Telehealth - bringing healthcare to one's doorstep:How ready is Sri Lanka?

Dr. Rohana B. Marasinghe MBBS, MPhil, PhD
Senior Lecturer in Medical Education
Department of Medical Education and Health Sciences
Faculty of Medical Sciences
University of Sri Jayewardenepura
Sri Lanka
E-mail address: rohanabm@yahoo.com

Sri Lanka Journal of Bio-Medical Informatics 2010;**1**(3):124-138
DOI: 10.4038/sljbmi.v1i3.2056

Abstract

Provision of healthcare at a distance is not a new concept. However, with the advancement of Information and Communication Technologies (ICT), the term 'Telehealth' has been cited frequently in the health/medical literature. Similar terms such as 'Online Health', 'eHealth' and Telemedicine' are also begining to appear. The purpose of this article is to provide readers with an understanding of telehealth with special reference to Sri Lanka. First, different terms and definitions related to telehealth will be reviewed. Then, the history of telehealth and evolutionary milestones of telecommunication activities will be examined. Next, telecommunication activities in Sri Lanka and its trend will be explored. Later, telehealth effectiveness will be examined briefly. Finally, a brief overview of telehealth activities related to Sri Lanka will be presented before suggesting a way forward.

Keywords: Telehealth, Telemedicine, eHealth, Healthcare, ICT, Health Economics, eLearning, Sri Lanka

Sri Lanka Journal of Bio-Medical Informatics 2010;**1**(3):124-138
DOI: 10.4038/sljbmi.v1i3.2056

Introduction

Telehealth is the delivery of healthcare at a distance using telecommunication technologies. Loane and Wootton introduced telehealth as 'not a technology per se, but rather a *technique* for delivering care when individuals are located in different places'[(1)]. There are number of related terms, such as *e*Health, *online*Health, and *m*Health which are used interchangeably with the term *tele*health, although they all have specific meanings. The prefix, *tele* means "at a distance". When healthcare is delivered at a distance, it is called tele-healthcare or telehealth.

Similarly, if a term begins with the prefix *e*, this implies that information is communicated in an electronic form (e.g., *e*healthcare or *e*health). Likewise, communication that occurs over the Internet is referred to as online-health. It is interesting to note that although there is a technical difference between online (which refers to real-time) and offline (which refers to store-and-forward) communication, the term *online health* often encompasses the two forms. With recent advancements in mobile communication, the prefix *m* has come to denote health care delivered via mobile communication devices (e.g., m-health)[(2)].

Alternatively, medical/health informatics is a very broad field which encompasses information science, computer science, and health care. Therefore, medical/health informatics tools

include not only computers and communication systems but also clinical guidelines, processes and formal medical terminology. Despite being defined by different characteristics, the above terms are often used interchangeably.

Telehealth: history and evolution

It is interesting to note the incident of the invention of the telephone by Alexander Graham Bell. On the 10th of March 1876, Alexander Graham Bell shouted to his assistant, "Watson! Come here! I need you.", after Sulphuric Acid spilled over his hand. This marked the birth of the telephone (Figure 1).

Figure 1. A sample of Alexander Graham Bell"s early telephone equipment

Although the first case of telemedicine was reported in the Lancet in 1897, when the telephone was used to diagnose a child with croup[3], the history of telehealth may predate this even further. From the beginning of human communication, there is evidence to highlight the strong desires of people to communicate health related messages. For instance, the terms people use today to greet each other often include health related references. The English greetings, "How are you (doing)?" or "How do you do?", and the Sinhalese term *Arubowan* (which means wishing you a long life) are some examples[2]. In the past, a number of means have been utilised to communicate these messages over distances, including audio stimuli such as bells and visual aids (i.e. flags and fire). There are reports that the ships carrying the Plague (a bacterial disease transmitted through fleas) displayed coloured flags to indicate that other ships should keep their distance[4].

The first telephone call made by Alexander Graham Bell when he called his assistant, was also a help-seeking call. It was meant to prevent a further accident/deterioration of Bell's condition after sulphuric acid spilled over his hand. Therefore, by closely examining past and present examples of health related communication, it is apparent that there is a need for health related communication modes, such as telehealth.

The following table summarises the reported telecommunication and telehealth activities in chronological order.

