

FINANCING RURAL TELEMEDICINE: BRINGING HEALTHCARE TO THE UNDERSERVED

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Abstract. This article reports on rural telehealth programs around the world, where mobile telephony is used to bring basic healthcare to poor populations. The financing methods used by these programs help us understand how these innovations may be spread to alleviate human suffering. We classify the different financing programs into four major financing models: (1) Those that seek grants to finance operations; (2) Those that are supported by local and/or foreign governments; (3) Those that develop a self-sustaining model through revenue generation (charging rural patients for medical services); and (4) those that are funded through global human services programs. We conclude that global partnerships between large for-profit corporations, world health organizations and the local governments can help spread rural telemedicine.

Keywords: Telemedicine, Financing, Non-profits For-profit Partnerships.

According to the World Health Organization (WHO), Pakistan has 160 million people, 75% of whom live in remote rural areas. 70% of Pakistanis never see a doctor in their lifetimes. They rely on local health care workers for treatment and education. There are 110,000 doctors and 1000 government hospitals in Pakistan, which is approximately one doctor for every 2000 people, approximately half of what the WHO recommends in general, which is that there be one doctor for every 1000 people. Pakistan suffers the highest infant and maternal mortality rates in the Asia Pacific at 86.8 per 1000 and 170.8 per 1000 respectively (US National Academy of Sciences, n.d.). One in 10 children dies by the age of five (United Nations State of the World's Children Report, 2007). These unfortunate statistics are illustrative of conditions in many other developing nations. There is a definite need in undeveloped and developing countries for a better solution for meeting the health care needs of large rural populations. This need becomes even more urgent when you add the fact that in Pakistan, 80% of deaths and 90% of illnesses are caused by preventable diseases. If the innovation in disease control has found remedies for these illnesses, why do these still continue to take lives all over the world?

One reason is that while medical solutions to the problems have been developed, these are not sufficient. In order for these medical solutions to reach the rural populations, there are a number of hurdles that need to be overcome. For example, the willingness of doctors to practice in these poor regions, or the financing of such care when the poor are unable to afford it, and many other such hurdles. Lately, technology has made it possible to link distant expert doctors with remote patients and a new solution to address this is in the form of telemedicine. Telemedicine refers to the practice of providing basic healthcare services in remote areas using modern communication technologies to connect the local health-care workers in the regions with doctors who are at a distance but available for consultations and training via the communication network. However, even with technology and medical innovation of telemedicine, there are still other barriers, organizational and financial, to solving the problem of providing healthcare to the poor in remote regions.

One such hurdle is the financing of these telemedicine programs. In this article, we focus on the financial aspects of the telemedicine-based solutions to the problem of providing rural healthcare. We survey some telemedicine programs around the world with a particular emphasis on how these are financed. Our goal is to shed light on the financial and organizational capabilities that are needed for telemedicine programs to become more pervasive.

WHAT IS TELEMEDICINE?

In this section, we summarize some of the different definitions of telemedicine, and provide the background on how this integration of medicine and technology has created the pioneers who are using it to address the problem of lack of healthcare in rural areas. We describe the types of organizations we selected for this study and what they do in general. This background will provide the basis for our core focus, which is to study the impact of the financial models on the overall dynamic capabilities of these organizations to meet their goals. One definition of telemedicine is: "...the use of modern information technology, especially two-way interactive audio/video communications, computers, and telemetry, to deliver health services to remote patients and to facilitate information exchange between primary care physicians and specialists at some distance from each other" (Darkins & Cary, 2000, p. 2). The Institute of Medicine of the National Academy of Science defines telemedicine as "the use of electronic information and communication technologies to provide and support health care when distance separates the participants". This can be as simple as two physicians talking over the phone about a case or more sophisticated video conferencing where real time clinical assessments take place. The federal Office for the Advancement of Telehealth defines telehealth as "the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration." Telemedicine only refers to providing medical services, whereas telehealth is a broader term that encompasses telemedicine and non-clinical applications such as education and research. For our purpose, we focus narrowly on telemedicine programs serving unmet basic healthcare needs in the under-developed parts of the world; so we will use the term telemedicine to incorporate both these aspects of delivering care as well as training and education.

