Telehealth in the Developing World

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Laurent Elder and Michael Clarke

Introduction

In 1970, Lester B Pearson, then Prime Minister of Canada and a strong proponent of international development, stated the need for ‘a new instrument concentrating more attention and resources on applying technology to the solution of … economic and social problems on a global basis’. In May 1970, the International Development Research Centre (IDRC) was founded by an act of the Canadian parliament. One of the Centre’s priorities was Information and Communication Technologies for Development (ICT4D), since access to information and an effective means to communicate are necessary for sustainable development. IDRC’s ICT4D programme now supports projects in Africa, Asia, Latin America and the Caribbean at a cost of nearly Can$20 million each year.

Exploring the means by which information and communication technology (ICT) can solve health problems was part of IDRC’s early work in ICT4D. The IDRC was interested in answering questions such as the following:

- How can ICTs play a role in providing health care services to rural and remote regions of developing countries?
- Which applications afford the most potential with respect to effectiveness, adaptability and sustainability?
- What are the challenges to setting up e-health programmes in developing countries?
- How do different user groups access and use these programmes?

Early work

Much of the work supported by IDRC in the 1990s in the area of health and ICT focused on the development of health information systems. It included projects such as the Latin American Health Information Network, the National Health Information Network (Colombia) and HealthNet. The IDRC also supported the application of
Experiences and lessons learnt from telemedicine projects supported by the IDRC

dearth of telecommunication infrastructures in developing countries. It was not until the Internet started to become available in developing countries that IDRC began to investigate the potential of telemedicine.

Telemedicine in Uganda
An early project to establish telemedicine in Uganda began in 2000. The project, which received Can$452 300 in funding, focused on health problems such as cholera, malaria, HIV/AIDS and the application of telemedicine to address them. To achieve this, Makerere University School of Medicine aimed to establish telemedicine centres at Mulago and Butabika, set up the telemedicine infrastructure in the centres, conduct online consultations with the rural centres and start a continuing medical education programme.

What actually happened? As was typical of early telemedicine projects in Africa, there were difficulties in procuring appropriate telemedicine equipment and in setting up the telecommunications, which were based on VSAT. (A very small-aperture terminal, or VSAT, is a two-way satellite ground station with a dish antenna.) No online consultations actually took place between Kampala and the rural health centres, and there was no evidence of any beneficial health outcomes for the rural population.

None the less, with the support of Memorial University in Canada, the telemedicine in Uganda project helped to train staff in telemedicine activities. It also helped to focus government attention on rural health problems and it developed educational materials that are still used to this day. The project also contributed valuable lessons for future e-health projects. It set the stage for more successful e-health projects in Uganda, such as the Uganda Health Information Network and a subsequent telemedicine project in Mengo.

As far as IDRC was concerned, the project helped the organization better understand the challenges of supporting telemedicine projects in Africa and helped define some of the key questions that it would try to answer. These questions included how appropriate local capacities should be built, both technical and institutional. Second, there was a need to focus on ‘e-readiness’, which is the state of a country’s ICT infrastructure and the ability of its consumers, businesses and governments to use ICT for their benefit. Finally, the IDRC needed to think about how it could help answer the key underlying question: is telemedicine a viable method for solving health problems in developing countries? In the Uganda project, cost–benefit analyses had not been conducted and health outcomes had not been measured, mainly because of the problems of implementing the pilot. All of these lessons helped shape IDRC’s thinking about supporting the development of effective health applications (see below).

E-health applications in Asia
The IDRC programme, Pan Asia Networking (PAN), supports research into new ways of using ICT in the areas of health, education, livelihoods and governance. Most of
the activity related to health occurs in the PAN R&D Grants Program. An example is the Pan Asian Collaborative for Evidence-Based eHealth Adoption and Applications (PANACEA) project, discussed in greater detail below. The health-related projects that have been funded are summarized in Table 7.1. Some recent evaluations have helped to shed light on the outcomes of some of these projects. There were two activities related to telemedicine in India and Indonesia.