Table 1. Main milestones in telecommunication activities

Year	Method	Main modality	Initial use	Remarks
Pre technology era	Audio (e.g. horns, bells, drums), visual (e.g. Flags, smoke), distant delivery (e.g.bow and arrow), use of messenger (e.g. animal)	Audio-visual	War, to inform a large community.	Some applications are still in use.
1830	Morse code (Samuel Finley Morse and Alfred Vail)	Text messages	War, electric telegraph	For about 30 years this was the best method of long distance communication.
1876	Telephone (Alexander Graham Bell)	Voice	War, person to person	This is currently the most widely used personal means of communication.
1880	Photophone (Wireless)	Audio	First in military communications and later in fibre-optic communications	Although this was the first wireless communication, it has little practical value.
1892	Wireless telephony	Audio	"Cave radio" and military use of radio telephony links	Private demonstration of wireless telephony (1892), shore-to-ship demonstration of radio telephony, hand-held cellular radio devices (since 1973).
1897	Radio signals (Edouard Branly)	Voice	War, wireless telegraph, navigation of ships	Still popular for mass communication
1950	Real time video conferencing (VC) in health (NASA)	Audio + video		Video Conferencing is becoming popular
1960s	Computer networks (US defence department)	Text + Audio + video	Defense	Internet (WWW) is the most widely used network around the world.
1978	Mobile phones	Audio + Text + Video + Data		American Telephone & Telegraph Company (1915) discussed the development of the first mobile phone
1985	Wi-Fi (Wireless Fidelity)	Text + Audio + Video	Residential applications via local area networks, Wireless broadband etc.	The first wireless products was WaveLAN. Vic Hayes, who held the chair of IEEE 802.11 for 10 years and has been named the father of Wi-Fi, was involved in designing standards such as IEEE.802.11b,a.
1998	Bluetooth	Voice + Data	Initially to replace wired technology but now has mostly non- residential	There is a health concern as it uses microwave radio frequency spectrum in the 2.402 GHz to 2.480 GHz range.

			applications	

Some obvious patterns are evident when examining the evolution of communication technologies. For example, technologies have progressed from wired to wireless. Furthermore, communication devices initially supported only one mode of transmission (e.g. voice in telephones, text in telegraph). However, more recently developed devices have the capability to transmit information in multiple forms including text, voice, video and data. Nowadays, it is possible to combine most devices with the use of computers. Most communication devices now incorporate a computer which is embedded with technology to connect to networks and communicate effectively over long distances. These examples show how the telecommunication industry has demonstrated exponential growth.

Telecommunication technology in Sri Lanka

Telecommunication devices can be divided into two kinds, mass communication (e.g. television) and one-to-one contact communication devices (e.g. telephone). Television and radio have been widely used mass communication devices. The telephone has also been playing a substantial role in providing one-to-one personal contact communication in Sri Lanka. Telephones have a long history with the first telegraph circuit being installed between Colombo and Galle in 1858 and the first telephone line installation taking place in 1880. Mobile phone services were introduced in 1989. Thereafter, rapid expansion occurred. At present, the teledensity rate (phone lines/person) for mobile phones is far greater than that of land lines. Table 2 shows the recent uptake of telecommunication technologies in Sri Lanka.

Table 21: Uptake of telecommunication in Sri Lanka*

Type	**Number**	**Teledensity rate[1]**
Fixed Telephone (end of 4th Quarter 2007)*	2,742,059	13.1
Mobile Phones (end of 4th Quarter 2007)*	7,983,489	38.2
Overall *	10,725,548	51.4
Internet Service Providers (ISPs)	10	
Internet & Email*	202,348	
Network Readiness Index** (assessment of a country"s capacity to make use of ICT resources)	3.79	
Radio broadcast stations***		
AM	15	
FM	52	
Shortwave	4	
Estimated number of radios***	12M	
Television broadcast stations (2006)***	14	
Estimated number of television sets	5M	

[1]Phone lines per 100 persons

* Source: Telecommunication Regulatory Commission of Sri Lanka

** Source: The Global Information Technology Report 2007-2008 -World Economic Forum (country position was 72)

*** Source: CIA World Factbook

Mobile telephones

In recent years, mobile telephones have become quite popular in Sri Lanka. It is estimated that there were nearly eight million mobile phone owners in Sri Lanka in 2005. Mobile phones have both real-time (ordinary telephone calls), as well as store-and-forward (recorded message and SMS) features. SMS and mobile phone displays in the Sinhalese language are now available in Sri Lanka. Figure 2 shows the remarkable growth in cellular (mobile) subscriptions in Sri Lanka.

