Advances in the application of information and communication technologies in healthcare at the patient's home

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ADVANCES IN THE APPLICATION

OF INFORMATION AND COMMUNICATION TECHNOLOGIES

IN HEALTH CARE AT THE PATIENT'S HOME

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If you put your mind to it, you can accomplish anything.

Marty McFly, "Back to the future", 1985

ACKNOWLEDGMENTS

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Chapter 1

INTRODUCTION

1.1 TELEMEDICINE

Almost half a century ago, telemedicine was initially ignored for being considered an unreliable and unaffordable technology. In recent years, the rapid evolution of communication and information technologies (ICTs) has provided a solid basis for telemedicine as a feasible, reliable and helpful tool for delivering healthcare. Clinical researchers from a wide range of fields have claimed success in their telemedicine pursuits. Gradually, this new strategy of healthcare delivery is finding its way into the clinical practice.

As a multidisciplinary, dynamic, and constantly evolving tool in medicine, researchers and users have developed various definitions for telemedicine, depending on the context in which the term was applied. An extensive literature review produced more than one hundred peer-reviewed definitions of telemedicine [1]. These many definitions highlight that telemedicine is an open science, as it incorporates new advancements in technology and responds and adapts to the changing health needs and contexts of societies. In 1998 the World Health Organization adopted the following definition of telemedicine: "*The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities*" [2]. Essentially, we can say that telemedicine is the delivery of healthcare and the exchange of healthcare information across distance [3]. The prefix "tele" derives from the Ancient Greek "*τελε*" for "at distance"; thus, more simply telemedicine is medicine at distance. As such, it includes a broad range of medical activities including diagnosis, treatment and prevention of disease, continuing education of healthcare providers and consumers, research and assessment.

Telemedicine can be traced back to the early 20th century, with one of the first published records occurring when electrocardiograph data were transmitted over telephone wires [4]. Since then,

many researchers started to investigate on this topic, proposing more or less realistic solutions (Fig. 1.1). In its modern concept, telemedicine started in the 1960s especially driven by the military and space technology sectors (Fig. 1.2) [3;5;6]. Examples of early telemedicine milestones include the use of television to support consultations between specialists at a psychiatric institute and general practitioners at a state mental hospital [7], and the provision of expert medical counsel from a main teaching hospital to an airport medical centre [8].

The recent technological advancements and the increasing availability and utilization of ICTs by the general population have been the main drivers of telemedicine over the past decade, rapidly generating new possibilities for healthcare service and delivery. This has happened in a number of developing countries and underserved areas of industrialized nations [7]. The substitution of analogue with digital communication methods, together with a rapid decrease in the cost of ICTs, have generated a big interest in the application of telemedicine among healthcare providers, and have enabled healthcare organizations to imagine and implement new and more efficient ways of providing care [3;5]. The introduction and popularization of the Internet has further extended the

Figure 1.1. A doctor's diagnosis "by radio" on the cover of the February, 1925 issue of Science and Invention magazine.

scope of telemedicine to include web-based applications (e.g. e-mail, teleconsultations and conferences via the Internet) and multimedia approaches (e.g. digital imaging and video). These progresses have led to the creation of a rich spectrum of telemedicine applications that is every day more available to the general population.

All telemedicine applications deal with a client (e.g. patient or healthcare professional) who receives an opinion/service from an individual with more expertise in the significant field, when the actors are separated in space, time or both [3]. Considering the interaction between the client and the expert, telemedicine applications can be classified as asynchronous (or store-and-forward), or synchronous (or real time). Asynchronous telemedicine comprises the exchange of pre-recorded data between two or more individuals at different times. An example may be the patient or health professional who sends an e-mail describing a medical case to a specialist that sends back an opinion about diagnosis and optimal management [8]. In contrast, in real time interactions, there is no noticeable delay between the information (including physiological signals) being collected, transmitted and displayed, as happens in monitoring and videoconferencing [8]. The information transmitted between the two sites includes a variety of forms, such as text, audio video and image. These two basic approaches to telemedicine are applied to a wide arrange of healthcare services in different settings, including teledermatology, telepathology, and
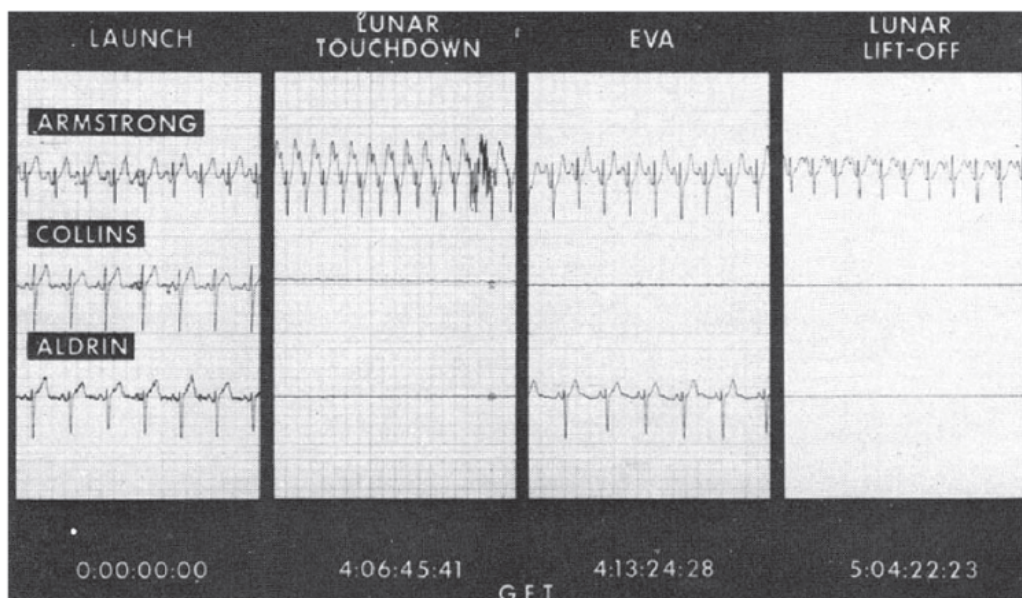
Figure 1.2. Electrocardiograph received at Mission Control during different periods of the Apollo 11 mission in 1969 (NASA). Source: Nangalia V, Prytherch DR, Smith GB. Health technology assessment review: Remote monitoring of vital signs – current status and future challenges. Critical Care 2010

teleradiology [5].

Born as a method to deliver healthcare at distance, telemedicine seems to offer credible solutions, which have been tested in real medical settings, to the main challenges facing our society, such as:

- The ageing of the population, which leads to an aggravation of chronic diseases;
- The lack of availability of qualified personnel in rural and underserved areas;
- The growing need for patients to become actors in monitoring their own health;
- The necessity of controlling healthcare costs whilst maintaining high quality care.

1.2   TELEMEDICINE IN HOME CARE

The pressure to contain health costs, particularly by avoiding rehospitalizations and promoting the early discharge of patients, is generating an increasing demand for home healthcare. In addition, population ageing is a real fact (Fig. 1.3), having major consequences and implications for all facets of human life, including health and healthcare. The percentage of older people in Europe is projected to reach 21% in 2050 [9]. In fact, as individuals become older, the incidence and prevalence of chronic diseases, such as cardiovascular disease, chronic obstructive pulmonary disease (COPD), and diabetes, continue to increase [10;11]. Chronic diseases have become major causes of death in almost all countries [12]. The economic burden of chronic diseases is dramatic, especially in United States, where it represents about 78% of healthcare costs [13] and it is rising also across Europe, where spending on chronic care is taking up an increasing proportion of public and private budgets [14] (Fig. 1.4).

The challenge is even more dramatic if we consider the supply-and-demand curve in healthcare [15]. Actually, at the same time as we face serious increases in the number of chronically ill patients, there are global provider shortages. The current economic situation is leading to a large-scale reduction in the healthcare budget in many developed countries, particularly in Europe.
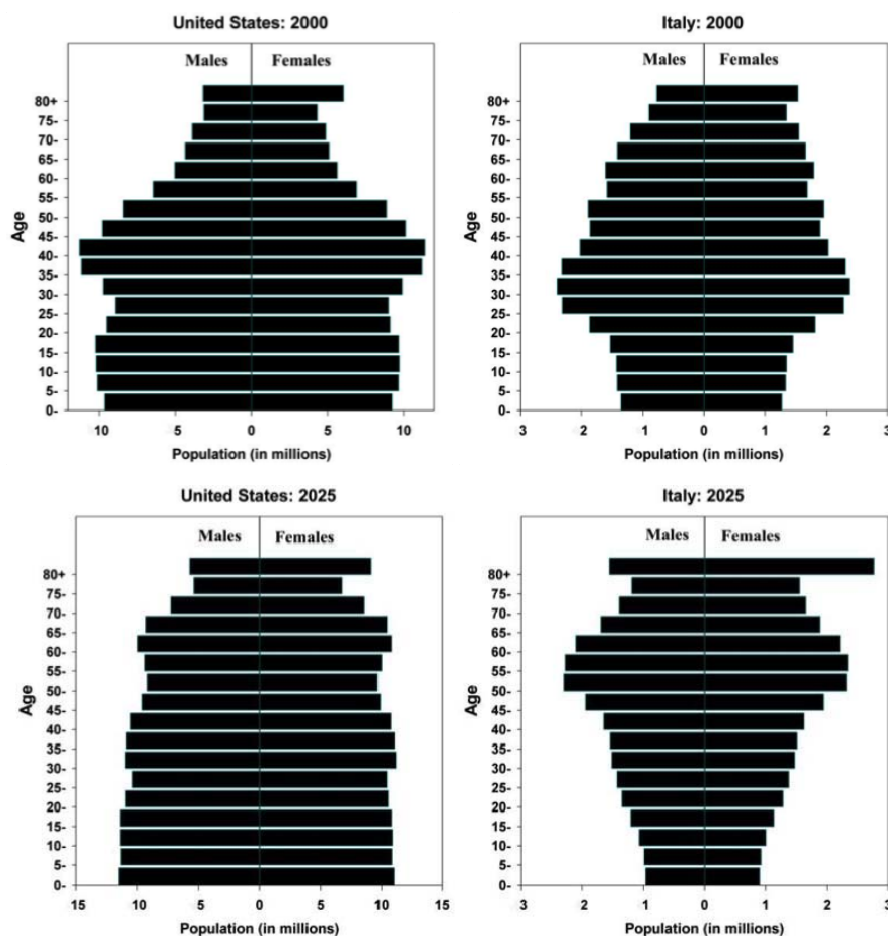
Figure 1.3. Two examples of population age distributions in developed countries and the projections in 2025. Source: Gavrilov LA, Heuveline P. "Aging of population". 2003 [9].

Chronic disease	Increase in prevalence (2003–2023)[a]	Current cost (2003)	Future cost (2023)
Overall chronic illness[b]	42%	$1.3 trillion	$4.2 trillion
Cancers[c]	62	$319 billion	$1,106 billion
Diabetes	53	$132 billion	$430 billion
Hypertension	39	$312 billion	$927 billion
Pulmonary conditions	31	$139 billion	$384 billion
Heart disease	41	$169 billion	$927 billion
Mental disorders	54	$217 billion	$704 billion
Stroke	29	$36 billion	$98 billion

Figure 1.4. Current and projected economic burden of chronic diseases in United States. [a]Population is expected to grow 19% from 2003 to 2023. [b]Based on seven common chronic diseases: cancers, diabetes, hypertension, stroke, heart disease, pulmonary conditions and mental disorders. [c]Includes breast, colon, lung prostate and other cancers. Source: DeVol R., Bedroussian A., "An Unhealthy America: The Economic Burden of Chronic Disease". Santa Monica (USA), Milken Institute, 2007.

The enormous current and expected rise in the number of chronically ill patients combined with the decreasing provider numbers and significant cost pressures mean that a fundamental change is required in the process of care. A special effort should be made to identify patient management approaches that would ensure appropriate monitoring and treatment of patients while reducing the cost involved in the process.

In the last decades, telemedicine has been increasingly considered to potentially play a key role in closing the gap between the demand for and availability of home healthcare services [14;16]. The need to reduce this burden brought healthcare providers to rely on telemedicine services, which on one hand can perform a close follow-up of the patient at home, and on the other it aims to provide home healthcare preventing acute events that may lead to the hospitalization of the patient.

1.2.1 Potentialities of home telemedicine

Several publications have described the use of telemedicine for home monitoring of patients with respiratory diseases [17], congestive heart failure [18], psychiatric [19] and other chronic illnesses [20] as well as geriatric patients with risk of falling [21]. Together with portable electronic monitoring equipment, telemedicine has been shown to support the home monitoring of blood glucose [22] and also pulmonary [23] and cardiac function [24].

Studies have indicated that home telemedicine leaded to socio-economic benefits, such as enhanced quality of life and reduced utilization of services (hospital days or clinic visits) [25]. In addition, there have been indications of cost-savings for patients, home care providers and the healthcare system as a whole. For example, there is good evidence that the use of home telemedicine enhances the quality of diabetes home care, including improved self-monitoring and self-care and better physiological control [26]. In addition, home telemedicine for patients with chronic heart failure showed significant reductions in rehospitalizations, emergency department (ED) visits and the overall cost of care [27].

Together with the reduction of healthcare utilization, home telemedicine seems to have a positive impact on the health cost reduction. Economic analyses have focused on the introduction of new telehealth services to replace hospital visits by patients or home care visits by health-care staff.

The results showed that the costs of telehealth applications were similar to, or less than, those of conventional services [25].

Furthermore, telemedicine can be expected to promote equity of access to healthcare and its delivery efficacy, by improving the communication through the healthcare pyramid (Fig. 1.5). In fact, telemedicine application would permit decentralization in healthcare [3]. For instance, activities previously performed in the secondary care sector could be done in primary care and work previously done in the primary care could be transferred to the community level.

