ORIGINAL ARTICLE

COACTION PUBLISHING

The role of information communication technology (ICT) towards universal health coverage: the first steps of a telemedicine project in Ethiopia

Fassil Shiferaw[1]* and Maria Zolfo[2]

[1]Ethiopian Telecommunication, Department of Medical Services, Addis Ababa, Ethiopia; [2]Institute of Tropical Medicine, Clinical Sciences Department, Antwerp, Belgium

Background: Eighty-five per cent of the Ethiopian population lives in remote areas, without access to modern health services. The limited health care budget, chronic shortage of health care workers and lack of incentives to retain those in remote areas further jeopardize the national health care delivery system. Recently, the application of information communication technology (ICT) to health care delivery and the use of telemedicine have raised hopes.

Objective: This paper analyzes the challenges, failures and successes encountered in setting-up and implementing a telemedicine program in Ethiopia and provides possible recommendations for developing telemedicine strategies in countries with limited resources.

Design: Ten sites in Ethiopia were selected to participate in this pilot between 2004 and 2006 and twenty physicians, two per site, were trained in the use of a store and forward telemedicine system, using a dial-up internet connection. Teledermatology, teleradiology and telepathology were the chosen disciplines for the electronic referrals, across the selected ten sites.

Results: Telemedicine implementation does not depend only on technological factors, rather on e-government readiness, enabling policies, multisectoral involvement and capacity building processes. There is no perfect 'one size fits all' technology and the use of combined interoperable applications, according to the local context, is highly recommended.

Conclusions: Telemedicine is still in a premature phase of development in Ethiopia and other sub-Saharan African countries, and it remains difficult to talk objectively about measurable impact of its use, even though it has demonstrated practical applicability beyond reasonable doubts.

Keywords: *telemedicine*; *eHealth*; *developing countries*; *pilot project*; *Africa*; *Ethiopia*

Received: 9 December 2011; Revised: 29 February 2012; Accepted: 5 March 2012; Published: 2 April 2012

More than three decades have passed since the Alma Ata vision to ensure 'health for all by the year 2000'. Its spirit remains alive and kicking, with the world still aiming for universal coverage in terms of access, equity and quality of care (1).

In Ethiopia about 85% of the population lives in remote locations, far away from the overcrowded urban areas, without access to modern health care services. Hence, the health care system is unable to respond both quantitatively and qualitatively to the health needs of this population. Access to modern health care and specialty services is still very limited, and it is further challenged by the ever growing case loads of HIV/AIDS, tuberculosis and malaria, and the rise in non-communicable chronic illnesses, like diabetes and hypertension.

Information and Communication Technology (ICT) is revolutionizing our life, our ways to interact with each other, and day-to-day life and work. Its application in health is described broadly as eHealth, which includes telemedicine[1], electronic medical records, and health

[1]According to a WHO definition, telemedicine is 'the delivery of health care services, where distance is a critical factor by all health care professionals using information communication technology for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation and for continuing education of health care providers all in the interest of advancing the health of individuals and communities' (WHO, 1997).

 Citation: Glob Health Action 2012, **5**: 15638 - DOI: 10.3402/gha.v5i0.15638

information systems with decision support, mobile health and eLearning tools. eHealth has shown potential in facilitating a better health care delivery system, leading to better health and universal health coverage (2). It creates access, enhances quality, improves primary health care interventions and can act as a solution for situations where human resources for health are scarce (3).

This paper presents an Ethiopian telemedicine case study, one of the earliest telemedicine pilot projects in east Africa. It provides an overview of its challenges, successes and failures, all of which can be taken as lesson for future telemedicine applications in resource-limited settings, in the region and elsewhere.

Methods

This is a descriptive case study of the first Ethiopian telemedicine project, run between 2004 and 2006, and it analyses the reasons for its non-successful adoption and implementation. This pilot was started in 10 health care sites all over the country, with two physicians per site selected to participate. The idea of the telemedicine project was pioneered by the International Telecommunication Union, supported by United Nations Economic Commission for Africa (UNECA), infoDev and many other local stakeholders.

