Andean e-Health Initiative

Teleconsultation Service - Pedro Vicente Maldonado, Ecuador

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A. Introduction: Information and Communications Technology as a Development Tool in Ecuador

The growing momentum of globalization provides the opportunity to improve human development and confront social, economic, and health disparities. As United Nations Secretary General Kofi Annan noted in September 2002:

> Clearly, if we are to succeed, the process must engage all stakeholders - donors, the private sector, civil society organizations, governments, and especially those in the developing world itself. The Millennium Development Goals, adopted by the world community at the highest level, should help rally all stakeholders around a common agenda. ICT is a powerful instrument for speeding up the realization of these goals. Now is the time to think of partnerships and initiatives for concrete programs and projects that will make a difference on the ground.

A quarter of a century earlier, an equally powerful assertion was made in The Declaration of Alma-Ata (1978). This declaration proposed that governments, academic and research institutions, and NGOs identify, develop, adapt, and implement technology that addresses the health needs of the community while promoting self-sustainability. Considerations of social acceptability and self-sustainability were integral to its definition of primary health care, which is now upheld as a right of all citizens in the world today:

> essential health care based on practical, scientifically sound and socially acceptable methods and technology … at a cost that the community and the country can afford…(1)

If the call to implement projects that will link ICT with the health needs of the developing world goes unheeded, many communities risk further increased disenfranchisement and increased poverty. Ecuador is no exception.

Ecuador: Statistical Overview

Demographics		
VARIABLE	NUMBER	YEAR
Population	13,183,978	(2001)*
Life Expectancy:	71.3	(2001)*
Socioeconomic Indicators		
GNP per capita:	$1329 ($US)	(2001)**
GNI per capita	$2820	(1999)*
Living in poverty:	55%	(1999)**
Living in poverty:	88%	(1999)**
Health	3.6% of GDP	(1990-

Physicians per	1.7	(1990-
Mortality		
Maternal	207/100,000 live	(1995)*
Infant Mortality:	33/1000 live	(2002)*
Under-5 Mortality:	45.4/1000 live	(2001)*

Table 1. Demographics, Socioeconomic Indicators

***= Population, Health and Nutrition Information Project: Ecuador, 9/02**

****= Profile of the Health Services System of Ecuador. PAHO, 11/01**

Health Services in Ecuador

The health sector comprises various public and private institutions, both non-profit and for-profit. The Ministry of Health (MoH) and the Ecuadorian Social Security Institute (IESS) are the primary institutions with the largest infrastructure. The MoH uses a management model based on "Health Areas" consisting of small service networks defined by geographic and population regions, but with a yet unrealized goal to decentralize administrative and budgetary activities. The IESS has nine regions with a network of services - some of which are outsourced - under the direction of a centralized system of planning and financing. Individualistic and hospital-centered models of care have persisted in response to the realities of local needs, with an emphasis on primary health care.

In 1998, constitutional reforms established the right to health promotion and protection for its citizens. In response, the MoH and the National Health Council (CONASA) began promoting an inter-institutional collaboration to define policies for the eventual formation of a National Health System based on universal coverage, decentralization of management, and increased participation of local governments.

In general, current organizational and financing problems have made it impossible to guarantee equitable access to healthcare services. Over one-quarter of the population lacks access to regular health services and two-thirds lack health insurance or adequate financial resources to pay for them. (2)

ICT in the Health Sector of Ecuador

Information and Communications Technology (ICT), particularly the Internet, catalyzes globalization and holds promise as a powerful tool for addressing development goals. However, in much of the developing world, the majority of people have not used computers or the Internet. According to Conatel, the government-owned communications company in Ecuador, only 2.7 percent of its 13 million people have ever been online (3), and data from 1999 show only 3.9 personal computers per 1000 individuals. (4) These figures illustrate the extent of the digital divide threatening this country. In this case, the digital divide represents the disparities in

experiences with, and access to, computers in Ecuador as compared to industrialized nations such as the United States or Great Britain.

Figure 1. South America and Ecuador

Possible uses of ICT applications in healthcare include but are not limited to:

Health care delivery and monitoring

- Telemedicine links connecting primary care practitioners to medical specialists
- Telemedicine links connecting remote rural health workers to urban physicians
- Networked patient records and databases
- Monitoring and response mechanisms for disease outbreak

Health education and communication

- Patient and community health education and support employing interactive health communications (IHCs) strategies
- Access to medical information sources for clinicians and patients via electronic systems
- Locally conducted on-line medical, technical, vocational training

Administrative

- Remote conferencing capability: sharing voice, documents, presentations, web pages, video
- Integrated billing systems

B. Overview of e-Health and Telemedicine

The term "e-health" describes the use of ICTs in health promotion and healthcare delivery via the Internet. Gunther Eysenbach, a leader in the field and editor of the *Journal of Medical Internet Research* states,

> E-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology. (5)

"Telemedicine" is defined by the FDA as "the provision of health care consultations and other services, including the transmission of care-related information, with the help of telecommunication technologies"(6).

The spectrum of telemedicine sophistication is vast and is dependent on the bandwidth available for transmission of data. Capabilities range from the most basic "store-and-forward" applications such as e-mail to "real-time" applications such as live video consultation and can be conducted locally within a closed network or within an open system. When conducted over the Internet, as frequently done, telemedicine can be viewed as a form of e-health.

Certain fields of medicine have adopted telemedicine technologies into established practices faster and more successfully than others. Nearly every area of medicine has attempted to integrate digital technology, but with varying results. It is not surprising that image-dependant specialties such as Radiology and Pathology have been most successful in terms of establishing quality standards outlined by professional organizations. (For example, DICOM.) Psychiatry has utilized videoconferencing successfully for remote interviewing. These fields may be considered "mature", while the fields of Dermatology, Ophthalmology and Cardiology are quickly developing quality standards. (7)

At present, there is a shortage of studies that conclusively confirm the long-term benefit and cost effectiveness of telemedicine. (8,9) However, there is a growing body of evidence that store-and-forward telemedicine using low-cost digital imaging devices provides an accurate means of medical diagnosis in lieu of the availability of traditional face-to-face consultation. (10-15) Typical store and forward applications include digitizing of x-rays, CT scans, ultrasound, skin images, ECGs, and pathology slides.

Telemedicine using Internet technology holds promise of becoming a reliable and cost-effective means for the delivery of various specialty consultations, such as teleconsultations, to remote, underserved and under-funded populations. (16-19)

Accordingly, there has been growing interest in low-cost telemedicine initiatives in the developing world (20-25). Examples in Latin America include the Comision Nacional de Actividades Especiales (CONAE) in Argentina (26) and the GT Saude initiative in Brazil (27). A problem often plaguing telemedicine pilot projects such as these, however, has been the critical problem of creating a financially self-sustaining system.

In 1999, a United Nations special agency, the International Telecommunication Union (ITU), focused on the potential for telemedicine in developing countries striving to achieve equitable access to healthcare, and offered the following thoughts:

> Developing countries should consider undertaking some telemedicine pilot projects in order to identify the most cost-effective solutions to the provision of health care, especially to those living in remote and rural areas…There is a need for some quantitative analysis based on actual telemedicine experience, for example from pilot projects, which could demonstrate to policy makers and funding bodies the cost-benefits of telemedicine. (28)

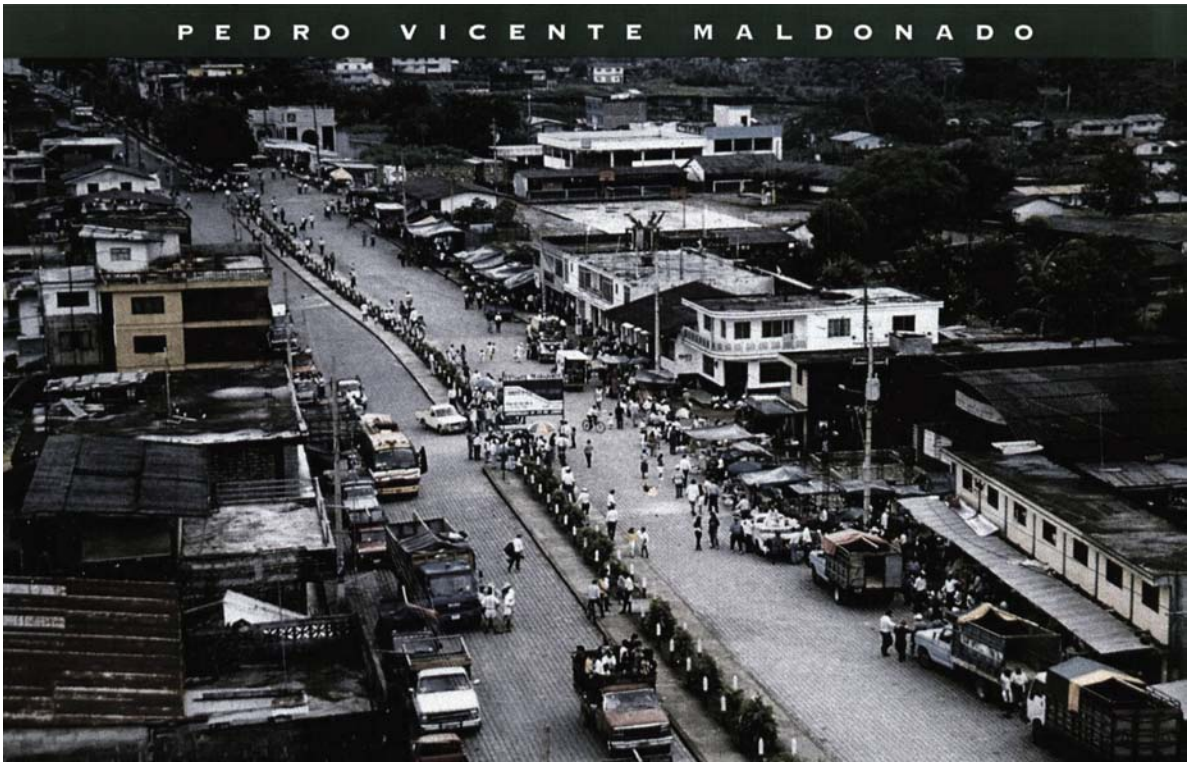
Perhaps no time is more appropriate than now to effectively address the health needs of the world's poor with the power of Internet technology. This has become the impetus of the Andean e-Health Initiative and is the driving force for the development of a teleconsultation service in rural Ecuador.

