Health Network in Peru and Brasil

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Abstract-*Access to medical care is sometimes very difficult to be reached for people living in rural and underserved areas. This problem is very well known in rural areas in Latin America. Citizens have no access to health care. They have to travel hundreds of kilometres to receive a medical diagnosis. Within the MEDNet project, a medical network will be developed that addresses the problems of providing health care from a distance. The medical network will be supported by expert physicians located in urban cities of Latin America. The examinations will involve ultrasound examination, ECG test, blood test and blood test imaging for automated diagnosis. All the patient information extracted from the examinations will be stored in a health care database, along with demographic information and medication prescriptions. MEDNet project will connect the isolated regions of Amazon, in two different countries: Brazil and Peru. Moreover, MEDNet will make use of AmerHis satellite communication based on DVB-RCS for communication and storage and medical data presentation.*

Keywords

Technology transfer, Health Network, Patient safety, teleconsulation

1. Introduction

In Peru there is high incidence of prenatal and maternal mortality due to poor maternal care during pregnancy and delivery. The maternal death rate in Junin in 2004 of 149.44 per 100, 000 was slightly above Peru's national average of 146. Approximately 65% of these cases occur due to puerperal fever – hemorrhaging accounting for 64% of these cases. With appropriate health services and nutrition during and after pregnancy, many of these deaths are preventable. The greatest causes of mortality are:

- respiratory diseases
- traumas
- malignant tumors
- chronic degenerative diseases in the adult population.

Health service coverage in Junin is low. Approximately 89% of health centres in the region are delivered by Ministerio de Salud (MINSA), however, 97% of these are "puestos de salud" – a level of medical attention characterised by limited infrastructure and resources, in both equipment and professional personnel. With this lack of infrastructure it is difficult to effectively confront the health problems faced by the population. The region faces health workforce crises due to a lack of trained physicians in rural areas. Professional health workers perceive there to be a strong sense of isolation associated with working in rural areas, particularly in terms of continuing professional development.

Telemedicine in this respect is an excellent tool in covering and integrating multiple areas of health care work, training and education.

Poverty is an important factor in assessing access to health services. In 2000, of 100% of people declaring symptoms in need of treatment, only 69% received attention from a health care professional. Approximately 31% failed to access the health service – for economic reasons. According to a map of poverty produced by MEF in 2004, and the United Nations Human Development Index in 2006, the poorest districts in Junin were situated in the province of **Satipo** (e.g. Rio Tambo has a 50.3% rate of extreme poverty and 54.4 % rate of chronic infant malnutrition, Llayla 37.2%: 39.9% respectively) and **Concepcion**.

The Pará State is located in the very north of Brazil and has 143 cities, 6,695,940 inhabitants, 1,248,042 km² of extension and represents 16.66% of the Brazilian territory and 26% of the Amazon Region.

The demographic density of the State and of all of the North Region of Brazil is too low (huge territory and proportionally few people). The capital city is Belém, with a population of 2,085,000. The state of Pará presents the rate of general mortality of 3,65 deaths in 1,000 inhabitants. The main reasons are the following:

- blood circulation diseases
- birth associated diseases
- breath associated diseases

- infectious diseases
- external causes

Child mortality is about 20 to 49 cases in 1,000 inhabitants. Some common diseases are diarrhea, malaria, tuberculosis, typhoid, hepatitis, leptospirosis, yellow fever and tetanus. An estimated 35% to 40% of the total medical cost of the cities is spent on treatments in other urban centers. Besides that, there is a great difficulty in the human resources availability in remote areas where a large part of the population lives in poverty. High complexity medical services are totally concentrated in the Belém area.

The lack of infrastructure and specialist Medical Doctors in remote areas cause the transference of many patients to hospitals in the metropolitan area of Belém for diagnosis and treatment [2].

2. Medical Collaboration Application / Teleconsult

TeleConsult is a stand-alone application running on Windows XP/VISTA. The application is able to acquire medical images from any ultrasound device through a video grabber attached to the computer. Furthermore, DICOM based agents would store medical images from any DICOM compliant device (DICOM is an international standard for the representation of medical imaging data).