The sources of information for this paper are derived from project documents, reports, baseline surveys and final semi-structured interviews, conducted by the corresponding author. Before the start of the pilot, the study selected participants had to fill in a questionnaire regarding their own computer literacy and skills: this provided a snapshot of participants' past and present use of technology and guided later the development of complementary introductory computer trainings.

At the closing of the project semi-structured interviews were conducted during site visits to six of the ten selected locations and through telephone conversations with the participants from the remaining four sites. One physician per site was interviewed, and the themes explored included: training satisfaction, appreciation/issues related to project coordination, and administrative/technical problems encountered during the implementation of the project. The interview framework was developed by the corresponding author and included the above mentioned topics as well as questions for discussion. The qualitative and quantitative information gathered from each site was entered into excel charts and thereafter displayed in simple tables, line graphs, or histograms. Consent was obtained from patients before any photographs were taken to be posted on the telemedicine system. The images, along with part of the patient's record, were stored in password-protected systems, accessible only to physicians registered on the system.

Results

Assessment of computer knowledge of project participants

A survey carried out prior to the start of the pilot among participating physicians, showed that 25% of participants had *average* computer knowledge, 65% *minimal* computer knowledge, and 10% reported to be *computer illiterate*. To address this gap, participants went through intensive basic computer training as well as a number of theoretical and practical telemedicine sessions, over a period of 2 weeks.

Software development

During project implementation, a telemedicine software from WDS technologies, Switzerland, was trialled. It was found that the software platform minimum clinical data compression rate was too poor, and that to send a 1–2 megabyte (MB) picture could take more than 45 min, using a regular dialup line as was available in 70% of the pilot sites. Moreover the 'on and off' internet connection resulted in frequent error messages such as 'download time expired'. Because of these technical difficulties, a technical task force was established and a new 'home-made' open source telemedicine software developed: 'Telemed-ETH' (Fig. 1). This software was able to send minimal clinical data in a compression range of 45–60 kb (Fig. 2). The quality of the compressed images assessed by different dermatology and radiology specialists was around 90%, with an overall good quality of the pictures, allowing an appropriate remote consultation and second-opinion gathering.

Telemedicine practice according to the local context and customization activity

X-rays with different natural light intensities were tested to get some experience for rural practice, where there is no X-ray reader and electricity. It was found that taking photographs of X-ray pictures with a regular camera, using natural light on a white glared window, produced good quality images and this was proposed as good solution for areas where a diaphanoscope was not available and a stable power source was an issue (Fig. 3). The task force also experimented with the use of a 5 megapixel digital camera with magnifier to shoot dermatological pictures. It was suggested to take a picture with a 'non–distracting' background and no back light, and to provide at least three pictures per consultation, moreover for dermatologic lesions, to take pictures with closer magnification. Closer dermatologic pictures should have included lesions at different stages of evolution. The objective of the whole practice was to give combined written and visual information to a dermatologist, mimicking the real practice consultation (Fig. 4).

Citation: Glob Health Action 2012, **5**: 15638 - DOI: 10.3402/gha.v5i0.15638

Fig. 1. 'TelemedETH' telemedicine software developed for use in Ethiopia.

Human factors

During the lifespan of the Ethiopian telemedicine pilot project, between 2004 and 2006, four (20%) of the physicians participating left their respective working places (either they were transferred or joined private/non-governmental organizations) some of them as soon as the project had started. Three (15%) did not participate in the pilot despite their presence and availability at the working place, due to unspecified reasons, and 13 (65%) of the participants used the system for medical web-browsing and/or e-mail communication.

