Online Journal of Space Communication

Volume 8
Issue 14 *Satellites and Health (Winter 2009)*

Article 6

Re-Inventing Health Care Training In The Developing World: The Case For Satellite Applications In Rural Environments

Krishnan Haridasan

Srinivasan Rangarajan

Gregory Pirio

Re-Inventing Health Care Training In The Developing World: The Case For Satellite Applications In Rural Environments

Krishnan Haridasan
President, Protean, LLC

Srinivasan Rangarajan
Senior VP, Engineering Solutions, WorldSpace Inc.

Gregory Pirio
President, Empowering Communications

---

1. Introduction

The rapid advance of Information Communication Technology (ICT) in low and middle income countries has created an unprecedented opportunity to change the way that pre-service and in-service education of health care workers is delivered. The virtual ubiquity of satellite delivery, the dramatically increasing accessibility to the Internet, and the ever expanding mobile phone platform means that there is virtually no part of the world that cannot take advantage of ICT to deliver more effective and less costly learning experience to health care practitioners. ICT can play a vital role in training healthcare professionals, across the board - in nursing schools, medical schools, urban settings, and even in rural areas where it is often needed the most, that is, in remote hospitals, health centers and dispensaries that are under-staffed and where the addressable population is scattered. The health care sector can reap the benefits of ICT globalization, and our vision sees the deployment of ICT to deliver world class health education/training seamlessly and reliably to practitioners in the remotest village to cosmopolitan capital cities wherever they be located.

Through this article, the authors would like to set the foundation for a conversation among ICT experts and health educators about the best ways of advancing the use of ICT in health education in developing countries with the goal of ultimately establishing national and international policy frameworks that optimize the benefits to be accrued from ICT globalization. Advances in ICT deliverability seem to have placed health education/training in developing countries at historic crossroads. Do we continue to invest billions of dollars, much of it by bilateral and multilateral donors in traditional educational methodologies that have not significantly changed in decades and that are costly and seldom evaluated for effectiveness? Or do we begin to invest more consistently in ICT education solutions that are less expensive in the long run and that may be a more effective way of educating the workforce?

There have been ample demonstrations of the utility of ICT in health education/training;[1] but from our observation point, little effort has been made to learn systematically from these very promising ICT experiences and to mainstream ICT best practices. E-learning implementers interviewed for this article often expressed frustration at ad hoc, disease-driven approaches to ICT health education solutions. Not infrequently, a donor will fund a specific ICT education project to achieve a certain knowledge objective within a given time frame, and once that particular project ends, so does the use of the ICT infrastructure that is put into place. Thus, to make the leap into more generalized use of ICT, the question of sustainability needs to be addressed, and the answer would seem to lie in embedding ICT delivered education in health care system strengthening strategies, so that the ICT infrastructure that is put into place can be deployed for diverse purposes and audiences over a continuing time frame.

2. Converging Trends: A Historic Opportunity

Now may be the right time for such an approach, as concern for health system strengthening appears to be growing. The World Health Organization (WHO) reports that an increasing number of member states and the world's political and international health leaders recognize the urgent need to make a major, sustained commitment to strengthening health systems based on primary health care. According to WHO, this renewed political interest presents an opportunity to make sustainable improvements that benefit across disease areas and health programs, and redouble global efforts to meet the challenge of achieving the Millennium Development Goals.[2] In the United States, for example, the subject of strengthening the human health capacity in Africa received the increasing attention of Congress in 2007 with the introduction of the African Health Capacity Investment Act that would have required the President to develop "a strategy for coordinating, implementing, and monitoring assistance programs for human health care capacity in sub-Saharan Africa."[3] Such interest represents the type of political starting point needed to re-invent health training/education, so that all peoples everywhere enjoy access to the highest standards of health care.