Radiology Pathology Psychiatry	MATURING
Dermatology Cardiology Ophthalmology	MATURING
Surgery Pediatrics Emergency Medicine Rare Diseases	EMERGING

Table 2. Selected Clinical Applications of Telemedicine by Level of Maturity (7)

C. Project Framework

Andean Health & Development is in a unique position to successfully develop and implement ICT solutions in Ecuador due to its strong relationships with the local community, the national government, academic institutions and other NGOs. Project development will occur through the Andean e-Health Initiative[1] and will first target the rural community of Pedro Vicente Maldonado and the surrounding three-county region.



The Andean e-Health Initiative will introduce a simple telemedicine system, allowing primary care practitioners to conduct teleconsultations with medical specialists – via an Internet connection – anywhere in the world. The chosen configuration for this telemedicine system considers both the power of the technology and how it can be used to address existing problems, as well as the reality that successful e-health projects must balance the needs of the community and culture with the technological possibilities such that people's needs come before the desire to implement innovative technological solutions.

Individuals from several recognized stakeholder organizations will facilitate the process of development, evaluation, and implementation of the Andean Health & Development ICT venture. Teams are as follows[2]:

1. Development Team - to lay the groundwork for the implementation and evaluation plan of this project. The current Development Team is comprised of individuals from various stakeholder organizations and includes:

[1] See: www.andeanehealth.homestead.com

[2] Individuals may participate on more than one team

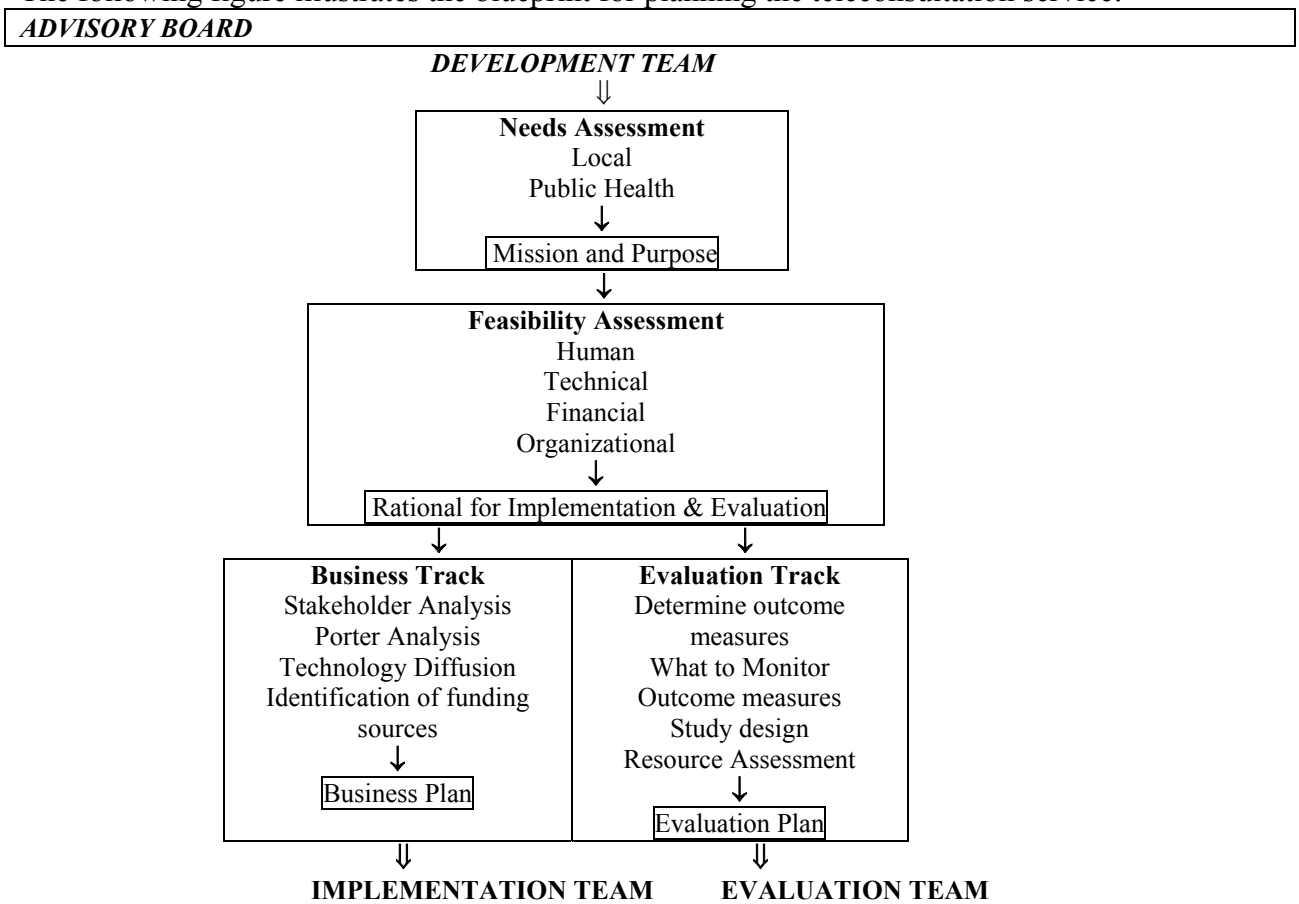
- Augusto Maldonado, MD: Medical Director of Hospital Pedro Vicente Maldonado
- Klaus Stoll: Executive Director Chasquinet Foundation
- Hamish Fraser, MD: Developer/Designer of TeleMedMail Software
- Paul Heinzelmann, MD: Officer of Andean Health & Development
- Jenny Hapgood, MS Candidate: Harvard School of Public Health
- Eric Fleegler, MD, Research Fellow: Harvard Pediatric Health Services Program
- Emily Lam, MPP: Kennedy School of Government

2. Implementation Team - to introduce the project into the current healthcare delivery system.

3. Evaluation Team - to monitor and evaluate impact measures and outcomes.

4. Advisory Board – to provide guidance throughout the entire process, including offering their networks and contacts.

The following figure illustrates the blueprint for planning the teleconsultation service:



A repeating cycle of "develop→implement→evaluate" will continue as the project matures.

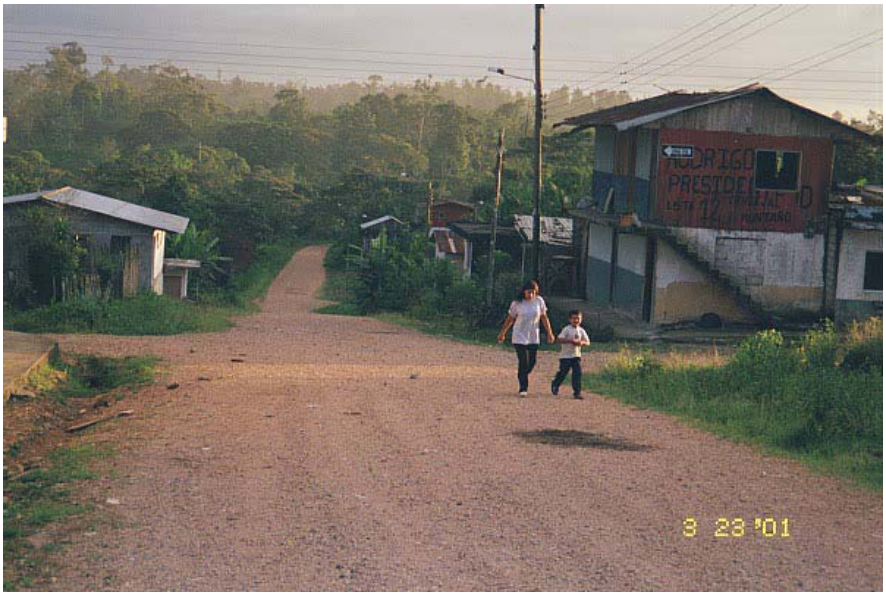
D. Target Community: Pedro Vicente Maldonado

Efforts of the Andean e-Health Initiative are focused initially on the community of Pedro Vicente Maldonado, which has the potential to become a model community for future projects of the Andean e-Health Initiative. Eventually, this project could lead the way to a nation-wide approach to integrate ICTs into the health sector.

Pedro Vicente Maldonado is a remote rural community of approximately 5000 rural poor individuals with a surrounding catchment area encompassing 70,000 people or more in a three county region. The region is primarily agricultural and major local employers include macadamia nut, pepper, heart of palm, and pineapple growers, dairy farmers, and cattle ranchers. A teacher's association, the Ministries of Health and Agriculture are also organizations that employ locals. In the past several years, tourism has become a new industry to the region, and two resorts now lie on the outskirts of Pedro Vicente Maldonado. These are primarily sites of leisure for wealthy Europeans, Americans, and Ecuadorians; however, local individuals find employment there.

This community is approximately 115 kilometers miles from the capital city of Quito where the vast majority of Northern Ecuador's secondary and tertiary care is provided. The drive to Quito is approximately 3 hours up twisting mountainous terrain and an increase in elevation of over 10,000 feet.

Until 2001, the community of Pedro Vicente Maldonado had no local healthcare delivery services except for a poorly staffed and funded Ministry of Health clinic. With funds from private donors, the World Bank, and the local municipality, a new hospital was constructed under the direction of Andean Health & Development, a US-based non-profit organization. This organization aims to create a self-sustaining model of healthcare delivery through a sliding scale of user fees and the sale of healthcare service packages to large local employers such as commercial farming, fisheries, and credit unions.