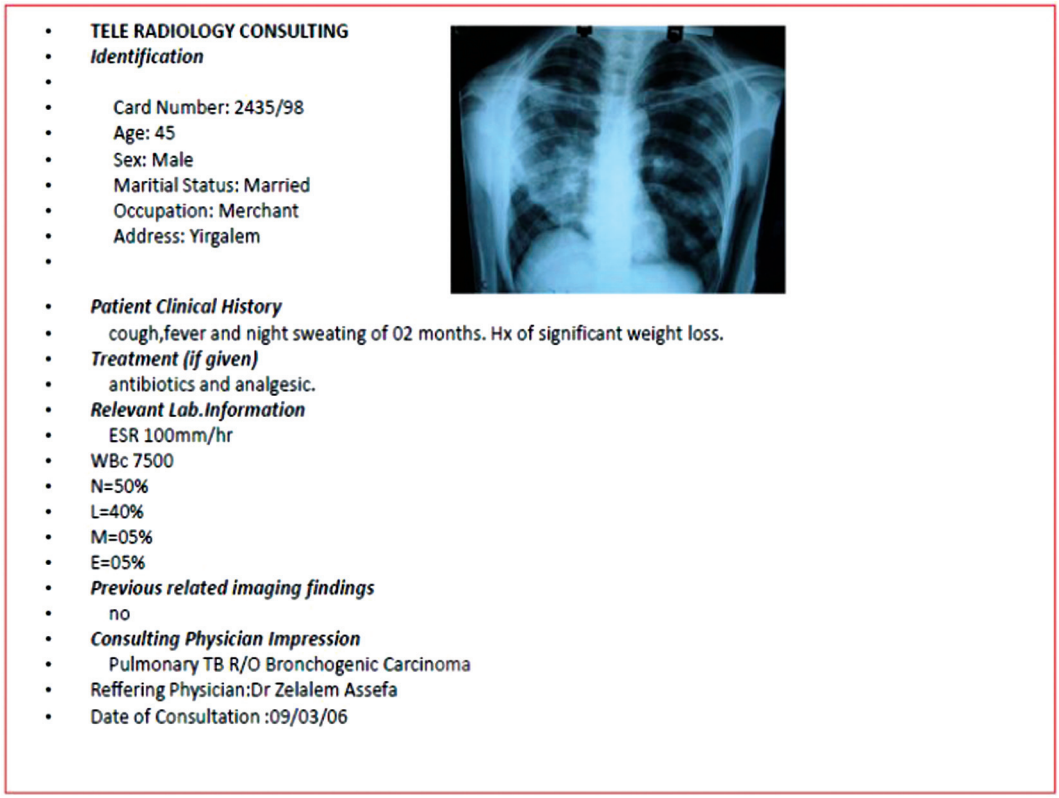

Fig. 2. Example of telemedicine clinical data.

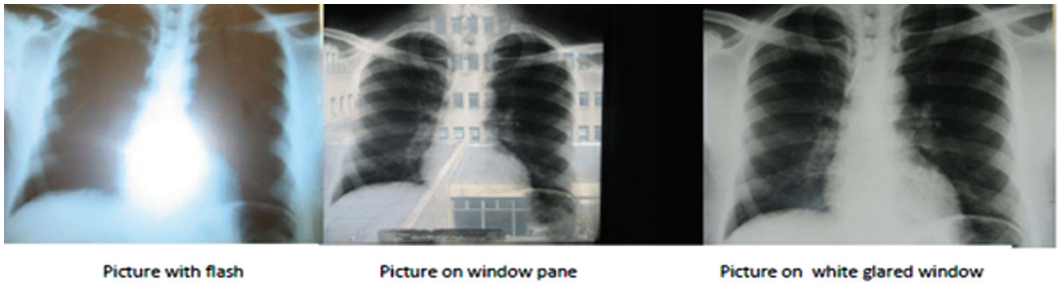

Fig. 3. Different approaches to capturing X-ray images.

Only 58 telemedicine consultations were undertaken throughout the duration of the pilot and most consultations were conducted by the three hospitals participating in the technical task force group in the capital Addis Ababa as soon the new Telemed-ETH software was developed (Table 1). However, after a short period of time, it was decided that the well running Basel University telepathology service, available on the iPath web-platform, could be used for the referral of specific anatomo-pathology cases, taking advantage of a well-established teleconsultation network; the Telemed-ETH software has been thereafter used only for radiology and dermatology consultations.

Results of semi-structured interviews

After project implementation, the pilot site representatives, replying to a semi-structured questionnaire, reported that the system was poorly organized (61%); there was a lack of proper project follow-up and a lack of necessary support from the Ministry of Health and respective local institutions.

As one of the informants expressed: 'We perceived that this technology helps us in assisting our patients, and updating our medical knowledge through the web. However, lack of institutionalization and commitment from the higher level results in disorganization, despite the effort of the National Telemedicine Committee, and the commitment of a few very interested individuals'.