The growing interest in a systems strengthening approach comes at a time, however, when financial resources for global health investment may witness a decline, as the global economy contracts due to the current economic crisis. An examination of the donor practices in Japan, Finland, Norway and Sweden showed that after each previous financial crisis since 1970, the country's aid declined. "Foreign assistance tends to be pro-cyclical - that is, shortfalls in aid and domestic revenue tend to coincide, and aid for health is no exception." Foundations and the governments of developing countries go through similar fiscal contractions during economic crises.[4] So, just as interest in systems strengthening is up; the resources needed to achieve desired outcomes in systems strengthening may be down.

The convergence of expanding ICT accessibility, the interest in systems strengthening and the possible shortfalls in global health spending that may emerge due to the current economic crisis may actually present an opportunity to advance ICT solution in health education/training. Arguably ICT can deliver quality education at reduced costs, creating learning environments in which the best teachers can reach large numbers of learners with quality curriculum, and in which digital data on health subjects become readily available to health care professionals where this was previously not possible.

To visualize what may be required to switch over to ICT educational platforms, it may be useful to compare it to the changeover to the use of electric automobiles that is being planned in industrialized countries as part of the answer to global warming. Most of the technology requirements are already known, but it takes a commitment to changing systems, adding more renewable sources of energy, enhancing the electric grid, manufacturing the vehicles (batteries included), getting consumer compliance, etc. to accomplish this.

The transition to ICT education platforms will be much easier than is the case for the electric automobile. As the technical discussion in this article illustrates, the technical components for widespread use of ICT are readily available. It is basically a question of assembling the components and adapting the current curriculum to the ICT medium. Once the mostly off-the-shelf components are in place, multiple users can take advantage of the infrastructure to educate large numbers of health care workers at lower costs and for longer periods. As new ICT emerge, the system can be upgraded continually to adopt advantageous innovations. Human resource structures and policies also need to be developed to support the introduction of new learning delivery platforms.

3. Benefits In Remote And Rural Environments

In addition to the inherent advantages of using information in digital form, such as the accelerated gathering and compilation of information, ease of use/re-use etc., ICTs have the unique ability to address capacity-related issues in developing countries such as providing standardized education on a national and trans-national scale, addressing the shortage of qualified trainers/instructors and providing ongoing training of field-workers to keep their knowledge current while maximizing their face-time with patients. In other words, ICTs make it possible to provide nationwide (and even transnational), de-centralized, in-situ training of field workers at the frontlines of health care with the objective of maximizing the number of people benefiting from knowledge of the latest advances in treatment, disease prevention, and general wellness. However, as shown in this paper the choice of an appropriate ICT, with respect to its availability in rural settings of developing countries, is vital to ensure that the remote health care worker can fully leverage the potential of the ICT for distance learning.

As alluded to above, there are readily available ICT education solutions for virtually every work and institutional environment. The technical discussion in this article focuses, however, on the use of innovative ICT solution to bring quality in-situ distance learning to health care workers practicing in rural and remote areas. ICT can help play a role in increasing access to quality health care workers in remote and rural areas. Among the reasons for this are the following:

- ICT can deliver the same quality of learning to rural practitioners that is available to their urban counterparts to the benefit of the local community's health.
- In-situ training ICT can reduce the amount of time that health care workers spend away from their posts. Health facilities are often understaffed, and the absence of health care workers to attend traditional style training workshops often means that community health facilities have no staffing or may be staffed by individuals with less qualification to the detriment of the health of the local community. As one village headmen in Nigeria graphically explained to us during a village health meeting, "When our health officer goes to training, our women die [due to complications of childbirth]."
- Enhanced training opportunity in remote and rural areas is an important component of a retention strategy designed to reduce the migration of rural health care workers to urban areas where they can better keep up with developments in their profession through continuing education.[5]

To motivate participation in in-situ training, a range of human resource development issues needs to be addressed. For instance, currently the per diem allowance offered in traditional off-site training workshops acts as an effective incentive for participation in training activities. It will likely be necessary to develop alternative incentives to motivate long-term participation in in-situ training activities. Such incentives could come in the form of promotions, bonuses and pay increases that are linked to demonstration of knowledge and skills gained rather than based just on participation, which is the criteria currently used for the per diem allowance incentive.