Typical scene from Pedro Vicente Maldonado

E. Needs Assessment[3]

Prior to the development and implementation of a teleconsultation service, one needs to answer the question, "What does this community lack that can be delivered via telemedicine?" We shall apply this standard to the community of Pedro Vicente Maldonado, the pilot community for the Andean e-Health Initiative.

Clinical Needs Based on Examination of Existing Services [4]

Staff physicians

At present there are eight staff physicians: one Emergency Medicine physician (Medical Director), three Family Practice physicians, two surgeons and two anesthesiologists (one of each is always on call for emergency and scheduled cases). One of three moonlighting resident physicians takes overnight call for admissions. Typically, there are two physicians staffing the outpatient clinic and admitting inpatients during regular clinic hours of 8am –5pm Wednesday through Sunday. The Emergency room is open 24 hours, 7 days per week.

Specialist physicians

There is one radiologist that comes to PVM from Quito one day a week to review all x-rays and ultrasounds that have accumulated over the week – typically 20-30 films and 15 ultrasounds. He is paid $380 per visit, with the majority of his time spent in transport to and from PVM (three hour drive each way) – a considerable amount of time during which he could be working in Quito.

Specialty surgeons perform scheduled surgeries on a volunteer basis nearly every Saturday. This occurs on a rotating basis, with each specialty returning approximately every six weeks (ie. Orthopedics, Urology, Ophthalmology, Plastics).

Referral methods

No formal system of specialist consultation exists, though physicians do occasionally make telephone contact with personal acquaintances in the specialty fields to discuss cases. This method of ad hoc communication is often unreliable and unpredictable and includes no standardized format such as a template for clinical text or images of clinical relevancy.

Other local health facilities and their available services

- Quito
  - Multiple hospitals, three hours away, (120 km) full array of specialty and tertiary care
- Santo Domingo
  - One hospital, two hours away, (130 km) some specialist services

[3] Clinical and hospital needs were identified through a focus group led by Paul Heinzelmann with the Medical Director, the Executive Director of Saludesa, and the Director of HPVM Laboratory.
[4] This information is based on one-on-one interviews with the Medical Director at HPVM

- Puerto Quito
    - Ministry of Health clinic, 45 minutes away (30 km)
- Los Bancos
    - Ministry of Health clinic, 45 minutes away (20 km)

Only the hospital in Quito has reliable specialty staff such as radiologists, dermatologists, cardiologists, and pathologists. Santo Domingo does have some specialist staff, however no referrals are made there by physicians at HPVM due to a lack of confidence in their abilities when compared to the urban specialists in Quito. The Ministry of Health clinics are notoriously understaffed and under funded.

Patient referrals or transfers to other facilities

Patients that are transferred by ambulance go to one of the following Ministry of Health hospitals – all of which have Internet access:

i. Hospital Pablo A. Suarez (most commonly)
ii. Hospital Eugenio Espejo
iii. Hospital Enrique Garces

They are transferred to Quito via the following modes:

- ambulance at a cost to the patient of $40.00
- public transportation (bus) at a cost of approximately $8.00 round trip.
- private vehicle

Patient referrals or transfers from other facilities

- Rarely. However, surgical services will soon be offered at this site, and more transfers/referrals are expected.

Hospital statistical data

Table 3. Patient Visits (2002 Annual Data)

Outpatient visits	3614 (average of 14 visits per day)
Emergency Room visits	896
Transferred Patients	98
Inpatient Admissions	317 (average of 1.5 admissions per day)
Birthing Deliveries	211
Dental visits	1344

Outpatient Visits

- 14 patients per day, but a persistent decrease in patient numbers over time.
- Most frequent visits:

1. Prenatal care
2. Urinary tract infections
3. Parasitic infections
4. Child health
5. Respiratory tract infections
6. Pneumonia (particularly under age 5)
7. Gastroenteritis
8. Back pain
9. Pelvic Inflammatory Disease
10. Anemia

Emergency Room Visits

- Most frequent visits
    1. Wounds
    2. Gastroenteritis
    3. Acute Respiratory infections
    4. Urinary Tract Infections
    5. Fever
    6. Malaria
    7. Multiple trauma
    8. Intoxication
    9. Tonsillitis
    10. Onset of Labor

Hospitalized patients

- Most frequent visits
    1. Pneumonia
    2. Gastroenteritis
    3. Pyelonephritis
    4. Dehydration
    5. Malaria
    6. Organophosphate poisoning
    7. Cellulitis
    8. Asthma Crisis
    9. Cholelithiasis/Cholecystitis
    10. Urinary Tract Infection

Transferred Patients

Majority of patients come for trauma and OB complications

Public Health Needs

From the perspective of the country as a whole, several aspects of the current health services system and the current disease burden are particularly amenable to the potential benefits of telemedicine and include the following:

- Several major causes of morbidity and mortality involve image-dependent diagnoses, compatible with the use of telemedicine.
- TB, the 4th leading cause of death in males aged 20 to 44, and pneumonia a leading cause of death (2) are regularly diagnosed with microscope specimens and x-ray.
- Malignant tumors, the 2nd leading cause of death in females aged 20-44 and the 3rd leading cause in males aged 20-44 (2) involves diagnosis by pathology slide exam.
- Several existing prevention and control programs involve diagnoses that are image-dependent and thus potentially augmented with the use of telemedicine.
- Ecuador participates in the WHO *Stop TB* program and requires microscopy and x-ray for screening and follow up. (2)
- Public Health Dermatology initiative to control leishmaniasis and leprosy 2 holds potential for the use of skin photography to expand its outreach.
- Comprehensive Care for Diseases Prevalent in Childhood is focused primarily on acute respiratory infections and regularly involves the use of x-ray imaging. (2)
- There is an unequal distribution of health funding and services.
- There are 13.8 physicians per 10,000 with a vast majority in urban centers, particularly specialist physicians. (2)
- Approximately 40% of the population lives in rural areas, while 76% of private health expenditures occur in urban areas. (2)
- Increased inter-institution collaboration has been a stated goal of the Ministry of Health.

Needs Identified by Focus Group

The HPVM Medical Director, the Executive Director of Andean Health & Development, and the HPVM Lab Director concurred that the following general problems exist at a February 2003 focus group.

1. Physician uncertainty regarding diagnosis and treatment and the associated mismanagement.

2. Time and cost to patients referred to other facilities for definitive care at their own expense, time, and risk

3. Lack of definitive care for patients due to factors prohibiting transport to facilities with specialists (unstable patients, lack of finances, lack of adequate transportation)

4. Physician isolation

5. Lost local revenue from patients referred to other facilities for definitive care

6. Physician education in the form of specialist feedback

Current Hospital Goals

The following are based on the 2003 recommendations to improve hospital services as outlined by the medical director after review of the hospital statistical data. They are meant to improve quality of services and increase hospital revenue. Those that may be affected by the introduction of a teleconsultation service have been listed below.

Recommendations for Hospital Income

- Improved medical management of infectious diseases, obstetrics and perinatology.
- Counter the persistent decrease in outpatient visits.

Outpatient Goals

- Greater promotion of the available hospital services
- Increase patient population at HPVM

Disease-Specific Goals

- Greater identification of actual pneumonia during the expected peaks of acute respiratory infection.
- Improved capability in the management of cardiovascular patients

Emergency Room Recommendations

- Improved management of infectious diseases
- Improved management of trauma locally
- Creation of a communications system regarding pre-hospital transfer

F. Mission and Purpose

Our goal is to implement a simple store-and-forward telemedicine system using digital cameras, a scanner and Internet technology in the rural region of Pedro Vicente Maldonado – in a manner that is technically, financially, and culturally feasible and sustainable – to address the problems associated with a lack of specialist consultation capability. Though not capable of replicating all the benefits of face-to-face patient encounters, a teleconsulation service such as this promises to become an additional tool to provide this region with access to quality care at an affordable cost. Additionally, data collected on the impact of telemedicine in this community has implications for future public health research and policy in this area.

Identified targets include the following:

1. Reducing physician uncertainty regarding diagnosis and treatment and the associated mismanagement.

2. Decreasing time and cost to patients referred or transferred to other facilities for definitive care at their own expense and risk

3. Having care available for patients that transcends prohibiting factors such as lack of finances, lack of adequate transportation, and distance to specialist care

4. Networking physicians to decrease physician isolation

5. Decreasing lost local revenue from patients referred or transferred to other facilities for definitive care

6. Improving quality of specialist feedback

7. Fostering collaboration between health facilities (as targeted by the Ministry of Health)

8. Creating a test bed for research to assess the impact of telemedicine.

G. Proposed Work Plan and Use Policy

Two computers dedicated to telemedicine purposes will be used for teleconsultations – a laptop used primarily by the Telemedicine Technician, and a desktop station networked wirelessly within a local area network (LAN) to the laptop exclusively for physician use. The laptop computer will be kept on a wheeled cart to allow for mobility throughout the hospital. The components of each patient case will include:

1. Textual description the clinical case provided by the physician

2. Accompanying images/video clips provided by the Telemedicine Technician. These may include the following: radiograph images (x-rays); electrocardiograms (ECGs); skin pathology images; microscope images (parasitic, hematologic, pathologic); ultrasound (short clips); other clinically relevant images.

Physicians choosing to initiate an e-Consultation will make the Telemedicine technician aware of any clinically relevant images they would like to include in the pending case. The Telemedicine Technician will then obtain the appropriate images, and the accompanying clinical text will be entered into the computer directly by the physician – or alternately by the technician who has obtained the information from the physician. Urgent cases may be preceded by telephone contact to alert the receiving e-Consultant about a pending case. Information about each teleconsultation will be recorded into a logbook by the technician.

The use of the telemedicine system will be solely at the discretion of the individual attending physician and used on a case-by-case basis for those patients that pose exceptional diagnostic and treatment challenges, or as determined by hospital administrators. Individual doctors may request the opinion of one or more e-Consultants.