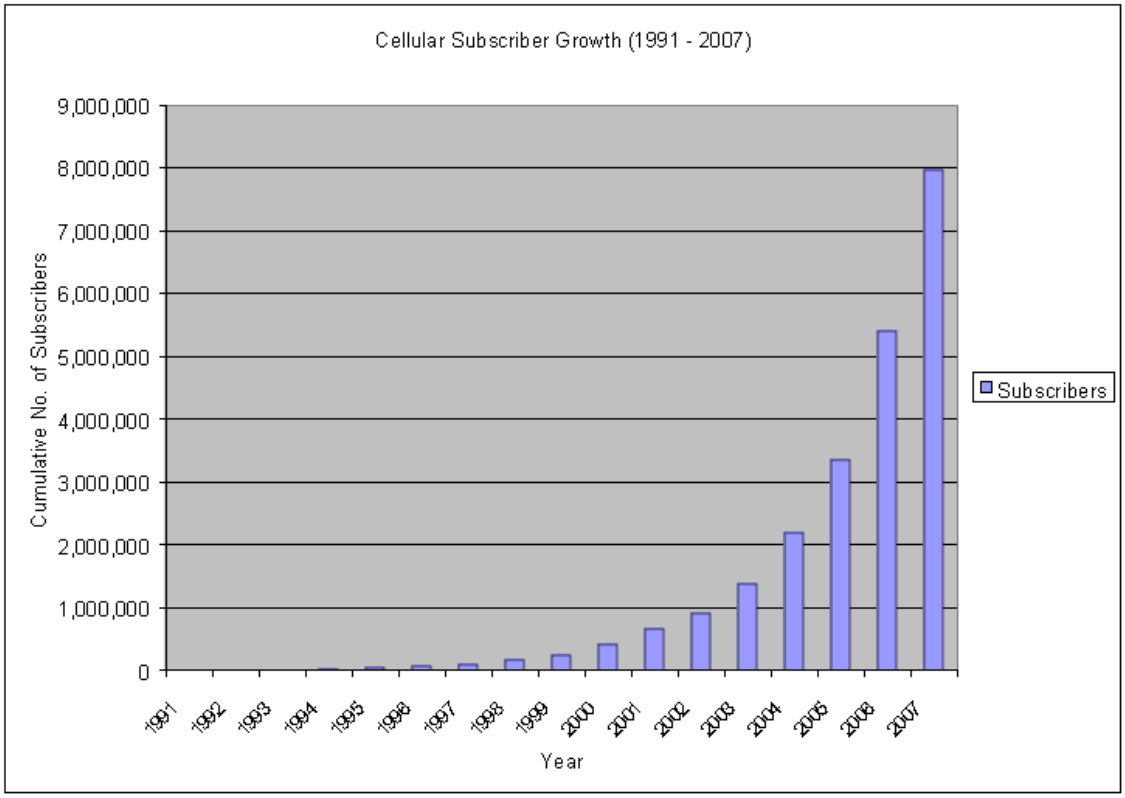

Figure 2. Cellular (mobile) subscription growth from 1991-2007
(Source: Telecommunication Regulatory Commission of Sri Lanka)

ICT Initiatives

The Sri Lankan government has played a significant role in promoting the use of ICT in general to advance the economy. An e-government initiative was advocated in the mid-1990s. The e-Sri Lanka initiative is to "take the dividends of ICT to every village, to every citizen, to every business and also transform the way Government works". In addition the improvement of quality of care using ICT has also been identified as a priority area. Moreover, the Government of Sri Lanka (GOSL) had declared the year 2009 as the Year of English and IT[5].

Although the GOSL is promoting ICT usage in general, there is a relative low level of ICT use in its healthcare practices. At a basic level, the Sri Lankan government is responsible for providing telephone and other ICT and network facilities to the hospitals. Very few wireless networks are provided by GOSL. One example is the "paging network" which is used to contact consultants in emergencies at the National Hospital in Sri Lanka (NHSL). However, it is limited to the Colombo area only. In addition, there is a dedicated phone number available to the public to call the NHSL Colombo. Generally, the use of the telephone by the public to communicate with hospitals is not common practice.

How effective is telehealth?

It is imperative to understand that the telehealth is not designed or expected to replace the present healthcare system. Rather it is used as an adjuvant, or more precisely, to be used as an alternative to provide health care more effectively. One would ask how can one know that telehealth is effective or not?. A common approach taken to answer this question is by reviewing the effectiveness in terms of either clinical or economic effectiveness or both. Evidence from Randomised Controlled Trials (RCT) is the gold standard in evaluating clinical effectiveness. The economic aspect can be evaluated by different means such as cost-minimization analysis, cost-effectiveness analysis, cost-utility analysis and cost-benefit analysis. The following section provides a brief overview of clinical and economic evaluation separately.

Clinical effectiveness

Evidence from RCTs for telehealth clinical effectiveness is emerging. However, review of such studies has shown that evidence from properly conducted RCTs is still limited. For instance, most RCT studies were limited to either pilot projects or assessed only short-term outcomes while majority were of low quality[6]. In spite of this, some areas of telehealth has shown relatively convincing evidence. These include telepsychiatry, teleradiology, teleneurosurgery, transmission of echocardiographic images, and the use of electronic referrals enabling email consultations and video conferencing between primary and secondary health care providers. Out of the clinical specialities, telepsychiatry has been reported frequently as most telepsychiatry trials only needed to establish good communication channels between therapist and client whereas other clinical specialities may warrant devices other than just a communication channel (i.e. Telecardiology may need ECG/Echo images)[2].