As demonstrated in the section below, the technology already exists to deliver in-situ, high-quality educational opportunities to health care works in remote and rural areas through individual handheld devices and computers directly from satellite.

4. ICTs For Health Care Training

In this article, we examine various ICTs that could potentially be used to deliver health care training, analyze the pros and cons of each technology in the rural health care training context of the developing world, classify them in terms of their usage modes and thereby identify the essential elements of an ideal training. We then use this knowledge to craft an innovative ICT platform that combines the

best aspects of previous experiences and the latest advances in mobile technologies, with a cost-effective, field-proven satellite technology for multimedia learning thus developing the ideal cost-effective, in-situ distance learning/training platform for itinerant health care workers.

Health care training modes can be classified in terms of asynchronous or synchronous education - terms borrowed from communication technology. While synchronous education requires the training provider and recipient to be simultaneously present for the duration of training, at each end of the communication channel, asynchronous education does not. Both training modes have their uses, and a given ICT could be used in either or both modes, based on the application.

4.1 The Internet and IP technology

There is no doubt that over the last decade, the Internet has fundamentally transformed information availability and accessibility, and made connectedness an inherent part of the developed world. Many urban locations in the developing world are also on par with the developed world in terms of Internet availability and access speeds. Once connected to the Internet, or more accurately by means of Internet Protocol (IP) technology, one could argue that applications such as World Wide Web, Video Streaming, Video Tele-Conferencing can be combined into a Health Care training server - located either on the public Internet or on a private IP network to offer a standardized rich multimedia (audio, video, text) experience in synchronous and asynchronous health care training. While this is true, *it is prudent to ask whether a rural health care worker can access this rich multimedia digital learning service, from the field*. Although, IP technologies have become the ubiquitous standard in networking, it requires underlying bi-directional (two-way) ICTs that can provide Physical Layer and Data Link Layer - Layers 1 and 2 respectively of the Open Systems Interconnection (OSI) Model. Thus, *Internet availability, reach and speeds are a function of the underlying bi-directional ICT*. What this implies is that the availability of bi-directional ICTs is critical to Internet access. So while Internet technologies have made it easy to gather, distribute and access digital health care training information in multimedia formats, *the availability of a bi-directional ICT seems essential to a health care worker*, if they are to gain access to this wealth of information from the field or from a remotely-located hospital/dispensary. The latter part of the paper will show how IP technologies can be combined with unidirectional broadcast technologies to deliver cost-effective, in-situ, distance learning solutions that can provide health care education in both synchronous and asynchronous modes.

4.2 Optical Fiber

While terrestrial bi-directional ICTs such as dial-up over the old copper-line based Public Switched Telephone Networks (PSTNs) formed the underlying technology that powered the growth of the public-domain Internet in the mid

1990s in developing countries, it was quickly superseded by advances in optical fiber technologies, with the result that optical fiber infrastructures form the bulk of terrestrial broadband (high-speed) Internet networks - even in DSL, only the so-called last-mile circuit, from the Central Office to the Home/Office, is copper. While it is commonplace now to get residential broadband Internet at multimegabit speeds, the fact that the infrastructure still has to be laid on the ground, inch-by-inch limits the reach and availability of broadband Internet, especially in developing countries. Laying down terrestrial broadband optical fiber infrastructure is costly and requires heavy investments and is usually caught up in the chicken-and-egg issues of demand/supply. In effect, it is extremely rare to come across terrestrial broadband optical fiber in rural areas. Hence, *optical fiber technology is not a viable technology when crafting rural healthcare distance learning solutions*.