A list of available e-Consultants will be organized in a registry and likely come from multiple sources throughout the globe. An e-Consultant will be notified by e-mail when s/he has a case to review. S/he will then follow a link in the e-mail to the web-based cases. To review the case, s/he will enter a password. The case will be evaluated by the e-Consultant who will provide diagnosis and treatment recommendations as well as any requests for additional information. The case will also be encrypted to HIPAA standards to maximize security and privacy.

Local physicians will regularly check their e-mail accounts for e-Consultant replies to their e-Consultation requests at a computer dedicated to receiving teleconsultation reports.

This setup will also allow for the future capacity to receive consultation requests from health workers in even more remote areas, who may eventually be equipped with digital cameras and access to the Internet. As such, a dynamic network of health workers, primary care clinicians, and specialists is likely to evolve over time.

Evaluation of early use will be important to refine the use policy. The hospital administrators and local physicians will be responsible for final logistics and policies of the system to promote a sense of ownership and to minimize interruption of the typical clinic workflow.

H. Competitive analysis of Telemedicine in Ecuador

Before a successful launch of the HPVM teleconsultation service project is possible, significant research into the local market, analysis of key competitors and stakeholders, assessment of our financial, technical, and human resources, and evaluation of the service in its pilot stage is necessary. Given those requirements, the development team felt it necessary to focus on the following project components:

1. Stakeholder Analysis
2. Business Plan
3. Evaluation Plan

The Stakeholder Analysis (shown below) provides information on all the people and organizations that stand to benefit from the telemedicine project at HPVM. Those listed will in some way be affected by the change to teleconsultations, even if they are not directly involved with using the software, taking patient images, or providing consultations. The list is expansive but necessary, as it also drives the business plan.

In order to introduce the telemedicine system to HPVM and expect sustainability and user satisfaction, the development team must fully understand the financial, technical, and human costs of implementing such change and must prepare to meet those demands. Listed below are several factors that affect a community's adoption of technology.[5]

Barriers to entry

Economic considerations

Though telemedicine is likely to be cost-effective for the delivery of care to remote populations compared to costs of weekly consultation in which a specialist travels to a remote site, few studies currently demonstrate that adequately. Until proven, this legitimate concern will continue to adversely affect diffusion.

Societal considerations

As in the United States, there are barriers to diffusion of technology that include the following: lack of coverage and concrete payment policy, lack of infrastructure and engineering standards, and concerns over security and confidentiality. Unlike industrialized countries, however, there are currently no real concerns about licensure or liability issues in Ecuador.

Organizational considerations (hospitals, healthcare organizations)

Bashur noted, "when technological innovations are not accepted or implemented properly, generally the failure may be traced to a poor fit between the nature of the innovation and the vested interests, resources and expectations of its major gatekeepers"(27).

Scott identified 16 intra-institutional variables that influence adoption of telemedicine, while Kalunzey and Verey derived that the three most important of these are: (27)

1. anticipated rate of payoff

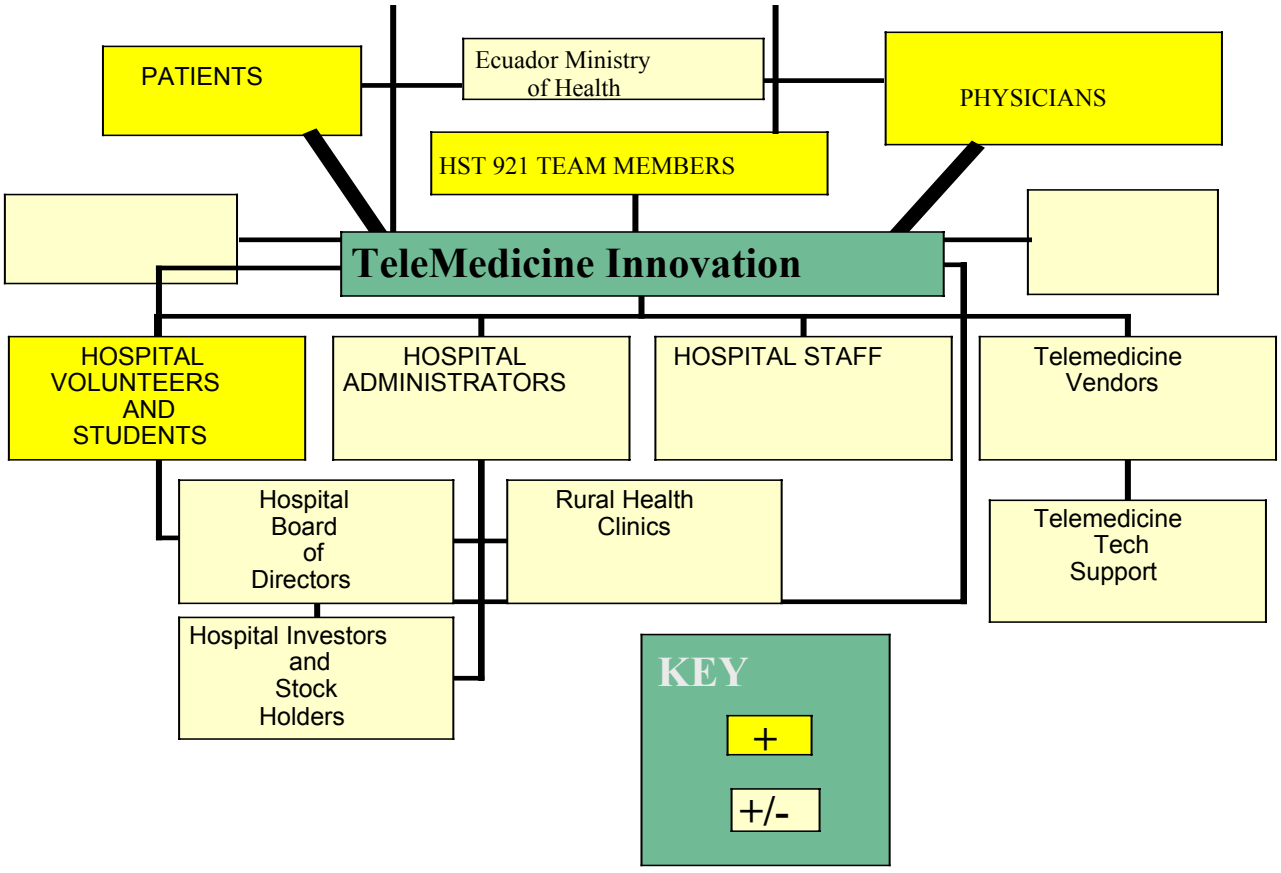
[5] Grigsby identified four categories influencing diffusion of telemedicine: economic, societal, organizational, and individual – each with its own set of unique potential barriers.

2. rate of recovery of investment (ROI)
3. social approval

Adoption at the institutional level is influenced by the authoritarian structure and the ability to mandate the use of technology. This is evidenced by wide adoption of telemedicine in prison programs, the VA system, and the Department of Defense where mandates are commonplace.

Individual considerations (physicians, hospital staff, patients)
Certain variables at the individual level can be barriers to adoption and the diffusion of telemedicine. These can be considered in terms of people's attitudes and perceptions toward the technology, their comfort and experience level with it, and their willingness to use it.

Stakeholder Analysis



Stakeholders:

a. Physicians –
Local (at HPVM): +/-
They will have some new time pressures to meet, extra workload in terms of needing to check email, and some time needed to adjust to new system. Positives outweigh the negatives, as they will be able to get radiologists'/specialists'

opinions overnight or at least in much shorter turn-a-round than the current 7 day turn-a-round system. Initially, there could be resistance, as doctors may perceive telemedicine as a threat to their necessity or autonomy. Providers in the hospitals need to be informed that it will allow them to treat more patients themselves without having to send them to city for care. Also allows them to become more skilled in interpreting films, as they will collaborate with radiologists/specialists. The radiologist who currently visits once a week might also be resistant to the idea, as his services may longer be needed. Arrangements should be made to have him do consultations from Quito and continue to pay him a portion of what he currently receives.

Quito in-country e-Health Consultants: +/-
They may lose some patients because HPVM physicians may not so readily send patients for consult because they will get the consult they need through the software. Result: patients sent to urban hospital are patients truly needing speciality care (as opposed to referrals that could have been dealt with electronically without needing patient to actually travel the three hours to meet specialist in person). Benefits: More cost effective, better use of resources and specialists' time. May in fact result in more face-to-face referrals as diagnoses warrant

U.S. e-Health Consultants: +/-
Benefits for US specialists are "feel good." They are not compensated and are volunteering their expertise out of interest in rural medicine and developing nations' healthcare. Stand to experience negatives due to time requirements, pressures to balance their own patients with responding to Ecuadorian consults, and pressure to check emails regularly.

b. Hospital staff/visiting students/volunteers: +/-
These people will benefit from the experience of working with the technology and learning from specialists from the United States and Quito. Negatives could include added workload.

c. Hospital Administrators: +
The HPVM director is enthusiastic about the project. Will benefit from linking his rural hospital to the urban hospital, a main goal of Ecuador's Ministry of Health. More cost effective to not have to pay the radiologist to drive three hours each way once a week to read films. Better patient care.

d. Ministry of Health: +/-
May view this project as challenging its authority as it has the potential to network a rural hospital with an urban hospital – something the Ministry might like to take credit for accomplishing. On the other side of that coin, collaboration between rural/urban medical centers is a high priority of the Ministry and this project speaks directly to that objective.

e. Chasquinet Foundation: +

This non-profit foundation in Ecuador promotes ICT as a human development tool. Interested in providing/funding training, idea development, and needs assessment. Benefit from adding this project to their roster of ICT successes in Ecuador.

f. Saludesa (Andean Health & Development): +
U.S. based non-profit organization with an Ecuadorian branch that stands to benefit as this project supports their mission of providing better healthcare to rural populations in Ecuador.

g. MIT/Harvard/Partners in Health: +/-
This project uses their software so they stand to benefit as we can collect data for their database, show usability of the software, and provide them with good marketing materials and evaluations. Stand to lose only if software is used inappropriately and brings the software and Partners in Health into question.

h. Patients: +
Stand to benefit from receiving better care because there will be more consults on their cases and they will not have to needlessly travel to city for referrals when their care could have been dealt with at HPVM. They will save money and time in being able to receive their care within their town. With earlier diagnosis and treatment, they will also benefit from preventing progressed stages of illness.

i. Local Telecom Providers: +/-
Will experience increase in demand as hospital has more Internet traffic and physicians may complain when server is down or other technological problems arise. Benefit from their service being used in the rural and urban hospital with links to physicians in the U.S. Project gives more weight to push for future innovations like bigger bandwidth, satellites, and real time video capabilities.

j. Local Interests: +/-
Farmers/employers benefit because better care for their employees means healthier workers with lower absenteeism. Employers however might be reluctant to pay for additional fees to cover the costs of the telemedicine system, especially if they are not convinced it improves their profitability.