The earliest form of bringing healthcare to the remote rural populations was to set up remote clinics or have traveling doctors. Distance and cost involved in this meant that aid organizations and governments were only able to treat limited portions of the rural population. With rapid developments in information and communication technologies and the increasingly affordable costs at which these are available, the distance between the urban and developed parts of the world and the remote and rural parts in the developing world have become less important for bringing health care at a distance. Instead of remote clinics or traveling doctors, now healthcare workers are able to use telemedicine to treat villagers in rural areas. With the introduction of telemedicine, the citizens of rural villages are able to connect to a network of doctors and specialists remotely through an intermediary like a community based health care worker equipped with a mobile device and basic training on medical treatment and care. Telemedicine makes distance and road access irrelevant, spreads the bandwidth of a single specialist across thousands of patients, and is low to no cost for patients.

Since the early 1990's health care professionals in the United States (US) began implementing technology to better share information within and across medical networks. The increasing use of technology created the innovation of telemedicine. It is widely used in many other aspects of practice of medicine today. Within the US, there are many organizations, such as, the American Telemedicine Association, Association of Telemedicine Service Providers, the Centre for Telemedicine Law, the Federal Office for the Advancement of Telehealth, the Telemedicine Information Exchange, which exist to promote and facilitate the use of telemedicine. Even at the state and local levels, there are chapters for telemedicine; for example, in California, one can reach out to the California Telemedicine and eHealth Centre at www.cteconline.org. Our analysis focuses only on a special segment of the use of telemedicine, which is directed towards solving the problem of providing basic healthcare to the poor populations in remote rural regions of the under-developed parts of the world. The organizations we survey are the pioneers in that domain.

The telemedicine programs that we surveyed are managed by organizations committed to improving health care in a rural area. The telemedicine program operators

perform several functions. These organizations recruit individuals already living in the rural area to become community-based health care workers. The organization provides initial training to the field workers, and supplies them with hand-held mobile devices (such as PDA's) to be used to collect medical information from patients. Medical records collected during patient consultations by the field worker are transmitted wirelessly to the telemedicine program operator. The organizations also locate and organize a network of medical professionals willing and available to do several functions. The program operator transfers the medical records to a medical professional who is able to diagnose and treat the ailments of the rural patient who may potentially be thousands of miles away. After reviewing patient cases electronically, the doctor or specialist sends the treatment instructions back to the telemedicine operator who in turn passes the directions back to the local community-based health care worker's mobile device so that he or she can ultimately treat the patient. The telemedicine operator is wirelessly connecting the rural patient with a doctor or specialist in another location. The medical professionals offer continuing education to the field health care workers with whom they communicate, they review the medical records of the rural patients, they provide treatment instructions to the field workers, they may also offer follow up care.

As mobile technology has become more established and affordable, telemedicine programs have grown more popular with governments, public health officials, and medical research communities as they serve an unmet need in innovative ways. These programs address one of the most basic and challenging health care problems faced by large segments of human population. Our survey provides some evidence that the manner in which these programs are funded can have a significant impact on their success. For an innovation to succeed, there are multiple capabilities needed. Telemedicine programs have come about based on well-developed medicine and technology knowledge, but their success may depend on dynamic capabilities in the area of financial models used to fund these programs. In the next section, we provide the specific details of the organizations we surveyed, while elaborating how these different programs have been funded.

FINANCING TELEMEDICINE PROGRAMS

The information we provide in this section was gathered from public sources. We researched different public sources, library databases, academic journals, the internet, and telemedicine associations mentioned earlier, to find information on telemedicine programs delivering rural healthcare to remote populations. We gathered all data that we could find that would help us investigate these organizations, be it their operational structures, the kinds of services they deliver, the size of their operations, performance metrics, and specially how they are financed. At this time, there are only a handful of these pioneering organizations, and information about them is difficult to find. Financing and performance information was even more difficult to find.