Economic aspects of telehealth

Although evidence is emerging about the cost effectiveness of telemedicine[7], evidence to fully assess the economic impact of telemedicine is limited[8]. Methods for economic analyses also vary. Drummond and colleagues classified economic evaluation methods into three main areas viz. cost analysis, cost-effectiveness analysis and benefit-cost analysis[9],while Kernick identified a category called cost-utility analysis[10]. Table 3 classifies four types of formal economic evaluations.

Table 3. Types of economic evaluations adopted by Kernick[10]

Form of Evaluation	**Measurement and Valuation of Outcomes**
Cost minimization Analysis	Outcomes are assumed to be equivalent. Focus of measurement is on costs. Not often relevant as outcomes are rarely equivalent.
Cost-effectiveness analysis	Natural units (e.g. life years gained, deaths prevented). This approach forms the bulk of published studies and will be of most relevance to practitioners.
Cost-utility analysis	Health state values based on individual preferences (e.g. quality adjusted life-years gained). This approach is gaining importance owing to the need to decide between different interventions at a national level and the importance placed on quality of life. Many methodological problems remain.
Cost-benefit	All outcomes are valued in monetary units (e.g. valuation of amount

analysis	willing to pay to prevent a death). Rarely used due to methodological problems in valuing all outcomes in monetary terms.

A simple "cost analysis" identifies the amount of resources used to deliver the services of a specific program and the associated opportunity costs. For instance, in cost minimization, the costs of a program are compared to the costs of alternative methods of service delivery assuming that both approaches result in similar outcomes. Table 4 summarises the key categories of telehealth programmes from various stakeholders' perspectives.

Table 4. Cost analysis components of telehealth-adapted from Davalos and colleagues[8].

	Variable costs	**Other costs**
Client/patient		
Time costs (employment, learning time or leisure) Medical costs (out-of- pocket)		
Provider		
Equipment/technology (capital investment) Depreciation Facilities (office space)	Maintenance and repairs Telecommunication costs (connections, etc.) Administrative support and supplies Training Wages to technicians Wages to staff Other expenses	Travel (transportation, accommodation, per diem costs; travel time) Training Other expenses (promoting the program, etc.)
Other Stakeholders		
Costs to the taxpayer from expanded coverage and payment of telemedicine services in Medicare etc. Costs to private insurers from expanded coverage and payment of telemedicine services and costs to their clients if, as a result, insurance premiums increase Loss of productivity (work absences) for the employer from workers" participation in a program		

Simple cost analysis has its own limitation of excluding the program outcomes from the analysis, thereby limiting decision power. In Cost-effectiveness analyses (CEA), the program outcomes (non-monetary outcomes) are taken into consideration and expressed as "cost per unit of outcome". Although this is superior to the cost analysis, often the analysis is limited to a single outcome.

The cost-utility analysis compares the costs of different procedures with their outcomes. The outcomes are measured in utility based "units" and the units are related to a person's level of well-being. The most commonly used unit is the quality adjusted life year (QALY) which is based on estimating the total life years gained from a particular procedure and subsequently weighting each year to reflect the quality of life in that particular year. The Rosser Index is used to compare outcomes of different programs. By combining the Rosser Index and QALY, the cost per QALY gained can be calculated. This method claims to be superior in a health

care setting as it helps to compare different health programmes with unit quality of life, hence it is helpful for making decisions when allocating health resources[11].

The benefit–cost analysis (BCA) is a much more comprehensive evaluation. This allows costs for multiple outcomes to be evaluated. Both input (economic cost) and output (economic benefit) are expressed in monetary terms. A positive "net benefit" (total economic benefit minus total economic cost) and "benefit–cost ratio" (total economic benefit/total economic cost), greater than one, provides strong evidence for the worthiness of a programme.

As mentioned previously, several limitations can be identified in economic evaluations of telemedicine although some economic analyses suggests that teleradiology, especially transmission of CT images, can be cost-saving[6]. Most economic evaluations are focused on program cost analysis. The number of benefit–cost analysis studies is still limited[12]. As is common with economic evaluations, proper RCT evidence is still lacking for telehealth. Even with the existing studies, lack of generalisability arises[13, 14]. Additionally, the quality of data available for appropriate measures within economic evaluations is often limited[15]. Heterogeneity of trials[13], statistical limitations due to small sample size and limited, long-term RCT trials[12], exacerbate the situation. A need for uniform methodology or guidelines to conduct standardized economic evaluation in telemedicine has been identified[8].

Telehealth activities in Sri Lanka

Telehealth is not yet in common practice in Sri Lanka[16]. Following is a brief overview of different telehealth activities in Sri Lanka. Telehealth activities will be presented by grouping them into main four categories namely, international organisations, government sector, private sector and identifiable groups/activists. There is a place for education of telehealth as well as the use of e-Learning modality in telehealth in Sri Lanka.