Tourism industry (i.e. Arasha Rainforest Resort & Spa) can market to tourists that HPVM physicians can communicate with tourists' physicians in their home countries via Internet for rapid consultations. It makes medical care in Ecuador seem less isolated from tourist's medical care experiences at home. In addition, the nearby resorts can advertise the availability of the services in case of emergency, adding "peace of mind" to potential tourists.

k. Manufacturing Corporations: + (e.g. Kodak, Olympus, Dell…) may benefit from positive PR by associating with this project. They may also benefit from establishing themselves as the source for certain telemedicine system products, initially giving products away for free. As telemedicine grows and expands, they can start charging for their products and telemedicine systems that are running already will most likely buy the established brand and may eventually bring the corporation a sizeable volume of business.

Competitive/Porter Analysis

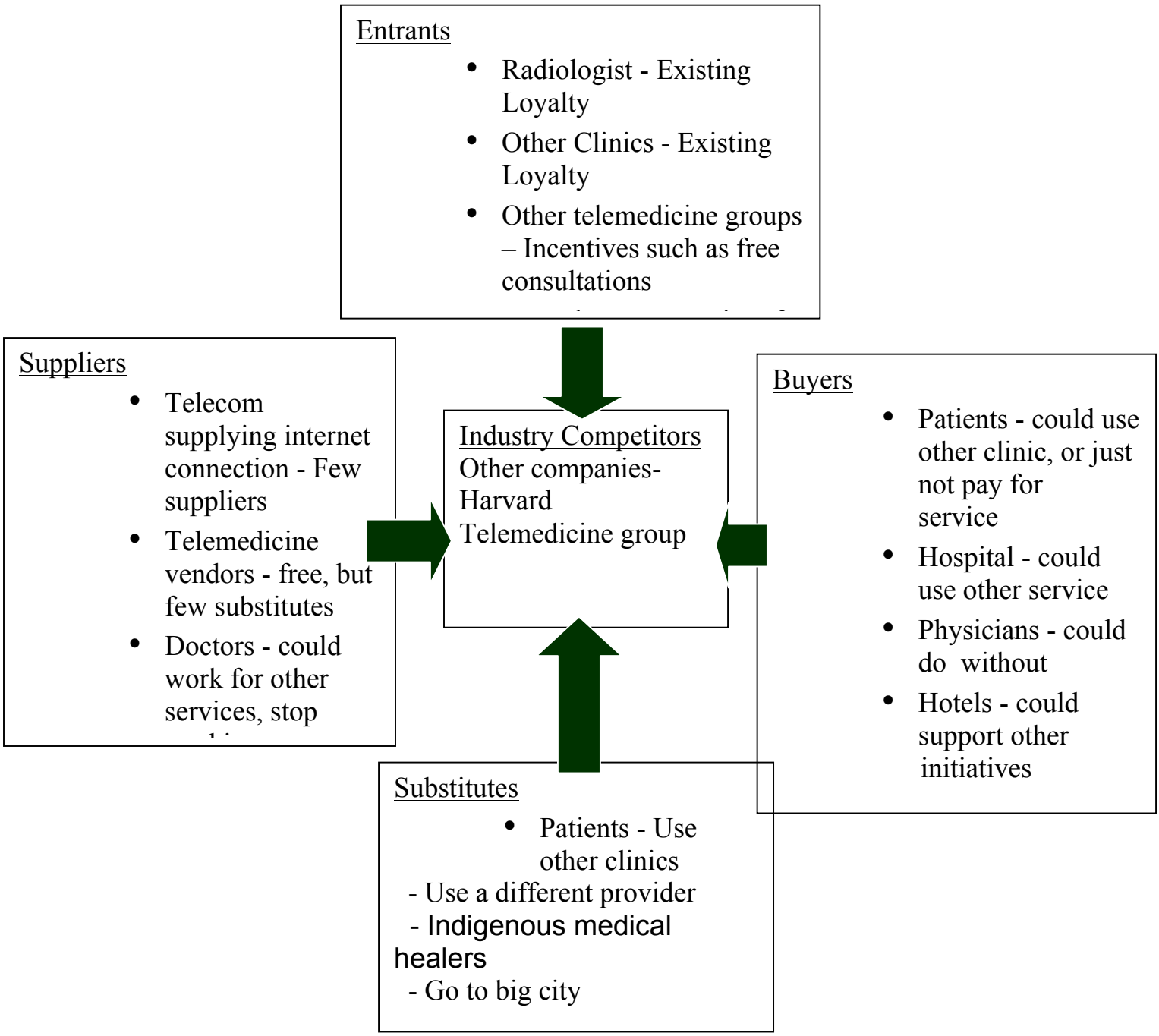


Figure 4. Porter Analysis

Threat of new entrants

1. Radiologist – The hospital currently has an established relationship with a radiologist. However, this technology could allow the hospital to bypass him. The best approach would likely include developing the system so that consultations with the existing radiologist could continue more efficiently.

2. Other Clinics – Other clinics could develop their own systems and connections. However, they are small and are unlikely to have the ability or desire to invest in a new international relationship such as this project.

3. Other telemedicine groups – There is the potential for larger established groups to try and offer similar services in our area. Given the limited market of this region, it is unlikely that other telemedicine groups would have the desire to compete here.

4. Consultants – We are relying on a previously established network of doctors willing to volunteer their services. The extent to which they can stretch themselves will be limited, and likely the demand for their services will grow over time. The consultants, if they see this as a potentially profitable venture may compete for our customers.

Bargaining powers of buyers

1. Hospital – The hospital we are working with could theoretically use another telemedicine provider. However, the hospital helped initiate and develop the Andean e-health initiative and wishes to work together to build this system. The greatest strengths that this initiative offers include energy, enthusiasm and free labor. However, we do not have substantial funding and do not bring offers of free computers and other technologically oriented products that larger companies could offer.

2. Physicians – The physicians could do without our services. They have been working so far without Telemedicine and may decide that the effort is not worthwhile. In addition, the radiologist at the hospital may feel threatened and the other doctors may try to avoid alienating him. On the other hand, if they find the service useful, efficient, and their career skills develop as a result of this interaction, we feel they will want to continue to use and expand this program.

3. Patients – Patient could decide to use another clinic, or just not pay for the service. At this time, there are only a few small medical clinics in the region – this is the only local hospital. Whether a patient chooses to use the service is up to him or her, if s/he chooses not to have the consultation, then s/he solely relies on the medical clinician. It is our hope that if the clinician feels the consultation is warranted, s/he will explain this to the patient and get him/her to agree to the consultation. As the fee schedule evolves, the hope is that by using this mostly free service, a sliding scale will give access to any patient in need of a consultation.

4. Hotels – We are hoping to build support with the local developing luxury hotels. The notion is to convince them to advertise ‘American doctors’ via partnership with the hospital system. The hotels could support other initiatives, again especially if the other initiatives offered monetary type support. However, this is a unique partnership and it is unlikely that other telemedicine groups would take this partnership approach.

Threat of substitutes

1. Patients – The patients could use other clinics, other individual providers, or even turn to indigenous medical healers if they did not want to use our services. The idea of the program is not to substitute for the services provided by the hospital already, but to supplement them. The threat of moving to another provider should not be a significant one since the services offered are not forced upon the patients, but are available as an additional benefit if desired.
2. Other Cities - Patients could decide to go to the big cities for their consultations. However, this involves a significant investment of time on their part that we hope will be circumvented via the telemedicine system.

Bargaining power of suppliers

1. Telecom supplying Internet connection – There are only a few suppliers of telecommunication services in the entire country, and only one supplier in the surrounding community. The potential for the company to increase its fees does exist. However, more companies are expected to enter the market and this competition should keep the costs down.

2. Telemedicine vendors – Our telemedicine vendor is offering the services for free. However, there is no guarantee that this will last, and there are only few substitute companies with similar products on the market. However, the venture is non-profit, and we do not expect them to charge for the services provided. As an additional incentive to keep the services for free, the potential for collaborative research is being explored.

3. Doctors – The consultants working with us could work for other services, or stop working altogether. The work provided is volunteered. However, the pool of doctors available for this type of volunteer work is quite large. Additionally, at the current time we do rely on one company to connect us to these doctors, and the long-term viability of this company is unknown. As back up, there are other organizations that connect physicians to volunteer programs such as ours.

4. Digital equipment companies – There are a lot of companies providing digital equipment, which helps keep costs low. Additionally, we do not expect to have to purchase equipment with any regularity.

Competitive rivalry within the industry

1. Other companies – As noted above, there are other telemedicine groups that could compete for the hospital connection. However, this is a relatively small hospital in a large world filled with hospitals in need. It is unlikely that this type of competition will develop in this location.

I. Business Plan

Feasibility assessment

The examination of feasibility can be divided into four components: human, technical, financial, and organizational. We will examine these areas to identify new resources that will likely be necessary to implement this project successfully.

i. Human considerations

User Attitudes and Perceptions about telemedicine

In general, the community at large (potential patients) and the local physicians appear accepting of the potential benefit of a telemedicine service at Hospital Pedro Vicente Maldonado, suggesting that a demand for this service exists. Due to the importance of user attitudes in the success of any technological project, this suggests an increased potential for feasibility and sustainability.