The first project concerned the impact of telemedicine on rural health in selected villages in India. The project aimed to field test with the help of N-Logue, a low-cost medical kit, called ReMeDiTM. The equipment was developed by Neurosynaptic Communications Pvt Ltd and installed in rural Internet kiosks around Tirupattur. The object was to transmit medical information to a doctor in Tirupattur.

After the service was launched, there was an increase in the number of visitors to the kiosk. However, following the initial interest, the number of visitors dropped precipitously to a few regular, repeat visitors. The drop was explained by the following factors: the kiosk operator’s ability to administer the equipment properly; acceptability by the villagers; identification of the kiosk in a place where medical care is already dispensed; lack of awareness of the service; distance of the doctor from the village; and availability of competing services such as Registered Indian Medical Practitioners, Primary Health Centres and local doctors. Although the project was not able to

<p>| Table 7.1 Telemedicine and e-health projects funded by the PAN Asia small grants programme |
|---------------------------------|---------------------------------|---------------------------------|-----|</p>
<table>
<thead>
<tr>
<th>Country</th>
<th>Project</th>
<th>Organization</th>
<th>Grant (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>ICT-enabled life skill and sexuality education for adolescent girls</td>
<td>Centre for Women’s Development and Research</td>
<td>8911</td>
</tr>
<tr>
<td>India</td>
<td>Using ICT to build capacities of HIV/AIDS service providers in India</td>
<td>SAATHII (Solidarity and Action Against The HIV Infection in India)</td>
<td>29 786</td>
</tr>
<tr>
<td>India</td>
<td>Impact of remote telemedicine in improving rural health, India</td>
<td>n-Logue Communications Pvt Ltd</td>
<td>29 313</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Development of ICT-based telemedicine system for primary community health care in Indonesia</td>
<td>Biomedical Engineering Program, Department of Electrical Engineering, Institut Teknologi Bandung (ITB)</td>
<td>29 479</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Development of ICT-based mobile telemedicine system with multiple communication links for urban and rural areas in Indonesia</td>
<td>Biomedical Engineering Program, Department of Electrical Engineering, Institut Teknologi Bandung (ITB)</td>
<td>29 479</td>
</tr>
<tr>
<td>Nepal</td>
<td>Telemedicine in Nepal: a pilot project</td>
<td>HealthNet Nepal</td>
<td>30 000</td>
</tr>
<tr>
<td>Pakistan</td>
<td>ICT-assisted learning tool for the deaf in Pakistan</td>
<td>Sustainable Development Networking Programme, Pakistan</td>
<td>28 500</td>
</tr>
<tr>
<td>Philippines</td>
<td>A community-based child injury surveillance system: rapid data collection using SMS</td>
<td>Medical Informatics Unit, College of Medicine, University of the Philippines</td>
<td>22 642</td>
</tr>
<tr>
<td>Philippines</td>
<td>Mobile telemedicine and information resource system for community health workers</td>
<td>SynapseHealth Solutions, Inc</td>
<td>29 784</td>
</tr>
</tbody>
</table>
Figure 7.1  Indonesian mobile telemedicine application being demonstrated

Figure 7.2  Indonesian mobile telemedicine application
document any health outcomes, it was – contrary to the Ugandan experience – able to demonstrate actual telemedicine activity.

The second project, in Indonesia, was to develop a telemedicine system for primary community health care. It was based on existing Internet technology to enhance PC-based medical stations. The pilot telemedicine network consisted of six medical stations in community health centres, and a station for the referral hospital, health office and a test laboratory. The system included teleconsultation and telediagnosis applications, medical information display software, a blood pressure and fetal heart rate interface, and an ECG interface (Figures 7.1 and 7.2).

It was found that human resource capacity building, in particular training to facilitate computer and telemedicine adoption, required substantially more time than expected. The project therefore demonstrated the significant role that human resource development plays in the implementation of telemedicine systems. However, as before, no findings were documented on the effect that the pilots had on people’s health or health systems.