We gathered information on as many of these as we could find. There are a few telemedicine programs that have been actively addressing the large and growing unmet need for rural healthcare in many remote parts of the world. These programs are spread out in different remote areas of the under-developed parts of the world. There is not much information available about them, and even less about their internal financing or operations or performance metrics. We think this is one of the reasons why our study is important, as it can even be helpful to these very organizations as they pioneer this important work. Amongst the programs we investigated, we found that different programs used different methods to fund their operations. We found it useful to categorize these into four major types of financing models. These are described in more detail in this section, and are labeled as: (1) Grant seeker model (2) Local and/or foreign government supported (3) Self-sustaining through revenue generation (charging rural patients for medical services), and (4) funded by the global human services programs. These are representative, not comprehensive, ways of financing

Exhibit A

Financing Model	Start Date/ Program Name	Countries	Funding (USD)	Funding Sources	Patients Treated	Website/Notes
Grant Seeker	7/2008 Tele-Health Care	Pakistan	USAID-\$38,325 HEC-\$110,000 ISIF-Unknown	USAID, ISIF, HEC	250 patients/day	www.tele-healthcare.org
Government Funded	2005 UHIN	Uganda	Unknown	IDRC	1 million since 2005	www.healthnet.org/uhin
Government Funded	2006 MHIN	Mozambique	Unknown	IDRC	Unknown 66 facilities	www.healthnet.org/mhin
Self-Sustaining	2003 Pilot Jiva Tele - Doc	India	Initial Grant from Soros-Unknown \$1million cash positive in 2006 from franchising model	Soros Foundation (Pilot) Franchising model	9 million patients/year, 2006	http://www.infosci-journals.com/downloadPDF/pdf/ITJ3276_6gg4DgSKcD.pdf
Global Partnership	2008 Technology Partnership	24 countries in Africa	\$2 million initial investment Unknown additional	UN Foundation Vodafone Foundation	Unknown	www.datadyne.org/about

Key:

HEC= Higher Education Commission of Pakistan

IDRC= International Development Research Centre, Ottawa, Canada

ISIF= Information Society Innovation Fund

MHIN= Mozambique Health Information Network

UHIN= Uganda Health Information Network, USAID= United States Agency for International Development

Exhibit A above provides a comparative matrix summarizing the key features of these organizations and the four different types of financing models. Using a short case-study format, we further describe each of these different telemedicine programs. Consider the conjecture that understanding the implications of each of the financing models is crucial to sustaining and expanding any telemedicine program. There is very little data available by way of performance metrics or size of these various programs. To our knowledge, this is the first survey of such programs. Therefore, to make our argument, we use various proxies of size such as number of patients served or number of doctors enlisted with the program or expansion or growth of the programs. Through this research, we show how the innovations in technology or medicine alone are not adequate to solve the many problems of lack of access to healthcare. Innovations in financing and organizing are a key differentiator of how these innovations work together in order to provide solutions to a real problem.

Grant Seeker Model: Tele-HealthCare in Mardan, Pakistan

In 1994 Pakistan introduced a program called the Lady Health Workers or LHW's. This program was to be managed by the government's National Program for Family Planning and Primary Health Care and planned to hire 100,000 LHWs to serve in 130 districts in Pakistan (GSMA Development Fund, n.d.). The LHW program was intended to serve two purposes: to treat the rural population of Pakistan where doctors were not available, and to act as medical resources for women who were not seeking medical care from male doctors as it was not traditionally acceptable for them to do so. LHW's received training and were then dispatched to their rural territories. LHWs struggled to maintain contact with their supervisors because of the distance. They also could not easily refer serious cases to seek emergency medical attention, because of the remote locations.

In 2008, a partnership was formed between Mobilink, the GSMA Development Fund, the UNFPA and Pakistan's Ministry of Health, with the goal to bring mobile technology to the LHWs. They issued mobile phones and PDA's to the LHWs with the expectation that this would help improve the care they provide. However, this only got mixed success because there was no central authority designated to provide timely ongoing medical oversight, guidance, and education for the LHWs.

In July 2008, a pilot telemedicine program in Skardu, Balistan, Pakistan was completed and the partnership applied for and was awarded grants from the United States Agency for International Development (USAID) and the Higher Education Commission of Pakistan (HEC). Thus began the Tele-HealthCare program, which is now managing a telemedicine program in rural Mardan, in the North West Frontier Province of Pakistan. The Tele-HealthCare program treats approximately 250 patients per day.

