# Evaluation of Patient Adherence and Satisfaction with a Self-measurement Blood Pressure Telemonitoring Program

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## Abstract

*The aim of this study was to evaluate the patients adherence and satisfaction with a self-measurement blood pressure telemonitoring program. The study enrolled patients dismissed from a health structure after the acute phase of a major cardiac or cerebro-vascular event. At dismission each patient received a telemedicine system equipped with an automatic blood pressure device, and an evaluation questionnaire. 17 patients were monitored for an average of 75 days each. 16 out of 17 participants completed the feedback questionnaire. All patients (100%) scored installation, usability and quality of service as "good" or "very good". The majority of patients (13 out of 16) declared to feel comfortable with the self-measurement of blood pressure and the use of the telemonitoring system. Telemonitoring of blood pressure measurement can be considered a mature technology which find favour with patients dismissed after a acute cardiac or cerebro-vascular event.*

## 1. Introduction

Cardiovascular diseases are the world's leading killer, with extremely high costs, more than 50% of those caused by patient hospitalizations [1]. Post-acute cardiovascular event patients, discharged by a health structure, have to follow a long and complex therapeutic/rehabilitation path, which involves either medical doctors and his/her own family. In this context, utilization of information and communication technologies in home monitoring applications is becoming more and more common [2,3]. In the cardiological field, telemedicine projects include the monitoring of several parameters of cardiovascular interest (heart rate, arterial pressure, glycaemia) helpful to delineate the patient health state and to assess the risk of acute events. As far as blood pressure measurement (BPM) is concerned, Office BPM (OBPM) has been the gold standard for over 100 years. However, OBPM has important limitations. In particular, a single OBP reading often does not represent a patient's true BP status [4]. Home Blood Pressure Monitoring (HBPM) is becoming increasingly important in the diagnosis and management of cardiovascular disease such as arterial hypertension. The rapid diffusion of this technique has been favoured by a number of factors, including technical progress and wider availability of HBPM devices, increasing awareness of the importance of regular BP monitoring, and recognition of the usefulness of HBPM by the international medical community [4]. Accurate reporting of BP readings must be ensured, as it has been shown that HBPM reported by patients frequently differs from the actually measured values [5]. The need for automated HBPM data storage, analysis and reporting functions has stimulated the development of HBP telemonitoring (HBPT) systems. Several HBPT systems are available on the market, with different modalities of data transmission and reporting.

HBPT shares most advantages of traditional HBPM, however, multiple factors can limit the diffusion: the high cost of purchasing and maintaining the system is considered as the main disadvantage. Other limitations of HBPT include the need for training and the requirement of a telephonic/ Internet connection [4,6].

While home telemonitoring's potential to reduce health care costs and improve health conditions appears clear in most paper [7,8], the patients' perceptions regarding HBPT have received scarse attention: most studies addressed the feasibility of the telemonitoring system rather than the usability and satisfaction of the patents [9,10,11].

The aim of this study was to to evaluate the patients adherence and satisfaction with a self-measurement blood pressure telemonitoring program.

## 2. Methods and materials

### 2.1. The telemedicine platform

We developed a telemedicine platform (Fig. 1) for HBPM which try to overcome some of the abovementioned limitations. In particular the need of a telephonic/internet connection was avoided by the use of the mobile phone service, the running costs of the telemedicine service were reduced by relying on the

(Short Message Service (SMS) available in the GSM networks; This technical choices also resulted in no need of dedicate operation/personnel to install the system, nor for the use. A brief description of the platform is given below.

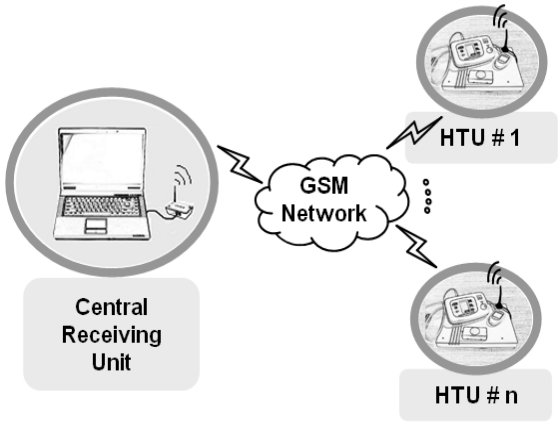


Figure 1. Model of the platform for blood pressure telemonitoring.