1.2.2   Criticalities of home telemedicine

Most of the studies cited above showed a lot of potentialities and possibilities, but did not develop further into clinical routine because of problems and difficulties involving the use of telemedicine [26]. Firstly, the architecture of the conventional telemedicine systems is generally based on a complex informatics structure managed by external providers and centralized computer servers, which usually work through a call centre [28]. This structure requires complex and expensive agreements among hospitals, telemedicine service providers and communication line providers
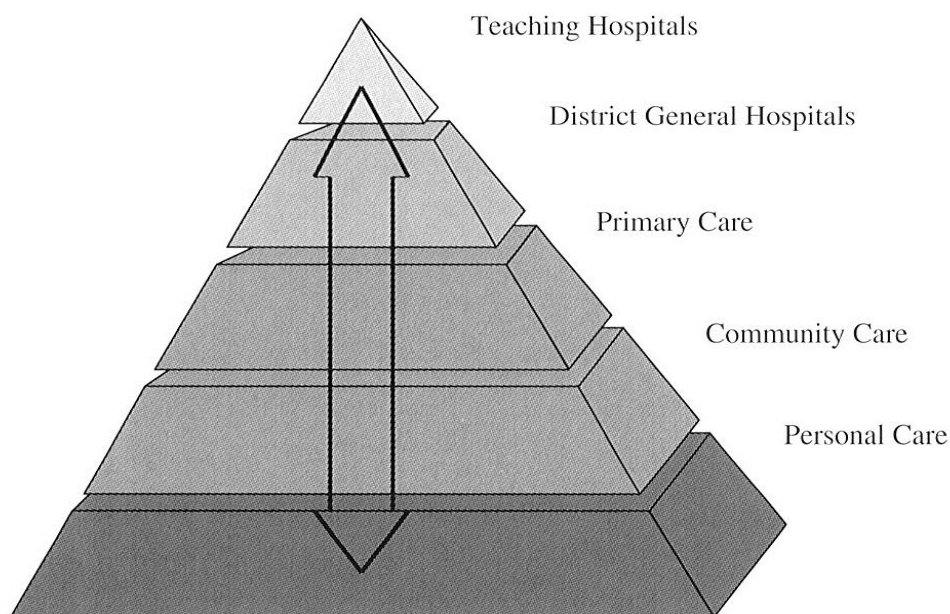

Figure 1.5. Telemedicine as a tool for enhancing the communication up and down the health-care pyramid. Source: Craig J., Patterson V. "Introduction to the practice of telemedicine". Journal of Telemedicine and Telecare, 2005 [3]

and is the main obstacle to the wide application of the ICTs in the medical routine.

In addition, although home telemonitoring seems to be a promising patient management approach that produces accurate and reliable data, empowers patients, influences their attitudes and behaviours, and potentially improves their medical conditions, future studies need to build evidence related to its clinical effects, cost-effectiveness, impacts on services utilization, and acceptance by health care providers [15].

Although in certain countries, such as Britain and United States, telemedicine strategies have been proposed as a cost-effective means of responding to structural problems of the national health system [29], several questions are still to be answered about the actual cost-effectiveness of this healthcare delivery approach. This is because the data used to support such claims are the often inconsistent and methodologically flawed [29]. For example, very few studies in the literature about cost-effectiveness analyses of telemedicine approaches constructed formal hypotheses as first evaluation phase, used the societal perspective, which is the most suitable because considers all the costs for society, or undertook a sensitivity analysis, a method that any economic analyses should incorporate. Therefore, even though economic analysis tools are being increasingly used for telemedicine and telecare studies, different authors suggested that a better reporting of the methodologies and findings of the economic evaluations is required [29;30].

The need of further analyses about healthcare strategies based on telemedicine is also justified by recently published results, which questioned the validity of this technology as healthcare delivery method. Takahashi et al [31] reported on the results of a rigorous randomized controlled trial of telemonitoring in older adults at high risk for hospitalization. They found that in-home monitoring of biometrics (e.g., blood pressure and weight) and symptoms failed to reduce hospital readmissions or the need for ED visits compared with usual care. Few months later another study ran into similar results [32].

The data of these studies are important to make careful considerations about research on telemedicine and its future clinical applications. Firstly, we need a better understanding of the factors depending on critical patient, physician, health system, and telemedicine program that predict success and that would allow us to target these interventions to patients who are most likely to benefit from them. Moreover, we should carefully select the appropriate outcomes that telemedicine healthcare strategies seek to effect. In the future, it may be important for physicians

and funding organizations to evaluate which patient populations might be most receptive and which implementation strategies will be most effective [33].

In addition, legal and ethical aspects of telemedicine should be properly considered and addressed. Several issues of concern have been identified, such as the responsibilities and potential liabilities of the health professional, the problem of the reimbursement of the care provided by telemedicine services and the obligation to maintain privacy and confidentiality of the patient's information [34]. Like any other healthcare service, telemedicine applications should comply with the national and international standards on security and privacy of health data, such as the ones included in the Health Insurance Portability and Accountability Act (HIPAA) in United States, the European Union's Directives on Data Protection (95/46/EC) and on Privacy and Electronic Communications (2002/58/EC), and the Health Level Seven (HL7), which incorporates the international healthcare informatics interoperability standards. Despite legislation and policy has been identified as one of the essential factors for a successful telemedicine implementation [35], this topic is poorly addressed in telemedicine research studies in the literature [36]. Actually, legal issues in telemedicine should be addressed differently from legal issues in traditional healthcare, but until now there are no specific standards. Sporadically, some international organizations, such as the American Telemedicine Association (ATA) or the Internet Healthcare Coalition (IHC), have produced some specific guidelines on this topic.

It seems clear that, despite the many encouraging results, the wide implementation of telemedicine programs should still wait for important questions to be answered. Consequently, there is still the need of simple and straightforward applications, which can provide useful and widely applicable services to healthcare and as well as reliable data to assess the actual impact of telemedicine on homecare.

1.3   ADDRESSING THREE SPECIFIC APPLICATIONS OF HOME TELEMEDICINE

In this PhD thesis report, we have attempted to make a step forward in the application of telemedicine in the home healthcare. First, we developed a novel Internet-based support tool for the home monitoring of low-risk newborn after hospital discharge and we evaluated its financial viability in a rigorous cost-effectiveness analysis. Second, we have proposed a new remote monitoring approach of patients with obstructive sleep apnea syndrome (OSAS) treated with continuous positive airways pressure ventilation (CPAP). With this aim we have developed a

telemedicine follow-up system to be used in a randomized multicenter clinical trial, which is gathering reliable data to assess the validity and cost-effectiveness of this telemedicine approach. Finally, we have evaluated a new telemonitoring device in a bench test. With this validation analysis we considered another therapy-telecontrol method based on the wireless transmission of CPAP treatment compliance and efficacy data for the home monitoring of OSAS patients.

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Chapter 2

AIMS AND HYPOTHESES OF THE THESIS

2.1 GENERAL AIM

To design, develop, validate and assess the benefit of new Information and Communication Technology (ICT) applications in healthcare at patient's home.

2.2 HYPOTHESES

1. An Internet-based support system for monitoring newborn patients after discharge from nursery would improve care, be well accepted by parents and reduce unplanned healthcare, particularly visits to the emergency department;

2. The development of a specific web-based tool could introduce a new strategy for the continuous positive airway pressure (CPAP) therapy follow-up of patients with obstructive sleep apnea syndrome (OSAS), which could improve the CPAP compliance, reduce face-to-face clinical visits, and be more cost-effective;

3. A new telemedicine system for remote CPAP therapy monitoring could provide valuable and useful data about treatment compliance and efficacy for the follow-up of OSAS patients.

2.3 SPECIFIC AIMS

1. To develop a new Internet-based tool to support the post-discharge follow-up of newborns patients;

2. To assess the acceptance and satisfaction of the patients' parents or caregivers as final users of the developed Internet-based support tool for the post-discharge follow-up of newborns patients;

3. To evaluate the cost-effectiveness of the new Internet-based babies' post-discharge follow-up strategy in comparison to the standard hospital-based follow-up;

4. To test the usability and feasibility of an Internet-based monitoring system for the CPAP therapy follow-up with OSAS patients and to evaluate their opinion and satisfaction level of the new monitoring strategy;

5. To test the usability and feasibility of an Internet-based monitoring system for the CPAP therapy follow-up with sleep center medical staff members and to evaluate their opinion and satisfaction level of the new monitoring strategy;

6. To develop a final optimized and multicenter version of the Internet-based monitoring system for the CPAP therapy follow-up of OSAS patients;

7. To design and start a multicenter clinical trial to demonstrate that a new strategy for the CPAP therapy follow-up of OSAS patients could improve the CPAP compliance, reduce face-to-face clinical visits, and be more cost-effective (the study results presentation and analysis are not aims of this thesis report);

8. To assess whether the connection of the sensor unit of a CPAP treatment telemonitoring system to different CPAP/APAP machines influenced their responses to the disturbed breathing patterns generated by a bench;

9. To evaluate the telemonitoring system performance in accurately detecting the CPAP/APAP treatment duration and the residual disturbed-breathing events.

Chapter 3

COST-EFFECTIVENESS OF A NEW INTERNET-BASED MONITORING TOOL FOR NEONATAL POST-DISCHARGE HOME CARE

3.1 INTRODUCTION

The economic policies of Western countries are increasingly pushing toward reductions in healthcare costs, especially through the avoidance of unplanned hospital-based services. In this context, telemedicine is progressively becoming more widely used as a valuable technique for delivering nursing care, particularly in a patient's home, due to its capacity to provide efficient, long-distance service. Besides reducing the costs and problems related to a patient need to travel to health facilities, telemedicine enhances patients' involvement in their own care and reinforces the nurse-patient relationship [1].

One nursing care area in which telemedicine applications are still little seen is neonatology. Monitoring newborns in the first weeks of life is critical for assessing adequate feeding and weight gain and identifying alterations such as hyperbilirubinemia [2]. Since post-partum hospitalization has been gradually shortening in length over the past years, there is more chance of newborns' parents/caregivers failing to recognize conditions requiring intervention, such as jaundice, dehydration, cardiac lesions, and serious infections [3-5]. Moreover, shorter hospital stays leave less time for the parental education and training that traditionally follow a baby's birth [2]. This problem may be aggravated by an inconsistent or poorly scheduled follow-up after hospital discharge. In fact, some recent data suggest that post-discharge care for newborns may actually have worsened [6;7]. One major consequence of this is unplanned use of healthcare services, including emergency department (ED) visits and hospital readmissions.

Therefore, it would be of great interest to have a support tool that would provide a continuum of care during the first weeks of a newborn's life after going home [8]. Such a tool would facilitate contact and information-sharing between parents and specialized nurses, thereby enhancing

parents' confidence and their involvement in their baby's care [9;10]. It would also be cost-effective, as it would relieve the pressure on the healthcare system caused by unplanned hospital-based care.

The aim of this study was to implement and evaluate an innovative post-discharge monitoring strategy for newborn patients involving a new Internet-based support system. This telemedicine tool (called "Babies at home") includes a web application that provides educational information about neonatal care to new parents, as well as baby monitoring via a questionnaire that parents fill in periodically and an e-mail service that offers easy communication between parents and nurses.

To assess the effectiveness and financial viability of this new neonatal telemedicine service, a cost-effectiveness analysis was carried out by comparing this tool with the traditional hospital-based post-discharge follow-up.

3.2 HYPOTHESES

We hypothesized that an Internet-based support system for monitoring newborn patients after discharge from nursery would improve care, be well accepted by parents and reduce unplanned healthcare, particularly ED visits.

3.3 AIMS

The specific aims of this study were:

- To develop a new Internet-based tool to support the post-discharge follow-up of newborns patients;

- To assess the acceptance and satisfaction of the patients' parents or caregivers as final users of the developed system;

- To evaluate the cost-effectiveness of the new telemonitoring strategy in comparison to the standard hospital-based follow-up.

3.4 METHODS

The "Babies at home" web monitoring system (Fig. 3.1) was designed, put into clinical service and evaluated in a collaborative study involving the Neonatal Care Department of the Hospital de la Santa Creu i Sant Pau (HSP) of Barcelona and the Biophysics and Bioengineering Unit of the University of Barcelona. It has been in clinical use since July 2011 [11].

Study population

We conducted a retrospective cohort study on newborn patients born between January 1, 2011 and January 19, 2012 in the HSP delivery rooms. Patients included in the study were consecutive low-risk newborns, specifically: a) late preterm newborns, born between 35 and 37 weeks of gestation, b) babies weighing between 2,200g and 2.500g, c) babies weighing between 2,500g and 3,000g who were the first child and received only breastfeeding, d) babies weighing over 3,000g who were the first child and/or received only breastfeeding and suffered a weight reduction of over 7% after birth, and e) babies whose home was more than 40 km away from the hospital. Parents who were unable to communicate in written Spanish or Catalan or had no Internet access at home were excluded from the study.

Figure 3.1. "Babies at home" home page screenshot. Translation from original version in Catalan: Header: "Babies at home". Menu-bar: "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". Content: "Congratulations, parents, and thank you for your visit to 'Babies at home'! You as parents, and we as health professionals, know that the most important thing is the health of your children. In the Neonatal Unit at the Hospital de la Santa Creu i Sant Pau we have created a page where the babies are the stars and you will find tips, links and answers to frequently asked questions regarding baby care. Use the menu to navigate to different sections of the website.", "Project developed with the collaboration of the Unit of Biophysics and Bioengineering, Faculty of Medicine, University of Barcelona."

Our study was based on a before/after design, which included one group of patients from before the implementation of the Internet-based follow-up and another from afterward. One group of baby patients (control group), born between January 1 and June 30, 2011, received the standard hospital post-discharge follow-up, which consisted of a hospital visit within 48 hours of the newborn's discharge. The other group (intervention group), born between July 19, 2011 and January 19, 2012, was monitored by the new Internet-based tool.

Internet-based monitoring system "Babies at home"

We developed the Internet-based monitoring tool "Babies at home" as a dynamic server-side website based on PHP language and MySQL database on a Linux/Apache server. All the development phases, from the structural design to the content formulation, evolved in close collaboration with the medical/nursing staff. The application comprises three main areas:

- Free-access Area: open platform where all parents can find extensive high-quality information about baby care and useful links to breastfeeding and neonatal nursing association websites;

- Parents' Area: restricted area where only registered parents can access after authentication. They are asked to answer twice a week a questionnaire elaborated by the neonatal nurses about the baby's conditions (weight, feeding, sleeping, body temperature, skin color, etc.), thereby covering the essential topics that nurses usually assess during hospital visits. All data are sent to a MySQL relational database stored in the secure environment of the hospital server. Parents have visual feedback of their baby's weight trend, plotted and continuously updated on the basis of the answers on the periodic questionnaires. Another important feature is the option of exchanging e-mail messages with the nurses, making it possible to raise doubts and answer questions about baby care.

- Staff Area: by logging in, neonatal nurses and pediatricians can access their special area, where they can monitor parents' answers to the questionnaires retrieved from the database, shown in dynamic Flash charts. After evaluating the baby's data, nurses can write a message directly from the website to the parents to provide advice and comments about the newborn's care.

Once the patients' eligibility was established, the parents of the children participating in the study signed an informed consent form including a privacy protection statement, which was written with the endorsement of the hospital regulatory department. Before leaving the hospital, the latter

were taught how to use the website and supplied with appropriate information, both general and specific, about baby care, and also reassured about their capacity and commitment to take care of their baby at home. The neonatal nursing staff was in charge of both this initial training and the monitoring of the baby, undertaken by periodically checking parents' answers to the online questionnaire. In the event of any discrepancy in any parameter, nurses were able to contact the family by email or phone to check the newborn's conditions and address any possible problems in a suitable manner. Parents were also able to directly contact the nursing staff by e-mail to ask questions and clarify any doubts about neonatal care. The babies' condition continued to be monitored until they achieved an appropriate weight and condition. At the end of the monitoring period, the parents were kindly invited to answer a final online survey to assess their level of satisfaction with the web service. The survey comprised 9 statements about the usefulness of the website contents and functions, and the possible answers were distributed on a Likert scale from 0 (I strongly disagree) to 5 (I strongly agree).