Tele-HealthCare's mission in Mardan is to leverage the existing field staff (LHW) and Information Communication Technology (ICT) to provide better quality care to patients served by the LHWs. Tele-Health Care has built a network of doctors from Pakistan and America, mostly doctors of Pakistani descent living in America. The medical data collected by the LHWs in the field is entered into their mobile devices and transmitted to a central location. An internet based and mobile ready telemedicine network has been developed in Jakora, and it serves to connect the LHWs in Mardan with the doctors and specialists in urban Pakistan or abroad, by transferring the data collected in the field to these specialists. The program uses SMS (Short Messaging Service), MMS (Multimedia Messaging Service), GPRS/Edge, and VSAT. In addition to collecting and transferring patient data, LHWs are able to listen to recorded trainings and watch videos from their mobile devices. This program has trained 50 LHWs in Mardan. There are hopes to expand the project, provided additional funding can be obtained.

The USAID and HEC grants received in 2008 totaled US\$149,325. In 2009, Tele-Health Care received an additional grant from the Information Society Innovation Fund, a grants program aimed at stimulating creative solutions using ICTs for meeting the development needs in the Asia Pacific region. The USAID funding is expected to last until the end of June 2010. Other grants will need to be renewed or replaced for operations to continue past this expiration. For Tele-HealthCare, continuing regular operations within the existing footprint is totally dependent on the grants, and it is at risk when grants expire. The possibility of expanding health care services beyond its present footprint is not very likely either. Once the grant expires, the program may have to be shut down, unless new sources of funding are secured. Thus, this case illustrates how even successful programs that depend solely on grants are very vulnerable. We can conjecture that the grant seeker tele-medicine programs face significant uncertainty associated with being wholly dependent on whether or not new financing will be secured.

Government Funded Model: Health Information Networks in Uganda and Mozambique.

The next two organizations are similar in that they share the same technology, funding source, and operational model. Uganda Health Information Network (UHIN) and Mozambique Health Information Network (MHIN) are funded by the International Development Research Centre, Ottawa, Canada (IDRC), and rely on software from AED

SatelLife. In Uganda, AED SatelLife programmed PDA devices with software capable of collecting patients' medical information and dispatched them to 600 health workers in Rakai, Mbale, Manafwa, Lyantonde, and Bududa. Data are transferred to and from these PDAs wirelessly at African Access Points (AAP) developed by AED SatelLife and through a server in Kampala. The health workers collect medical information from patients during a consultation and enter it into their PDAs. "They then upload that data and e-mails they need to send to AAP via infrared, Bluetooth or wi-fi at a rural health facility. The AAP sends the data and messages over the cellular network to the server in the capital, which routes them to the correct recipients and sends back messages, data, and health information clinicians need. For Uganda, which has one of the highest burdens of disease in the world but also some of the best cellular telephone coverage in Africa, the marriage of handheld technology and cellular telephony represents a watershed moment in the battle against information poverty" (AED SatelLife- Uganda, n.d.). The data collected are both transferred to District Health Offices that use them to measure illnesses, produce statistical reports, and monitor drug usage and stock, and to tier one medical personnel (doctors, nurses, and clinical officers) to review patient records and transmit treatments back to field health workers. UHIN operates in 5 districts and has serviced over 1 million people in Uganda since 2005 (AED SatelLife- Uganda, n.d.). Like Tele-HealthCare in Pakistan, UHIN uses the mobile network to provide continuing education to all medical personnel and field workers.

MHIN is similar to UHIN except there is a higher level of integration between the data that are collected from the health workers in the field, and the District Health Offices that receive them. The Ministry of Health of Mozambique (Ministério de Saúde, MISAU), absorbs the data from the District Health Offices, reviews them, and then determines the appropriate education and training that should be transmitted through the wireless network to the field health workers based on the concentration of various medical conditions reported. Health workers are then provided with especially relevant training to treat the conditions they are encountering most often (AED SatelLife- Mozambique, n.d.). MHIN began operations in 2006 and operates in 66 health facilities in Chockwe, Manjacaze, Morrumbene, Namacurra and Nicoadala districts.

The UHIN and MHIN programs were created by their respective governments after funding arrangements were made with IDRC (International Development Research Centre). In 2005, independent consultants showed that UHIN, using AED SatelLife technology, was 24% less expensive per unit of spending than alternative methods for providing public health care services (AED SatelLife- Uganda, n.d.). Because of the investment by IDRC, the initial staff size and therefore service capacity of UHIN (1 million serviced) and MHIN (66 facilities) was far greater than Tele-HealthCare's 50 LHWs in a single facility.