Another informant said that 'The training we took and the equipment we received are tools to introduce us to the technology, but we were unable to put it into real practice.'

Data collected from key informants showed that during the project implementation about 70% of participants faced connectivity problems due to poor bandwidth, disruption of internet service for days and inadequacy of allotted free time, which resulted in paying extra service charges for the internet and telephone from their own pocket.

Although the pilot failed, when we looked at the decision makers' perceptions, a senior Ministry of Health official admitted he could see the benefits: 'I was considering telemedicine as a high-tech and very expensive solution, while I realized it can be as simple as that of using our pocket digital camera and our office desktops for helping our patients. Especially using this system for the task shifting program of accelerated health officer training could dramatically solve the shortage of expert trainers faced on the field.'

Impact

A survey conducted in the capital after the conceptualization of this pilot, in a moment of great advocacy and solicitation of ICT use, showed that 61% of the physicians and 83% of the nurses knew about telemedicine referrals and the use of the system as second opinion advice tool (4). It also created awareness at the level of officials and

Fig. 4. Examples of images for a teledermatology consultation.

Citation: Glob Health Action 2012, **5**: 15638 - DOI: 10.3402/gha.v5i0.15638

Table 1. Telemedicine consultations, 2004–2006

	Cases received		Average response time	
	Radiology	Dermatology	Hours	Remark
Telemedicine Specialty Centers				
Tikur Anbessa University Hospital	10	–	19.7	Participated in using the new 'Telemed-ETH' software
Jimma University Hospital	4	–	12.5	
Gondar Medical College	2	–	16	
ALERT Hospital	–	13	4.2	Used mobile telephone communication Participated in using the new 'Telemed-ETH' software
Telemedicine Consultation Centers				
Mekele Hospital	0	0	–	Used the system for local practice and medical web browsing
Debrebirhan Hospital	3	2	–	
Hossana Hospital	2	1	–	
Jijiga Hospital	1	1	–	
St. Paul Hospital	10	9	3.3	Used mobile telephone communication Participated in using the new 'Telemed-ETH' software
Adama Hospital	0	0	–	

into the community. However there was some ambiguity regarding ownership of the project, which had a negative impact on the adoption, resource allocation and proper monitoring and evaluation of the pilot.

A telepathology consultation on the iPath platform was able to save a 14-year-old boy's leg from amputation. This has been used in lobbying efforts, to convince decision makers of the impact of telemedicine in clinical applications.

At the end of the project, 25% of the trainees were able to take responsibility for the scaling-up of telemedicine in their respective universities, such as in Jimma and Addis Ababa hospitals. In addition, the central university hospital was able to establish a telemedicine unit. This unit is currently led by one of these pilot trainees. Since the pilot, cardiology, paediatric, and neurological case-consultations have been regularly referred via telemedicine, also case-based continuing medical education sessions have been established and delivered through video conferencing with Hyderabad University Hospital in India. The system expanded to its present coverage of four teaching hospitals and six district hospitals, serving more than 29 clinics or health centers (5).

Discussion

This study shows that application of ICT and telemedicine is feasible in countries like Ethiopia where there is a shortage of health manpower in remote and urbanized areas, and that integrating ICT in the health care system could contribute to universal health coverage and to the strengthening of the weakened health care delivery systems. Although the Ethiopian telemedicine pilot project cannot be taken as success story when evaluated against the proposed objectives, the challenges faced and the experience gained implementing it, created a glimpse of hope for further eHealth applications.

Over the last decade, politicians, policy makers, academics and many others have discussed the potential role of ICT in influencing the health and well-being of the poor and marginalized sections of society. Its potential contribution to poverty alleviation, sustainable development and health care improvement has been pointed out by the UN Millennium Development Goals (MDGs) framework and by many other organizations (6–8). Despite all these commitments there is still a lack of proven business models and shortage of global funding opportunities to support eHealth projects in developing nations. Arguably this telemedicine pilot project could have benefited from the availability of a policy framework and valuable technical infrastructures. Clear health policies and strategies in eHealth should address the benefits of the *clients*, their cultural and language differences, ICT interoperability and allow capacity building (9). Even though eHealth is global, policy formulation needs adaptation to fit into the cultural and traditional context of the local health system; this is sometimes coined a 'glocal' approach, showing impact influence between global and local experience (10, 11). Since telemedicine and other eHealth applications have a multidisciplinary nature, governments have to work in collaboration with citizens including patients, professionals, academia, health related business companies

(public-private partnership), bilateral organizations and international agencies (12). Each group has its own focus, which can explain the complexity involved in the effective use of the technology for health.

