

# Telemedicine as a Tool for Europe-Africa Cooperation: A Practical Experience

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**Abstract.** This paper presents the experience of an Europe-Africa telemedicine network, focused on the pediatric area, and involving hospitals located in Luanda (Angola), Benguela (Angola), Praia (Cape Verde) and Coimbra (Portugal). In the scope of this network, the cooperation between these hospitals goes beyond the teleconsultation sessions. Tele-training, clinical experience exchange, patient transfer agreements and health staff training to local development of new medical capabilities are some of the involved activities. It is therefore agreed that this kind of technical and knowledge network could also be expanded to other African countries with clear benefits to the local citizens, overcoming the digital-divide and improving the cooperation between developed and developing countries.

**Keywords:** telemedicine, telehealth, Africa, e-health, pediatric, cardiology, tele-echocardiography and telecommunications.

## 1 Introduction

Telemedicine is usually defined as the rapid access to remote medical expertise by means of telecommunications and information technologies regardless of where the patient, the physician and the relevant patient information are located [1]. Telemedicine has a surprisingly long history that began with the advent of the telephone. In 1906, Einthoven first investigated the chance to make use of electrocardiogram transmissions over telephone lines. In the 1920s, vessel radios were used to link physicians with sailors to assist during medical emergencies at sea. In 1955 the Nebraska Psychiatric Institute was among one of the first facilities to use closed-circuit television for healthcare purposes. In the 1970s, paramedics in remote Alaskan and Canadian villages were able to perform lifesaving techniques while linked with hospitals in distant towns using satellite communications. Today telemedicine is beginning to exponentially mature with the progressive advances in technology [1].

At the present time, by using modern telemedicine systems, various health related activities can be performed remotely, namely (1) teleconsultation, (2) telediagnostic

and (3) telemonitoring. The first category encompasses a real time interaction between two physicians, or at least one physician and the patient, typically using advanced videoconference services. The second category, which can be performed in real time or in store&forward mode, involves the transmission of medical exams (video, image, sound, etc) to be observed by a remote specialist. The interest in real time transmission of medical data resides on the allowance of interactivity between physician(s) and patient and also by the fact that a faster and more accurate diagnostic of the pathology can be achieved. The last category corresponds to the remote continuous real time monitoring of patient's biological parameters.

The following advantages are commonly accepted for what concerns the benefits of telemedicine:

- Cost reduction and the process efficiency increase;
- Medical knowledge sharing and continuous training;
- Decrease on the number of patient transfers within hospitals;
- Decrease on the number of unnecessary hospitalizations;
- Availability of specialized services away from big urban centers;
- Better patient satisfaction due to faster and more accurate diagnostic.

The utilization of telemedicine systems seems especially suitable in the following cases:

- Initial and urgent assessment of patients in order to decide where they have to be transferred to specialized healthcare units;
- Rapid access to a specialized second opinion;
- Remote monitoring of post-hospitalization and post-surgical cases;
- Regular medical teleconsultations;
- Transmission of medical images for remote diagnostic;
- Continuous remote monitoring of risky patient status;
- Remote monitoring of patients with chronic diseases.

Worldwide there are many initiatives happening in the telemedicine or telehealth area. In Africa several initiatives have been reported, for instance in [2][3] and [4] several scenarios in sub-Saharan African countries are presented, namely within the RAFT project that has developed a telemedicine network, connecting healthcare centers at the French speaking countries, and supporting several activities like videoconferences, teleconsultations, collaborative knowledge bases development and distance continuous education. The communication infrastructure used by this network is based on Internet connections, and in some cases, satellite links (in rural areas).

In Portugal, a particularly interesting project was launched more than a decade ago by the R&D department of Portugal Telecom and the Pediatric Hospital of Coimbra. In 1998, this latter Hospital started a regular cardio-pediatrics teleconsultation service within Portugal, that turned a break evolution to around 2000 teleconsultations made in 2008 (just ten years after the service has been launched). Based on this experience, in 2007 this Hospital has extended its telemedicine reference service to some African countries, in order to exchange knowledge among Portuguese and African healthcare professionals and specially to aid young children with heart pathologies.

In this paper, the experience of this Europe-Africa pediatric-focused telemedicine network is described. The following sections present the chronology, technology, methodology and results of this telemedicine experience between Portugal, Cape Verde and Angola healthcare units.

