teleconsultancy services were operated for a test period, and then later run operationally for patients in Skardu. Training and orientation of staff at the Abdullah Hospital were carried out. Development of a patient information system and linkages with experts and donor and medical organizations were also made.

A total of 361 patients received specialist consultations in the first 4 months of operation. Dermatology was the most common specialty. Women benefited greatly from the service, and showed confidence and satisfaction. In one period, 101 female patients received a specialist consultation, in comparison with 51 male patients. Feedback received from the specialist doctors at Islamabad, as well as project staff at Skardu, called for increased bandwidth to improve the quality of the service.

**Experience with the service**

The level of trust and confidence of the community grew steadily, as indicated by the steady number of follow-up cases, which ranged between 15% and 20% of the patients each month. A substantial proportion of females benefitted from the service (58% overall).

Despite some problems due to connectivity, infrequent availability of a general practitioner at Skardu and difficulties in data transfer, the telehealth service continued smoothly with minor glitches, and the level of satisfaction of patients and doctors remained satisfactory (on the basis of initial and post-project interviews).

The 1000th consultation was conducted during May 2006. More importantly, women and children (between the ages of a few months and 13 years) were the main beneficiaries of telehealth services. Women account for 61% and children 21% of those receiving specialist consultations from doctors in Islamabad. It was observed that women and children are the ones who suffer the most in the absence of specialized medical services. First, they find it difficult to travel on their own to tertiary care centres in remote areas. Second, it costs them more to travel, since they are dependent on male family members to accompany them because of societal and cultural norms.

Another important fact that indicated the acceptance of the service was that people from rural areas came pouring in to receive specialist consultation. No promotional campaign was run to inform people from outlying areas, and word of mouth seemed to be enough. The consultation data show that in the first few months more
consultancies were provided for people from urban areas, while in the later months more consultancies were provided for people from rural areas (Figure 23.2).

Teleconsultations continued as scheduled after the launch of the service in April 2005, i.e. one session a week for dermatology, cardiology, gastroenterology and general medicine. However, the services were disrupted for some time in the wake of the earthquake of October 2005, which caused havoc in the northern parts of Pakistan and killed some 80,000 people.

Although the earthquake did not affect the Baltistan region directly, it made the specialists at the Resource Centre (Islamabad) unavailable for telehealth for most of the consultations in the following month and a half. Most of the medical specialists were engaged in serving a large influx of patients from the earthquake-hit areas at their principal medical facilities, and therefore routine consultations had to be reduced or postponed owing to the emergency situation.

![Figure 23.2 Number of teleconsultations during the first 14 months of the project](image)

**Problems and corrective measures**

**Connectivity**

Low bandwidth and poor connectivity were the major impediments to telehealth services. Although the telehealth clinic was connected to the ISP through an HDSL modem, the increased clientèle of the ISP at Skardu affected the bandwidth available
for data transfer and videoconferencing. Weather conditions and physical damage to copper wires also caused problems.

Various measures were taken to overcome these difficulties. The videoconferencing system was adjusted to make the calls at 128 kbit/s so that packet loss could be minimized. This greatly improved the audio quality during consultations. Separate downlink services were arranged from another service at the ISP in Skardu to make VSAT link bandwidth available for the telehealth project (Figure 23.3). An average of only 32 kbit/s was then used by the COMSATS Internet service from the total 128 kbit/s VSAT link. Fine tuning was done at the ISP to decrease the choking and packet loss.

The graphs of bandwidth usage obtained from the ISP identified the time when the Internet usage was least, and the timings for teleconsultation were adjusted to take advantage of this. The connection between the Telehealth Centre and the ISP was lost twice owing to physical damage to the copper wires between the two sites, which subsequently halted the telehealth service for two or three days each time. Therefore, a second cable link was made available so that it could be used as an alternative connection in case of similar problems in the future.
Figure 23.3 Telecommunications

Unavailability of human resources

Infrequent availability of general physicians or well-trained paramedical staff has been one of the major problems in providing the telehealth service at Skardu. Most doctors in Pakistan prefer to work in large cities (either to gain experience or to earn more), and only those who are visiting their families, or female doctors whose spouses are stationed in army units, are available in rural areas. Often, these doctors are available only for a limited period of time, and many leave within a few months. There are few paramedics in the northern parts of Pakistan, and not many are sufficiently trained to provide telehealth services. In view of these problems, the following steps were taken.