The TeleConsult application is a combination of a 2D/3D DICOM viewer (**錯誤! 找不到參照來源。**), an image grabbing software, medical annotation tools and a medical telecommunication tool. Figure 1 illustrates the user interface of TeleConsult. The largest part of the user interface is used for displaying images. On the left side of the software, all images currently loaded into TeleConsult are listed [9]. In the centre of the user interface, there is space for showing the details of one or more images. All operations of the software can be assigned to following eight modules:

Table 1. Teleconsult modules

Menus	
Database Interface	✓
Image View	✓
File I/O	✓
Geometry	✓
Greylevels/Colors	✓
Measurement Tools	✓
The Cine	✓
Tele-collaboration - IM	✓

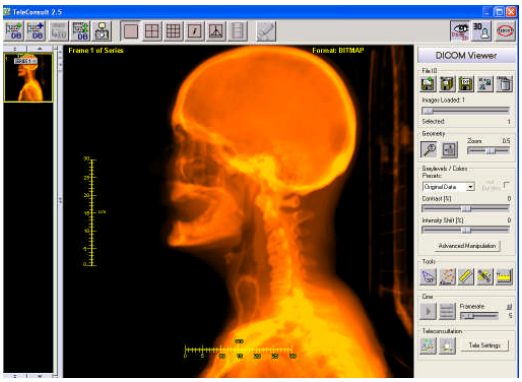

Figure 1. Medical Imaging collaboration application/TeleConsult

Teleconsult is currently used at several European locations and provides an excellent, proven communication tool for telemedicine systems. The system also provides easy localization options for Spanish and Portuguese [10].

3. Medical Database / Health Care Records

There are alternative ways to manage clinical information using paper cards and charts, but for clinical trials, monitoring and analysis of population data and telemedicine, computerization of some sort is generally required. A key challenge is to create sustainable systems that are able to be used widely and can support several of the above tasks, rather than using multiple “stovepipe” applications.

Problem issues with ICTs and Electronic Medical Records

- Data collection and entry (including data completeness and quality)
- Data standards (common data models and open standards)
- Difficulties in reuse of technology and avoiding re-invention of systems
- Tensions between standard approaches and local requirements
- Safety, security and confidentiality of medical data
- Language and cultural differences
- Short term quick solutions that do not scale up, especially spreadsheets

The medical imaging application offers a patient management database (**錯誤! 找不到參照來源。**) with the following possible operations:

- Creating, modifying and deleting patients.
- Creating, modifying and deleting studies.
- Storing images, configurations, videos and other (additional) files assigned to a patient and study.
- Swapping out data (images) to other storage medias, preserving free disk space on the local hard disk.
- Exporting and Importing patients/studies and images to external files, with the purpose of exchanging of data between several databases.
- Loading images, configurations and videos into TeleConsult.
- Importing DICOM images into the Database.
- Sending and receiving messages, including patient, study and image information from and to other TeleConsult workstations (Offline Messaging)
- Importing/exporting vital signals (ECG, BP, SPO2, Glucose) into the Database.

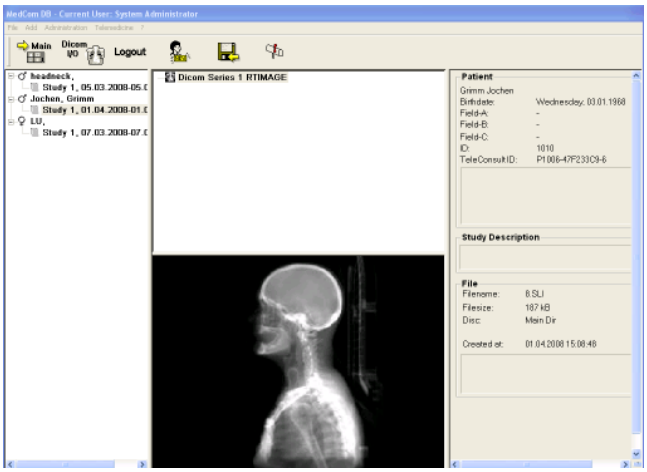

Figure 2. Electronic medical database

The database is based on *open*EHR; the definition of the "electronic health record" corresponds to the "Integrated Care EHR" as defined in ISO/DTR 20514: The Integrated Care EHR is defined as a repository of information regarding the health of a subject of care in computer processable form, stored and transmitted securely, and accessible by multiple authorised users. It has a commonly agreed logical information model which is independent of EHR systems. Its primary purpose is the support of continuing, efficient and quality integrated health care and it contains information which is retrospective, concurrent and prospective.

The EHR has the following characteristics:

- patient-centred: one EHR relates to one subject of care, not to an episode of care at an institution;
- longitudinal: it is a long-term record of care, possibly birth to death;
- comprehensive: it includes a record of care events from all types of carers and provider institutions tending to a patient, not just one speciality; in other words there are no important care events of any kind not in the EHR;
- prospective: not only are previous events recorded, so is decisional and prospective information such as plans, goals, orders and evaluations.