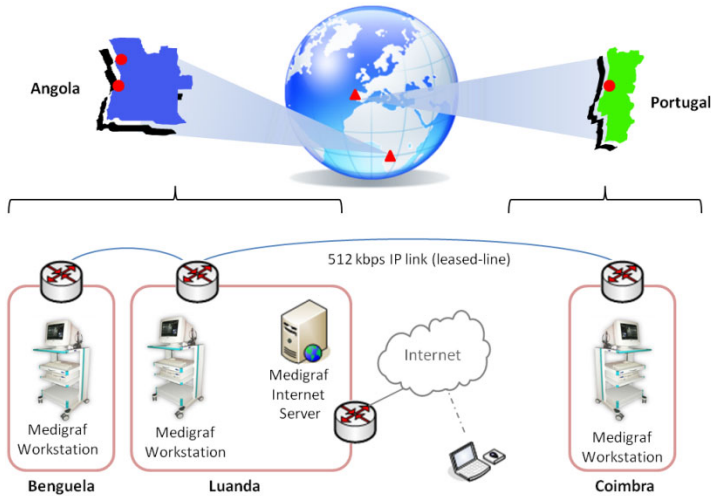
## 2 Chronology

Launched in November of 2007, with the contribution of several public and private companies, PEDITEL pilot project aimed to aid the children with heart pathologies in Angola, as well as to adapt and promote the current technology capabilities to the Angola's territory. This project was also launched in cooperation with several Portuguese and Angolan institutions, namely: Pediatric Hospital of Luanda, Hospital of Benguela, Pediatric Hospital of Coimbra, Angola Telecom, Multitel, Unitel, HemoPortugal/HemoAngola and PT Inovação. The role of each of the partners on the project was dependent on its area of expertise, being the hospitals and its patients the final service end users. The telecommunication operators (Angola Telecom, Multitel and Unitel) provided the telecommunication infrastructures while PT Inovação provided the telemedicine system solution and HemoAngola provided some medical equipment. Within the time context of this pilot project, all the telemedicine solution equipment and communications was delivered at zero cost for the end users.

The main goals of this pilot project are to:

- Implement the basis for an integrated telemedicine solution in Angola (connecting Luanda and Benguela in its initial phase) for pediatric usage;
- Focus the telemedicine activities, at the beginning on the cardiology area and expand later to other medical areas;
- Identify and evaluate the use of the most cost effective telecommunications circuit solutions for the interconnection of the healthcare institutions;
- Test and evaluate the network behavior and reliability concerning the proposed services;
- Use the project resources also for training activities and evaluate its impact on the medical staff and the corresponding trainees;
- Evaluate a user friendly interface concerning the respective autonomy of the physicians when using the telemedicine equipment;
- Evaluate the impact and improvement on the corresponding medical services;
- Evaluate the business model that will enable a countrywide (in Angola) coverage of the service.

The implemented technical infrastructure is shown in Figure 1. It was installed a telemedicine workstation (Medigraf workstation) in each of the three hospitals, supporting videoconference, real-time teleconsultations, and real-time training activities. In terms of communications, the Pediatric Hospital of Luanda, Hospital of Benguela and Pediatric Hospital of Coimbra, were interconnected with 512 kbit/s dedicated point-to-point telecommunications circuits.



**Fig. 1.** PEDITEL telemedicine pilot project technical infrastructure

It was also installed the infrastructure (Medigraf Internet Server and network equipment) to allow the remote access of physicians, using a broadband Internet connection, to get and execute store-and-forward teleconsultations.

After an initial training period, making use of the telemedicine technology, the physicians started regular weekly real-time teleconsultations. The infrastructure was also successfully used for teletraining sessions and knowledge share meetings between Portuguese and Angolan healthcare professionals.

In May of 2009, given the experience obtained with this project in Angola, the Pediatric Hospital of Coimbra extended the telemedicine service to Hospital Dr. Agostinho Neto in Cape Verde. This service put in place for Cape Verde closed the gap between this islands needs and the medical offer available in Portugal. The scope of the Cape Verde project included medical staff training, patient evaluation and diagnostic previously to patient transfer to on-shore mainland Hospitals.