A doctor dedicated to the telehealth service at the Abdullah Hospital in Skardu was employed for telehealth. The doctor’s role was to present accurate and detailed information about the patients (e.g. the history and basic physical examination results) to the specialist doctors. Having detailed medical data is important for successful
tele-consultation. In view of the large number of female patients seen by telemedicine, a female doctor was hired.

All the specialists opined that the quality of consultation was satisfactory when there was a supporting doctor (general physician) present at the remote site to provide the basic data. In the absence of a general physician, it was observed that the consultations were manageable, but did not meet the satisfaction of the specialists.

The computer operator, who was responsible for running the remote Telehealth Centre, gained a lot of experience through hands-on training. He was formally supervised by the doctors at the Telehealth Centre and the Resource Centre, which helped him to gain expertise in delivering services. After training, the computer operator could take a good patient history and perform a general physical examination, e.g. checking blood pressure, pulse and temperature. This was useful if the general physician at the remote centre was not available. Given suitable training, a paramedic or non-medical person can be a useful substitute when a doctor is not available for conducting telemedicine.

**Patient information software**

The patient information software proved to be of great help in maintaining the medical records of visitors and patients. Initially, the patient information system was developed as a client–server application. The information was thereafter transmitted using file transfer protocol (FTP) servers at both ends. In addition, FTP servers were placed at the ISP to increase the rate of transfer of files, as well as to avoid undue delays in the transfer during power failure or problems in the computers. This option improved the situation to some extent, leaving only the problem that complete data on a patient could not be accessed from one program, making it rather time-consuming. In the light of experience, it was realized that a web-based solution would be a better way in the future of providing similar services from different sites.

It was also realized that there is a need to provide the patient data to the specialists at their workplace and at their homes, so that they can conduct telemedicine without coming to the Resource Centre. Visits of the medical consultants to the Resource Centre could be reduced by using a web portal.

**Service methodology**

Although the consultations in this project were mainly based on real-time videoconferencing, in a few instances where live consultation was not possible (for technical reasons), the diagnosis and expert opinion were based on store-and-forward information. About 10% of all consultations were performed in this way. It turned out that patient management decisions were easily made in dermatology, while, in the single instance of a cardiology case, it was most difficult. The reason may be that the images in dermatology cases are self-explanatory and require little elaboration,
whereas in cardiology there are often many unanswered questions. However, the store-and-forward technique was more time-consuming than live interaction, for both the physician and the patient.

In discussion with the specialists, it appeared that both patients and doctors felt that store-and-forward consultations were inferior to real-time consultations, except in dermatology. In dermatology, a detailed history of the patient along with high-resolution pictures could be sent easily, thus facilitating the correct diagnosis.

**Recommendations**

Based on our experience, we recommend that careful attention be paid to the design and implementation of telehealth services in underdeveloped areas. It is feasible to utilize relatively inexpensive and robust equipment that is easy to operate and repair. Activities must be chosen that result in benefits for as many people as possible, while the technology chosen should be compatible with immediate health care needs.

As well as support from the government, it is important to persuade private sector and local organizations to participate in planning and implementing telehealth services. The participation of local organizations will not only assist in developing health care services attuned to the local settings, but also facilitate the acceptance of these services in the area. The collaboration between COMSATS and the Baltistan Health and Education Foundation has been a success. It demonstrates how local organizations can catalyze the implementation of telehealth and bring ownership to the community.

Appropriate guidelines need to be developed for establishing high-quality and consistent standards for teleconsultations. Formulating a tele-education strategy and conducting a resource inventory may be helpful in this regard.

An important factor in a successful telehealth service is the information management system. This should be devised in conjunction with the specialists and other doctors who are involved in delivering the telehealth services.

**Conclusions**

Despite the difficulties, telehealth can be a practical method of providing specialist consultations and supporting other health care services for people in developing countries, particularly those in remote regions. Telehealth can also be used to improve access to the health care providers of these regions and reduce their isolation.

Establishing a telehealth service in Skardu was a difficult task. However, with an enthusiastic team, the project was successful, and it is clear that many patients, especially women and children, have benefited from the service. Those who are
unable to travel to cities to obtain specialist advice now have easy access to specialist health care.

Economies may be possible in future by using digital cameras or newer versions of webcams, instead of specialized videoconferencing equipment. In future, the resource centre might be established at a hospital to save time for both the doctor and the patient. While promoting telehealth to doctors, it is important to emphasize that existing health care delivery methods will not be replaced – rather, telehealth will supplement them.

Finally, the general public, patients and health professionals should be informed as much as possible about telemedicine, so that they feel comfortable with the concept. This will mean that future generations will feel at ease in using telehealth to improve traditional methods of health care delivery.

Further reading


References


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