Outcomes

The main goal of our evaluation study was to assess the effectiveness of the new post-discharge Internet-based monitoring tool, which was evaluated in terms of the ED service used by the study population in the first month after discharge, before and after the implementation of the Internet-based follow-up. Accordingly, we performed a cost-effectiveness analysis from a social perspective. Our main outcome measures were: 1) the follow-up cost per patient; 2) the rate of newborns who did not require an ED visit in the first month after birth, either because they did not need it or because the nursing support received via the Internet-based monitoring allowed them to avoid it; and 3) the incremental cost-effectiveness ratio (ICER) of the Internet-based follow-up compared to usual care. Another outcome of interest was the rate of ED visits. The ICER is commonly used in health economics and is a standard measure for cost-effectiveness analysis [12]. It represents a measure of the additional cost per unit of health gain, which in our case is one ED visit required by a newborn within the first month of life. The ICER is computed as follows: $ICER = (C_{IF} - C_{HF})/(E_{IF} - E_{HF})$, where C_{IF} is the cost of the Internet-based follow-up strategy, C_{HF} is the cost of the hospital-based follow-up strategy, E_{IF} is the effectiveness of the Internet-based follow-up strategy and E_{HF} is the effectiveness of the hospital-based follow-up strategy.

The effectiveness values were measured in terms of the avoidance of hospital-based care services.

Cost assessment

We considered both direct and indirect costs for the cost-effectiveness analysis (Table 3.1). Immaterial costs were not taken into account. Direct health costs were associated with the use of healthcare resources and were classified as ED visits, hospital visits and nursing personnel costs related to the web monitoring. Information about the costs of ED and hospital visits and the nurses' hourly salary were provided by the administrative department of the hospital (which is participating in the Catalonian Public Health Service). The average time taken to train the newborn's families before leaving the hospital (10 minutes per family) and to perform the monitoring with the Internet-based tool (5 minutes per baby per day) was determined through interviews with the nursing staff in charge of it. Direct non-health costs corresponded to the travel expenses incurred by newborns' families to go to the hospital for ED or hospital visits. We also took into account indirect costs, such as opportunity costs related to parents' missed work time due to those visits. We considered that just one parent came to the hospital with the child. The most frequent transportation mode for parents to come to the hospital for a visit (in the city center) was by car or taxi. Average transport costs were estimated, considering that the study population lived within the Barcelona district. These travel costs were calculated as an average between the taxi fare paid by a family living near the hospital (5-10€ approximately) and the one paid for a ride from the city surroundings (45-50€ approximately). The cost of work time missed by the parents of the control group due to hospital visits was calculated, considering the average annual wage in Spain [13] and a regular weekly work time of 40 hours. We estimated an average of 3 hours lost for an ambulatory visit and 5 hours for an ED visit, considering the total sum of waiting, visit and travel times.

Sensitivity analysis

Uncertainty is a major consideration in cost-effectiveness analysis. Data input values are rarely all known with high precision and certainty. Thus, it is far more compelling if it includes detailed and thoughtful sensitivity analyses, which assess how results vary according to the input values [14]. In this work, the input values considered for the sensitivity analysis were: ED visit cost, hospital

visit cost, nurse's hourly salary, cost of families' travelling to hospital and parent's missed work time. First, the effect of each input value on the ICER was analyzed separately (one-way sensitivity analysis) and then varying a set of inputs simultaneously to simulate different scenarios (scenario sensitivity analysis).

Statistical analysis

Comparison of ED visit rates between patients who were monitored by the Internet-based system and those who received the standard hospital-based follow-up was made using Fisher's exact test.

3.5   RESULTS

Study groups

From January 1, 2011 to January 19, 2012, 931 newborns were discharged from the HSP nursery. Of these, 230 met the criteria to be included in the study. The study population was divided into two groups: a) the post-discharge follow-up for 114 newborns consisted of a hospital visit within the 48 hours after discharge from January 1 to June 31, 2011 (control group), b) for 116 infants this was performed using the Internet-based system "Babies at home" from July 19, 2011 to January 19, 2012 (intervention group). Out of 116 families included in the program, 90 (77.6%) participated actively until the end of their newborns' monitoring period and they were considered for the study. While each newborn from the control group received the standard

Direct Health Costs		Cost, €	Range	Source
	ED visit	127.2	±75%	HSP
	Hospital visit	85.4	±75%	HSP
	Nurse's hourly salary	33.0	±75%	HSP
Direct Non-Health Costs				
	Transport to hospital	30.0	±75%	Assumption
Indirect Costs				
	Missed work hour	15.0	±75%	Assumption

Table 3.1. Direct and indirect costs included in the analysis. Cost sources and ranges considered in the study are indicated.

hospital-based follow-up, in the intervention group 32 infants needed a hospital visit due to neonatal or maternal pathology, or because the nursing staff in charge of the Internet-based monitoring considered it appropriate.

Internet-based monitoring system and parents' satisfaction

Nursing staff received 382 answers to the online questionnaire (an average of 4.7 answers per patient) and 90 e-mail consultations from parents (an average of 1 e-mail per patient). Forty-eight percent of parents (N=43) answered the final satisfaction survey. Globally, they professed to be generally satisfied with the web service, showing a level of agreement of 4.3 ± 0.9 (mean ± SD) to the first satisfaction survey statement, equivalent to an overall positive evaluation of the helpfulness of the "Babies at home" website (Table 3.2).

ED visits

According to the instructions given to parents, our ED was the only one visited during the study. Eighteen (15.8%) of the 114 newborns who received the standard hospital-based follow-up returned to the hospital's ED in the first month after birth compared with 5 (5.6%) of the group monitored by the Internet-based tool (p=.026).

Survey statement	Answer (mean ± SD)
1. In general the Web service "Babies at home" was helpful.	4.3 ± 0.9
2. The available information helped me take care of the baby.	4.3 ± 0.8
3. The information available on the website could clarify my doubts.	4.1 ± 0.9
4. The e-mail service with nurses available on the website was useful.	4.6 ± 0.9
5. The files and recommended links were useful.	4.0 ± 1.0
6. The nurse's answers to my questions were useful.	4.7 ± 0.9
7. The use of the website avoided visits to the primary care center.	31 (yes) – 72%
8. The use of the website avoided visits to the emergency department.	16 (yes) – 37%
9. I would recommend this website.	41 (yes) – 95%

Table 3.2. Results of patients' satisfaction survey (mean ± SD) where 0 means "I strongly disagree" and 5 means "I strongly agree".

Cost-effectiveness analysis

Considering the first month after discharge, 94.4% of the patients who received the Internet-based follow-up had no ED visits, compared with 84.2% of the control group patients. Our analysis revealed that the cost of the Internet-based follow-up per patient was 86.1€, while the hospital-based follow-up cost per patient was 182.1€ (Table 3.3). Therefore, the Internet-based follow-up strategy is said to be dominant because it is both less costly and more effective. The ICER of the Internet-based follow-up strategy compared with the standard hospital visit was -941.2€, which implies that society will save 941.2€ for every additional infant who does not have an ED visit in the first month of life.

The programming costs of the Internet-based tool corresponded to 1.5 person/month, i.e. 7,500€ in a programmer's salary, including all taxes. Since the hospital already had the required computer and communication equipment, including a secure server, we only considered the cost of the programmer's salary for the tool development. With a saving of 96.0€ per patient follow-up, the Internet-based tool programming recovered its cost after 79 patients' follow-up – a figure that was attained within 6 months of the implementation of the new monitoring strategy.

One-way sensitivity analyses for ED visit cost, hospital visit cost, nurse's hourly salary, cost of families' travelling to hospital and parent's missed work time revealed, within a plausible range of selection (±75%), that the Internet-based follow-up was still superior to the standard hospital-based follow-up. The tornado diagram in Fig. 3.2 shows the impact of each cost parameters on ICER. Varying the cost values simultaneously in two different scenarios, the Internet-based strategy is still dominant in comparison to the standard one (Table 3.4).

3.6 DISCUSSION

Main results

To our knowledge, this study is the first financial viability assessment of a telemedicine

Strategy	Cost	Incremental cost	Effectiveness	Incremental Effectiveness	ICER
Internet-based Follow-up	86.1€	96.0€	0.944	-0.102	-941.2€
Hospital Visit	182.1€		0.842		

Table 3.3. Costs per infant and ICER of Internet-based follow-up for prevention of ED visits in the first month of life.

intervention in the neonatal post-discharge home care field. The results of the cost-effectiveness assessment provide support to the introduction of telemedicine services into routine clinical practice [15]. Specifically, the use of an Internet-based follow-up system to monitor low-risk newborns in the first month of life is both less costly and more effective than the usual hospital-based follow-up. This new monitoring approach resulted in a significant reduction in the subsequent use of hospital-based resources, such as ED visits, after discharge and a high level of parental satisfaction with the service. This reduction in ED visits can be considered not only a clear cost reduction for the healthcare provider but also an improvement in the newborn's clinical outcome after early discharge [16].

Besides providing high-quality educational contents about neonatal care to parents, "Babies at home" offers nursing staff a valuable and easy procedure for the home monitoring of newborns, as well as fast long-distance communication with families. An interactive website is a very convenient method, due to the wide availability of Internet-connected devices among healthcare consumers, especially in the homes of young families. Moreover, since usability and structural simplicity were crucial to the development of the application, the training required by nurses and parents is minimal. Concerns about security and data confidentiality have been minimized, as this application was easily incorporated into the secure environment of the hospital server, in compliance with all the applicable legal regulations.

This Internet-based tool has been effectively transferred to the health system since it is in routine clinical use in the Hospital de Sant Pau in Barcelona (www.petitsacasa.santpau.cat).
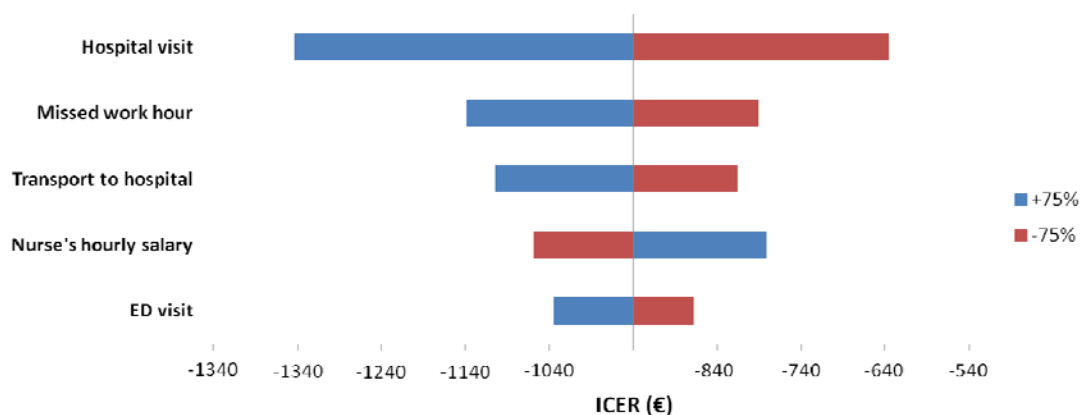

Figure 3.2. Sensitivity analysis for nurse's hourly salary while in charge of the neonatal Internet-based follow-up.

Other outcomes

Our analysis focused on assessing the clinical effectiveness of our Internet-based monitoring approach during the first month of the newborn's life. Extending the assessed period to 2 months after birth, which is considered a postnatal phase, we found that 29 infants (25.4%) who received the standard hospital-based follow-up had an ED visit, compared with 7 (7.8%) of those monitored by the new Internet-based system (p=.0014). Since the Internet-based monitoring period was generally no longer than 1 month, we may conclude that our approach also had a positive impact on families' education and empowerment with respect to their babies' daily care, and that this translated into a more pronounced decrease in the use of the ED.

Furthermore, this enhancement of parental education also had a positive effect on the continuance of breastfeeding, which is essential for babies' health and growth [17]. It has been widely demonstrated that the breastfeeding rate generally decreases by 10-20% within the first month of a baby's discharge [18;19]. Remarkably, the mothers included in the "Babies at home" program maintained the same breastfeeding rate after 1 month as at discharge (60%), with no reduction at all. This success in avoiding a decrease in breastfeeding could be attributed both to the access the mothers had to the informative and educational items available on the website and to the fluid contact with nurses during the monitoring period.

Comparison with previous studies

In the last decade, the telemedicine concept has been expanded to nursing care because of its

Costs (€)	Scenario +75%	Base case	Scenario -75%
Hospital visit	149.5	85.4	37.4
Missed work hour	26.3	15.0	6.6
Transport to hospital	52.5	30.0	13.1
Nurse's hourly salary	57.8	33.0	14.4
ED visit cost	222.6	127.2	55.7
Cost per patient (Internet-based – Hospital-based)	150.7 – 318.6	88.1 – 182.1	37.7 – 79.7
ICER	-1646.3	-941.2	-411.6

Table 3.4. Sensitivity analyses for two different scenarios.

capacity to provide efficient, long-distance healthcare. Most nurses recognize the contribution that Information and Communication Technology, particularly the Internet, can make to both their practice and patients' understanding of their own health and care [20]. There are several examples of telenursing applications in the literature. Internet-based tools for chronic disease management, such as dyspnea in COPD patients [21], for educational intervention, such as Web-assisted tobacco control [22], or to support nurse-led triaging [23], are recent examples of successful telenursing applications using the Web.

As regards the neonatal care field, several telemedicine applications have been previously developed, particularly to bring real-time diagnoses to neonatal facilities without in-house trained specialists. These include the remote evaluation of digital images for retinopathy in prematurity screening [24;25], interventions for deaf or hard-of-hearing infants [26], the long-distance interpretation of echocardiograms [27] and neonatal teleconsultations in general [28].

Nevertheless, very few researchers have developed Internet-based tools for supporting families in the care of their newborns during the first days of life. One study described a program in which nurses provided updates to family members of Neonatal Intensive Care Unit (NICU) patients on the Internet [29]. The authors reported significant improvements in family satisfaction with NICU in the in-patient care of babies with very low birth weights and pointed out the need to extend this service to the post-discharge period. In another study parents viewed real-time video images of their hospitalized newborns via an Internet browser or 3G cell phone [30]. Although no significant impact was found in terms of newborns' length of hospital stay, this virtual visiting was well accepted by families, suggesting the advisability of evaluating its role in improving post-discharge transition care.