Contribution of international organisations

A number of international organisations have initiated e-health programs in Sri Lanka. The World Health Organisation (WHO), United Nations Development Program (UNDP), World Bank and Asian Development Bank are a few examples. Some reputed telemedicine research organisations such as The Norwegian Telemedicine Institute and The International Society for Telemedicine (ISfT) have been instrumental in initiating projects within Sri Lanka.

In 1998, a pilot study on the use of telecommunications in disaster and emergency situations in Sri Lanka was conducted by the Telecommunications Regulatory Commission of Sri Lanka, in association with the United Nations Office for the Coordination of Humanitarian Affairs, the Working Group on Emergency Telecommunications and ICO Global Communications. The study surveyed the background information on emergency telecommunications in Sri Lanka, including identification of some of the problems and constraints in the current environment. The organisational structure and the equipment/personnel available have also been explored, thus providing institutional, regulatory, technical and financial recommendations for the improvement of emergency telecommunications capabilities in Sri Lanka[17].

A project was implemented between Sri Lanka and Singapore in 1999, using a combination of video, sound and externally-acquired images through networking and satellite interconnectivity. This project expected to provide instant diagnosis to patients located in any part of the world and used satellite facilities to link-up Sri Lanka and Singapore[18].

In 2001, WHO initiated a feasibility study in partnership with The Norwegian Centre for Telemedicine to examine the potential use of telemedicine in addressing problems in the healthcare sector in Sri Lanka[19]. In November 2003, a pilot e-health project involving eight hospitals in five districts[19] and funded by the WHO, in collaboration with The Ministry of Health, began. This low cost, store-and-forward telemedicine system envisioned connecting doctors in remote hospitals with specialists for consultation. Also in 2003, the WHO initiated a phase-based pilot programme to create a national telemedicine system which focused upon wireless communication technologies in Telehealth[21].

"The Report of Assessment and Situation Analysis in selected Hospitals in Sri Lanka", published in 2005 by The Norwegian Centre for Telemedicine with the WHO Regional Office in Colombo, recommended an "e-Health Emergency Hospital" project. The objectives of the project were to improve the capacity for recording and reporting, the capacity of communication via Internet, email as well as access to specialist advice in the case of emergency[22].

In 2004/5 a number of medical students from developed countries visited Sri Lanka as a part of U21 project on e-health in the developing countries. The project envisioned the support of local doctors by providing specialist advice and the help of intern medical students. The U21 e-health project was established by the U21 University consortium. The aim was to provide a framework for exploring research collaboration opportunities, the exchange of information and the sharing of resources. Another goal was to identify different methods of using e-health and e-learning to enable health-care delivery challenges to be met globally. In this regard, a pilot study was undertaken which was supported by the provision of information technology and student involvement[23].

The International Society for Telemedicine (ISfT) also set up a project to provide appropriate medical expertise for the victims of the tsunami and to optimise long term medical care in the affected areas. The applications used were teleconsultation via email, video-conferencing, linking to worldwide expert telemedicine networks and creating a network in Sri Lanka[24].

Several internationally collaborated telemedicine research projects have been conducted in Sri Lanka. For instance, the International Collaborative Research Project funded by the Saga University was one such project. This project was implemented between Sri Lanka and Singapore in 1999. The project examined the feasibility of real-time specialist consultation from overseas to Sri Lanka using a combination of video, sound and externally-acquired images through networking and satellite interconnectivity. It was expected to provide instant diagnosis to patients located in any part of the world and used satellite facilities to link between Sri Lanka and Singapore[25].

In 2001, a three-day course on Basic Surgical Skills and Specialist Registrar Skills in General Surgery conducted by The Royal College of Surgeons of England was delivered by distance education. It aimed to examine the feasibility of using alternative methods of providing medical education. Each participating centre received one copy of the video for teaching purposes and one copy of the handbook in both print and CD-ROM format, which could be duplicated locally for trainees within the terms of an agreement that was signed by the centre and the college of surgeons[26].

In the aftermath of the tsunami, various groups became interested in telemedicine activities. Disaster Management System: Sahana is one such group[27]. Sahana is a free and open source

disaster management system developed as a collaboration tool aiming to address common coordination problems during a disaster such as finding missing people, managing aid, managing volunteers, and tracking camps. The project has now grown to global level with deployments in many other disasters such as the Asian Quake in Pakistan (in 2005), the Southern Leyte Mudslide Disaster in the Philippines (in 2006) and the Yogyakarta Earthquake in Indonesia (in 2006).

Contribution by the government sector

The Ministry of Health, Sri Lanka is responsible for healthcare delivery in the country. The government has paid significant attention to promote ICT in general and the use of ICT in healthcare. The e-Sri Lanka initiative was commendable in this regard[28].