The health care system of many African countries including Ethiopia has been found to lack e-readiness (13) and determining investment priorities from scarce financial resources leads to dilemmas (14). When competing with vaccination, safe water supply, and other primary health care priorities, eHealth often loses out, therefore it should be considered as a means of facilitating our primary health activities rather than competing with them.

Appropriate health care support and information empowers health care workers at the primary health care units and is a cost effective and achievable strategy for sustainable improvement of health care in remote areas (15) through capacity building, and improving quality of health care (16, 17). Even though, in Ethiopia, there was a draft strategy plan (18), an experienced coach and demonstrator are still needed to put plans into practice. Simple e-mail consultations by doctors from different medical specialties have proved to be effective, useful and acceptable and showed a change in diagnosis in 50% of the cases after a telemedicine consultation (19, 20). In low-resource settings the use of electronic health records is given low priority among funders and decision makers, even though very high rates of lost to follow up in HIV/AIDS care and treatment are attributable to an information management problem, which can benefit from using ICT (21). At present health care professionals are able to communicate quickly with their colleagues and patients, get recent literature from the web and discuss cases through mobile phones (22, 23) and e-mails. All of these imply that telemedicine and other eHealth applications have not been considered as new services and new technologies, but rather as tools to facilitate or expand health care services (24).

In many developing countries decision makers have the problem of getting timely, correct and standardized data for resource allocation, effective drug and supply management. This can be addressed by integrating a Health Management Information System (HMIS) into the health care delivery system (25). By stating this, it does not mean that ICT is a readymade fit: ICT always needs to be contextualized and above all needs a commitment to be used, thus capacity building and the process of creating an informed society are crucial for its implementation. In Ethiopia and many sub-Saharan African countries low bandwidth, slow connections and high service charges are some of the current technological challenges. To overcome these constraints, telecommunication monopolies might need to be addressed (26). For many, the high cost of telecom services, competing with other basic priorities, such as food, clothing, school fees, etc makes internet and mobile phones unaffordable. However the recent trend of increasing penetration rates of mobile technology in the developing world, especially in Africa, can be considered as an opportunity to implement applications at the grass roots level by empowering community-based health care workers, using simple, relevant, and combined technology with local content and language interface (27). This allows the community to participate in the decision process of improving their own health, and brings health care and promotion to them rather than having to go to long distance to higher health units for care. For instance, in Uganda the use of a VHF radio by traditional birth attendants facilitated early referral and contributed to a significant reduction in maternal mortality (28), showing that the use of ICT technology can prevent avoidable maternal death. In South Africa and Rwanda mobile technology improved adherence to TB (29) and HIV treatment, respectively.

Electronic databases contribute to quality and effective epidemiological research and facilitate access and dissemination of research findings. Currently, health problems, such as HIV/AIDS, tuberculosis, transcend national boundaries, and among the tools to address these health issues is the global eHealth strategy (30). To answer many of these questions, we could say that developing countries still have to organize themselves nationally and regionally in order to benefit more from global partnerships between the North and the South in terms of knowledge transfer, capacity building and infrastructure development (31).

At the end of the pilot project, based on the practical experience and the lessons learned, the recommendations reported below were formulated for future telemedicine and other eHealth applications development in the country.

This case study has several limitations, the most important being that the pilot was implemented by a few practitioners and in relatively few places, so that the findings cannot be generalized. In addition, there was scarce knowledge, maturity and penetration of the subject in this region at the time of implementation, as well as a lack of supportive data because of its small scale conception.

Recommendations for future telemedicine/ eHealth projects

1. An eHealth policy and an 'enabling-policy environment' are essential requirements for the success of telemedicine and other eHealth activities adoption.
2. To be accepted by clients and health care givers, telemedicine and eHealth have to be integrated into the health care service delivery, especially in underserved areas.