Other potential clinical applications

Thanks to its simplicity and versatility, our Internet-based neonatal monitoring system could be easily adapted to a wider range of application. First, its application could be useful in developing countries, where remote and poor places need simple and cheap technological interventions to give access to beneficial health services to those most in need [31]. Also, our tool could be effectively integrated into programs of neonatal post-discharge home assistance, which provide in-home support from clinical nursing specialists after infants' discharge [32] but are hampered by clinical and geographical constraints that render this service inaccessible to many families that

could otherwise benefit from it. An Internet-based monitoring tool could effectively overcome such limitations and give more families access to such programs.

Limitations

This was a retrospective study. Our Internet-based follow-up system was implemented as a possibly more efficient and cheaper monitoring strategy. The markedly improved efficiency of our new system was evident right from the start. Treating some patients with an efficient system, while randomizing others to an inefficient system, precluded any randomized controlled trial. Moreover, it was logistically impossible within the hospital guidelines and policies to run both post-discharge systems simultaneously.

It should be pointed out that the control and intervention groups were analyzed in two different periods of the year. However, the rate of ED visits should have not been affected by any seasonal bias taking into account that each of the two time windows (January-July and August-January) shared the same number of winter months. Actually, the main season-related causes of ED visits and hospitalizations in infants up to 1-month old, are viral infections, such as respiratory syncytial and flu, [33] which exhibit a well-known incidence distributed along the winter months [34].

One advantage of our study was the use of real data of clinical costs and effectiveness in terms of ED use. It is worth noting that, although these cost values were measured for a public university hospital in a big Spanish city, such as Barcelona, the positive results obtained in this study could easily be translated to other public or private health systems providing postnatal care, taking into account the results of the sensitivity analyses confirming the cost-effectiveness of the new telemedicine strategy in different cost scenarios.

Future directions

"Babies at home" can be gradually expanded and optimized. To facilitate the assessment of some clinical parameters, such as newborn's skin color, navel care and correct breastfeeding, the web tool can be incorporated into a parent-nurse videoconference communication system. Also, the tool can be completely integrated into the hospital EHR system, so that the nursing staff in charge of web monitoring can easily access the patient's record, which would be automatically updated with the main clinical events and issues assessed during the telemonitoring.

3.6.1 Conclusion

Using the rate of ED visits and the costs for society, the cost of the Internet-based follow-up was shown to be much lower than that of the conventional hospital-based follow-up. Additionally, ED visits in the first month of patients' life decreased with the use of the Internet-based monitoring system. This telemedicine follow-up strategy proved absolute dominance (both more clinically effective and less costly) over the standard follow-up based on hospital visits.

3.6.2 Acknowledgements

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Chapter 4

A MULTICENTER SUPPORT SYSTEM FOR CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY FOLLOW-UP IN OBSTRUCTIVE SLEEP APNEA

4.1 INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a serious disorder caused by partial or complete obstruction of the upper airway and it is associated with deterioration of quality of life, daytime sleepiness, neurocognitive impairment and cardiovascular disease [1]. OSAS is estimated to affect 2–4% of adult men and 1–2% of adult women in Western countries [2;3]. OSAS is strongly related to obesity even though it is also increasingly identified in non-obese subjects with a particular craniofacial structure. The incidence of OSAS is likely to grow in parallel with the spread of obesity now occurring in many countries. European and Spanish public health resources assigned to this problem have proved to be relatively inadequate and unlikely to handle the increase in OSAS cases [4], so cheaper and alternative management approaches are needed.

The most frequently used treatment for OSAS is continuous positive airway pressure (CPAP) applied through a mask to the nose or the mouth of the patient at home during sleep. This pressure in the mask is transmitted to the pharyngeal area, thereby avoiding upper airway obstruction. One critical factor in CPAP effectiveness is compliance. A minimum of 4 hours per night of CPAP use is recommended to avoid compromising outcomes. However, a number of patients suspend or underuse CPAP treatment, mainly due to the numerous side effects and lack of knowledge about possible solutions [5;6]. Some of these side effects could be easily solved by a close follow-up, especially during the first weeks, but busy sleep centers have difficulties in giving such support [7]. Accordingly, there is a clear need to improve patients' understanding of the expected advantages of CPAP use and to monitor and properly address side effects of CPAP therapy, as well as facilitate the communication of patients with sleep centers.

It has recently been recognized that telemedicine could have a valuable role in improving CPAP adherence and should be integrated into OSAS patients' care as fast as possible [8]. Under the framework of an Investigation Project promoted by the Spanish Society of Pneumology and Thoracic Surgery (SEPAR) on sleep-related respiratory disorders, we developed a multicenter support system for the remote follow-up of CPAP therapy in OSAS patients. This system essentially comprises a support network that can be connected with several sleep centers to monitor and communicate online with their patients, whose data are stored in a secure central server. Patients interact with the system through a user-friendly web-based interface that can be accessed from their home personal computer or tablet. Moreover, videoconferencing is available to promote long-distance communication with the sleep center and provide remote medical visits.

This telemedicine application seeks to introduce a new approach to CPAP therapy monitoring, which focuses on enhancing patients' motivation and self-management skills and strengthening the professional-patient relationship.

4.2   HYPOTHESES

We hypothesized that the development of an Internet-based tool could introduce a new strategy for the CPAP therapy follow-up of OSAS patients, which could improve the CPAP compliance, reduce face-to-face clinical visits, and be more cost-effective.

4.3   AIMS

The specific aims of this work were:

- To test the usability and feasibility of an Internet-based monitoring system for the CPAP therapy follow-up with OSAS patients and to evaluate their opinion and satisfaction level of the new monitoring strategy;
- To test the usability and feasibility of an Internet-based monitoring system for the CPAP therapy follow-up with sleep center medical staff members and to evaluate their opinion and satisfaction level of the new monitoring strategy;
- To develop a final optimized and multicenter version of the telemonitoring system for the CPAP therapy follow-up of OSAS patients;

- To design and start a multicenter clinical trial to demonstrate the hypotheses of the study (the study results presentation and analysis are not aims of this thesis report).

4.4   METHODS

4.4.1   Feasibility pilot studies

Before developing the final version of the web-based support tool, we wanted to assess the potential users' opinion and in general the project feasibility. With this aim, we performed three pilot studies in a single centre, the Hospital Clinic of Barcelona. For all the approval of the hospital Ethics Committee was obtained.

Pilot study with patients (testing the CPAP therapy web-based follow-up)

The main aim of this first pilot study was to assess the feasibility of the web-based follow-up of the CPAP therapy as well as the patients' opinion and satisfaction level. For this study, a simple

Figure 4.1. Home Page of the pilot version of the CPAP follow-up web tool. Translation from the original Spanish version: *Header:* "Sleep apnea patients' follow-up". *Menu-bar:* "Home page", "Your weekly questionnaire", "Your record", "Useful files and links". *Content:* "Welcome! The Clinical Institute of Chest and Pulmonary Service - Sleep Unit - Hospital Clínic of Barcelona welcome you in your website for sleep apnea patients' follow-up. This personal space, which only you can access, is a support tool to remotely monitor your sleep apnea problem. As you can see in the sidebar on the left, you can navigate through three different pages: - In the "Your weekly questionnaire" you will find a few simple questions about your apnea problem and CPAP treatment. Please fill out the questionnaire weekly; - In the "Your record" page you can view the evolution of your weight, which will depend on your weekly responses to the questionnaire; - On the "Useful files and links" you will find documents and links to websites related to control and treatment of nocturnal apneas. For any technical questions about the operation of this site, you can contact the webmaster at this email address apneas.hcp@gmail.com. (In case you have any questions of a medical nature, contact your hospital staff.) Thank you for your cooperation!"

pilot version of the CPAP follow-up web tool was developed (Figure 4.1).

Since we decided to test the televisit strategy in a separated pilot study, in this tool version no videoconference application was integrated. The tool created for this study consisted in a personal easy-structured website where patients could answer to a questionnaire (Figure 4.2) about symptoms, sleep quality, potential CPAP side effects, physical activity and body weight, having the access to continuously updated temporal trends in graphical format (Figure 4.3). Moreover, informative documents about OSAS and CPAP therapy were available to free download.

The group of patients included was selected from consecutive patients coming to the Hospital Clinic sleep center for a routine CPAP therapy monitoring visit. At the end of the visit, the nurse in charge of the patient proposed the enrolment in the study. The patients who declared they had sufficient computer-Internet skills and were willing to participate in the study were included. The

Figure 4.2. Online questionnaire (pilot version). Translation from the original Spanish version: *Header:* "Sleep apnea patients' follow-up". *Menu-bar:* "Home page", "Your weekly questionnaire", "Your record", "Useful files and links". *Content:* "Your weekly questionnaire. Please answer the following questions. * Mandatory. What is your current weight? * Please insert your weight in kilograms. Use point for a decimal (e.g. "80.4"). During the last week, have you done any kind of physical activity every day? * Please choose an answer from the options below considering a daily average. No. Walking for half an hour. Walking a half hour to two hours. Walking more than two hours, or run or hit the gym. During the last week, how many hours did you sleep each night? * Please insert a daily average. Use for a decimal point (e.g. "7.5"). During the last week, how many hours did you use your CPAP machine each night? * Please insert a daily average. Use for a decimal point (eg "7.5")".

sleep center staff recorded the patients' personal data and e-mail addresses. After being recruited, patients received a first e-mail containing information about the study and the personal credentials required to access the web interface. In order to ensure the compliance with the questionnaire, a weekly e-mail reminder was sent automatically to each patient. Moreover, after the third completion of the questionnaire a more personalized e-mail was sent in order to thank him/her for their collaboration and to encourage him/her to keep answering the questionnaire. At the end of the monitoring period, participants were invited to express their satisfaction about the website by answering an online questionnaire. This questionnaire was developed from the Telemedicine Satisfaction and Usefulness Questionnaire (TSUQ), a 5-point Likert questionnaire designed as part of the telemedicine project IDEATel and validated in English and Spanish [9].

Pilot study with patients (testing the televisit approach)

Another aspect to test was the long-distance follow-up visiting by videoconference: the televisit. We recruited consecutive OSAS patients who came Hospital Clinic sleep center for a routine CPAP therapy monitoring visit. After finalizing the visit, the nurse proposed the patient to participate to the study. The only exclusion criteria were illiteracy, deafness and the refusal to participate. If included, the patient was accompanied to the next room, which was equipped with
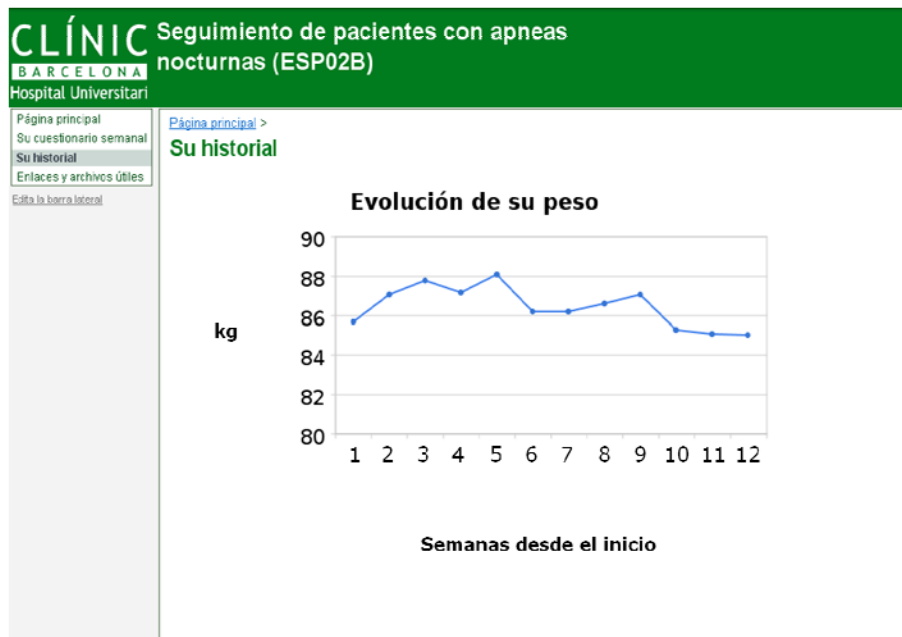

Figure 4.3. Trend of a patient's weight (pilot version). Translation from the original Spanish version: *Header:* "Sleep apnea patients' follow-up". *Menu-bar:* "Home page", "Your weekly questionnaire", "Your record", "Useful files and links". *Content:*"Your record. Evolution of your weight. Weeks from the start".

an Internet-connected PC with a web-cam and the free videoconference software Skype installed. The patient was connected with a physician, who was waiting in another room of the hospital, and, after checking the audio-video quality of the conference call, he/she was left alone for the interview with the physician. The brief consultation was composed by structured questions about the CPAP therapy and possible problems and discomforts. Once the televisit finalized, the patient, still alone in the room, answered to a multiple-choice questionnaire regarding his/her opinion about the televisit and then delivered it in a sealed envelope to keep it anonymous.

Pilot study with medical staff

After assessing the OSAS patients' satisfaction of the CPAP follow-up web tool and televisit, another pilot study was performed to explore the opinion of hospital medical staff members as potential users of the system. In this study, the respondents were also asked to give their opinion on the potential usefulness of the televisit, performed via videoconference.

Medical staff members (nurses and physicians; N=15) of Hospital Clinic of Barcelona sleep center were asked to evaluate this system in a test of potential users (UNE-EN 62366). This standard, entitled "Medical devices - Application of usability engineering to medical devices", defines the process of development and testing that should be followed to identify and validate the usability features of a medical device with respect to its security and normal use.

After receiving an explanation and a demo of the web tool, they performed a televisit with a simulated patient. Finally, the staff members answered a usability questionnaire based on a 5-point Likert answer scale (1=not useful at all, 5=very useful).

4.4.2   Final system overview and functionalities

After assessing the feasibility of the strategy in the previous pilot studies, we developed the final system. It was implemented on the basis of the architecture of "Babies at home" web tool, previously developed and described in Chapter XX, and then expanded and adapted to the requirements of this application. Also for this system we used PHP language and all the user interface components were developed as dynamic server-side pages. In order to enforce completion and internal consistency of all the forms and surveys contained in the web application, we employed Javascript components. We developed the system with a special focus on usability

and structural simplicity. During each development stage, special effort was made to guarantee the maintainability and versatility of the tool. The system architecture was designed to allow frequent updating of the individual modules and easy adaptability to different clinical requirements. The web application functioning was successfully tested with the most important operating systems (Windows XP, Windows Vista, Windows 7, Mac OS X) and web browsers (Internet Explorer 6 and later versions, Mozilla Firefox, Google Chrome, Opera and Safari).

The system overview is shown in Figure 4.4. The main actors of this structure are: the Patient, the Sleep Center and the Central Server.