One important role of the government is to provide infrastructure such as the provision of telephone and other ICT facilities to the hospitals. Additionally, the National Hospital has a paging network in the Colombo area for its doctors to be contacted in emergencies. Apart from that, in all the government hospitals in Colombo, the telephone network is enhanced with Private Automated Branch Exchange (PABX) linking that allows a single access number to offer multiple lines to outside callers while providing a range of external lines to internal callers or staff[29]. Although telehealth is not a established form of health care delivery for the government sector in Sri Lanka, the Sri Lankan government has been instrumental in facilitating a number of e-health projects initiated by national and international partners and organisations.

Contribution by the private sector

Since the deregulation of the economy in the mid 1980s, the private sector has begun to play a vital role in the healthcare sector. The number of private hospitals is growing. There is a tendency for these hospitals to spread in semi urban and rural areas. The use of technology in private sector hospitals has been more prevalent compared to public hospitals. Private hospitals use telephone, email and the Internet for advertising, on call ambulance/mobile services, appointment booking, financial handling, hospital management, patient record keeping, patient information, processing pathology records and much more. The Colombo branch of the Apollo Hospital is a leading private hospital in introducing ICT into its delivery of health services in Sri Lanka. As a pioneer in telemedicine in India, the Apollo Hospital may provide a positive example in this direction[30].

Telehealth use in General Practice (GP) in Sri Lanka

General practice in Sri Lanka is different to the UK general practice model in a number of ways[31]. Unlike the UK and some other countries, there is no necessity to have specific training or the equivalent RCGP qualifications to practice as an independent practitioner in Sri Lanka: it is enough have an M.B.B.S. qualification and full registration with the Sri Lanka Medical Council (SLMC). This often motivates junior doctors in Sri Lanka to practice as GPs after hours. On the other hand, the number of fully qualified consultant general practitioners is limited in Sri Lanka.

A survey recently conducted in Sri Lanka[32] to evaluate the state of telehealth in general practice found that the use of ICT in general (private) practice still remains low. The following section highlights the relevant study findings.

This cross-sectional descriptive study was conducted amongst general practitioners (GPs) in Sri Lanka from May 2008 to July 2008 using a semi structured questionnaire. The

questionnaire was administered by a pre-intern medical officer to a cohort of 100 GPs which was located in a semi-urban area in Sri Lanka.

The following graph (Figure 3) shows the main responsibilities perceived by the GPs. Most GPs reported spending the majority of their time on patient management activities but also reported keeping health records and preparing/presenting health information. However, only a very small number (1%) of GPs used computers at the GP centre.

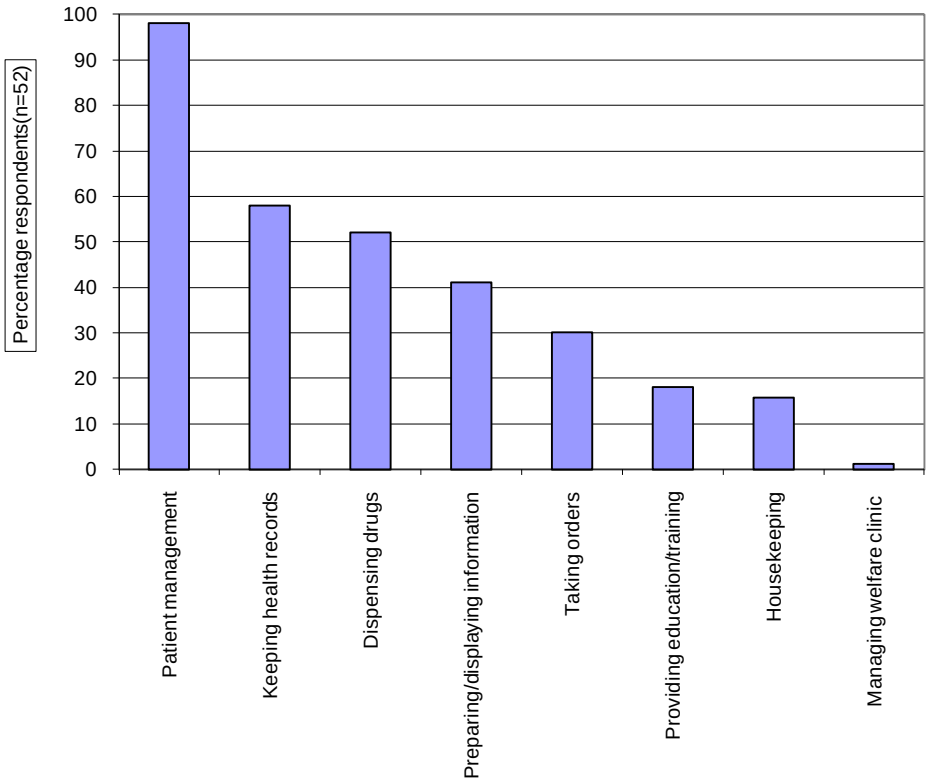

Figure 3. Responsibilities at the GP centre

On the other hand, telephones were widely used in General Practice (94%). While 49 percent of GPs used land lines, 48 percent used mobile phones. Use of personal digital assistants (PDAs), pagers and computers was limited to 1 percent each.