Self Sustaining Model: TeleDoc, India.

In 2003, the Jiva Institute, an India-based company, launched a pilot program called TeleDoc (ICT for Development, n.d.) which was funded by the Soros Foundation. It provided mobile devices to health workers in 15 villages in Haryana so that they could communicate with doctors who use a web application to help diagnose conditions and prescribe medications for patients. The intention of the pilot was to "deliver low-cost diagnostic and prescription services to rural villages currently underserved by existing healthcare systems, thereby improving treatment of diseases in these settings" (ICT for Development, n.d.).

The basic model used was similar to that of Tele-HealthCare and UHIN/MHIN, where TeleDoc provided health care workers with mobile phones equipped with software able to synchronize with record-management systems at Jiva's clinic. Doctors reviewed the information collected by the field workers, and prescribed medication and treatment. "Medicines were compounded at a regional office, picked up by field workers, and delivered to patients in their homes - a network of pharmacies and delivery people supported this process. The approximate cost of the entire TeleDoc process was 70 rupees (US\$1.50) per consultation" (ICT for Development, n.d.). The pilot was deemed a success. On the 10th of December 2003, TeleDoc won the World Summit Award for eHealth, presented at the World Summit on the Information Society (WSIS) in Geneva, Switzerland.

Based on the success of the pilot, Jiva decided to scale TeleDoc throughout India. It structured the organization as a non-profit, and implemented a franchising model for it. They also adopted a pricing strategy that allowed it to become cash positive relatively quickly. As part of the expansion, Jiva planned to develop software based training components directly related to women's health. As part of the expansion plans, Jiva and its franchisees continued providing cell phones to field workers, and charging nominal fees to patients. Franchise owners acted as the connection between field workers and doctors. "The TeleDoc field team collects data about illness and symptoms from rural patients on a case-by case basis... data are input to the GPRS data network through the J2ME application interfaces (e.g., patient records). These data elements reach the central database of TeleDoc doctors at Jiva's clinic. The doctors go through the descriptions of every case, and corresponding treatment procedures and prescriptions are messaged back to the TeleDoc field workers. The TeleDoc field workers, in turn, collect the prescribed medicines from their local franchisee and distribute them to the patients. The consultation fee and medicine fees are collected by the field workers and sent back to the central office via the franchisee network" (Bandopadhyay & Singh, 2006). During the year 2006, Jiva intended to provide consultation to nine million patients in 1,000 villages. At this volume, Jiva should have \$1 million net surplus per year (Bandopadhyay & Singh, 2006).

TeleDoc was able to develop a revenue generating model that helped attract franchisees, allowing the program to grow much faster than it might otherwise have. TeleDoc is unique among telemedicine program operators for this self-sustaining model, serving as an important example amongst the telemedicine programs. When franchisees seek to and achieve profits in telemedicine, they also create a "marketplace" that attracts other new organizations to enter the market based on the incentive to make profits as well. This increased participation expands the availability of health care services to rural populations much faster than other financing models have illustrated. Although this is just one organization, it is a good exemplar to illustrate the potentially important link between the expansion of telemedicine and the incentive of profits. The next model shows how this incentive for profit can accelerate the growth in telemedicine programs when several larger organizations come together

Global Partnerships Model: Corporate Charity, India and Africa.

The United Nations set out the Millennium Development Goals (MDGs) as a challenge to halve extreme poverty around the world by 2015, while improving education, health, and gender equality (Hospital Information Technology Europe, 2008). Numerous large multinational organizations stepped up to participate in supporting the initiative by forming partnerships. Two examples of such global partnerships, formed as a result of the MDGs, are the Ericsson-Apollo Telemedicine Networking Foundation (ATNF) mobile health services project in India, and the UN Foundation-Vodafone Foundation Partnership telemedicine project in sub-Saharan Africa. **Ericsson-ATNF**

Apollo Telemedicine Networking Foundation is a part of the Apollo hospital network in India. It is set up as a not-for-profit organization. "ATNF works with multiple entities including the Central and State Governments, medical bodies, private and public sectors, both at domestic and international levels to popularize the concept of Telemedicine. ATNF offers customized solutions addressing telemedicine support for primary, secondary and tertiary level of healthcare. 'Medintegra WEB', the proprietary Telemedicine Application supports the platform to carry out telemedicine consultation. Apollo Hospitals provide the medical support by rendering quality healthcare through its key hospitals (Apollo Telemedicine Network Foundation, n.d.)." ATNF acts as a technology partner for the local telemedicine programs and also sells telemedicine software programs. It links its affiliated programs with doctors directly since it is a part of Apollo Hospital Network.