Patient interface to the system

Patients included in the project are given access to an Internet-based application implemented as an interactive website. The equipment needed is nothing more than an Internet-connected computer or tablet, a microphone and a webcam. In order to ensure the confidentiality and preserve security, patients can access the website by logging in with their personal username and password, assigned during the enrollment. The system identifies the user by comparing inserted credentials to the ones stored in the Central Server and dynamically generates pages
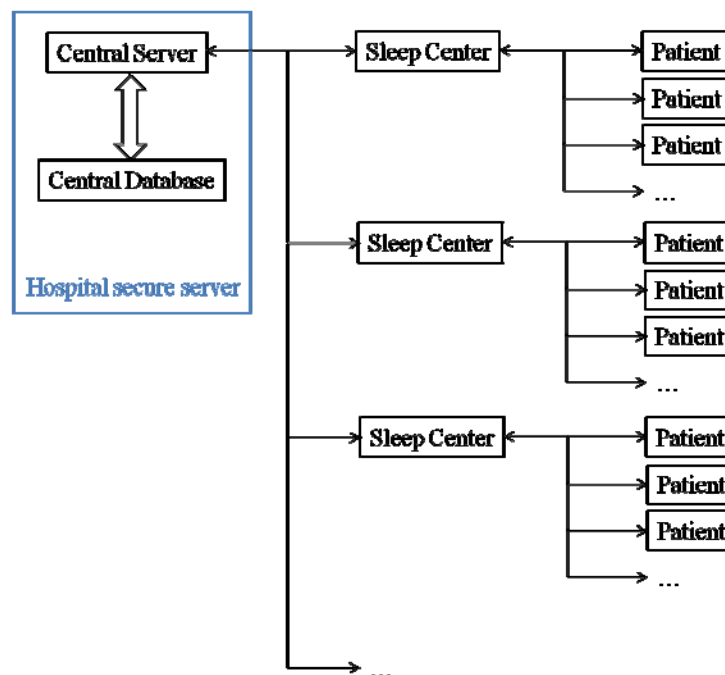

Figure 4.4. System overview.

containing only the information available to each user. After logging in, patients are redirected to the website Home Page (Figure 4.5).

The menu bar contains the links to the different sections of the website:

- The "Questionnaire" button in the menu bar of the website redirects patients to a short questionnaire they are asked to answer every 2 weeks. The questionnaire is composed of 6 questions about patients' weight, the amount and kind of physical activity they have done over the week, the time they have slept and used the CPAP device, the occurrence of sleepiness in daytime and problems caused by the use of the CPAP device. In order to ensure patients' compliance with the questionnaire, an e-mail reminder is sent automatically to each patient every 2 weeks.

- In the "Your record" section, the patient's parameters, which correspond to the questionnaire answers, are plotted in dynamic Flash charts and continuously updated. This section was created in order to give patients a visual feedback of their answers to the questionnaire (Figure 4.6).

- In the "Useful files and links" section, high-quality informative documents about OSAS management and CPAP therapy are available for free download. Moreover, a list of links

Figure 4.5. CPAP follow-up web tool Home Page. Translation from the original Spanish version: *Header:* "Online CPAP therapy follow-up". *Content:* "Login. Your e-mail address. Your password. Enter. Forgot your password?. Partially supported by: Spanish Society of Pneumology and Thoracic Surgery (SEPAR), Esteve-Teijin Healthcare".

to the official websites of the most relevant OSAS patients associations is also provided. Educational videos that train patients in the correct use of the CPAP device and mask are accessible from this section.

- A validated list of answers to "Frequently asked questions" elaborated by sleep specialists is available.

- By clicking on the "Contact the center staff" button, the patients can easily communicate online with the sleep center staff by exchanging messages via e-mail to discuss doubts and ask questions regarding OSAS and CPAP therapy.

- In addition, the "Televisit" section allows them to talk to the sleep center staff by videoconferencing. Videoconferences are scheduled by the sleep center staff and patients automatically receive a confirmation e-mail containing the day and time of the appointment. This allows patients to see the healthcare professionals and receive teaching and support regarding their therapy.

- The application also provides continuous technical support. By visiting the section "Technical support", patients can directly contact the Webmaster, who is available to solve potential technical problems about the website functioning.
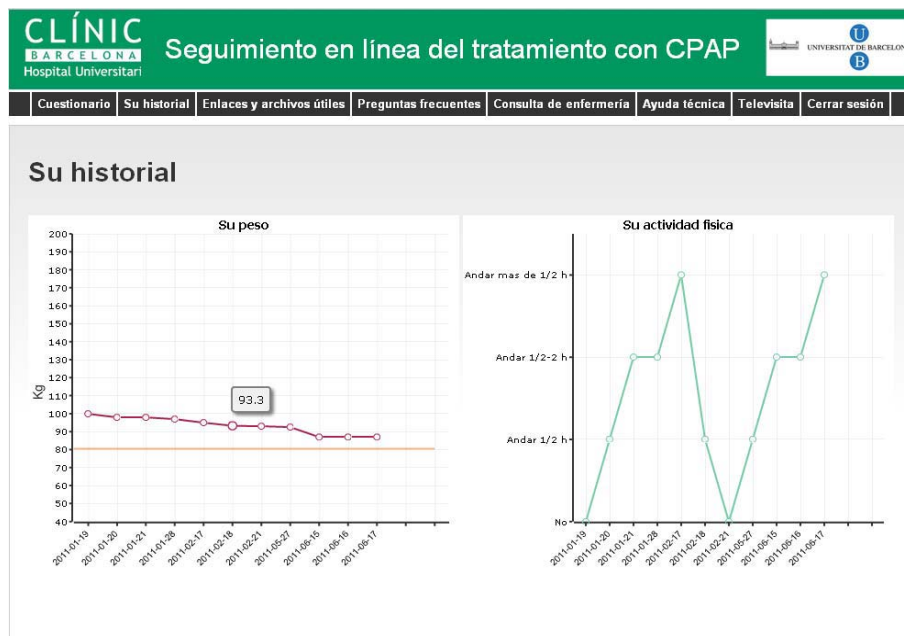
Figure 4.6. Screenshot of the "You record" page. Two of the six charts are shown here. Translation from the original Spanish version: *Header:* "Online CPAP therapy follow-up". *Menu-bar:* "Questionnaire", "Your record", "Useful links and files", "FAQ", "Contact the center staff", "Technical support", "Televisit". *Content:* "Your record. Your weight. Your physical activity".

Sleep center

Several sleep centers can connect simultaneously to the support system. The healthcare professionals from each center can undertake the following management activities:

- Patients' status monitoring. Each center can access only the list of its own patients. The sleep center staff can observe patients' data, corresponding to their answers to the online questionnaire. Data are retrieved from a MySQL database connected to the Central Server and shown in dynamic Flash charts. After evaluating the patients' data, if necessary, professionals can write them a message with advice and comments about their status.

- New patient registration. The sleep center staff has to fill in a simple registration form inserting the identification data of each patient, such as name initials and a contact e-mail address. To protect patients' personal information, their name and surname are not included in the registration form. In addition, some initial medical data are requested, such as weight, height, apnea-hypopnea index (AHI), cumulative time with oxygen saturation less than 90% (CT90), etc. Once the registration is completed, a "welcome" e-mail is sent to the patients' contact e-mail address with the credentials needed for authentication by the website. The username is the contact e-mail address and the password is automatically assigned, with the possibility of changing it at any time. If necessary, professionals can also deregister a patient and prevent his/her access to the website.

- E-mail and televisit. Besides e-mail communication, sleep center staff can easily arrange a televisit via videoconference with the patients. By filling in a short form, professionals schedule the videoconference for a time suited to both them and their patients.

Central Server

All network data, such as the patients' answers and authentication data, are stored in the system Central Server. Data storing is supported by a relational database developed with the MySQL management system, which is incorporated into a secure server. The central server administrator is responsible for all data management and system functioning supervision. Moreover, the administrator is in charge of the registration in the network of the sleep centers included in the project.

4.5   RESULTS

4.5.1   Pilot studies

Pilot study with patients (testing the CPAP therapy web-based follow-up)

Of a total of 163 consecutive patients from the Sleep Clinic, 66 reported basic knowledge of the Internet and agreed to participate. After 12 weeks of monitoring, the participation rate was high (82%). Thirty-five patients responded to the online satisfaction survey (Table 4.1) and the results are presented in Figure 4.7. Patients showed a level of agreement to the statement "Overall, I am satisfied with the web service" of 4.3 ± 0.58 points (mean ± SD, 1 = I strongly disagree, 5 = I strongly agree) and expressed their potential interest in participating in a long-term web-based monitoring.

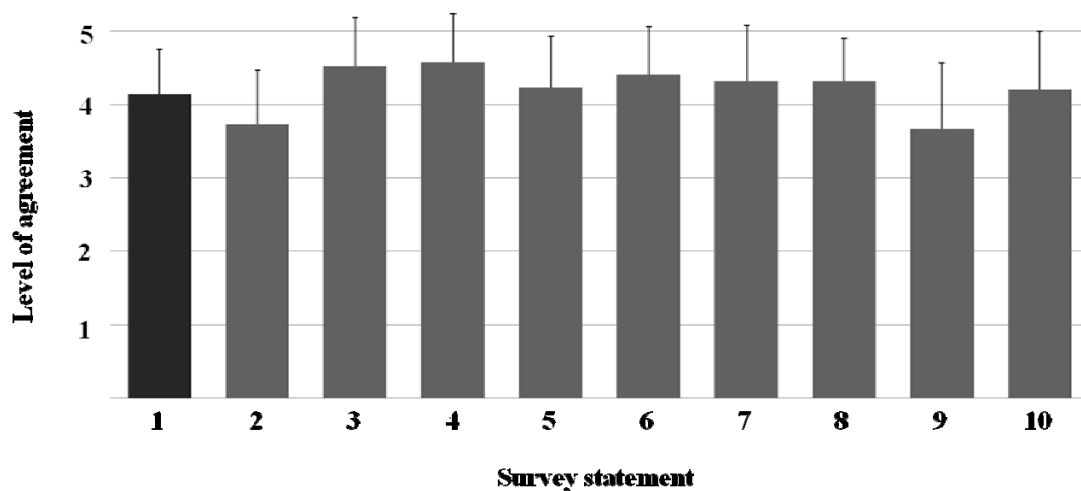| Survey statement |
|---|
| 1.   In general, I am satisfied with the CPAP follow-up web service. |
| 2.   The CPAP follow-up web service has helped me to better manage my health and medical needs. |
| 3.   I follow my doctor's advice better since working with the CPAP follow-up web service. |
| 4.   The CPAP follow-up web service has been easy to use. |
| 5.   The questionnaire of the CPAP follow-up web service has been easy to fill. |
| 6.   In the future I would like to use the CPAP follow-up web service as part of my treatment control. |
| 7.   In the future I would like to receive comments from my doctor about my questionnaire answers. |
| 8.   In the future I would like my doctor use information from the CPAP follow-up web service for my medical visits. |
| 9.   Files and information links about sleep apnea and CPAP therapy available on the website have been useful. |
| 10.   The ability to review the progress of my parameters on the "Your record" page has been useful. |

Table 4.1. Patient's satisfaction survey.

Figure 4.7. Results of patients' satisfaction survey (mean ± SD) where 1 means "I strongly disagree" and 5 means "I strongly agree". Survey statements are in Table 4.1.

Pilot study with patients (testing the televisit approach)

Of the 50 consecutive patients approached, all of them were included in the study. The results of the satisfaction survey are summarized in Table 4.2. As highlighted in grey, the majority of the patients answered positively to all questions. It is noteworthy that more than 90% of the patients was satisfied with the televisit and that almost 45% answered that the televisit could replace between 50% and 100% of the CPAP therapy follow-up visits (Questions A and B of Table 2).

Pilot study with medical staff

The results of the study are summarized in Table 4.3. The answer to the question which asked

Question	Multiple-choice answers	Results (%)
A. What is your satisfaction level of the televisit?	Very dissatisfied	0
	Dissatisfied	0
	Indifferent	2
	Satisfied	30
	Very Satisfied	68
B. Do you believe that such visits could replace the follow-up visits to monitor your condition?	No, never	6
	Yes, but only rarely (10-20%)	12
	Yes, several times (30-50%)	16
	Yes, many times (50-70%)	38
	Almost always (80 - 100%)	28
C. Would you recommend this telemedicine system to others?	No	4
	Perhaps	16
	Yes	80
D. Could you hear and see well the doctor during the interview?	I could not hear and/or see well the doctor	0
	Yes, I could hear and see the doctor with some problems	12
	Yes I could hear and see the doctor perfectly	88
E. Did you feel comfortable during the interview?	No	2
	Quite	20
	Much	78
F. Did you feel safe about your privacy and confidentiality in the interview?	No	0
	Indifferent	8
	Yes	92

Table 4.2. Results of the patients' satisfaction survey about the televisit.

Question	Answer (mean ± SD)
Is the web tool useful to evaluate basic aspects of patient's status?	4.3±0.6
Is the televisit useful to satisfactorily interview the patient?	4.1±0.8
What percentage of face-to-face medical visits could televisit replace?	45.3±15.4%

Table 4.3. Results of the pilot study with medical staff.

the level of utility of the web tool to evaluate basic aspects of patient's status was 4.3±0.6 (mean ± SD) and to the question which evaluated the televisit capability to satisfactorily interview the patient was 4.1±0.8. Furthermore, the staff believed that televisits could avoid 45.3±15.4% of face-to-face medical visits.

4.5.2   Multicenter clinical trial

After a successful pilot phase in which the feasibility of the web-based CPAP monitoring was verified and users' (patients and medical staff) positive opinion was collected, we finalized the development of the web tool, which was ready to be employed in its final clinical setting. To verify the hypotheses of the study, a multicenter clinical trial was launched in September 2012 and during the writing of this thesis report is still ongoing (the study results presentation and analysis are not an aim of this thesis report). The trial is registered to the "ClinicalTrials.gov", the official registry of clinical trial conducted on humans around the world (Identifier: NCT01716676).

The Spanish clinical centres included in the trial are the following: Hospital Clínic (Barcelona); Hospital de la Ribera (Valencia); Hospital Sagrado Corazón (Barcelona); Hospital Txagorritxu (Vitoria); Hospital Reina Sofia (Cordoba); Hospital Son Espases (Mallorca); Hospital San Pedro de Alcántara (Cáceres); Hospital de Can Ruti (Badalona); Hospital de Bellvitge (L'Hospitalet); Hospital de Valme (Sevilla); Hospital Vall d'Hebron (Barcelona) and Hospital Clínico Universitario de Valladolid (Valladolid). Moreover, a group of Argentinean hospitals joined the trial in November 2012: Hospital Aleman (Buenos Aires), Hospital E. Tornú (Buenos Aires), Hospital Universitario Austral (Buenos Aires), Instituto Argentino de Investigación Neurológica (Buenos Aires), Instituto Médico Insares (Mendoza), Centro Privado de Medicina Respiratoria de Paraná (Paraná, Entre Rios). The study was approved by the Ethics Committee of each participant hospital.