4. Satellite Communication

The selected regions in Amazon have no access to broadband communications. Therefore, AmerHis is going to be used. The AMERHIS system integrates a Multi-Media Broadcasting network with an Interaction network by combining two standards, the DVB-S and DVB-RCS, into one unique regenerative and multi-spot satellite system. In this manner, the users calling for broadband and interactive services will be able to utilize standard stations (RCSTs) at both transmitting and receiving sides.

Thales Alenia Space España has led the AMERHIS project within the Hispasat Amazonas satellite. **AmerHis** is an advanced communication system, supported and co-funded by **ESA** and the Industry, to deploy an advanced communications system based on a regenerative payload on board the **Amazonas** satellite.

DVB-RCS is a system that allows users receive and transmit capabilities via a geostationary non-regenerative satellite. The DVB-RCS return channel standard is applied by all users to access through a standard uplink to the satellite. On board, the regenerative payload (OBP) is in charge of multiplexing that information from diverse sources into one or more DVB-S data streams capable of being received by any standard IRD equipment (**錯誤! 找不到參照來源。**). The on board repeater is not only capable of multiplexing signals coming from the same uplink, but also cross-connecting and/or broadcasting channels coming from separate uplink coverage areas to different downlink coverage areas.

The Management Station manages all the elements of the system. It also controls the sessions, resources and connections of the ground terminals. It is composed of: NMC (Network Management Center), in charge of the management of all the system elements. NCC (Network Control Center), which controls the Interactive Network,

provides session control, routing and resource access to the subscriber RCSTs and manages the OBP configuration. The NCC can transmit signaling and timing information for network operation directly to the satellite by using the same DVB-RCS standard and receiving the different return channels via DVB-S signal. NCC_RCST, the satellite terminal of the MS, supporting modulation and demodulation functions to access to the satellite.

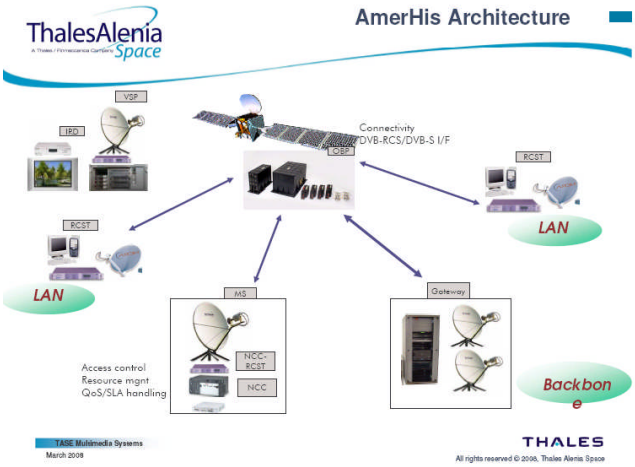

Figure 3. AmerHis architecture outlook

The RCST (or simply terminal) is the interface between the System and external users. These terminals are able to work in transparent or in OBP-based systems by a simple change of software. In OBP-based systems they allow different kinds of connectivity: single satellite-hop mesh (unicast and multicast) connections, single satellite-hop connections with ISDN through the RSGW and single satellite-hop connections with terrestrial IP networks (Internet, Intranet). In order to provide more complete Triple Play or Corporate services, the RCST can have different equipment attached to it [5].

5. Consortium & Roles

In the following **Table 2** we can see the roles each partner of MedNet project have.

Table 2. Consortium project roles

Organisation Name	**Business Activity / Main Mission / Area of Activity**	**RTD Role in project**
FhG-IGD	Research Institution	• Coordinator, contributor to architecture specs and requirements specs. • Medical protocols • Electronic Health Records
THALES	Large Company	• Satellite communication • Satellite configuration schema
Geopac	SME	• Facilitating implementation of project in Peru
VicomTech	SME	• European Medical protocols
MedCom	SME	• Medical imaging development
NTUA	University	• Medical assessment and process optimization
DIRESA Junin	Public Health Authority	• Provide medical expertise for implementation of project and run the pilots, communicate problems and recommendations in order to resolve outstanding issues.
Gobierno Regional de Junin	Local Government	• Supervise implementation of project, identify synergies with modernisation reforms, and communicate problems and recommendations in order to resolve outstanding issues.
SENAI-CETA	Research Institution	• Facilitating implementation of project in Brazil

Santa Casa Hospital (SACA)	Hospital	• Pilots running
HISPASAT	Large company	• Satellite operator • Bandwidth provider

6. Deployment in Brazil & Peru

We are going to finish the installation of satellite terminals to the referral hospital in Huancayo, in Peru simultaneously.