Although the use of land line phones was restricted generally to administrative purposes (70%), mobile phone use was expanded to answering patient queries as well as providing advice/information to patients. A substantial number of GPs used SMS for communicating with patients.

Contribution by active groups/individual activists

There are several institutions and organisations which are dedicated to the promotion of e-health. One such organisation is the Health Informatics Society in Sri Lanka (HISSL). The HISSL was established in 1998 with the aim of promoting Health Informatics and fostering links between ICT professionals and Healthcare professionals[33].

Furthermore, there are several organisations which provide health information and consultation via web sites, free of charge. For example, the E-Health (www.Ehealth.lk) website provides information about available drugs in the Sri Lankan market and information

about disease specific to Sri Lanka. Another web based health and medical information site is Laksuwa (www.laksuwa.com).

Telethelth teaching and e-Learning initiatives

Telehealth Teaching

With regard to the telehealth teaching, the Postgraduate Institute of Medicine of the University of Colombo (PGIM) has started a masters programme in BioMedical Informatics in which telehealth has been included[34]. This MSc. programme is not limited to medical doctors or nurses but equally welcome computer sciences as well as other biomedical science graduates. Therefore, the scope is broad in this MSc. The mode of delivery uses blended technologies (URL: http://www.msc-bmi-pgim.org/guest/outline.php).

eLearning activities

As a result of the government initiative to promote ICT, the need for telehealth recently has gained considerable attention among health care workers, especially in telehealth education. E-learning is also a growing area. Several universities have acquired the capability to provide multimedia informational services through their own internet sites. Mobile learning (mLearning) has also gained attention at the University of Colombo. In relation to e-learning, the contribution of the Distance Learning Centre (DLC) is noteworthy. This World Bank funded institution is set up to promote distance learning. It provides services to both the public and private sector with the opportunity for interaction with peers and experts across the globe on different themes. The centre puts significant emphasis on e-learning methods to provide education and professional development[35]. A recent survey revealed that there is a place for e-health in medical education in Sri Lanka[36].

The way forward

Although the Sri Lankan government is promoting ICT in general, the use of ICT in health care practice is still limited. Although the government hospitals in Sri Lanka are slow to implement ICT practices, private hospitals are more adoptive. There have been a considerable number of "pilot" projects conducted in Sri Lanka on telehealth. Most have not reached full potential and usually projects are not continued once the initial funding is exhausted. One reason is the lack of convincing evidence of telehealth effectiveness compared with conventional methods. Although this is a global issue, Sri Lanka needs to show its evidences too. Academics, researchers as well as service providers need to work together when introducing telehealth projects and it is not too difficult to design projects which can evaluate evidences of telehealth effectiveness. The other reason is the lack of trained human resources. The emphasis placed by universities on eLearning will also have a positive effect. In this context, the introduction of a postgraduate course in Biomedical Informatics is one of a significant step taken by the PGIM in educating telehalth among healthcare professionals in Sri Lanka. Similarly, undergraduate programs as well as continuing professional education programmes could also be introduced to overcome this problem.

References:

1. Loane M, Wootton R. A Review of Telehealth. Medical Principles and Practice, 2001. **10**: p. 163-170.

2. Marasinghe RB. Distance delivery of a brief training using e-solutions (web/mobile based) to address suicidal behaviour in Sri Lanka. 2010, Centre for Online Health, School of Medicine. University of Queensland, Brisbane, Australia.

3. Darkens A, Cary MA. Telemedicine and Telehealth. Principles, Policies, Performance and Pitfalls. New York: Springer; 2000.

4. Martins-Tuválkin A. Quarantine Flag. 2008 . [cited 2010 Feb 15]: Available from: http://www.fanshop-online.de/fahnen-flaggen-infos/xf~q.html.

5. 2009 - Year of ICT and English: A milestone towards peace and prosperity, in DAILYNEWS ONLINE. 2009, Lake House-The Associated Newspapers of Ceylon Ltd: Colombo.

6. Roine R, Ohinmaa A, Hailey D. Assessing Telemedicine: A Systematic Review of the Literature. *Canadian Medical Association Journal*, 2001; **165**(6): 765-71.

7. Wootton R. Recent advances: Telemedicine. *BMJ*. 2001; **323**(7312): 557-60.

8. Davalos ME, et al. Economic evaluation of telemedicine: review of the literature and research guidelines for benefit-cost analysis. *Telemed J E Health*, 2009; **15**(10): 933-48.

9. Drummond MF, et al. Methods for the economic evaluation of health care programmes. 3rd ed. Oxford, UK: Oxford University Press; 2005.

10. Kernick D. An introduction to the basic principles of health economics for those involved in the development and delivery of headache care. *Cephalalgia*. 2005; **25**(9): 709-14.