In November of 2001, survey data was collected from members of the community and 4 of the 5 staff physicians. A brief written description of telemedicine and questionnaire was provided.

Local Community Survey Data: N = 59 (male=38.5%, female=61.5%)

Percent of those surveyed "agreed" or "strongly agreed" that telemedicine would be beneficial includes the following:

- 89.6% something they would allow their doctor to use in their care
- 87.7% something they would be comfortable with having their doctor use
- 83.3% useful to the community of Pedro Vicente Maldonado
- 65.8% equal to or adequate to traditional specialist referral

The majority believe telemedicine would change the following in a "beneficial" way:

- 82.7% the way hospitals and clinics operate
- 71.7% the way doctors treat patients
- 68.8% the role of doctors and specialists

Local Physician Survey Data: N=4 (male=100%)
In a 2001 survey, four of the then five staff physicians were asked various questions on their beliefs about telemedicine and interest in implementing the system at HPVM.

Physicians were asked how often they would likely consult a specialist if such services were available. The range of anticipated consults varied greatly but averaged as follows per physician: (note: other specialist options were not considered in this questionnaire)

Radiologist: 7.0 times a week per physician

Dermatologist: 6.0 times a week per physician
Pathologist: 4.8 times a week per physician
Cardiologist: 2.9 times a week per physician

(A more recent survey of desired physician consultation rates is pending.)

More results:

- Two doctors rated their experience with computers as "average" and two as "above average."

- All "strongly agree" with the following statements:

  1. I am interested in learning more about computers and the Internet
  2. I am comfortable using computers and the Internet to evaluate patients
  3. Computers and the Internet will be used commonly to diagnose patients in the future
  4. Telemedicine could be useful for doctors and patients in Pedro Vicente Maldonado
  5. Hospital costs could be saved by using telemedicine
  6. I would personally allow other doctors to evaluate me using telemedicine

- All agreed they would prefer to have patients evaluated here using telemedicine than have to send them to visit a specialist in Quito.

- All "agreed" or "strongly agreed" that telemedicine could change the following in a beneficial way:
  - the way hospitals and clinics operate
  - the role of primary care and specialist physicians
  - the way patients are treated

- 3 of 4 either "agreed" or "strongly agreed" that patients could get an "adequate" or "equal"
  - specialist evaluation through telemedicine when compared to traditional consultation.

- 1 of 4 "strongly agreed" that telemedicine is a poor tool for patient care due to the remote possibility that information sent over the Internet could be retrieved by someone not intended to receive it.

Staffing Requirements:

Immediate:

- *Telemedicine imaging technician*
  This person will prepare the images for use with the teleconsultation software.

- *e-Consultants*
  These are the specialists from various fields of medicine who have agreed to review patient cases via the Internet. (See Appendix for current registry of e-Health Consultants)

- *Computer Technical Consultant*
  This would be a person available during typical clinic hours of 8-5 to assist with hardware and software problems. Availability by telephone, instant messaging, and in-person.

Future:

- *Operations coordinator*
  A registry of available specialists will require periodic updating.
  This person would likely become necessary to coordinate the availability of the e-Health specialist physicians if the volume of consults increase or if timely applications become more frequent.

Training Requirements:

- *Local Physicians*
  The level of training needed will depend on the level of experience of individual physicians. Skills necessary include:
  1. Connecting to the Internet and retrieving email
  2. Basic use of the TeleMedMail software

- *Telemedicine technician*
  S/he will require training in use of computers, various software applications, other equipment use.

- *e-Consultants*
  Informal "test cases" will be sent to each e-Health specialist and accommodated on an individual basis with the e-Health facilitator.

Telemedicine User Prerequisites:

- *Local Physicians*
  Must have predictable access to Internet to retrieve email responses from e-Health specialists. Ability to read English will be necessary to receive consults from English-speaking e-Health specialists.

- *e- Consultants*
  A demonstrated comfort receiving and responding to TeleMedMail consult requests. Those who speak only English will be available only to those local physicians who read English to a satisfactory degree.

Existing Human Resources

NetAid.com is an Internet-based organization that networks people and partners throughout the world to form coalitions of volunteers to work toward ending extreme poverty. NetAid.com matches volunteers with organizations that need more human resources to achieve goals in the developing world.

Volunteers from NetAid.com are a suitable resource to assist in the implementation and long-term sustainability of the telemedicine system at HPVM. Additionally, their support will make future expansion more feasible.

II. Technical Considerations

This project places the needs of the user before the implementation of equipment and avoids being technology driven. Thus, the technical aspects of the system will be developed with the identified needs of the hospital guiding the project and upgrading as necessary. It is likely that if the initial system proves useful, a physician demand for new more sophisticated applications will occur.

The initial system will be a simple asynchronous store-and-forward configuration allowing the transmission of text detailing clinical information and any relevant captured still images or video clips. Due to its relative simplicity, such a system becomes technically feasible and satisfies concerns about interoperability, compatibility, reliability, and scalability.

The software TeleMedMail (TMM)[6] is a primary component and is available in English and Spanish. It simplifies the steps necessary for transmitting text and images via the Internet by including image acquisition, processing (i.e. conversion to grayscale for x-rays), compression, annotation capability, and placement within a usable medical document. Additionally, dedicated servers are utilized to allow increased security, a web-based rather than email-based system, and the ability to archive cases. (9)

Equipment Requirements

The initial equipment configuration will consist of the following:

1. Laptop computer (equipped with TMM software and photo-editing software)
   a. Wi-Fi capability to allow for mobility when sending cases
   b. High-end video capability (video card)

2. Olympus C-4000 zoom digital camera for imaging
   a. Radiographs
   b. Skin lesions
   c. Microscope field of view
   d. Other clinically relevant images

3. Software
   a. TeleMedMail
   b. Camedia image software for the Olympus digital camera

4. High resolution consumer-grade digital Scanner
   a. EKGs
   b. Documents

[6] For a software demonstration, see http://medg.lcs.mit.edu/telemedicine/demonstration.html

5. Microscope attachment for digital camera

6. Dedicated desktop computer and monitor to review completed e-Consultant recommendations

7. Uninterruptible Power Supply to protect from surges and power outages

8. Wheeled cart to contain system and provide mobility

9. Fax machine

Infrastructure Requirements

1. Bandwidth of at least 56 kbps
2. Wi-Fi capability

III. Financials

The following budget demonstrates that a simple store-and-forward system can be installed at a relatively low financial investment, and is therefore feasible.

BUDGET

START-UP COSTS (based on estimates from…)

Equipment costs	
Ergo Notebook Computer dedicated for telemedicine	$2400
Computer for receiving e-Health specialist consultation reports	$900
PC Monitor for viewing cases (17-inch, with at least 1025 x 768 resolution)	$200
WiFi base and card	$150
Printer	$150
Software	
TeleMedMail telemedicine software	(no cost)
Vueprint image software ($40/user; 2 users)	$80
Uninterrupted Power Source (UPS) to protect against power outages and surges	$100
Rolling Cart to contain telemedicine setup	$100

Digital cameras and attachments	
Olympus C-4000 digital camera (2) (radiographs, skin images) $500 X 2	$1000
Digital scanner (for documents, ECGs, etc)	$100
Digital camera microscope attachment (ScopeTronix MaxView Plus)	$300
Tripod (48" height)	$80
Fax Machine	$100
Subtotal	**$5,660**

Personnel costs	
Telemedicine technician annual salary	$2500
Two-day training of telemedicine technician in use of computer, camera and software at Chasqinet Foundation office in Quito, Ecuador	$55
Two-day training of five physicians in use of computer, camera and software at Chasqinet Foundation office in Quito, Ecuador	$300
Specialist consulting on the cases from PVM (rely on volunteers for first year)	$0
Subtotal	**$2,855**
Total start up costs for first year	**$8,265**

Recurring Operating Costs (Annual Estimates)

Equipment costs	
Internet service provider fees	$600
Print cartridges for printer	$200
Upgrade and replacement costs	$500
Personnel costs	
Ongoing training of new technician(s)/physicians (estimate)	$110
Specialist consulting on the cases from PVM ($3/case * 2,153 cases/year[†])	$6,458
Telemedicine technician annual salary	$2500
Service contract with local computer technician	$250

Administrative costs (10% of total)	$1100
Unexpected costs (5% of total)	$650
Total recurring operating costs	**$12,368**

†Cases/year = number of estimated cases per week from physician survey (see p. x) * 2 staff physician * 52 weeks

Potential Revenue Sources and Partnerships

One or several of these may be effective means to finance our simple service.

1. Patient fees integrated into existing medical care financing system:

SALUDESA finances the cost of medical care to this poor community by 2 methods:

a. Out-of-pocket user fees on a tiered system that is based on the individual's level of wealth (as determined by a prior survey).
b. Healthcare packages. These cost approximately $15 per year per person and are purchased by the large local employers to protect their workers. In essence, an insurance plan that provides primary and some secondary care services. Adding a small amount (ie 50 cents to the annual $15 the employers pay) could help cover operating costs for this inexpensive teleconsultation service.