The remote sites in Peru are:

1. Chongos Alto
2. Comos
3. Pariahuanca
4. Puerto Ocopa
5. Mazamari
6. Rio Negro
7. San Martin de Pangoa

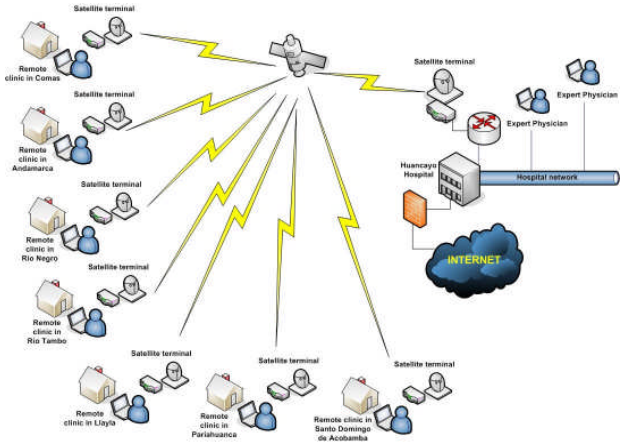

Figure 4. Deployment in Peru

The deployments will include the installation and configuration of the necessary hardware and software. The PC will be connected to the ultrasound device provided by the hospitals.

The remote sites in Brazil are:

1. Balsas
2. Carolina
3. Fortaleza dos Nougueiras
4. Alegrete
5. Pelotas
6. Lagoa dos Tres Cantos

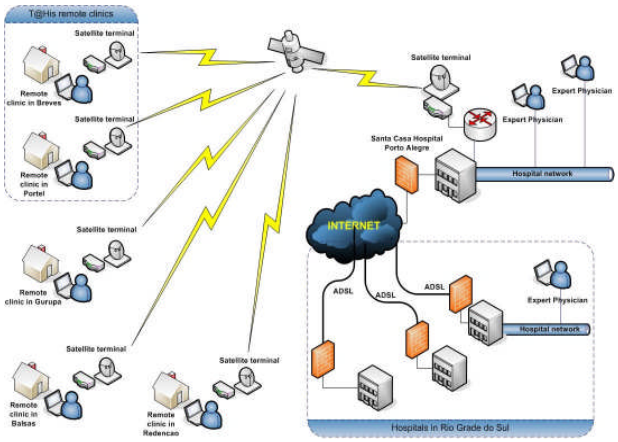

Figure 5. Deployment in Brazil

In addition, Santa Casa hospital is extending the medical network to MRI and CT medical imaging modalities. Santa Casa hospital is going to find three (3) remote hopsitals near to Rio Grade do Sul or/and Santa Catarina states that need medical tele-consultation on MRI and CT cases [2]. These three remote sites will make use of ADSL communication for data exchange.

7. Discussion

Health service coverage in Junin, Peru is low. Approximately 89% of health centres in the region are delivered by Ministerio de Salud (MINSA), however, 97% of these are “puestos de salud” – a level of medical attention characterised by limited infrastructure and resources, in both equipment and professional personnel. The region faces health workforce crises due to a lack of trained physicians in rural areas, which is very common in rural areas in Latin America .Telemedicine in this respect is an excellent tool in covering and integrating multiple areas of health care work, training and education. The demographic density of the State and of all the North Region of Brazil is too low (huge territory with proportionally few people).

The capital city is Belém that has a population of 2.085.000 people. The state of Pará presents the rate of general mortality of 3,65 deaths in 1.000 inhabitants. The main reasons are the following:

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- infectious diseases
- external causes

The children mortality is about 20 to 49 cases in 1.000 inhabitants. Some common diseases: diarrhoea, malaria, tuberculosis, typhoid, hepatitis, leptospirosis, yellow fever, tetanus. It's estimated that 35% to 40% of the total medical cost of the cities are spent in treatments in other urban centers. Besides that, there is a great difficulty in the human resources availability in remote areas where a large part of the population lives in poverty. The high complexity medical services are totally

concentrated in the Belém area. In order to deal these problems, Brazil and Peru starting this health care network for their remote areas.

8. Acknowledgements

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