Ericsson (NASDAQ:ERIC) and ATNF... have taken a major step towards helping bridge the digital divide in rural India by laying the foundation for the introduction of mobile

health services. Telemedicine delivered using HSPA technology will enable the provision of affordable and accessible healthcare to millions of people in remote areas. Mats Granryd, President of Ericsson India, says: "Mobility has proven to be a major catalyst for social and economic empowerment, and a key ingredient in helping to bridge the digital divide. Through our ongoing partnership with Apollo, we are putting an ecosystem in place to support telemedicine applications once the 3G network is deployed." Prathap C. Reddy, Chairman of Apollo Hospitals Group, says: "With the availability of wireless technology, mobile health will be integrated into the healthcare delivery system. The new mantra could well be 'Healthcare for anyone, anywhere, anytime.'" (Ericsson, 2008).

Outside of its partnership with ATNF in India, Ericsson has also joined the United Nations Office for Partnerships' mHealth project, which uses telecommunications to bring mobile health applications and telemedicine to rural Africa. "As the leading telecom provider, Ericsson will use its expertise to head the initiative's technology stream, and will explore the use of mobile communications to deliver telemedicine to rural communities, to help to improve access to and delivery of emergency and general health services, assist with disease surveillance and control, enhance the collection of basic health data such as birth and death registration, and deliver mobile learning to health workers in remote areas. Ericsson's experience in India and Bangladesh shows that even people with an average income of US \$1.25 per day can have access to medical care with the help of mobile connectivity" (Hospital Information Technology Europe, 2008).

Though Ericsson's initial participation in providing mobile technology to rural areas of India and Africa is in response to a call from the UN, it is expected that the introduction of this technology for the purposes of healthcare will eventually expand into the more mainstream use of mobile technology in previously inactive markets. Ericsson, as the pioneer of the technology locally, may have much to gain as these rural villages of needy patients transform into marketplaces of mobile consumers in need of both mobile goods and infrastructure. Many organizations struggle to identify the appropriate products or business models to use when targeting inaccessible markets. Using charitable development projects as a method for learning the market landscape is an innovative practice. While TeleDoc in India was able to expand its business and ultimately rural health care services by attracting franchisees seeking profits, the UN is able to expand health care services in underserved areas by soliciting Ericsson's investment in exchange for access to new commercialization opportunities.

The Technology Partnership

The Technology Partnership was founded in 2005, when the Vodafone Foundation committed £10 million and the UN Foundation committed £5 million towards meeting the UN's Millennium Development Goals. The Technology Partnership committed \$2 million to the mHealth project which went to support DataDyne's development initiatives and the local telemedicine programs facilitating service. "DataDyne provides free mobile phone data collection and other technologies to hundreds of non-profits ... working in international development and global health" (Data Dyne.org, n.d.). The funds invested in the mHealth project started at the top of a large network and trickled down through the World Health Organization and various ministries of health to the local telemedicine program operators in 24 sub-Saharan countries (See Exhibit B below for a schematic representation of this network).