Study design

The trial has been designed as a multicenter randomized study with parallel groups and blind final evaluation. The study flowchart is showed in Figure 4.8. The two groups receive the CPAP treatment following two different strategies: one through the conventional follow-up which consists of face-to-face hospital visits (control group) and another through a telemedicine monitoring by using the developed web-based tool and televisits (intervention group).

Population

- Inclusion criteria: 18-75 years old patients with a diagnosis of OSAS who need CPAP therapy and have given their informed consent to participate to the trial.

- Exclusion criteria: Disabling hypersomnia, pregnancy, psychiatric disorders, previous CPAP treatment, clinical instability in the previous month and inability to use information and communication technologies (computers and the Internet).

Technology

The patients included and randomized in the intervention group are monitored by using the multicenter support system described before. To perform the televisit the videoconference free software Skype has been chosen, thanks to its universality and easiness of use.
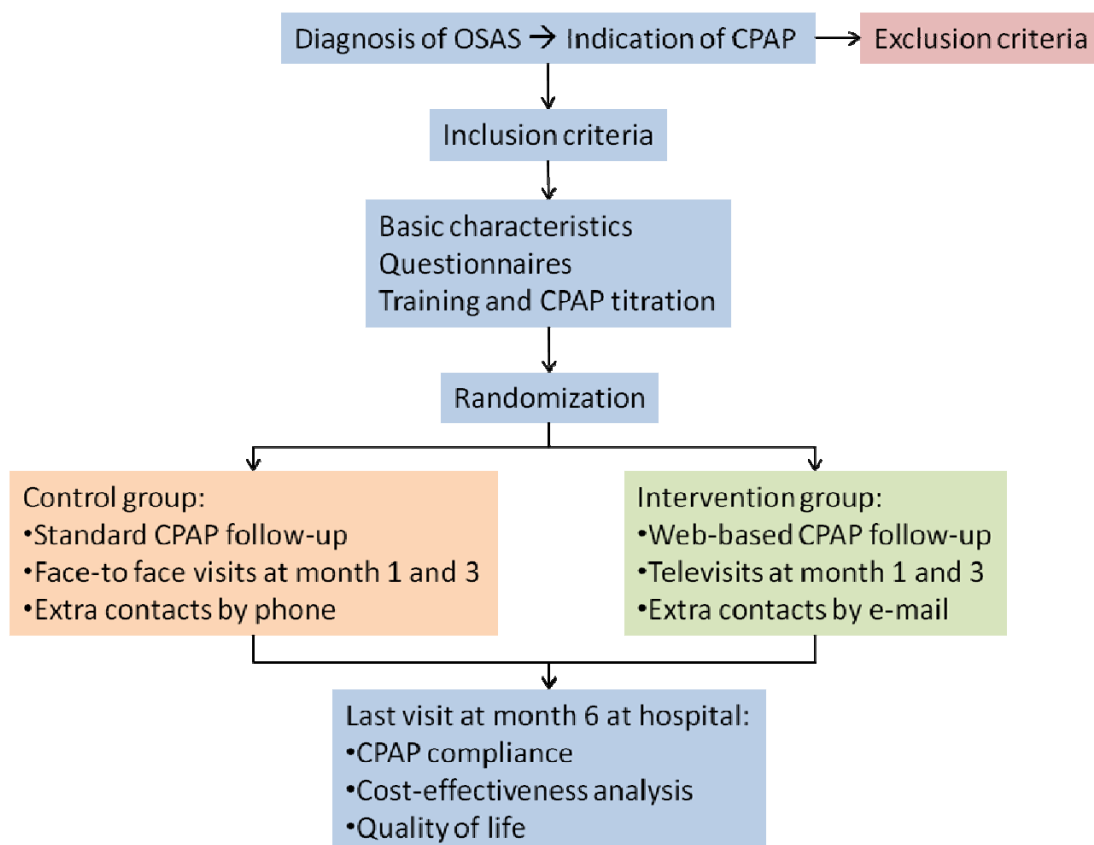
Figure 4.8. Study design flowchart.

Outcomes

The main outcomes of the study are the following:

1. CPAP therapy compliance measured by the counter of the CPAP device;
2. Level of quality of life measured by the EuroQol (EQ-5D) general health outcome questionnaire [10] and by specific sleep disorders questionnaires, such as the simplified Quebec questionnaire [11], Masa et al "visual analogical well-being scale for sleep apnea" [12] and the FOSQ-10 [13];
3. Level of sleepiness measure by Epworth scale [14] and ASDA [15];
4. Cost-effectiveness of the telemedicine monitoring strategy versus the conventional follow-up;
5. Patient's satisfaction of the follow-up.

Trial procedure

The procedure is as follows:

- Recruitment. Every patient indicated to need CPAP treatment is asked to participate. Patients who do not regularly use computers and the Internet are excluded. In this case some basic parameters are collected to determine the characteristics of non-participants and the reasons.

- Visit 1. Patients' data are collected: anthropometric data, history and background information, diagnostic study results, standard treatment, blood test, measured blood pressure, quality of life questionnaires. Subsequently, the CPAP titration is requested within 2 weeks maximum.

- Once the patient receives the training on the CPAP device use, then his/her proper CPAP pressure is obtained. Both the diagnosis and titration can be done with respiratory polygraphy (PR) or polysomnography (PSG). With PR a maximum of 2 attempts are allowed. Then, the randomization is performed.

- Randomization: The control group continues with the standard monitoring and the intervention group is monitored via telemedicine. The intervention group is instructed during 20 minutes on the use of the web tool and Skype.
    - Control group: Each hospital follows its own follow-up schema (compliance control, etc). The face-to-face visits are scheduled at month 1, 3 and 6.

- Intervention group: Televisits are scheduled with the same frequency of the control group. (The last visit will be at the hospital for the evaluation of all outcomes). The patients can communicate with the sleep center via e-mail. The medical staff in charge of the follow-up has to check periodically the patients' answers to the online questionnaire and can contact the patients by phone, e-mail and scheduling an extra televisit.

- The last visit at 6 months is at the hospital and similar data gathered in the visit 1 are collected.

Sample size calculation

A total of 140 patients (70 per study group), considering a power of 80% and an alpha error of 5% and a non-inferiority trial, has been estimated to verify that the CPAP compliance in the intervention group is not less than 1 hour/day (SD: 2) and the average compliance without intervention (4.5 h, SD: 1.8). A dropout rate of 10% is assumed.

Statistical analysis

After performing a quality control of the data, a one-way analysis will be performed. In the case of qualitative variables, frequency and valid percentage will be determined. For quantitative variables, measures of central tendency and dispersion position will be included. For comparison between the study groups in terms of the number of hours of CPAP use (dependent variable of the study) and other numeric variables, the Student's t test will be employed or U Mann Whitney in the case of non-normal distribution. For the qualitative variables, the Chi-square will be used or the Fisher exact test in case of expected frequencies <5. The linear relationship between two variables will be determined by Pearson's correlation (or Spearman). Finally a multivariate model will be considered taking into account potential confounding and interaction variables (age, gender, BMI, etc). $p < 0.05$ will be considered significant. Statistical analysis will be by Intention to Treat. A protocol analysis will be performed after removing randomized patients which present some of the following problems: a) Suffer a medical disease or condition which prevents them from continuing and b) dropout during the follow-up.

Cost-effectiveness analysis

The costs incurred by the two monitoring strategies will be evaluated against the CPAP treatment compliance as primary endpoint through Bayesian cost-effectiveness analysis. To assess the costs of the two follow-up strategies a number of items are taken into account, including the number of masks and humidifiers used by the patient, the follow-up visit duration, the number of patient's extra-visits and hospitalizations during the 6-months monitoring period, etc (Table 4.4). CPAP treatment effectiveness will be assessed taking into account changes in the Epworth sleepiness scale. Also the quality of life questionnaires will be analyzed to assess treatment effectiveness.

Multicenter data collection website

To ensure a correct and exact data collection from all the participant centres to the trial, a dedicated web application was developed. Also in this case, all data are stored in relational MySQL database incorporated into a secure server. We implemented Javascript components to guarantee an accurate and consistent data upload. Special attention was given to the patients' privacy protection. No data containing any possible patient identification were stored in the database.

After the login, the health professionals of each centre can visualize the list of patients they have

Study variables
Employment status
Civil status
Studies
Follow-up visit duration (face-to-face or televisit)
Time dedicated to patient's monitoring (nurse and physician)
N° of extra follow-up visits (face-to-face or televisit)
N° of extra Emergency Department visits
N° of hospitalizations and duration
N° of hospitalizations in Intensive Care Unit and duration
N° of extra visits to General Practitioner
Medicines taken
Travel to hospital transport and duration
Work time lost
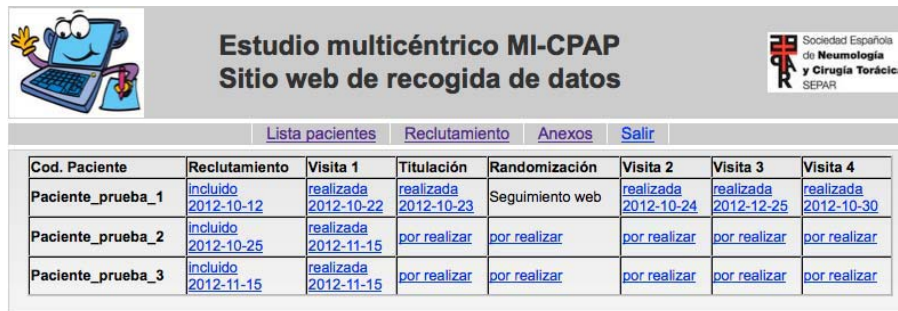
Table 4.4. Study variables to assess the two follow-up strategies costs.

included in the study (Figure 4.9). For each patient, data can be uploaded progressively from the initial Recruitment phase until the last visit (Visit 4) of the study, at 6 months from the beginning. As an example, the Titration data collection page is shown in Figure 4.10. Additionally, all the documentation related to the trial is available for download from the Annexes page (Figure 4.11).

4.6 DISCUSSION

Main results

The opinion of the interviewed patients and medical staff about the usefulness and satisfaction of the telemedicine monitoring approach indicated that the web-based support tool together with the televisit are potentially useful to support the home follow-up of CPAP treatment in OSAS patients.

Figure 4.9. Included patients list in the data collection website. Translation from the original version in Spanish: *Header:* "Multicenter trial MI-CPAP. Data collection website." *Menu-bar:* "Patients list, Recruitment, Annexes, Logout". *Content:* "Patient ID, Recruitment, Visit1, Titration, Randomization, Visit 2, Visit 3, Visit 4".

Figure 4.10. CPAP titration data collection page. Translation from the original version in Spanish: *Header:* "Multicenter trial MI-CPAP. Data collection website." *Menu-bar:* "Patients list, Recruitment, Annexes, Logout". *Content:* "CPAP Titration. Patient ID, Titration date, Visual pressure, If prescribed by PSG, indicate the reason: Availability, Patient profile, Failure with automatic. If prescribed by PSG, indicate the following parameters: Sleep efficiency, Arousals, Phase 1, Phase 2, Phase 3, Phase REM, CT90, ID3, RLS, Final prescription method, Initial hours of CPAP counter. Comments. Send."

Moreover, the high patients' compliance to the remote monitoring by the online questionnaire suggested this strategy to be helpful and practical for the long-period CPAP therapy control.

The optimized multicenter support system we developed represents a novel telemedicine approach to CPAP therapy follow-up in OSAS, where the main objectives are patients' confidence and improved therapy adherence. The availability of easy communication tools with the sleep centre staff can help patients to rapidly solve problems related to CPAP use and consequently increase their satisfaction with community service. This system application can be particularly interesting for the management of difficult-to-treat patients, because they do not adapt easily to CPAP, and of special populations. Moreover, the possibility of carrying out long-distance visits via videoconference represents a valuable opportunity to release sleep clinics from a considerable amount of support interventions and extra visits, thereby enhancing the cost-effectiveness of CPAP therapy.

The developed telemedicine support system has been effectively transferred to the health system since it is in use in a multinational clinical trial currently involving 18 hospitals (www.mi-cpap.com). As highlighted before, the trial is registered to the "ClinicalTrials.gov" international
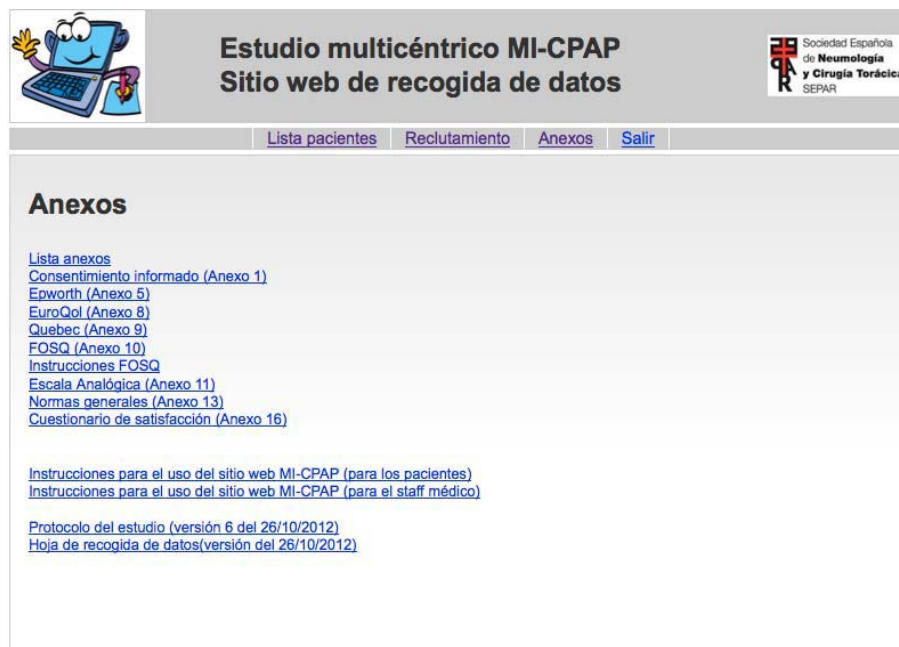

Figure 4.11. Annexes page of the data collection website. Translation from the original version in Spanish: *Header:* "Multicenter trial MI-CPAP. Data collection website." *Menu-bar:* "Patients list, Recruitment, Annexes, Logout". *Content:* "Annexes. Annexes list. Informed consent (Annex 1), Epworth (Annex 5), EuroQol (Annex 8), Quebec (Annex 9), FOSQ (Annex 10), FOSQ instructions, Analogical scale (Annex 11), General rules (Annex 13), Satisfaction survey (Annex 16), User manual for the follow-up web application (for patients), User manual for the follow-up web application (for medical staff), Study protocol, Data collection sheet".

registry with the identifier NCT01716676.