Citation: Glob Health Action 2012, **5**: 15638 - DOI: 10.3402/gha.v5i0.15638

3. The use of simple, local technology and locally adopted user-friendly software, are key to overcoming the technical difficulties that can be encountered in terms of software interoperability and maintenance problems.
4. Telemedicine and other eHealth initiatives should be encouraged in private health institutions in the spirit of public-private partnership for better success.
5. If telemedicine is to be sustainable, it needs a business model for reimbursement, along with practices and research work, which have to be encouraged and budgeted.
6. For reliable eHealth implementations, referring national practice and experiences, guidelines and IT security protocols are needed.
7. To build an information society, it is needed to integrate lessons coming from medical informatics and the health management information system in the medical curricula at all levels; this will help to promote a 'user culture' in the health care system.
8. Training of paramedics and nurses in using telemedicine tools can save busy physicians' time and contributes to the sustainability of the practice.
9. Since telemedicine is a multidisciplinary process, its coordination requires active participation from policy makers, technology providers, IT experts, researchers and health professionals, under the umbrella of a coordinating body.

Conclusion

This case study shows that the success or the failure of a telemedicine story does not only rely on technological factors, but on e-governance, an enabling policy environment, multi sectorial involvement of stakeholders and effective human resource management and capacity building. There is no single perfect technology in eHealth projects; using combined technology adjusting to the local context is encouraged. Since telemedicine is still in a relatively premature phase in sub-Saharan Africa, it is difficult to talk about objectively measurable impact at present, even though the technology has already demonstrated practical applicability in a number of settings. Further research is needed on how to scale up beyond proof of concept, evaluation of impact, how telemedicine or eHealth can address the voice of those affected by poor health and the marginalized, taking into account the local language, and content development to use telemedicine at the grass roots level.

Acknowledgements

This article was developed as part of a master thesis and as part of the "Emerging voice for Universal Health Coverage Initiative" event at the Institute of Tropical Medicine (ITM) in Antwerp, Belgium. The telemedicine project would not have been realized without the financial and administrative support of: the International Telecommunication Union, infoDev, UNECA, the Ethiopian Telecommunication Corporation and the Federal Ministry of Health. My heartfelt gratitude also goes to Sewenet Mamo, PhD for her support on project proposal, and to Mengistu Kifle, PhD, for his technical assistance during this project implementation. The authors also thank Kristof Decoster from ITM for his critical inputs on the structure of the article and language editing and Inge de Waard from ITM for the technical support and feedback.

Conflict of interest and funding

No competing financial interests and/or funding exist for the authors.

References

1. 'Health Care for All'. Declaration on 'Health care for all'. Antwerp; 2001, http://www.itg.be/hca/
2. Marker P, McNamara K, Wallace L. The significance of information and communication technologies for reducing poverty. London, UK: DFID; 2002.
3. Dzenowagis J. Bridging the digital divide. In: Richard Wootton, Nivritti G. Patil, Richard E. Scott, Kendall Ho, eds. Telehealth in the developing world. London: Royal Society of Medicine Press; 2009 pp. 9–25.
4. Lemma F. Design of architecture and implementation issues for a terrestrial & VSAT based National telemedicine network in Ethiopia. AAUniversity, Dept. of Computer Sciences; 2004 (unpublished)
5. Kifle M, Payton FC, Mbarika V, Meso P. Transfer and adoption of advanced information technology solutions in resource-poor environments: the case of telemedicine systems adoption in Ethiopia. Telemed J E Health 2010; 16: 327–43.
6. WHO. World Health Assembly Resolution on E-health. WHA58.28. Geneva: World Health Organization; 2005.
7. EU COM 486. EU strategy for Africa: towards a Euro-African pact to accelerate Africa's development. European union (EU), Brussels: EC Communication; 2005.
8. Ministers of Health of the AU. NEPAD health strategy. Maputo: The New Partnership for Africa's Development (NEPAD); 2003.
9. Kay M, Van Andel MO-G, Klint K, Tristram C. Building foundations for e-health: progress of member ststes. Report of the WHO global Observatory for E-Health. Geneva: World Health Organization; 2006.
10. Scott RE, Chowdhury MF, Varghese S. Telehealth policy-looking for global complimentarity. J Telemed Telecare 2002; 8: 55–7.
11. Scott RE, Jennett PA, Yeo M. Access and authorization in a glocal e-health policy context. Int J Med inform 2004; 73: 259–66.
12. Dzenowagis J. Connecting for health : global vision, local insight. Geneva: World Health Organization; 2005.
13. Sorensen T, Rivett U, Fortuin J. A review of ICT systems for HIV/AIDS and anti-retroviral treatment management in South Africa. J Telemed Telecare 2008; 14: 37–41.
14. Chandrasekhar CP, Ghosh J. Information and communication Technologies and health in low income countries: the potential and the constraints. Bull World Health Org 2001; 79: 850–5.
15. Pakenham-Walsh N, Priestly C, Smith R. Meeting the information needs of health workers in developing countries. BMJ 1997; 314: 90.
16. Desai S. Telepathology and telecytology. In: Wootton Richard, Nivritti G. Patil, Richard E. Scott, Kendall Ho, eds. Telehealth