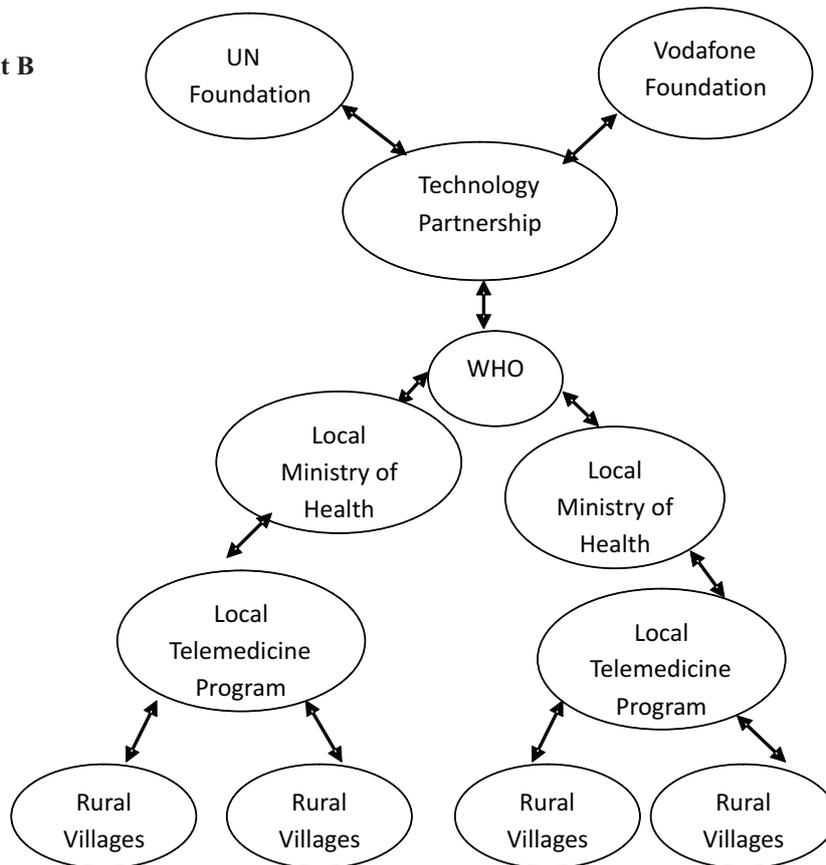
In 2008, the Technology Partnership further partnered with the World Health Organization (WHO) and the non-profit DataDyne.org with the goal to expand telemedicine programs. DataDyne's primary product, EpiSurveyor, "is an open-source application that helps healthcare workers track health data. EpiSurveyor can be downloaded to handheld devices and is easily adaptable by workers in the field. WHO, DataDyne.org and the Technology Partnership piloted EpiSurveyor in Kenya and Zambia. Its successful implementation has greatly improved the timeliness and availability of health care data, making it easier to strengthen district level healthcare programs involving immunizations against malaria and other preventative programs aimed at improving public health."

(AllAfrica, Inc., September 9, 2008).

These local telemedicine program operators may have already been established or could have been founded in response to the investment made by the Technology Partnership. What is critical to take away from this example, is that the local telemedicine program operators at the bottom of the network did not have a pre-existing relationship with the investing organizations. These rural telemedicine programs only had access to the funds because they were included in a network that benefited them, the network created as the global partnerships financing model.

The global partnerships model illustrates how the United Nations was effective in attracting large organizations to invest in charitable programs that supported the Millennium Development Goals, due to the potential that they saw for future profits (Ericsson). As a result of large organizations participating in global partnerships, more telemedicine programs are created, more rural populations receive treatment, and health care is made more accessible to the underserved. The participation and investment pushes money from the top of the network down towards the ground level telemedicine service providers, expanding their capacity to serve.

Exhibit B



Both the examples of this global partnership financial model show how innovative ways to combine the altruistic goals set by the UN, with the investment power of profit seeking large companies can lead to overall benefits all around. Under-funded areas of development, like the social need for rural healthcare, can benefit from the large investments that trickle down to the local level from the commitments made by large companies in support of charitable goals set by international agencies. Large companies benefit from learning about reaching remote marketplaces, where future profits may come from. They also get the immediate benefit of generating goodwill from supporting worthy causes. The Ericsson-ATNF example illustrates how the lure of future profits can incentivize charitable acts in the present. The UN-Vodafone example illustrates how the global partnerships financing model creates new local programs as a result of funds that trickle down the network from the top. This financing model further develops the underlying concept of the TeleDoc model: that profit can encourage organizations to participate in the telemedicine marketplace, thereby expanding health care services.