2. Retainer fees from nearby resorts advertising this service to their guests.

3. e-Consultant Costs through non-monetary incentives:
   A. US-based e-Consultant Services:
   - Sweepstakes for trip to resort in Ecuador

   B. Ecuador-based e-Consultant Services:
   - Provide capability to consult with US-based e-Consultants on cases of their own

4. Financial and Gifts In Kind from corporate sector in trade for PR
   A. Kodak, a global provider of digital radiography services and traditional x-ray systems
   B. Olympus, digital imaging equipment, including digital cameras
   C. Lotus Software
   D. IBM
   E. Apple
   F. Oracle

5. Grants (especially for start-up costs)
   A. USAID
      - $5000 discretionary fund (specifically for pilot projects)
      - Larger grants subsequent to establishment and some proof of "success" from the evaluation

   B. Chasquinet-World Bank Funds:
   C. Private Donations through Andean Health & Development

D. Pharmaceuticals and/or pharmaceutical foundations (i.e. Bristol-Myers Squib Foundation)

Recurring Annual Revenue and Operating Costs

In order to be self-sustainable over the long-term, recurring annual revenues must exceed recurring annual operating costs. Above we calculated that recurring annual operating costs are $11,468. Currently, there are three main anticipated forms of revenue: fee-for-service, prepaid health care packages, and retainer fees from the nearby resorts.

Projected revenue from fee-for-service

Fee-for-service would be based on a sliding scale based on patient's ability to pay. We will use a few of the assumptions that AHD use in their financial calculations.[7]

Assumption #1: Regional and community data including the AHD 1997 Needs Assessment Survey indicate the distribution of "ability to pay" as follows:

5% of the population can pay 100% = 5.00
15% of the population can pay 75% = 11.25
40% of the population can pay 50% = 20.00
20% of the population can pay 25% = 5.00
15% of the population can pay 5% = 0.75

Added together, 42% represents the total theoretical percentage recoverable from fee for service.

According to the survey of staff physicians at the hospital, the desired consultation rate is estimated as:

Radiologist:	7.0 times a week per physician
Dermatologist:	6.0 times a week per physician
Cardiologist:	2.9 times a week per physician
Pathologist:	4.8 times a week per physician

Multiply this rate by the number of staff physicians by the number of weeks in a year to obtain an estimated utilization rate for each specialty area:

Utilization rate per year = X times a week * number of physicians on staff per week (2) * 52 week/year

Assume however that it will take three years for the hospital to be utilizing telemedicine at this rate. The first year, providers will be familiarizing themselves with it while patients will not know of its existence, so utilization maybe low at first. By the second year, familiarity will increase utilization rate and by the third year, they should be able to request consults for all of the cases

[7] AHD plan 2002

that can use it. This will be taken into consideration by multiplying the utilization rate by one third the first year, two thirds the second, and the full utilization rate will be used for the third.

Price for each visit is determined by the relative price of these services to each other (see cost for specialty visits under economic benefits) and how much other services cost at the hospital cost relative to each other.

Table X: Revenue from fee-for-service

Year 1 – Low utilization (one third of full rate)

	Fee-for-Service Model				Revenue		
	Low	Medium	High	Cases/year	Low	Medium	High
Radiology	$ 22	$ 30	$ 70	243	$ 5,339	$ 7,280	$ 16,987
Dermatology	$ 20	$ 25	$ 50	208	$ 4,160	$ 5,200	$ 10,400
Cardiology	$ 25	$ 35	$ 80	101	$ 2,513	$ 3,519	$ 8,043
Pathology	$ 22	$ 30	$ 70	166	$ 3,661	$ 4,992	$ 11,648
					$ 15,673	$ 20,991	$ 47,077

Year 2 - Moderate utilization (two thirds of full rate)

Usage	Fee-for-Service Model				Revenue		
	Low	Medium	High	Cases/year	Low	Medium	High
Radiology	$ 22	$ 30	$ 70	485	$ 10,677	$ 14,560	$ 33,973
Dermatology	$ 20	$ 25	$ 50	416	$ 8,320	$ 10,400	$ 20,800
Cardiology	$ 25	$ 35	$ 80	201	$ 5,027	$ 7,037	$ 16,085
Pathology	$ 22	$ 30	$ 70	333	$ 7,322	$ 9,984	$ 23,296
					$ 31,346	$ 41,981	$ 94,155

Year 3 - Full utilization of telemedicine

Usage	Fee-for-Service Model				Revenue		
	Low	Medium	High	Cases/year	Low	Medium	High
Radiology	$ 22	$ 30	$ 70	728	$ 16,016	$ 21,840	$ 50,960
Dermatology	$ 20	$ 25	$ 50	624	$ 12,480	$ 15,600	$ 31,200
Cardiology	$ 25	$ 35	$ 80	302	$ 7,540	$ 10,556	$ 24,128
Pathology	$ 22	$ 30	$ 70	499	$ 10,982	$ 14,976	$ 34,944
					$ 47,018	$ 62,972	$ 141,232

An interesting note about Table X is that the high range fees are what people are currently being charged for specialty visits in Quito. The difference between the low/medium fees and the high fees are what people theoretically will save on just their medical visit with the telemedicine consult.

Assumption #2: One half of the non-resort patients seen will cover costs via fee for service and half will have purchased prepaid healthcare packages.

Based on assumption 1 and 2 and using the middle range fee-for-service rates, estimated revenue is multiplied by the percent recoverable from sliding scale policy times .5 (half of the population):

Therefore fee-for-service revenue will be calculated as the sum of fees charged * .42 (percent collected through sliding scale) * .5 (only half of patients are charged fee for service

	Year 1	Year 2	Year 3
Low	$15,673*.42*.5= $ 3,291	$31,346*.42*.5= $ 6,583	$47,077*.42.5= $ 9,866
Medium	$20,991*.42*.5= $ 4,408	$41,981*.42*.5= $ 8,816	$94,155*.42.5= $ 19,772
High	$34,805*.42*.5= $ 7,309	$69,611*.42*.5= $ 14,618	$141,232*.42.5= $ 29,659

Projected revenue from prepaid packages
Assumption #3: A certain percentage of the population purchases a prepaid healthcare plan. A fee of $.50 is added to the existing price of each package to cover telemedicine consults.

"Andean Health & Development has already identified and begun negotiations with 30 user groups, including:

- Dairy farmers
- Cattle ranchers
- "Hearts of palm" farmers
- Macadamia nut, pepper, and pineapple growers
- Schools teachers associations
- Association of small businesses
- Municipal government employees
- Ministry of Health employees
- Ministry of Agriculture employees

These user groups represent 17,500 potential consumers or 25% of the 70,000 base population in the PVM
project area. AHD will sell prepaid packages to individuals as well. The following projections of potential annual sales of pre-paid packages are extremely conservative based on the 1997 regional survey. For example, 9000 pre-paid packages sold in year six (2007) only represent approximately one-half of the already identified 17,500.[8]

Revenue would then equal their estimates for the number of packages to be sold for the next three years multiplied by the additional fee for telemedicine consults:

Year 1	5,000 people @ $.50	$2,500
Year 2	6,500 people @ $.50	$3,250
Year 3	8,000 people @ $.50	$4,000

Projected revenue from retainer fees
Two neighboring resorts will pay an annual upfront fee of $1,000 for the use of the telemedicine fees. This fee can be negotiated in the future depending on their actual utilization rates.

Total estimated revenue:

Low range fees

[8] AHD plan 2002

YEAR	Prepaid fee	Fee-for-service	Retainer fee	Total
1	$ 2,500	$ 3,291	$ 2,000	$ 5,791
2	$ 3,250	$ 6,583	$ 2,000	$ 9,833
3	$ 4,000	$ 9,874	$ 2,000	$ 13,874

Medium range fees

YEAR	Prepaid fee	Fee-for-service	Retainer fee	Total
1	$ 2,500	$ 4,408	$ 2,000	$ 6,908
2	$ 3,250	$ 8,816	$ 2,000	$ 12,066
3	$ 4,000	$ 13,224	$ 2,000	$ 17,224

High range fees

YEAR	Prepaid fee	Fee-for-service	Retainer fee	Total
1	$ 2,500	$ 9,886	$ 2,000	$ 12,386
2	$ 3,250	$ 19,772	$ 2,000	$ 23,022
3	$ 4,000	$ 29,659	$ 2,000	$ 33,659

According to the assumptions and price structure used above, the telemedicine system should be financially self-sustaining in approximately year 3 for the low range fees, year 2 for the medium range fees and in year 1 for the high range fees.

Limitations to revenue calculations
The revenue calculations are very sensitive to:

- survey results which are from a pilot survey of 4 out of the 5 physicians,
- fee-for-service rates which have yet to be determined,
- the retainer fee negotiated with the resort, and
- assumptions taken from AHD about the number of pre-paid packages.

Another concern is the upper utilization curve of the equipment. At some point, their capacity will be saturated and they will not be able to do any more consults without investing in more infrastructure.
It also does not account for how utilization would change because of the use of telemedicine (assuming it would increase because of its success). Lastly both cost and revenue are not adjusted for inflation, which is dependent on the country's economic situation.

Economic benefits
Savings and increase in QoL from:

- Decreased morbidity and mortality
    - Identifying diseases in early stages: more expensive care from advanced stages of illness or misdiagnosis and associated mismanagement (more cost-effective)
- Human capital:
    - Less of a decrease in productivity for the employer and less time off of work (less lost wages for patient)
- Travel
    - $40 for ambulance ride
    - $8 for bus ride
- Decrease cost for patient:
    - Visit a radiologist for a chest x-ray $US 70
    - Visit with a dermatologist $US 45-50, 120-150 including biopsy and result
    - Visit with a cardiologist $US 70-80, including EKG
    - Approximate cost of having a pathology slide reviewed by a pathologist in Quito $US 50-70
- Increased hospital revenue as patients previously referred stay at PVM and others may be referred to hospital because of telemedicine capacity.
- Increased business for specialists who consult with PVM from telemedicine consults that still need referrals.

Societal benefit

- Establishment of an infrastructure
    - Forms possible basis for other future projects/functions dependent on IT
    - Increases interconnectedness with other facilities and health care systems
- Faster identification of communicable disease for better containment/control and response times in case of an outbreak

IV. Organizational Considerations

The following outlines the resources required from each of these key stakeholder organizations:

Hospital PVM

- Local administrative oversight
- Readily available digital line to transmit and receive patient cases
- Willing users / operators of the system
- Telemedicine Technician
- Individual(s) to collect ongoing survey data

Saludesa

- e-Consultant Coordinator to coordinate the project's implementation and evaluation
- Volunteers to collect ongoing survey data
- Potential funding

Chasquinet

- Training services for doctors and telemedicine technician
- Technical consultation
- Potential funding

TeleMedMail Developers / Partners in Health

- Software provision and troubleshooting

Risk Management

The successful implementation of any telemedicine project is dependent on many variables. We have made many assumptions about laying the foundation for the use of telemedicine at HPVM. However, we must anticipate and plan for various risks and setbacks.