The telemedicine system that was installed at the Hospital Dr. Agostinho Neto, is similar to the one that was previously running in Angola healthcare units in the context of the PEDITEL project, however the communications infrastructure is based on ISDN lines in the Cape Verde project. The necessary bandwidth for real-time teleconsultations, is basically achieved over a four line aggregation, using for that purpose a router with a four BRI module.

### 3 Technology Description

The implemented telemedicine infrastructure was based on the Medigraf<sup>®</sup> platform (see Figure 2). This system supports remote healthcare services, offering a collaborative work environment, videoconference and clinical data share.



**Fig. 2.** The Medigraf<sup>®</sup> telemedicine workstation

The mobile telemedicine cart includes a computational base, a TFT LCD monitor, a pan-tilt-zoom camera, a microphone, speakers and a wireless headset.

The platform's software has a number of features which are shortly enumerated below:

- ✓ Multi-user access with login and password authentication;
- ✓ Encrypted communications over IP (Internet Protocol);
- ✓ Videoconference features;
- ✓ Collaborative work environment;
- ✓ Teleconsultation record management and storage;
- ✓ Interface to digital cameras, scanners and film digitizers;
- ✓ Real time transmission of clinical exams;
- ✓ Integrated DICOM image visualization and manipulation tool;
- ✓ Integration with Healthcare Information Systems and PACS;
- ✓ Web-based access, in intranet, for system and clinical data management;
- ✓ System usage reporting to monitor system utilization and access (lists of session's detailed information, statistics, etc);
- ✓ User-friendly interface.

By using this platform, healthcare professionals can remotely work together towards a common diagnosis, despite the physical distance that might be between them.

## 4 Methodology

A key aspect for the success of telemedicine projects, is the existence of a strong methodological approach that is being continuously refined as a result of the long time experience of the Pediatric Hospital of Coimbra in this area.

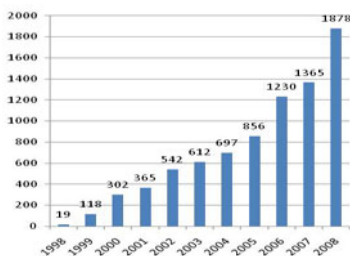
As a first step, previous to the usage of the technology, all the healthcare professionals and specialists that will be involved in the telemedicine project meet together at Pediatric Hospital of Coimbra and are exposed to the medical practices of the Pediatric Cardiology Service. Also the Portuguese physicians visit the involved African Hospitals, to take contact with the local health reality.

After that introductory stage, using the telemedicine infrastructure, the children are remotely observed in real-time and the heart pathologies diagnosed by the Portuguese physicians in close collaboration with the remote counterpart. During the Teleconsultation sessions the physicians share clinical data, echo-cardiograms and medical reports.

After the pathology identification, and in cases where local facilities are not available to solve the identified problem, such as is the case when a more specialized surgery is required, the local healthcare unit tries to transfer the children to other better equipped units.

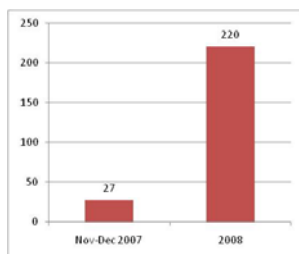
## 5 Results

The Pediatric Hospital of Coimbra in Portugal holds a long experience in telemedicine. As a matter of historical data, Figure 3 displays the evolution in terms of the number of teleconsultations per year between this hospital and other Portuguese hospitals since 1998. Nowadays 8 Portuguese hospitals establish, in a regular basis, teleconsultations with the Pediatric Hospital of Coimbra.



**Fig. 3.** Evolution of medical consultations using telemedicine in the Pediatric Hospital of Coimbra

This consolidated experience in Portugal, of more than 10 years, was crucial to launch in November of 2007 the first pilot of telemedicine with Angola (PEDITEL project). Since then, teleconsultations are running regularly between Pediatric Hospital of Coimbra and the two Angolan hospitals (Pediatric Hospital of Luanda and Hospital of Benguela). Figure 4 displays the number of teleconsultations performed in 2007 and 2008 between both Pediatric Hospitals.



**Fig. 4.** Evolution of medical consultations using telemedicine in the scope of PEDITEL project

Up to now, more than 500 teleconsultations were done mainly in the area of Pediatric and Fetal Cardiology. There are also other clinical areas using the telemedicine system, namely Gastroenterology, Oncology and Infectology.

