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### The Boario Home Care Project

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*This article on the Boario Home Care Project is the first in a two-part series. In this issue, the background and achieved results of the Boario Home Care Project, a telemedicine project that was implemented regionally and nationally across Italy, are explained. In the second part of this series, which will be published in Issue 2, a cost analysis of the project will be given.*

#### The History of the Boario Home Care Project

The seemingly intransigent problems of increasing costs and inequitable access to quality health care, coupled with the merger of information technology and health services, gave rise to the field of telemedicine. In broad terms, since its inception in 1998, the history of the Boario Home Care Project can be characterised as consisting of three major phases: the creation of a telematic network in a remote territory, extending the network regionally and nationally, and finally implementing a service centre structure with the use of broadband technologies. Each phase has been closely linked to significant advances in information technology and telecommunications.

#### Phase One: Establishing a Telematic Network

The first phase goal of the project was to implement a telematic network for the General Practitioners (GPs) in a mountain territory particularly hard to reach (Vallecamonica, a valley in the PreAlps) and to give them the possibility, over a 24-hour basis, of monitoring the cardiovascular diseases of their patients using a mobile electrocardiographer (ECG). The recorded ECG could then be sent by a fixed and mobile GSM telephone to the receiving station in Boario Terme, where a Cardiologist reported the trace, offered an interactive teleconsultation and prescribed therapy, if necessary. In this scenario, the Cardiologist was physically present and worked directly at a workstation in the call centre.

#### Phase Two: Extending the Network Regionally and Nationally

In phase two, the project was extended to the regional and then national territory and the number of enrolled GPs increased. At the same time, a new way of disease management for chronic cardiac patients began. The vast amount of work generated by the call centre created an obligation to imagine the following "telework" flow: the call centre operator received the call, asked for the patient's data and received the ECG. Afterwards, the patient was put through to the Cardiologist who received the trace at home on his PC via fax, reported the trace and provided teleconsultation.

#### **Phase The: Implementing Broadband Technologies**

In the third and present phase, the structure of the Service Centre was implemented with new broadband technologies (HDLS). The nerve centre is now equipped with four Hewlett Packard servers (with back-up hardware to avoid activity interruptions), a web server for Internet connection, a firewall for data security, a computerised call centre, 15 LAN workstations with four printers (over a network) and a central fax machine.

The system information flow consisted of the following: a phone call arrived (from GPs, patients, health centres, rest homes, etc.) and the patient was automatically identified through the stored telephone number or his identity code. Next, the phone call was sent to a free operator who recalled the patient's data stored in the enrolment phase and activated the "new call procedure", inserting new data relative to the call (a control call or a call made in the presence of symptoms). At this point, the trace could be received, the user put through to the Cardiologist or the duty nurse (a three-way call occurs) - both at home and connected to the central database through Internet. The specialist or the nurse proceeded by examining the stored clinical report and compared the trace with the baseline. Then, information was collected about the patient's history and clinical symptoms and a teleconsultation and / or nursing triage was provided. Finally, the reported ECG trace was sent to the patient by e-mail or fax and the data was stored, transferred to the web-server and made available on the Internet in the informatic clinical report, in an anonymous way and encrypted to ensure security.

An innovative teleworking model has been adopted for the medical professionals involved (the specialists and nurses), providing for a dedicated telephone line, a personal computer connected to the central system through the Internet via an "always on" ADSL Internet connection and a data protection system (Virtual Private Network). In this way, the remote personal computer works as a terminal emulator to prevent the data stored in the central server from being transferred on local disk or printed.

#### **Current Services Being Offered**

As a result of this project, four different types of services are now available:

##### **Service One: General Practitioners**

1,200 GPs receive a portable 12 leads electrocardiographer that can be interfaced to a fixed or mobile telephone and can transfer the recorded ECG trace back to the receiving station where a Cardiologist reports the trace and offers a teleconsultation. To date, GPs have requested teleconsultations for 104,568 patients, of which 35 cardiologists were involved. The analysis of a sample of 13,177 patients showed that teleconsultations solved the GPs' problems for 10,606 patients (80.4%); in 5% of cases, the patients were addressed to the Emergency Department and in 14.7% of cases a request for further diagnostic tests was made<sup>1</sup>. The diagnostic accuracy of the service (as regards the Emergency Department referral)<sup>2</sup>, was tested on a sample of 3,456 patients and was 94.5% accurate, showing a substantial diagnostic value. The same accuracy was tested for chest pain symptoms with the results that the telecardiology service showed a sensitivity of 97.4%, a specificity of 89.5% and a diagnostic accuracy of 86.95%, compared against Emergency Department admissions for chest pains<sup>3</sup>.