11. Robinson R. Cost-utility analysis. *BMJ*, 1993; **307**(6908): 859-62.

12. Whitten PS, et al. Systematic review of cost effectiveness studies of telemedicine interventions. BMJ. 2002; **324**(7351): 1434-7.

13. Bashshur R, Shannon G, Sapci H. Telemedicine evaluation: Telemed J E Health. 2005; **11**(3): 296-316.

14. Hakansson S, Gavelin C. What do we really know about the cost-effectiveness of telemedicine? *J Telemed Telecare*. 2000. **6 Suppl 1**: p. S133-6.

15. Kennedy CA. The challenges of economic evaluations of remote technical health interventions. *Clin Invest Med*, 2005; **28**(2): 71-4.

16. Marasinghe RB, et al. A snapshot of e-health activity in Sri Lanka. *Journal of Telemedicine and Telecare*, 2007; **13**(3): 53-56.

17. WHO. Recent Events: Sri Lanka National Health Information Technology Workshop. 2009 . [cited 2010 Feb 15]; Available from: http://www.whosrilanka.org/EN/Section29_35.htm.

18. Chin R. Telemedicine: A Case Study Between Sri Lanka and Singapore. 1999. [cited 2010 Feb 15]; Available from: http://www.isoc.org/inet99/proceedings/posters/257/index.htm

19. Blanchet KD. Innovative programs in telemedicine. *Telemed J E Health*, 2007; **13**(6): 627-34.

20. Gunawardena P. Telemedicine Implementation Experience in Sri Lanka. 2006: Centre for Telemedicine, General Hospital Kandy, Sri Lanka.

21. Drury P. The eHealth agenda for developing countries. World Hosp Health Serv, 2005; **41**(4): 38-40.

22. Olsen JH. Report of Assessment and Situation Analysis in selected Hospitals in Sri Lanka. 2005, Norwegian Centre for Telemedicine. [cited 2010 Feb 15]; Available from: www.telemed.no/getfile.php/187842.../Report_SriLanka_Final_Version.pdf

23. U21_Project. U21 E-health Project 2005 .[cited 2010 Feb 15]; Available from: http://www.uq.edu.au/coh/index.html?page=39356.

24. SCT. ISfT plan for action in telemedicine, concerning the Tsunami in Sri Lanka, . 2005. [cited 2010 Feb 15]; Available from: http://www.isft.net/cms/index.php?id=1.

25. Hayashida Y. Real-time High-Quality Captured-Image Transmission System for International Medical Volunteers. 2005. [cited 2010 Feb 15]; Available from: http://turkey.fu.is.saga-u.ac.jp/education/project/Collabo1.html.

26. 'HIF-net_at_WHO'. Chairperson'sIntroductoryRemarks. 2001 . [cited 2007 Feb 15]; Available from: http://www.dgroups.org/groups/hif-net/docs/2003.txt.

27. Sahana. Disaster Management System:Sahana Free and Open Source Disaster Management system 2005. [cited 2010 Feb 11]; Available from: http://sahana.lk/.

28. Samarajiva R, Zainudeen A. e-Government - Sri Lanka, in The bimonthly magazine on e-Governance. 2005. [cited 2010 Feb 11]; Available from: http://www.egov.vic.gov.au/focus-on-countries/asia/sri-lanka/e-government-sri-lanka-archive.html

29. InterimReport. Pilot Study on the Use of Telecommunications in Disaster and Emergency Situations in Sri Lanka 1998. [cited 2010 Feb 11]; Available from: http://www.reliefweb.int/telecoms/tampere/slcs.html.

30. Apollohospitals. Apollo Hospitals. 2010. [cited 2010 Feb 11]; Available from: http://www.apollohospitals.com/.

31. Marasinghe RB. Undergraduate education in General Practice in Southampton and Sri Lanka: a study visit report, in RCGP International Newsletter, R. Caird, Editor. 2003, International Department, Royal College of General Practitioners, UK. .

32. Edirippulige S, et al. A Preliminary Study Evaluating the Use of Information and Communication Technologies (ICT) In General Practice in Sri Lanka, in Health Informatics Conference, V.S.a.P. Croll, Editor. 2009, HISA Ltd.

33. HISSL. Health Informatics Society in Sri Lanka (HISSL). 2009. [cited 2010 Feb 11]; Available from: http://hissl.org/index.php.

34. Dissanayake VHW. Developing Human Resources Capacity in Health and Medical Informatics in Sri Lank. Sri Lanka Journal of Bio-Medical Informatics. 2001; **1**(1): 6-11.

35. DLC. Distance Learning Center. 2007. [cited 2010 Feb 11]; Available from: http://www.dlcsrilanka.org/.

36. Edirippulige S. et al. Medical students' knowledge and perceptions of e-health: results of a study in Sri Lanka. Stud Health Technol Inform, 2007; **129**(Pt 2): 1406-9.