Comparison with previous studies

In the last decades, it has been shown that simple telemedicine interventions, such as weekly phone calls to clarify doubts and encourage CPAP use, can markedly improve compliance [16]. A randomized clinical trial showed that the use of a telephone-linked communication system providing feedback and counseling to OSAS patients at home improved CPAP adherence, patients' functional status and reduced depressive symptoms [6]. Furthermore, another previous study employed an Internet-based informational support service for problems experienced with CPAP use [17]. Despite the organizational limitations and poor differences between intervention and control group follow-up, they obtained good patients' acceptance of this monitoring approach.

Considering a more technical approach, a randomized pilot study assessed the impact on CPAP compliance and OSAS outcomes of a wireless telemonitoring of CPAP compliance and efficacy data, compared to usual clinical care [18]. In this study the intervention group was equipped with a CPAP machine outfitted with a wireless transmitter, which allowed the remote data transmission of compliance and efficacy information to a computer server. Physicians could accessed it and use this information for the management of the patients. Although no significant difference in terms of CPAP compliance was found between the study groups, patients of the intervention group demonstrated a higher likelihood to continue using CPAP. It is also remarkable that telehealth interventions, such as televisits, have been found to improve CPAP adherence in a small group of nonadherent patients versus a placebo-controlled group [19]. The cost of the interventions, including the telehealth monitor, home installation and telephone charges, was lower than the same number of face-to-face visits. Nevertheless, larger studies are needed to generalize any conclusion.

To date the telemedicine system we developed is the first to provide a new monitoring strategy that combines patient's self-reported data collection and Internet-based communication between nurse/physician and patient via e-mail and videoconference. Besides promoting patient's involvement and participation in his/her own care and offering a closer CPAP follow-up, the use of this tool can provide reliable data on a multicenter basis to assess the actual impact of a telemedicine monitoring approach on CPAP compliance and OSAS patients' management.

Other potential clinical applications

Throughout all the design and development phases of this telemedicine system, we kept focusing on versatility and flexibility. This allows the tool to be employed in many other clinical applications, especially for those needing long-term monitoring like chronic diseases. Additionally, our follow-up approach can also easily be integrated with the use of home monitoring devices, for instance spirometers, glucometers, blood pressure monitors, etc. Several telemedicine applications have been developed and studied for the management of chronic patients, such as those suffering of chronic obstructive pulmonary disease (COPD) [20], asthma [21], diabetes [22], heart failure [23] and hypertension [24]. Results are generally encouraging but still weak, thus simple and long-term monitoring approaches which can provide reliable information about the real usefulness of telemedicine in the chronic disease management and help to find the profile of patients who can potentially benefit from telemedicine are needed [25;26]. Moreover, it is remarkable that this system can be readily applicable thanks to the widespread availability of Internet-connected home computers or tablets in the population [27].

Videoconferencing and Skype

In recent years, videoconferencing has demonstrated to be a valuable mean of delivering healthcare interventions for chronic patients. Results of several studies indicated that interventions for a variety of conditions, including psychological and physical, delivered by videoconferencing produce similar outcomes to treatment delivered in-person and a high level of patients' satisfaction [28]. In this study we chose to employ the free videoconference tool Skype for its fast availability, easiness of use and good performance. Besides lay literature highlights numerous scenarios documenting the potential uses of Skype, also scientific literature has recently started to discuss its potential value in different clinical applications [29-32]. Although the encouraging results of these studies, the risks and benefits of the use of Skype for clinical purposes should be further assessed [33].

Limitations

It may be argued that the proposed monitoring strategy is based on self-reported data on CPAP compliance, weight, physical activity, etc. assessed by the online questionnaire that is filled in by patients themselves at home, whose reliability might be doubtful, especially for CPAP compliance [34]. However, it has become common and well accepted for clinical investigators to use patient-

reported data to collect patients' data and outcomes. Moreover, some parameters can be objectively measured by home monitoring devices (e.g. wirelessly transmitting CPAP machines and weight scales).

Additionally, it should be explained that the online questionnaire, besides having the patient's monitoring as objective, aims also to enhance the patient's awareness and involvement in his/her own care and must be integrated with televisits and face-to-face visits when necessary.

Future directions

As reported above, the multicenter clinical trial is still ongoing during the writing of this thesis report. In this study, besides assessing the impact of this new approach on the patients' CPAP therapy compliance and satisfaction, a detailed cost-effectiveness analysis of this strategy in comparison with the standard hospital-based follow-up will be performed. The results of this study will be submitted to high impact scientific journals.

4.6.1 Conclusion

The multicenter support system we developed represents a new telemedicine approach to CPAP therapy follow-up for OSAS patients, which seeks enforcing patients' confidence and improving therapy adherence.

4.6.2 Acknowledgements

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Chapter 5

VALIDATION OF A TELEMONITORING SYSTEM FOR OBSTRUCTIVE SLEEP APNEA TREATMENT

5.1 INTRODUCTION

As extensively described in Chapter 4, obstructive sleep apnea syndrome (OSAS) is a very prevalent disease mainly associated with daytime sleepiness and deterioration of quality of life and is suffered by 2% to 4% of middle-aged adults [1]. OSAS entails repetitive partial or total occlusion of the upper airway, which results in significant levels of sleep disturbance and snoring. However, the seriousness of untreated OSAS is stressed by its significant consequences, including depression, ischemic heart disease, stroke, hypertension and significantly increased risk of motor vehicle crashes [2;3].

The treatment of choice for OSAS is continuous positive airway pressure (CPAP) applied through a nasal mask during sleep. This constant pressure is transmitted to the pharyngeal area, thereby avoiding upper airway obstruction [4]. Despite the documented clinical efficacy of CPAP, a considerable amount of patients suspend or underuse CPAP treatment, mainly due to its discomforting side effects, such as pressure intolerance, claustrophobic reaction to the mask, mask displacement, and machine noise [5;6]. Many of these problems could be easily solved by a closer follow-up, especially during the first weeks, but busy sleep centres have difficulties in giving such support.

If patients do not use CPAP for the recommended minimum of 4 hours per night, clinical outcomes are compromised [7], demonstrating that adherence optimization is a critical aspect of patient management. Several studies confirmed that treatment compliance could be significantly improved by comprehensive support programmes and timely interventions by health professionals [8].

Some existing CPAP and APAP (Automatic Positive Airway Pressure) devices monitor patient's compliance by using different algorithms, but only few of them offer continuous remote

monitoring. Air Liquide has recently developed NOWAPI, a prototype of telemonitoring system designed to be compatible with all commercially available CPAP/APAP devices.

5.2 HYPOTHESIS

The hypothesis of this study was that a new telemedicine system for CPAP therapy remote monitoring could provide valuable and useful data about treatment compliance and efficacy for the follow-up OSAS patients.

5.3 AIMS

The specific aims of this study were:

- To assess whether the connection of NOWAPI sensor unit to different CPAP/APAP machines influenced their normal functioning and responses to the disturbed breathing patterns generated by a simulated OSAS patient in a bench;
- To evaluate the NOWAPI's performance in accurately detecting the CPAP/APAP treatment duration and the residual disturbed-breathing events in a bench test.

5.4 METHODS

5.4.1 System Description

NOWAPI system has been designed to remotely monitor the CPAP or APAP treatment of patients with sleep apnea at home. The system overview is depicted in Fig. 5.1. NOWAPI comprises a small sensor unit (15x4x7 cm) powered by a rechargeable battery, which contains a pressure and flow sensing module, a specifically developed detection software for the analysis of the measured signals and detection the breathing events, a GPRS communication module, which enables data transmission to a server, and a clinical interface, which enables the physician to visualize and properly evaluate the data downloaded from the server. The NOWAPI sensors unit is connected between the CPAP/APAP device outlet and the patient's tubing. During the patient's CPAP/APAP treatment, the system detects the pressure and flow signals which characterize the patient's breathing and estimates the treatment use rate and some important parameters to

assess the effectiveness of the therapy, such as the number of apneas, hypopneas, flow limitations, snoring periods, and average breathing flow and nasal pressure. The system stores all data in 2 different files, a detailed file with a sampling rate of 25 Hz and a synthetic file where data are recorded as mean values over 15–minute consecutive periods. The latter file is sent by the GPRS module integrated into the device to a secure server then available to be downloaded and analyzed.

Furthermore, a led in the sensors unit turns red if the treatment duration is less than the minimum standard of 4 hours/night, giving an immediate useful feedback to the patient about his/her treatment compliance.

5.4.2   Patterns of disturbed breathing

NOWAPI was tested with 2 different sets of simulated breathing patterns. In the first phase, a series of 10 waveforms consisting of the successive repetition of apneic or hypopneic events or persistent flow limitation [9;10] was used.

In the second phase, the system performance was tested in 30 different test scenarios especially
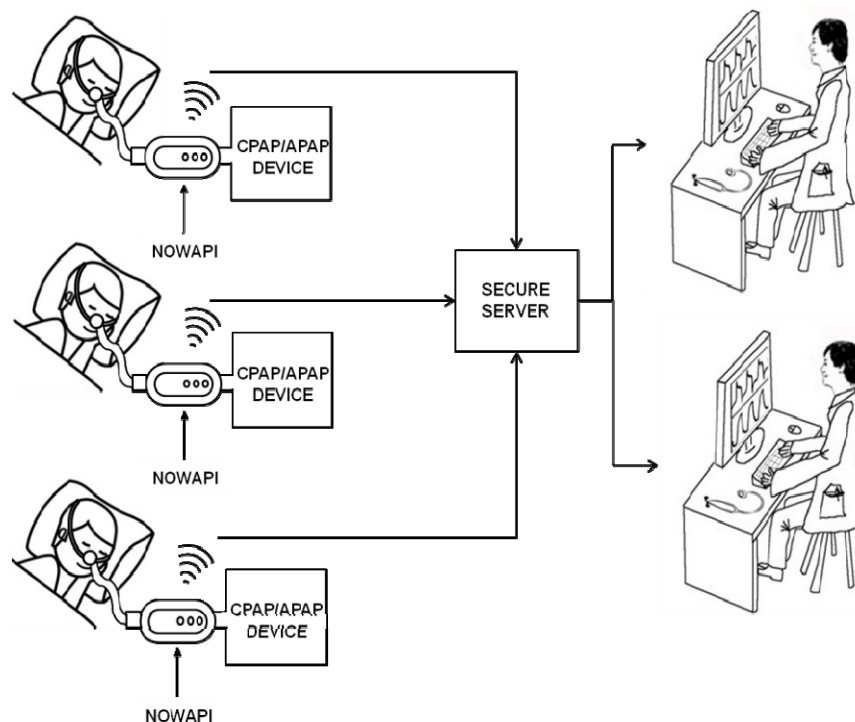
Figure 5.1 NOWAPI system data flow.

developed for this study, simulating 30 sleep periods of OSAS patients under CPAP treatment, lasting 4 hours each. These simulated breathings consisted of realistic airflow patterns built from a library of actual events (e.g. normal breathing, apneas, hypopneas, flow limitations), which were selected from real OSAS patients' polysomnographic recordings by a pneumologist. The selected events were exported by using the polygraph software with a sampling rate of 64 Hz. Then, each event was properly elaborated by an algorithm specifically implemented for this study. The block diagram describing the algorithm, developed by using Matlab computing tool, is shown in Fig. 5.2. First, the flow event was integrated to obtain the volume signal. Then, the signal was detrended and adjusted in order to have the minimum signal point at zero. After that, to reproduce the typical tidal volumes for normal breathing (0.5 l approx) and hypopnea (0.2 l approx), the signal gain was iteratively adjusted until the mean value of the signal peaks was 0.5 in the case of normal breathing and 0.2 in the case of hypopnea. Subsequently, the obstruction signal controlling the test bench valve was added to obstructive events. Moreover, a snore signal was added where requested. Then, the processed events (see Fig. 5.3, 5.4, 5.5 and 5.6) were assembled to obtain the 30 4-hour simulated breathing patterns (Fig. 5.7 and table 5.1).
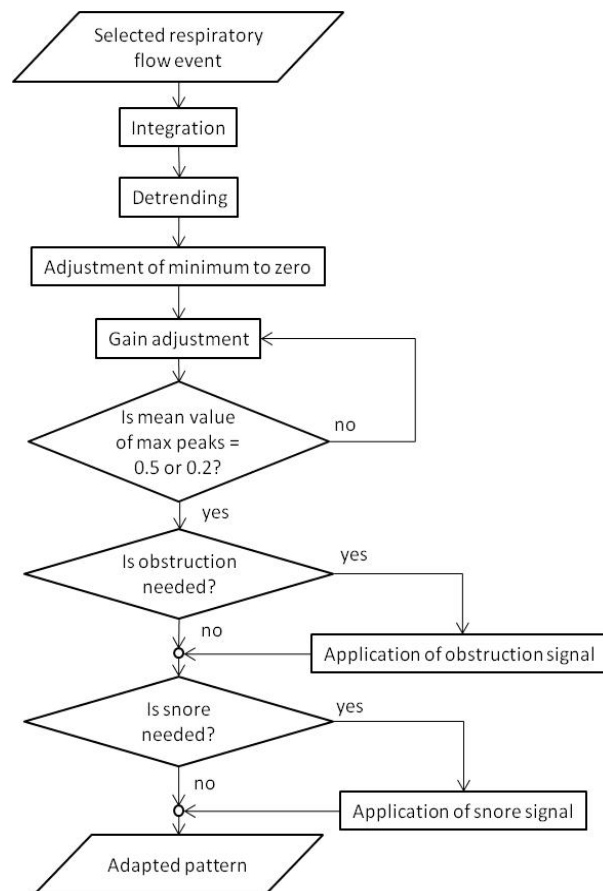
Figure 5.2. Block diagram of the algorithm implemented to obtain the breathing patterns simulating patients with OSAS.
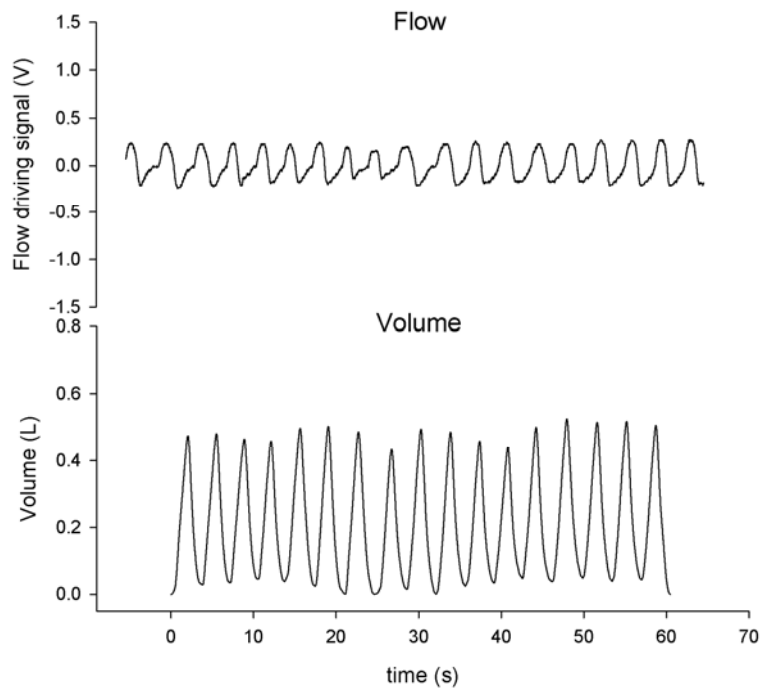
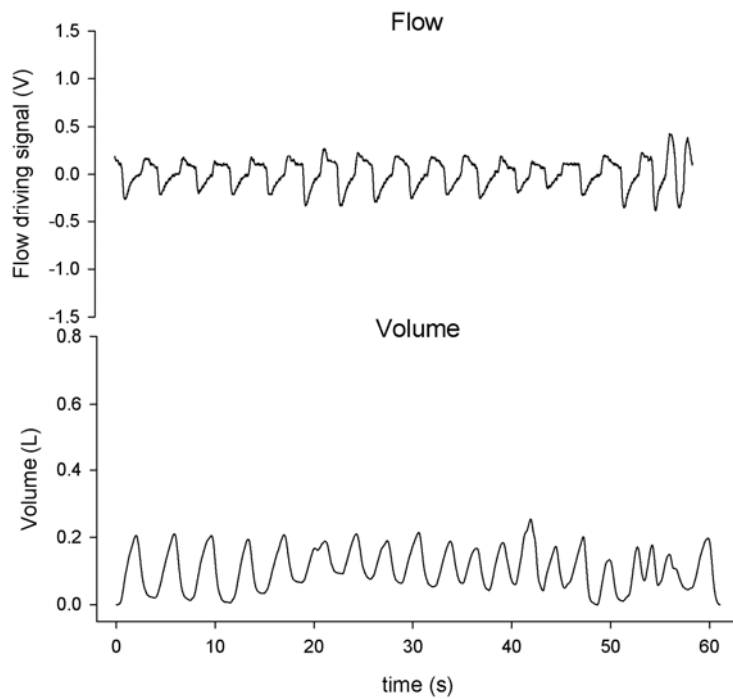Figure 5.3. Normal breathing obtained by using the algorithm developed in this study.