In a report commissioned by IDRC, the projects listed in Table 7.1 were assessed in order to evaluate their outcomes. The factors examined were:

- knowledge production – any type of publication
- research targeting, capacity building and absorption – follow-on research, training of staff
- e-health solution adoption or integration – expansion or adoption of an e-health solution
- informing policy – policy documents, meetings with government officials
- broader community, institutional, or country benefit – including social and economic benefit
- health benefits to individuals or the population – more effective health care.

All projects were then ranked in terms of health outcomes and common themes were identified. The most troubling common theme was that all projects ranked ‘low’ with respect to demonstrated health benefits.

When Scott compared the projects, he saw that several common deficiencies had an adverse effect on nearly all of them. The deficiencies included:

Lack of planning for a sound, strategic health needs assessment, lack of planning for sustainability of (proven) solutions, lack of consideration for and mitigation of change management issues, lack of sound evaluation planning or execution, limited or no dissemination (formal or informal) of findings, and no significant or structured knowledge translation and transfer to influence decision- or policy-making around future e-health implementations. ... In addition, several general issues came to light, which also will need to be addressed. These included considerations around application software (i.e. open source versus proprietary solutions), application focus (e.g. use of traditional versus more novel technology such as GIS or m-health tools8), and local e-health knowledge and expertise (i.e. need for skill transfer and capacity building).
Present work

The early telemedicine projects that IDRC supported did not achieve all that was expected of them and raised more questions than it answered. Present projects include work in Africa and Asia.

Eastern and southern Africa

In 2004, the AfriAfya organization undertook a study in eastern and southern Africa in conjunction with other African partners. The project was designed to study the application of ICT in the HIV/AIDS response in Uganda, Kenya, Tanzania, South Africa and Botswana. After conducting a literature review, the project staff undertook an electronic survey of individuals and organizations involved in HIV/AIDS matters. There were 990 respondents in a face-to-face survey undertaken in Tanzania and South Africa.

Unsurprisingly, the study found that South Africans and Tanzanians generally obtained their information on antiretroviral treatment (ART) from traditional media, rather than new media (Table 7.2). However, a surprisingly high proportion (30%) of South Africans obtained information from mobile phones and SMS. The assumption is that, as access to mobile telephony and the Internet rises in Africa, so will the number of people accessing health information from mobile phones.

According to the survey, illiteracy ranked highest of the factors impeding the use of ICT in both Tanzania and South Africa (although all factors scored highly in the latter). The results echo most of the research done by IDRC, which shows that illiteracy and localization matters are generally seen as among the most important factors impeding the more widespread use of ICT (Table 7.3).

Table 7.2 Sources of information on antiretroviral therapy. Values shown are percentages of sample (n = 990)

<table>
<thead>
<tr>
<th>ICT</th>
<th>South Africa (%)</th>
<th>Tanzania (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print</td>
<td>75</td>
<td>53</td>
</tr>
<tr>
<td>Radio</td>
<td>88</td>
<td>81</td>
</tr>
<tr>
<td>TV</td>
<td>83</td>
<td>50</td>
</tr>
<tr>
<td>Video</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>Audiotapes</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Telephones</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>Face-to-face meetings</td>
<td>77</td>
<td>82</td>
</tr>
<tr>
<td>Mobile phones and SMS</td>
<td>31</td>
<td>10</td>
</tr>
<tr>
<td>Computer/CDs</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Email</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Internet</td>
<td>25</td>
<td>2</td>
</tr>
</tbody>
</table>
The respondents perceived that radio, print media and TV, as well as face-to-face meetings, were ‘extremely effective’. However, the majority of respondents did not know whether computers, email and the Internet could be effective (Table 7.4). Strangely, almost 9% saw the Internet as ‘harmful’, the highest percentage in that category. One can question the methodology of a perception questionnaire, as well as the terms used. For example, what does ‘harmful’ actually mean? What is meant by ‘extremely effective’? However, one cannot deny that conventional communication methods are still perceived as the most widely used modes of information transmission.