In this financing model, large multinational organizations commit to improving the quality of life for persons in undeveloped/developing countries, and this commitment comes in the form of charitable aid or investment in programs to support this objective. The investment starts at the top of the network and trickles down to governments and public health agencies with a charge to develop programs to improve education, health, living conditions, etc for their populations. Public health agencies then develop programs, such as a telemedicine program, in response to new funding. In the event a telemedicine program operator is already in place, then the public health agency may distribute funds to established programs. The actual programs are never likely to have approached these large investors for funding directly, but the existence of such partnership networks makes it possible to connect the large investors with the small programs, by creating these partnership networks. The sheer size of the large investments in certain areas, say to expand healthcare, creates an incentive that spurs growth in new programs in that priority area. The creation of numerous programs or growth of existing programs rapidly results in significantly larger proportions of rural populations receiving health care services. This financing model often results in the fastest and largest expansion of health care services to rural populations primarily as a result of the large size of the investments made possible by this method.

CONCLUSIONS AND FUTURE RESEARCH

We have identified four different ways that these telemedicine programs get funded. Three of these ways are similar to the way a new venture in business may be financed, i.e. the organizer seeks capital from various sources. This can be considered to be a bottom up approach where the grass roots level organization seeks financing from larger investors in the form of government financing or grants. In contrast, the fourth and final financing model is a top-down approach. A large investment, made by a large foundation or an aid agency, and distributed through existing administrative networks like government agencies, creates incentives for growth in new and existing programs in the selected priority area. We found that this global partnerships model allows for the most rapid expansion of telemedicine. The contrast in both size and capacity between this model and others is significant and favors the top down approach to solving such social problems. The government funded programs do not face the same uncertainty and risk as a grant seeker program like Tele-HealthCare in Pakistan. However, they are not fully empowered to make their own decisions on expanding services to new rural populations because they are dependent on government financing.

All the four different financing models highlight the way that the performance and impact of the telemedicine program can vary significantly depending on the way it is financed. They are not all equally effective in their ability to sustain themselves or expand their services. The unmet demand for health care in rural areas is great, yet there is no competition in organizations rushing to provide these services. In the absence of competition, organizations do not naturally

have the content in which to become more agile, or offer different medical services, or otherwise manage their performance in any way that would distinguish one program from another. They are focused on providing a much needed social good by treating rural patients that would otherwise not be served. In such circumstances, to know that the different financing models can have a significant impact on performance is a valuable contribution.

Based on this survey of telemedicine programs and the financial models used to sustain these, we summarize the following conclusions:

1. Grant seeker telemedicine programs are the least likely to expand rapidly due to the exposure they face from uncertain future funding.
2. Government funded programs are more stable than grant seeker programs and may be able to serve larger populations, but these programs are restricted in their ability to expand to new geographies because of their dependence on their funding source.
3. Self-sustaining programs that offer profits have increased flexibility to expand, and operators will be incentivized to do so.
4. Global partnership model of financing telemedicine programs, like those inspired by the UN's MDGs, will attract large organizations to make significant investments in health care services in exchange for future commercialization opportunities, and these investments will allow telemedicine programs to expand rapidly at the local level despite not being directly related to the distant donor.

This early evidence has significant policy implications. Based on these conclusions, we can recommend that telemedicine programs be setup to be self-sustaining and that a greater role be taken up by global partnerships in funding such initiatives. This would mean more public-private partnerships to support the organizations that address this basic healthcare problem. Further research is needed to validate our main contributions. These early results are inductively derived and need further verification, which will become possible as these and other programs in the area grow. We recommend this as future research. Most of the programs are in their early stages and there is little information available currently but this should change as time goes on. We also feel that the policy implications of our study can be verified in any other domain where social goods other than telemedicine may be studied. The results should be generalizable to other situations where there are unmet needs with limited funding methods for the social programs that try to meet the need.

In summary, based on our analysis, telemedicine programs financed through the global partnerships model have the capacity to grow most rapidly and serve greater proportions of rural populations than telemedicine programs financed using other models. The significant investments made by large corporations dwarf the funds telemedicine programs are able to generate through grant programs, or through partnerships with local and foreign governments. As a result of these large corporate investments, telemedicine programs are able to expand into multiple countries at once, compared to treating one to five districts within a single country. To further grow telemedicine services, additional investments by large corporations are needed. Global agencies like the United Nations along with the governments of undeveloped countries, should seek out large corporations interested in potential commercialization opportunities in areas that do not receive sufficient health care services today. Partnerships to secure investment in health care programs can be created, perhaps in exchange for early or exclusive access to the future marketplace.

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