4.3 Wireless WAN

Wireless Wide Area Network (WAN) technologies such as evolved cellular-based 3G networks that incorporate high-speed Internet access as well as those incorporating broadband Wi-Max technologies are now being deployed mostly in urban areas of the developing world with some spill-over coverage into rural areas. Of the two technologies, cellular technologies are the more widely deployed - it should be noted that 2G and 2.5G networks, most notably using GSM technology, have been widely deployed and have made cell-phone based telephony available to large swaths of the developing world, even in rural areas.[6] While cell-phones (or mobiles as they are called in certain parts of the world) may seem a welcome relief to the itinerant health care field worker on account of it being untethered, the limited availability and prohibitive costs make it an infeasible ICT for continuing health care training. The one thing that these networks are extremely good for is texting or SMS (Short Message Service). In fact, this SMS service has been leveraged by health care providers using applications such as FrontlineSMS[7] to address a range of healthcare-related issues such as Remote Data Collection, Remote Monitoring, Disease and Epidemic Outbreak Tracking and Alert as well as Diagnostic and Treatment Support.[8] (Although, one could argue that 3G technologies are likely to be available with time, even in rural areas of developing countries, the use of a non-broadcast medium, wherein each health care worker has to individually download material makes it cost-prohibitive when using this technology on a nation-wide scale for asynchronous education of large multimedia files; the non-broadcast topology of such a medium does not lend itself to national level synchronous education. Thus, although cell-phone technology is indispensable to the rural health care worker, it does not lend itself to devising cost-effective distance learning solutions for the health care worker.

4.4 Handhelds

Over the last decade, handheld devices - which initially started out as Personal Data Assistants (PDAs) - have became increasingly powerful in terms of processing and the range of applications that they can support. Simultaneously, they have become very affordable, over the last few years, with many of them also functioning as cell-phones. The availability of a pocket-sized, extremely portable device that can communicate (text and voice) as well as store large amounts of information - removable storage in the order of GBytes is now reasonably cheap - has been leveraged by health care workers in many developing countries for the purposes of carrying rich reference information (including photos, videos etc.) for enhanced education and awareness while on field visits.[8] The handheld can be used to download information using a (terrestrial or wireless) broadband Internet connection while visiting urban areas (either directly through a high-speed wireless modem or indirectly by synchronizing with a PC/laptop), and have the information handy for reference while visiting rural areas. Although, not truly achieving in-situ training, Handhelds/PDAs can help in asynchronous Communication and Training of the itinerant health worker, as they can stay connected via email and text with their regional hospitals and universities using the cell-phone network, and catch up on medical literature and new protocols for administering medicines between field visits, during their downtime. Thus, Handheld/PDA technology has been a great success in advancing health care training especially for the itinerant remote health care worker.[8] They have served well as a portable platform for standardized data collection in conjunction with health surveys.

5. Satellite Radio Handheld

The success of the handheld/PDA technology noted above, with regard to asynchronous health care education, is tempered by the fact that the asynchronous updates can only be performed at locations where there is Internet connectivity. Also, we have previously seen, even with 3G technology, cellular network topologies do not allow for synchronous education, on a nationwide scale. The popularity of cellular-powered handheld with health care workers is undeniable as it provides all the functionalities of a cell phone with the data storage and retrieval capabilities of a PDA on a portable, pocket-sized platform. What if the handheld could receive satellite signals directly in broadcast fashion, across national and international boundaries, using a small stub-antenna? Then it would be possible to perform in-situ training of health care officials in the field, extremely cost-effectively, in both synchronous and asynchronous modes. As a matter of fact, all the elements needed to implement this platform exist today and have been independently field-proven.

5.1 WorldSpace Satellite Radio

WorldSpace pioneered a satellite radio system in the 1990s to carry to broadcast quality digital audio directly to compact, portable receivers. Over the last decade, the WorldSpace system has been successfully adapted to carry digital data in the

last decade for education and disaster alert.[9] Although, unidirectional, the technology is by no means restrictive in terms of its use as an educational platform.[10] In fact, its receive-only mode of operation makes it possible for it to be used without requiring satellite-skilled personnel. The WorldSpace system provides all the advantages associated with satellite technology - ubiquitous coverage including last mile connectivity, instant communications infrastructure, independent of existing terrestrial infrastructure that is highly survivable and inherently scalable - at a fraction of the cost of VSAT bandwidth, making it highly cost-effective in reaching remote, unconnected regions of the developing nations in Africa and Asia. In fact, the WorldSpace Satellite Radio technology was singularly recognized for the important role it can play in bridging the last-mile barrier by several international agencies.[11]

5.2 WorldSpace DataCasting

The WorldSpace system provides all the advantages associated with satellite technology with the portability of handhelds to provide a single platform capable of addressing not only e-health, but also agriculture, rural development, disaster management and e-governance.