Finally, according to the AfriAfya study, the best practices for using ICT in the fight against HIV/AIDS were:

<table>
<thead>
<tr>
<th>Table 7.3 Factors impeding the use of ICTs for the fight against HIV/AIDS. Values shown are percentages of sample (n = 990)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>Inappropriate language</td>
</tr>
<tr>
<td>Inappropriate and embarrassing messages</td>
</tr>
<tr>
<td>Lack of information, education and communication materials</td>
</tr>
<tr>
<td>Lack of feedback mechanism</td>
</tr>
<tr>
<td>Lack of enabling ICT policies</td>
</tr>
<tr>
<td>Poor infrastructure/physical access</td>
</tr>
<tr>
<td>People’s attitudes</td>
</tr>
<tr>
<td>Traditional/cultural beliefs</td>
</tr>
<tr>
<td>Cost</td>
</tr>
<tr>
<td>Illiteracy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 7.4 Effectiveness of ICTs. Values shown are percentages of sample (n = 990)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
</tr>
<tr>
<td>Print</td>
</tr>
<tr>
<td>Radio</td>
</tr>
<tr>
<td>TV</td>
</tr>
<tr>
<td>Video</td>
</tr>
<tr>
<td>Audiotapes</td>
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<tr>
<td>Telephone</td>
</tr>
<tr>
<td>Face-to-face meetings</td>
</tr>
<tr>
<td>Mobile phones/SMS</td>
</tr>
<tr>
<td>Computer/CDs</td>
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Finally, according to the AfriAfya study, the best practices for using ICT in the fight against HIV/AIDS were:
1. Use of mobile phones and SMS
2. ICT for up-to-date HIV management information
3. ICT for mobilization
4. A combination of different forms of ICT
5. Telephone counselling.

The main lessons from this research were: that the use of ‘modern’ ICT is still very limited, but that there is huge potential; that institutions and health workers remain reliant on ‘conventional’ ICT and that there is therefore a need to integrate both ‘modern’ and ‘conventional’ to obtain the best results; and, perhaps most important, that to change perceptions and behaviours requires careful planning and patience.

**Acacia project**

Most mobile telecommunications infrastructure in Africa is too slow and expensive for connecting computers to the Internet. However, low-bandwidth applications have emerged that use mobile phones or personal digital assistants (PDAs) such as Palm Pilots, to connect via mobile networks. While information designed and formatted for the web is generally too bandwidth intensive to be transmitted over mobile networks, it can be formatted for small devices and low-bandwidth transmission. PDAs and smart phones are also seen as advantageous because of their robustness (no moving parts), their relative affordability, and their ability to be maintained in areas with little or no electricity infrastructure through the use of solar power rechargers. Examples of Acacia-supported mobile-enabled health applications include:

- automation of demographic surveillance activities, such as those at the core of pioneering health care initiatives, for example the Tanzanian Essential Health Interventions Project;\(^{10}\)
- the use of SMS reminders in the treatment of tuberculosis in Cape Town;\(^ {11}\)
- delivery of continuing medical education and professional development via PDAs;\(^{12}\)
- delivery of time-sensitive alerts to patients and health workers;
- maintenance of patient records for HIV-positive patients’ lifelong drug treatments;
- management of specific health care initiatives such as the roll-out of ART and tuberculosis treatment initiatives.\(^ {13}\)

The IDRC programme Acacia has funded projects in all of these areas. The main research questions are:

- What are the most effective, relevant, affordable and scalable technologies to facilitate mobile health delivery?
- Can mobile-enabled health services and applications reduce the costs of health service management and delivery? What is the cost–benefit of using these applications?
- What kinds of health services can best be enabled through a mobile infrastructure?
• How are economies of scale being realized across the continent, and how can innovations be shared between African countries?
• What are the social effects of the introduction of these technologies in rural areas?
• What is the relationship between mobile health applications and broadband technologies, including VSAT?