Community Buy-In: There is a possibility that community members view the project as a Westernized/American attempt to put a system in place and get it off the ground but then abandon it in the long run. The public and physicians may also question the security of transmitting information over the Internet. With Dr. Maldonado, the Medical Director, as an advocate, we can communicate with the community to educate them about the process and benefits and of the project.

Provider Buy-In: The visiting radiologist may need convincing that teleconsulations are more efficient for reading films, as it means he may no longer need to drive to Pedro Vicente Maldonado each week. Additionally, the chance to collaborate with physicians in the United States is a benefit for physicians in Ecuador as they also improve patient care, network with more specialists, and adopt technology in their center. Lastly, providers will need to be convinced that checking email and using the software will not greatly disrupt their schedules and their patient interactions. Incentives must also be made for the specialist physicians in the U.S. who are providing the teleconsultation to compensate for their time.

In the long-run, it may be difficult to get specialists to consistently donate their time and check email to do the teleconsultations. In this case, specialists from Quito can be hired on a per case basis.

Political Buy-In: Obtaining political buy-in requires the backing of the Ministry of Health; efforts will be made to show that the project addresses government interests in linking rural and urban hospitals in a functioning model to be implemented in other Ecuadorian hospitals.

Technical difficulties: There is a strong possibility that at some point the equipment will fail, needing support or replacement. The proper protocol, resources and responsibility must be in place for when such problems arise so that the system is up and running as quickly as possible. Chasquinet staff will be able to provide a "Help Desk" and technical assistance. A contract with a local computer technician should also be made for in-person evaluation and needs.

Communication difficulties: There is always the risk that communication problems arise when dealing with diagnosis and treatment in a secondary language.

Alternative Solutions to lack of access to specialist opinion

Other conceivable options for improving care at HPVM might include having specialist physicians staff this rural hospital or providing a funded means of transport for patients from this rural community to specialist physicians in the capital city of Quito. However, securing funding for patient transportation or attracting specialists who will reside in the area are likely to be expensive and non- sustainable solutions.

K. Evaluation Plan

Research Objective:
We are interested in the telemedicine system's effect on physicians' daily routines in terms of their behaviour in seeking and receiving consultations, efficiency in decision-making in cases of consultations, and assessments of educational benefits from using the system. We are also interested in assessing patients' impressions of their care under the telemedicine system.

The evaluation will be conducted using the following domains:

Domain 1: We are interested in assessing how the telemedicine system changes physicians' daily practices.

Operational Definition:
Physicians' daily practices will be measured by a comparison of individual baseline rates to intervention rates on the following:

- referrals ordered
- consultations sought with radiologist
- consultations received by radiologist
- time between request for and receipt of radiologist consultation

Domain 2: We are interested in learning how interaction with the telemedicine software affects physicians' skills and feelings of empowerment.

Operational Definition:
Physicians' skills and feelings of empowerment will be measured according to the following questions through a self-report mechanism:

- Do physicians feel they are becoming more adept at reading x-rays because of consultations with specialists?
- Do physicians feel they are learning new skills or improving their skills due to interaction with specialists?
- Do physicians feel more or less confident in their decision-making ability with the use of the telemedicine software?

Domain 3: Information should be gathered on patients' impressions of the telemedicine system according to their beliefs of how the system improves care, helps doctors offer better care, and raises the value of the clinic.

Methods:

Sample: Five physicians will be involved in the primary evaluation – all five will utilize the telemedicine software.

Data Collection for Domain 1:

1. Baseline measures will be collected for each of the components under Domain 1 (as outlined above) for a period of three months prior to the intervention. (Data will be gathered from physician records and medical record review)

2. Collection of Domain 1 measures will continue once physicians begin using the telemedicine software. Collection of data under the intervention will continue for six months.
3. Post-intervention data will be collected for one month during which physicians will not have access to the telemedicine software.

Analysis of Domain 1 Data:
Each physician's baseline measures will serve as the control against which to compare their measures while using the telemedicine system. The post-intervention measures will be gathered in order to compare them to both the baseline and the intervention measures.

Data Collection for Domain 2:

1. Self- report questionnaire (administered at three stages: pre-intervention, intervention, post-intervention)
2. Structured focus group (administered after first two months of intervention and again in the post-intervention stage)

Measures of physicians' skills and feelings of empowerment will be collected via self-report through two means: self-report questionnaire and structured focus groups. The questionnaire and focus group will also ask physicians to rate their experiences with using the software/telemedicine project. The focus group will aim to outline weaknesses in the system as well as improvements that can be made. The combination of quantitative survey and qualitative focus group will allow researchers the opportunity to learn about physicians' "real world" reactions to and experiences with the telemedicine program.

Data Collection for Domain 3:
Patients will be invited to participate in voluntary focus groups with the goal to identify patient impressions of the telemedicine system. The focus group will follow a topic guide but will remain relatively unstructured to allow for free discussion and development of new issues. Topics to cover in the focus group include: awareness of the telemedicine system being used by physicians at the clinic, apprehension or concern of patient information being sent over the Internet, impressions of physician's care, and beliefs about how the telemedicine system serves the community.

The focus groups will need to be conducted several times with 8-10 participants in each session throughout the course of the entire study. The moderator should be familiar with the telemedicine project and fluent in Spanish. The need for additional focus groups and one-on-one interviews may arise as information is uncovered – this sort of qualitative study should be encouraged.

Resources Needed for Evaluation Study

- Researchers to design the questionnaires, collect data, maintain database, and analyse and publish results

- Researchers/research assistants to lead focus groups and administer questionnaires

- Compensation or some reward for subjects taking part in focus group sessions

Timeline for Study

	July Ğ Dec, Ğ3	June, Ğ4	Dec, Ğ4	June, Ğ5	Dec, Ğ5	June, Ğ6	Dec, Ğ6
Physicians							
Develop Usage Survey							
Collect Usage Data							
Develop Human Behavior Model Survey							
Collect HBM Data							
Data Analysis							
Implement Telemedicine							
Best Practice Guidelines							
Manuscript Developed							
Reach Full Capacity							

Patients							
Develop Topic Guides							
Subject Recruitment							
Key Informant Interviews							
Focus Groups							
Analysis							
Report Findings							

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Other Resources

1. Teleheahealth Projects: A Practical Guide
2. Assessment of Approaches to Evaluating Telemedicine
3. Telemedicine and Developing Countries – Lessons learned
4. Assessing Community Telecentres: Guidelines for researchers. Anne Whyte, Acacia Initiative if the International Development Research Centre, 2000

Appendix A. Existing Human resources

AHD has compiled a registry of volunteer e-Health specialists who have agreed to volunteer their services from the U.S. and within Ecuador. The registry as of May13, 2003 consists of the following individuals:

Radiology:

Tim Jenkins, MD
tjenkins@cinci.rr.com
Mercy Hospital-Anderson, Cincinnati, OH

Peter Bessette, MD
pelelieu@execpc.com
St. Lukes medical Center, Milwaukee, WI

Juan Carlos Guerra, MD
radiolog@hoy.net
Clinica Radiologia Quito, Ecuador

German Castillo, MD
castillo@uio.telconet.net
Harvard Radiologia, Quito Ecuador

Dermatology:

Anya Landeck, MD
alandeck@bigplanet.com
solo practice

Pathology:

Armed Forces Institute of Pathology
ww.afip.org/Departments/telepathology/

Ophthalmology:

Russ Gonnering, MD, FACS
rsgonnering@hotmail.com
Medical College of WI

Internal medicine:

Philip A. Bain,MD
pbain@execpc.com
Wilkinson Medical Clinic, Waukesha, WI

Appendix B. Other Potential ICT applications

Andean Health & Development's continued exploitation of ICT as a development tool would expectedly result in more sophisticated programs and creative initiatives with the potential to evolve into a "community telecenter" framework. Likely applications include the following:

Economic Opportunity

- Leveraged ICT capacity to increase revenue and promote ICT program self-sustainability
- Microcredit lending program for locally introduced ventures using ICT capability

Cultural Activities

- Innovative ICT applications that promote expression of local culture and customs

Future infrastructure upgrades might include the use of satellite and wireless technology to allow for greater bandwidth while providing access to those in more remote areas without land lines.

Finally, positive experience with ICT in the delivery and management of health care may eventually lend support to future policy regarding funding of ICT applications on a national level.

Glossary

Bandwidth – the capacity of an electronic transmission medium to transmit data per unit of time. The higher the bandwidth, the more data can be transmitted. Typically measured in kilobits or megabits per second.

DICOM – Digital Imaging and Communications in Medicine. An industry standard for connection of, and communications among, medical imaging devices.

Encryption – A mathematical transposition of a file or data stream so that it cannot be deciphered at the receiving end without the proper key. Encryption is a security feature that assures that only the parties who are supposed to be participating in a video or data transfer are able to do so.

Internet – a loose aggregation of thousands of computer networks forming an enormous world-wide WAN.

JPEG – Joint Photographic Experts Group. This international group, a joint effort of the ISO and TSS, has developed standards for still image compression.

LAN – Local Area Network. A computer network linking computers, printers, servers, and other equipment within an enterprise.

MPEG – Moving Picture Experts Group. A group of standards for compression and storage of motion video.

Real-time – sends and receives audio/video/data simultaneously, without more than a fraction of a second delay.

Store-and-forward – captured audio clips, video clips, still images, or data that is transmitted or received at a later time (sometimes no more than a minute). Email is a store and forward system.

WAN – Wide area network. Wider in scope than a LAN.