The platform has two main components: a central server for SMS receiving (Central Receiving Unit, CRU) and the remote sending data collection and transmitting units (Home Transmitting Unit, HTU) (Fig. 2).

Figure 2. The Home Transmitting Unit, with the commercial blood pressure meters.

The data collected remotely are transmitted by the HTU using a single SMS message, each day, to the CRU, where the messages are stored. The CRU, which is located in the clinical center, acts also as a server for the database housing and for the users applications (data display, trend visualizations, alarms). The platform is fully automated: no specific action is required to the patient for transmitting the data, nor from the clinicians for receiving and analyzing them. To increase the robustness of the system, in this project, in case of lacked or uncorrected reception of the measures, the clinical center may interact with the patients in order to implement corrective actions. The application also sends alerts and alarms in case of missing SMS or corrupted SMS content. At the start-up (HTU connected to the mains), the system performs an initial check for the GSM signal quality as well as the local GSM service availability. A feedback led indicates that a valid connection to the operator has been established. The patients are instructed to place the HTU following this led indication. Then the HTU waits for interrogate the blood pressure meter. Such interrogation is scheduled at night (02.00 AM) to not interfere with the use of the meters by the patients. After the nocturnal interrogation, measures are codified in a text string. This string can contain up to three measures of blood pressure and heart rate. A Web application allows the clinicians to review the data (Fig. 3).

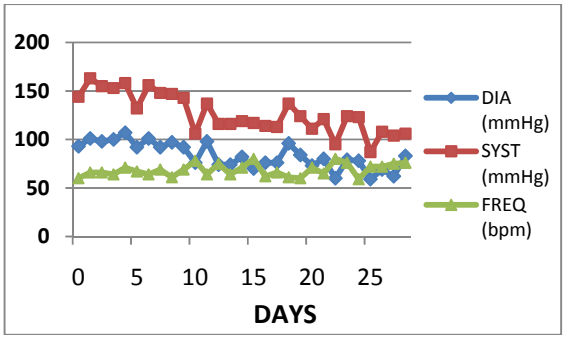


Figure 3. Example of blood pressure measures received in a month from one patient.

## 2.2. Evaluation questionnaire

The evaluation of the HBPT system was achieved by the use of a questionnaire. The questionnaire content is reported in Table 1. Each patient was asked to answer to 6 questions, dealing with the system installation, system installation, service quality, improvement of health conditions and changing in habits. In addiction patients have to indicate if they experienced any discomfort in performing blood pressure measuring. The rating satisfaction has to be chosen between the following: “poor”, “satisfactory”, “good” and “very good”.

Indexes based on the amount of BP measures received, compared to the actual medical prescriptions were also computed.

## 2.3. Clinical protocol

The study was conducted in collaboration with the Department of Cardiovascular and Respiratory Sciences, “Sapienza” University, Rome. The study enrolled patients dismissed from a health structure (Umberto I Hospital,

"Sapienza" University of Rome) after the acute phase of a major cardiac or cerebro-vascular event. Seventeen post-acute cardiovascular patient were enrolled. The protocol was approved by the local ethics committee. At dismission each patient received a telemedicine system equipped with an automatic blood pressure device and a brief training, and he/she was asked to perform one blood pressure testing per day. Each patient was asked to complete the questionnaire at the end of the program.

## 3. Results

During the monitoring period, no feedback was given to the patients. 17 patients (71 +/- 14 years, 71% men) were monitored for an average of 75 days each. During a cumulative monitoring period of 1275 days, there were 1139 data transfer sessions. On average, the blood pressure measures received were 0.84 per day. The percentage of successful encoding of the data transferred was 100%. The stability of the telemonitoring system was 100%, meaning that patient data transfer was always possible. 16 out of 17 participants completed the feedback questionnaire. Summaries of acceptance ratings for the patients are listed in table 1.