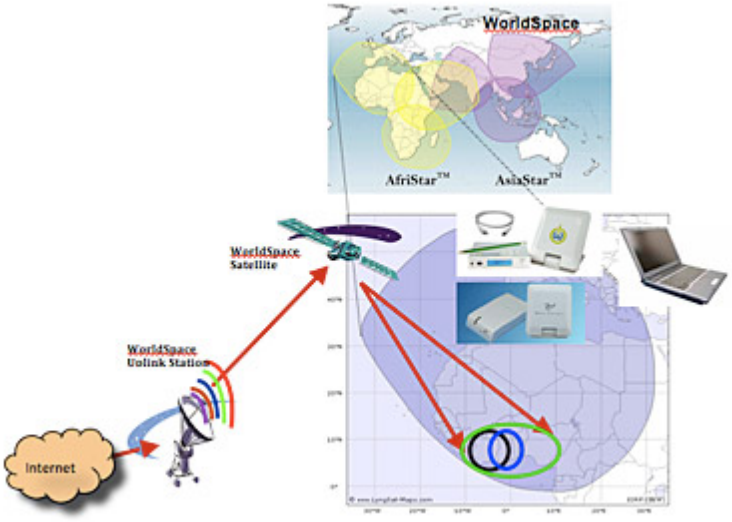

Figure 1: WorldSpace Architecture for Datacasting files to a laptop.

As shown in Figure 1, with the WorldSpace Datacasting system, data can be uploaded from any Internet-connected site to be broadcast at rates of up to 128 kbps to any country in the continents of Africa and Asia - where bulk of the developing countries are located. Upto 50 MBytes of data can be downloaded in an hour which makes it ideal to transfer text, photos, graphics, audio, and even short video clips. The system was developed with encryption capability that enables selective addressing of receivers - which allows receivers to be grouped and addressed collectively, thus achieving multicasting. Multicast groups can be

formed on any arbitrary basis. If a GPS receiver is present at the receiving end, multicast groups can be formed based on geographic location-based groupings.

Of all the applications previously identified on the WorldSpace Datacasting system in the Online Journal of Space Communications,[8] two applications - namely File Broadcast and Combined Live Audio and Slide Show (CLASS) have particular relevance in the health care training context as they can be used to deliver asynchronous and synchronous modes of education in a cost-effective manner on a national or trans-national scale. WorldSpace technology has been field-proven to be effective in providing cost-effective, in-situ health care training in many developing countries).[12]

With today's technology it is possible to integrate the WorldSpace antenna and receiver technology into a handheld. In fact, such a device is available today in the US on the XM radio platform, an offshoot of the original WorldSpace technology. Today's handheld processors can easily support the PowerPoint-based application needed for CLASS that originally required a laptop. Thus, we believe that today, with the advanced communications chipsets, low-power processing, flash-storage and touch-screen technology that goes into handhelds, such as the iPhone, it is possible to develop a satellite-radio based handheld/PDA that at once provides both synchronous and asynchronous education on an extremely portable platform throughout the greater part of the developing world (see Figure 2).