Moreover, the potential reduction of costs for the National Health Service through providing telecardiology services has also been estimated. In a group of 891 patients, there was a reduction of 47% of Emergency Department referrals and 95% in the number of cardiologic consultations in comparison with the normal procedure followed by GPs<sup>4</sup>.

The same potential reduction of costs was tested in a subgroup of 311 elderly patients<sup>5</sup>. In Italy, many elderly patients with Atrial Fibrillation (AF) were followed by their GPs on a routine basis; it is therefore believed that a telecardiology service may provide a useful tool in the home-management of chronic AF and in the first detection of new cases<sup>6</sup>.

##### **Service Two: Chronic Patients**

Chronic cardiac diseases, such as chronic heart failure, profit from multidisciplinary approaches that are able to reduce hospitalisation and improve the patient's quality of life, while at the same time, reduce costs involved for the National Health Service. Home Telenursing<sup>7</sup> is an integrated approach that must involve the patient, his family, the GP and Specialised Cardiac Centres. The physiological data and biological signal transmissions present objective data that may show the need for the intervention of a physician or a nurse. The possibility of the real-time transmission of this objective data by telephone, in association with subjective data given by the patient, allows telemedicine to become a new and unique approach to the problem of treating chronic patients.

As an example, a device that was able to record a one-lead trace was given to chronic heart failure patients; the trace could then be transmitted to the Service Centre where specially trained and experienced nurses were available for the evaluation of the trace and for an interactive teleconsultation about the patient's state of health, symptoms, weight, diuresis and therapy. This teleconsultation provided two different

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possibilities. Firstly, scheduled appointments (telemonitoring) and secondly, calls in the presence of symptoms (teleassistance), in which the patients could call the service centre 24 hours a day and 365 days a year, and speak with a nurse. The GP and the cardiologist of the reference hospital were informed about the patient's situation and could intervene at any moment regarding diagnostic and therapy arrangements. This study<sup>8</sup> showed significant reductions in hospitalisation and re-admission rates. In a preliminary study, the cost benefit ratio for telemonitoring (in which the implementation of a telemonitoring programme decreased annual medical costs) was assessed. This reduction was mainly attributed to hospitalisation costs<sup>9</sup>.

#### **Service Three: Telediagnosis**

Palpitations are a common symptom that sometimes results from a substantial cardiac arrhythmia. Establishing the cause of palpitations may be difficult because historical clues are not always accurate. A 24-hour Holter monitor is usually used, but the yield of this instrument is low in patients whose symptoms occur infrequently. Another instrument used to study palpitations is a transtelephonic event recorder. This hand-held device is given to patients and they can apply it to the chest when the symptoms occur. The patient presses a button to record about 30 records of cardiac rhythm, which is then stored in the memory of the device. The recording is later transmitted over the telephone for printing and interpretation to a call centre working 24 hours a day. In this case, a nurse compares the trace with the baseline, checks the patient's symptoms, and decides to end the telephone call or, in the presence of major arrhythmia, to request the cardiologist's intervention.

In a study to assess the effectiveness of telediagnosis, 310 patients were randomly assigned to receive an event recorder (ER) or a 24-hour Holter monitor. In the cases where an ER was assigned, it was used for seven days or until two recordings were obtained while symptoms occurred. The percentage of patients in whom the ER was able to record the ECG trace during palpitations was 76.8%, in comparison with the Holter monitoring in which the percentage was 47.8%<sup>10</sup>. In conclusion, more patients reached a clear diagnosis in real time when an ER was used, in comparison with Holter, for monitoring palpitations. For this reason, it is believed that ERs should replace Holter monitoring for this purpose whenever possible.

#### **Service Four: Call Centre Services for Hospitals**

The fourth service now available as a result of this project is that terminals have been implemented in 21 University and public hospitals, functionally linked with the Service Centre and configured to share the application program interface of the Central Station with an "on site/ on line" license. The Service Centre then provides the technological and organisational support, while health activity is managed by the Cardiologists and nurses of the hospital.

#### **The Result of the Project**

Currently, the Boario Home Care Project is eight years old and has demonstrated its value for increasing access to health care services, improving the quality of care and a reducing costs for the National Health Service in Italy. A main characteristic of the project is that it can easily be transferred to another context with different accessibility and quality requirements of local services. While the Boario Home Care Project has yet to reach maturity, evidence indicates that many objective results can be achieved - even if they are considered preliminary. In fact, in the field of telemedicine, although claims about the utility and the efficacy of new telecommunication systems have been widely made, these are not founded on strong evidence. The research published on this has shown some deficiencies in the design and is often not controlled<sup>11</sup>. In attempting to solve these problems, it is necessary to plan some controlled studies hoping that these new results will be able to give some answers to the main open questions in the field of telecardiology.

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