Pan Asia Networking

In the Pan Asia Networking programme, more pervasive technologies, such as mobile phones and PDAs, are expected to be important for health applications. Since mobile phone use is more widespread in Asia than in Africa, it is clear that there is great potential in Asia. The PAN programme emphasizes that more research is needed to gauge which applications and projects in the area of health have made a difference, to understand why they have or have not been successful, and, when warranted, to scale them up. However, the fast pace of innovation in both ICT and health research means that there is also a need for developing, implementing and evaluating new applications, particularly in the area of demographic surveillance of disease incidence and medical compliance, using new technologies such as mobile devices.

Another important matter in Asia is pandemics. Severe acute respiratory syndrome (SARS) and Avian influenza are serious threats to the health of Asians, as well as the rest of the world. A key to reducing the spread of these infectious diseases is to ensure that appropriate information on outbreaks is captured and communicated to the relevant experts as quickly as possible. ICT can therefore play an important role in helping to prevent or control pandemics, although more research and experimentation are needed to identify the best means of communication in rural and remote areas, where many of these outbreaks begin.

The questions that PAN would like to answer are:

• Which ICT health applications have had the most beneficial outcomes on people’s health and health systems? What are the best ways of ensuring that beneficial outcomes can reach the segment of the population that does not have adequate access to health services?
• What is the potential of using new pervasive technologies, such as mobile phones, to make the delivery of health services or information more effective?
• What types of applications are best suited to help prepare for, or mitigate the effects of, pandemics such as SARS and Avian influenza?

PANACeA project

The PANACeA project (Pan Asian Collaborative for Evidence-Based eHealth Adoption and Application) will support research on e-health solutions in Asia. The research programme includes:

• a portable system for telemedicine and health information in rural and remote areas;
Experiences and lessons learnt from telemedicine projects supported by the IDRC

- a pilot programme in Mongolia and the Philippines of remote consultation to improve health services for rural mothers;
- a disaster/emergency telemedicine system;
- a cost–benefit analysis of hospital information management system data mining and data warehousing;
- an evidence-based approach to mainstreaming e-health initiatives in primary care;
- basic intervention research on e-health for persons with disabilities;
- online tuberculosis diagnostic committees for clinically suspect, sputum-negative patients in the TB-DOTS programme;
- use of mobile phones for referral of pregnant women.

The research programme also includes research activities such as reviews of telemedicine and health informatics in Asia.

Future work

IDRC will continue to support research and development projects in telemedicine and e-health in its next five-year planning cycle beyond 2010. Sufficient evidence has been generated from work carried out by IDRC partners and others to show that implementing telemedicine and e-health applications can have many benefits, including direct benefits to patients. The benefits include reductions in medical errors, cost savings, real-time monitoring of public health incidents, and provision of validated data and information for health systems decision and policy making. However, there is a continuing need to support research that demonstrates these benefits within the framework of a cost–benefit analysis in order to justify the often substantial initial investments associated with telemedicine. This, of course, is particularly significant in the context of developing countries with limited financial resources and telecommunications infrastructure.

Telemedicine and e-health applications that are shown to be appropriate, affordable and effective in one region can be adopted in other regions, provided that they are localized and contextualized. This should be within the capacity of the networks of ICT workers and researchers that IDRC now supports around the world.

IDC’s work on telemedicine and e-health research in developing countries depends on innovation. Unfortunately, in several projects, satisfactory results were not achieved, for the reasons indicated above. However, it should be noted that the average failure rate for ICT projects is about 50% and is no different in the health care sector specifically. Such high failure rates are not acceptable in most countries. The research that IDRC supports in this area should improve the likelihood of success.

Our research programmes will also continue to respond to emerging technologies and markets. As pointed out above, we have developed a number of research collaborations focusing on the use of mobile telephony as a device for the monitoring, management and delivery of health care. The needs of people living in developing countries
are evident, but, ultimately, depend on a healthy society with full access to effective health care. IDRC is committed to helping them achieve just that.

Further reading

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