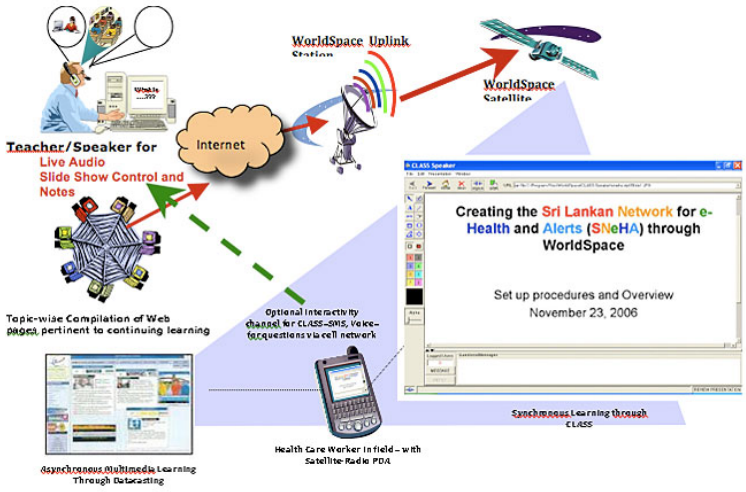

Figure 2: Asynchronous and Synchronous Learning on Handheld (click image for larger view).

6. Summary

By leveraging the health workers' ICT platform of choice, i,e. a handheld/PDA and endowing it with in-situ asynchronous and synchronous learning capabilities, we believe that this ICT can prove invaluable in catapulting the productivity of the health care worker to the next level wherein, they are able to continuously

update their knowledge while simultaneously maximizing their face time with patients. We stand at the threshold of the next evolution of satellite handheld technology, that has the potential to fundamentally transform how health care training is delivered - designed with the itinerant healthcare professional in mind, from the ground up, using field-proven elements that ensure its success. Combined with the extremely cost-effective bandwidth costs for file-transfer on the WorldSpace system, and by leveraging Public-Private-Partnerships, we believe that the Satellite Radio-PDA based health care training platform will go a long way in bringing about real, lasting progress in the health care for the developing world.

Contacts

Krishnan Haridasan, President
Protean, LLC
13934 Bromfield Road
Germantown, MD 20874 USA
Fax: +1 203 538 2600
Email: Krishnan@ProteanLLC.net

Srinivasan Rangarajan, Senior VP
Engineering Solutions, WorldSpace Inc.
8515 Georgia Avenue
Silver Spring, MD 20910 USA
Fax: +1 301 960 2200
Email: SRangarajan@worldspace.com

Gregory Pirio, President
Empowering Communications
13273 Fiji Way, #210
Marina Del Ray, CA 90292 USA
Fax: +1 516 665 7146
Email: GregPirio@EmpowerComm.com

REFERENCES

1. ICT in Health: the role of ICTs in the health sector in developing countries, IfoDev Working Paper No. 7, http://www.infodev.org/en/Project.38.html
2. http://www.who.int/healthsystems/en/
3. J. Stephen Morrison and Allen Moore, Health Worker Shortages Challenge PEPFAR Options for Strengthening Health Systems: A Report of the Task Force on HIV/AIDS Center for Strategic and International Studies (September 2007), http://www.csis.org/component/option,com_csis_pubs/task,view/id,4098/

4. Lindsay Morgan, "The Financial Crisis and Global Health," Global Health Magazine http://www.globalhealthmagazine.com/top_stories/what_does_the_financial_crisis_mean_for_global_health/
5. See Africa Health Workforce Observatory, http://www.afro.who.int/hrh-observatory/
6. http://upload.wikimedia.org/wikipedia/en/d/d0/GSM_World_Coverage_2008.png
7. http://www.frontlineSMS.com
8. http://www.globalproblems-globalsolutions-files.org/unf_website/assets/publications/technology/mhealth/mHealth_compendium_full.pdf
9. http://spacejournal.ohio.edu/Issue12/rangarajan1.html
10. http://schoolnetuganda.sc.ug/wp-content/uploads/2007/12/distance-education-by-worldspace-evaluation.pdf
11. http://lirneasia.net/projects/2006-07/evaluating-last-mile-hazard-information-dissemination-hazinfo/ and http://www.ituarabic.org/2007/Disaster-Relief/FinalDocs/3rd%20Day/SessionXa/Doc46-Rangarajan.doc
12. http://www.kaisernetwork.org/health_cast/uploaded_files/World_Health_Channel_-_Medical_Information_via_Sattelite.pdf