in developing world. London: The Royal Society of Medicine Press; 2009, pp. 149–54.
17. Geissbuhler A, Bagayoko CO, Ly O. The RAFT network: five years of distance continuing medical education and tele-consultations over the Internet in French-speaking Africa. IntJ Med Inform 2007; 76: 351–6.
18. Federal Ministry of Capacity Building. The National ICT for Development (ICT4D) five years action plan for Ethiopia [2006–2010]. Addis Ababa: Ministry of Capacity Building; 2006.
19. Schneider J. Telepathology at Tikur Anbessa Hospital: how telemedicine works. Ethiop Med J 2005; 43: 51–3.
20. Wootton R, Youngberry K, Swinfen P, Swinfen R. Prospective case review of a global e-health system for doctors in developing countries. J Telemed Telecare 2004; 10: 94–6.
21. Fraser HS, Allen C, Bailey C, Douglas G, Shin S, Blaya J. Information systems for patient follow-up and chronic management of HIV and tuberculosis: a life-saving technology in resource-poor areas. J Med Internet Res 2007; 9(4): e29. doi:10.2196/jmir.9.4.e29.
22. Kah JG, Joshua SY, Kahn JS. Mobile Health Needs And Opportunities In Developing Countries. *Health Aff* February 2010; 29: 252–8. doi:10.1377/hlthaff.2009.0965.
23. Michael PN, Sloninisky D. Towards the development of an m-health strategy,updated for the millenium villages project. New York: The Earth Institute at Columbia University; 2008.
24. Sorensen T. Guidelines for a country feasibility study on telemedicine. Tromso: Norwegian Center for Telemedicine; 2003.
25. Rao B, Lombardi A. Telemedicine: current status in developed and developing countries. J Drugs Dermatol 2009; 8: 371–5.
26. Asamoah-Odei E, De Becker H, Dologuele N, Embola I, Groth S, Horsch A, et al. eHealth for Africa Opportunities for Enhancing the Contribution of ICT to Improve Health Services. Eur J Med Res 2007; 12: 18–23.
27. Geissbuhler A, Ly O, Lovis C, L'Haire JF. Telemedicine in Western Africa: lessons learned from a pilot project in Mali, perspectives and recommendations. AMIA Annu Symp Proc. 2003; 2003: 249–53.
28. Musoke M. Maternal health care in rural Uganda, leveraging traditional and modern knowledge system. IK Notes, No. 40, January 2002.
29. Barclay E. Text messages could hasten tuberculosis drug compliance. Lancet 2009; 373: 15–6.
30. Board on International Health. 'The globalization of health:-common problems, common needs.' In Institute of Medicine, ed. America's vital interest in global health. Washington DC: National Academy Press; 1997, pp. 11–8.
31. Sachs J, McArthur J. The millennium project: a plan for meeting the millennium development goals. The Lancet 2005; 365: 347–53.

***Fassil Shiferaw**
Medical Director
Ethiopian Telecom Medical Services
PO Box 20915
Addis Ababa
Ethiopia
Tel: +251911211301
Email: et_fassil@hotmail.com

Citation: Glob Health Action 2012, **5**: 15638 - DOI: 10.3402/gha.v5i0.15638