Figure 5 shows an Angolan physician being assisted by a Portuguese physician while an echocardiography to a children heart is being performed and transmitted in real time from Luanda to Coimbra using the telemedicine platform.

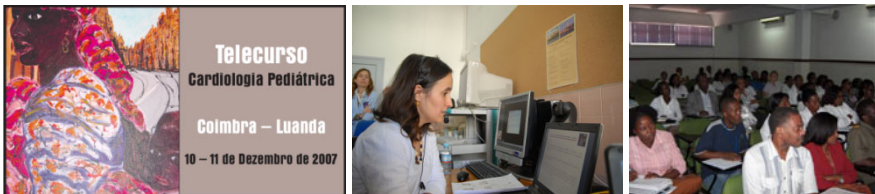


**Fig. 5.** Teleconsultation session between Pediatric Hospitals of Luanda (left) and Coimbra (right)

The physicians in Portugal are able to see in real-time the exam and identify the pathology. Moreover they are able to identify what should be done next, namely the steps the children should undertake, including their transfer to Portugal or other country for a possible surgery, given the fact that these facilities were not yet locally available in Angola. In situations where it was necessary to evacuate the patients to Coimbra by airplane, it became now possible to perform the medical diagnosis or confirm the diagnosis made earlier with a simple mouse click.

The installed technical infrastructure also has been applied, with high success, to the remote training of healthcare professionals (physicians, nurses, etc.). Since November of 2007, more than 5 tele-training sessions were performed between Pediatric Hospitals of Luanda and Coimbra, in areas like Pediatric Cardiology, Infectology and Pediatric Nursing.

Figure 6 shows pictures of the first tele-training session, in December 2007, with duration of two days and remotely attended by some tens of Angolan healthcare professionals.



**Fig. 6.** Tele-training session between Pediatric Hospitals of Coimbra and Luanda

Some sessions were performed from Coimbra to Luanda and other ones from Luanda to Coimbra. These tele-training sessions have contributed to the exchange of know-how and experience between these Portuguese and Angolan hospitals.

More recently, since May of 2009, Hospital Dr. Agostinho Neto (Cape Verde) started regular weekly teleconsultation sessions with Pediatric Hospital of Coimbra. Until now, more than fifty teleconsultation sessions were achieved between these two Hospitals, in the pediatric and fetal cardiology areas.

## 6 Conclusions and Final Remarks

African children in Luanda (Angola), Benguela (Angola) and Praia (Cape Verde) are already taking advantage of the telemedicine technology. Teleconsultations are occurring regularly between the involved hospitals. Given the results and experience already obtained, it can be concluded that the main benefits of the implemented telemedicine solution are related with the increase on the human resources efficiency, the decrease of the number of useless patient transfers to other hospitals and also the decrease on the number of unnecessary hospitalizations as well as the early identification to where the patients have to be transferred given the type of pathology.

Training, updating and knowledge share are other identified benefits. Moreover, it has also a pedagogical effect on the medical specialists from the central Hospital due to the fact that they will be exposed to some pathologies that no longer exist in developed countries and in that sense they also benefit from these experiences for their own proficiency development.

Cooperation is even taken further in terms of helping building surgery facilities and appropriate training to enable the local development of new medical capabilities and to locally expand the telemedicine.

The technology provided has been revealed as a user friendly mean to guarantee the local and independent operation whether by the physicians and/or network managers. A major impairment is typically the lack of telecommunication infrastructures at the remote areas, where interconnection circuits are mandatory. The cost of the circuits is of concern, mainly where there is a small offer, and the guaranteed 512 kbit/s bandwidth is not typically easy to get in many African countries.

The lack of specialized physicians is even a more severe problem once they are rare. This kind of technology is in fact the only one that allows for a faster widespread of specialized medical service in remote locations. From the social point of view the value of the service for the general population in the remote sites is priceless, and it constitutes a giant step forward in public health and general well being, with all the repercussions in the economic activities of those populations that came with it.

This type of network could also be expanded to other African countries with clear benefits to the local citizens and particularly to the youngest, due to the high children mortality rate in Africa. The development of an e-health network among the African countries could help in sharing experiences and allow for international cooperation with the foreign countries.



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