Table 1. Feasibility and usability rating of cardiovascular parameters telemonitoring system.

| **Questions** | **Answers (%)** | | | |
|---|---|---|---|---|
| | *poor* | *satisfactory* | *good* | *very good* |
| System installation | 0 | 0 | 12.50 | 87.50 |
| System usability | 0 | 0 | 12.50 | 87.50 |
| Service quality | 0 | 0 | 25.00 | 75.00 |
| Health conditions improvement | 12.50 | 43.75 | 43.75 | 0 |
| Changing of self-measurements habit | 0 | 12.50 | 25.00 | 62.50 |
| Discomfort of measurement activity | *arterial pressure* | | | *none* |
| | 18.75 | | | 81.25 |

All patients were either very satisfied or somewhat satisfied with services they had received. In particular all participants (16 out of 16, 100%) scored installation and the usability of service as "good" (2 out of 16, 12.50%) or "very good" (14 out of 16, 87.50%), and agreed that the quality of service was "good" (4 out of 16, 25.00%) or "very good" (12 out of 16, 75.00%).

The majority of patients (13 out of 16, 81.25%) declared to feel comfortable with the self-measurement of blood pressure and the use of the telemonitoring system while only 3 out of 16, 18.75%, felt uncomfortable with blood pressure meters. 14 out of 16 were either somewhat satisfied (7 out of 16, 43.75%) or satisfied (7 out of 16, 43.75%) agreed that an improved quality of health services was offered through telemonitoring system.

All patients (2 out of 16, 12.50 % somewhat satisfied, 4 out of 16, 25.00 % satisfied and 10 out of16, 62.50 % very satisfied) perceived that the presence of telemonitoring equipment in the home led to changing of self-measurements habit.

## 4. Discussion and conclusions

One of the most important causes of uncontrolled hypertension is poor adherence to therapy. In fact, success with lifestyle interventions in patients with chronic conditions is often improved by encouraging patients to become actively involved in their care. HBPM, being the BP measurement method that requires particular cooperation by the patient, may be particularly effective in favourably affecting patients' perceptions of their hypertension and thereby may encourage them to be compliant with lifestyle modifications and antihypertensive therapy. The better compliance to treatment associated to the HBPM has be shown in several studies [12]. However, HBP values are usually reported in handwritten logbooks, which are frequently inaccurate and/or illegible and do not provide an immediate insight into the overall time course and control of BP. This may discourage physicians from using them in clinical decision making. On the other hand HBPT systems can improve the quality of data reporting and facilitate their interpretation. It may also improve the control of blood pressure and compliance with treatment and be useful for fast identification of patient responding to the treatment. The HBPT systems today available on the market suffer for two main disadvantages: the high cost of purchasing and maintaining system (partly counterbalanced by a reduction in the cost of patients' management compare with usual care), and the need for training and requiring of a telephonic/internet connection.

The telemonitoring system we propose in this study definitely overcomes such limitations. The overall cost of the our system is 250 Euros. If compared with the equivalent HBPM device the increase in cost is about 150 Euros. In addiction the transmission via GSM network (one SMS per day) is very cheap and does not require any wired telephonic/internet connection. Non specific skills are required to the patients since data are collected and transmitted in a fully automated way. Beside the feasibility of the HBPT systems, it is also important to investigate the patients' perceptions and satisfaction about the usability and efficacy of the devices. As described in the paper, we paid great attention to this aspect. All patients were either very satisfied or somewhat satisfied with services they had received. In particular all

participants scored installation and the usability of service as “good” or “very good”, and agreed that the quality of service was “good” or “very good”. The majority of patients declared to feel comfortable with the self-measurement of blood pressure and the use of the telemonitoring system and were either somewhat satisfied or satisfied agreed that an improved quality of health services was offered through telemonitoring system.

All patients perceived that the presence of telemonitoring equipment in the home led to changing of self-measurements habit, seemed satisfied with home telecare and appeared ready to accept its widespread use.

During the monitoring period almost a blood pressure measure per day was received from each patient, without the need to give any feedback.

Since one measurement per day was the medical prescription, we can asses that our system implies an excellent adherence to the treatment to the blood pressure control.

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