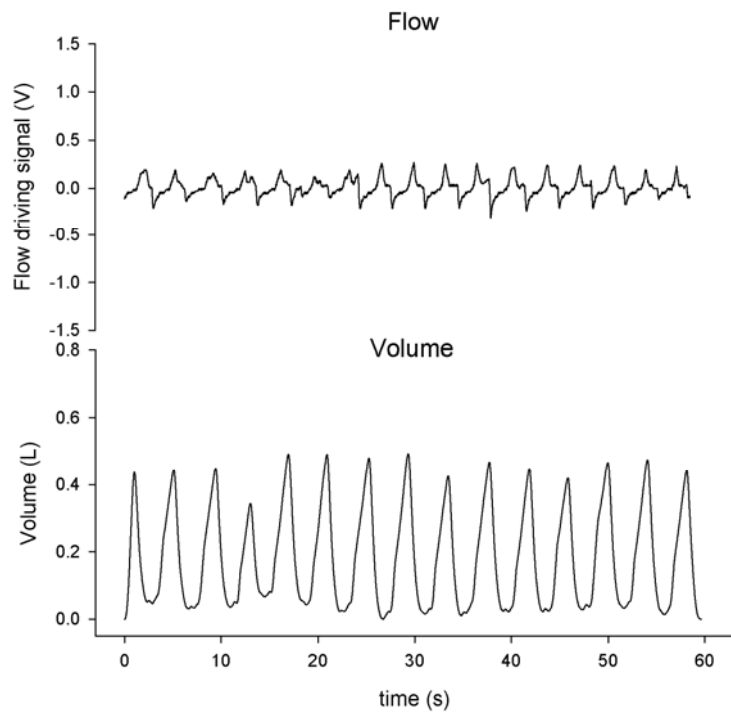Figure 5.4. Hypopnea event obtained by using the algorithm developed in this study.

Figure 5.5. Flow limitation event obtained by using the algorithm developed in this study.
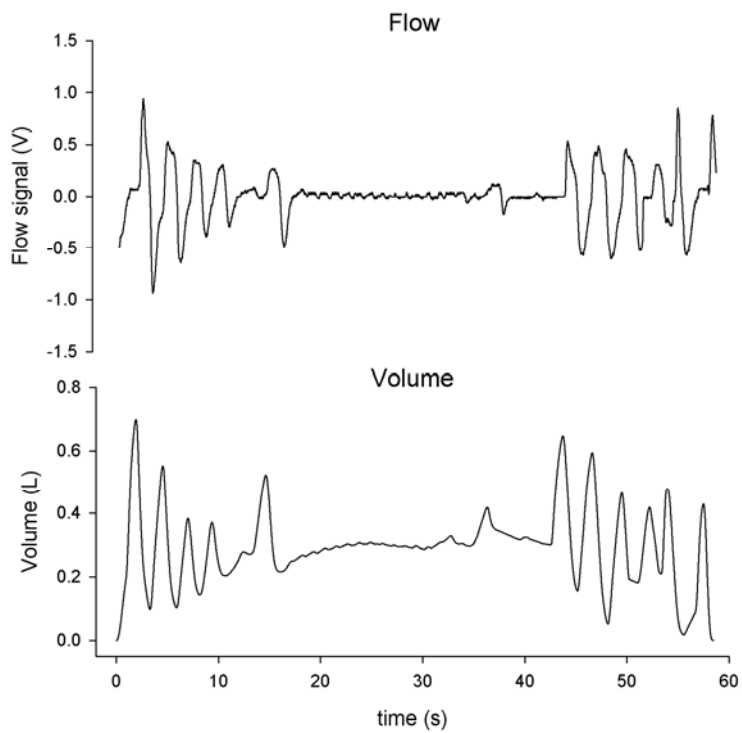

Figure 5.6. Apnea event obtained by using the algorithm developed in this study.
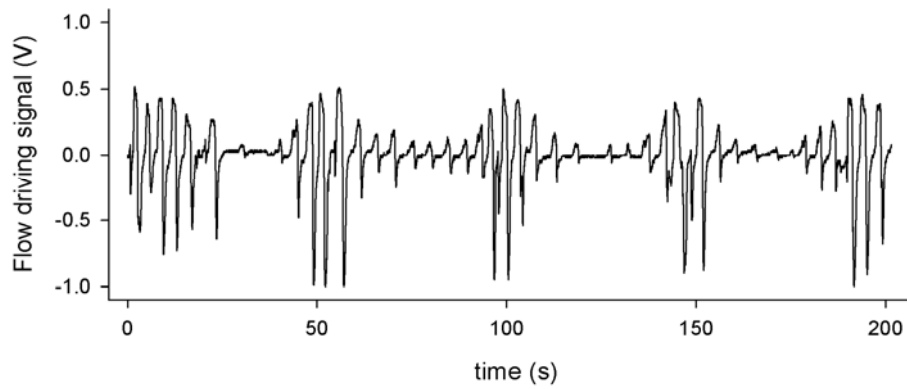
Figure 5.7. Fragment of a pattern of disturbed breathing which simulated an OSAS patient's sleep periods of treatment.

Test number	Average AHI	Number of obstructive apneas	Number of central apneas	Number of hypopneas with snoring	Number of hypopneas without snoring	Number of flow limited events with snoring	Number of flow limited events without snoring	Number of prolonged flow limitations without snoring	Number of prolonged flow limitations with snoring
1	0	0	0	0	0	2	2		
2	1	1	0	2	1	9	73		
3	1,25	1	0	4	0				1
4	1,75	0	0	4	3			1	
5	2	0	0	2	6	35	15		
6	2	0	0	3	5	20	90		
7	2,25	0	1	7	1				
8	2,5	1	2	7	0				1
9	2,5	3	0	6	1			1	
10	2,5	6	0	2	2			1	
11	2,75	2	0	6	3				1
12	2,75	2	0	9	0	0	17		
13	3,25	1	2	0	10			1	
14	3,5	0	0	8	6	2	1		
15	4	6	1	7	2				
16	4,25	0	1	14	2				
17	4,25	2	3	7	5				
18	4,5	5	2	9	2				
19	4,75	18	1	0	0				

20	4,75	4	3	9	3				
21	4,75	2	0	0	17	38	17		
22	5	17	1	2	0	6	89		
23	6	1	1	5	17	14	1		
24	7	0	0	18	10				
25	8,75	4	5	13	13	0	4		
26	10,8	12	6	25	0				
27	15	15	21	10	14	7	11		
28	20,3	37	2	32	10				
29	25,3	9	8	48	36				
30	30	31	31	29	29	38	17		

Table 5.1. Number of simulated events assigned for each test.

5.4.3   Measurement Setup and Protocol

NOWAPI sensors unit was plugged between the CPAP/APAP device (or its humidifier) outlet and a model simulating an OSAS patient [9;10], as shown in Fig. 5.8. This computer-driven model comprises a flow generator and an obstruction valve which allows the simulation of obstructive events. Other two valves (the leak and the exhalation valves) allow the simulation of leaks and mouth breathing and a loudspeaker simulates snoring. The bench test is equipped with two sensors, which record pressure and flow signals. A calibrated leak (see Fig. 5.8) simulates the mask leak. This validation study comprised two phases in which the same test setting was employed.
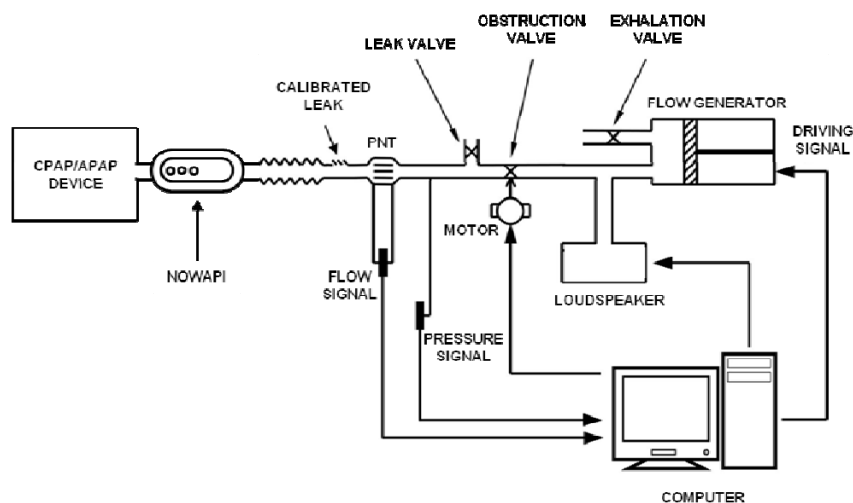
Figure 5.8. Scheme of the test setting.

First Test Phase

The aim of the first test phase was to verify that the NOWAPI sensor unit connected between a CPAP/APAP machine and the conventional tubing connected to the patient did not modify the normal performance of the CPAP/APAP machine. Two commercially available CPAP/APAP devices (S9 AutoSet, Resmed and Remstar Auto, Respironics) were subjected to a set of 10 breathing patterns described elsewhere [9;10] with 2 alternative settings: with or without their Comfort Mode (CPR) activated and with or without NOWAPI sensors unit connected to the test setting. The responses obtained in the 4 different experimental conditions were compared and evaluated.

Second Test Phase

In the second test phase, NOWAPI was subjected to the 30 patterns especially implemented for this study, which simulated 30 sleep periods of OSAS patients under CPAP treatment. The aim of this phase was the assessment of NOWAPI's performance in correctly detecting the treatment duration and the residual disturbed-breathing events.

In order to assess the effect of water condensation into the tubing on the measurements, usually caused by patient's breathing, three of the tests were performed with the APAP device humidifier turned on. To guarantee realistic water condensation, humidifier was set to maximum level and the APAP device tubing was immersed in ice.

The simulated patients were treated with 3 different currently available devices for APAP treatment: S9 Autoset (Resmed), Remstar Auto (Respironics) and Goodknight 420E (Sefam). Each APAP device was connected to the monitoring device with its own tubing. A Whisper Swivel valve (Respironics) was used as exhalation port for all devices.

Each 4-hour test was preceded and followed by a 30-minute period during which the NOWAPI device was functioning but not subjected to either APAP device pressure or patient simulator's breathing. This was to ensure test two epochs in which no treatment time and no events should have been detected. The experimental conditions for each test are summarized in Table 5.2.

Test number	CPAP machine	With/without comfort mode	With/Without humidifier
1	Resmed	without	without
2	Sefam	without	with
3	Sefam	without	without
4	Sefam	without	without
5	Resmed	without	with
6	Resmed	without	without
7	Resmed	without	without
8	Resmed	without	without
9	Respironics	without	without
10	Respironics	without	with
11	Respironics	without	without
12	Resmed	without	without
13	Resmed	without	without
14	Respironics	without	without
15	Sefam	without	without
16	Respironics	without	without
17	Respironics	without	without
18	Sefam	without	without
19	Resmed	without	without
20	Resmed	without	without
21	Respironics	without	without
22	Sefam	without	without
23	Respironics	without	without
24	Resmed	without	without
25	Sefam	without	without
26	Respironics	without	without
27	Resmed	without	without
28	Sefam	without	without
29	Respironics	without	without
30	Resmed	without	without

Table 5.2. Experimental conditions for each test.

The synthetic files for each of the 30 tests, containing the data recorded as mean values over 15–minute consecutive periods, were sent via GPRS to the Air Liquide secure server and then downloaded for analysis. In this study, treatment duration and respiratory events, measured as apnea-hypopnea index (AHI), detected by NOWAPI were considered for analysis and compared to the ones detected by the CPAP/APAP devices and to the actual simulated patterns generated by the bench.

5.5   RESULTS

First Test Phase

To assess whether the connection of NOWAPI sensor unit to the CPAP/APAP machines influenced their responses to the disturbed breathing patterns generated by the OSAS patient simulated by the bench, the absolute differences between the test setting with and test setting without NOWAPI in the circuit of the following parameters were calculated: the time taken by the CPAP/APAP machine to reach the pressure of 10 cmH$_2$O (T$_{10}$) and the maximum pressure applied by the machine (P$_{max}$). These values were calculated for CPAP/APAP machines S9 Autoset (Resmed) and Remstar Auto (Respironics) with and without CPR. Table 5.3 summarizes the results, which corresponded to the 4 experimental conditions.

To assess the intrinsic variability of the CPAP/APAP machines′ response to the same breathing pattern, we performed 3 rounds of the same 10 disturbed breathing patterns in both machines without the NOWAPI sensor unit in the circuit. The absolute differences between test rounds of T$_{10}$ and P$_{max}$ are comparable with the ones found previously (Table 5.4 and 5.5), hence they can be imputable to the intrinsic variability of the CPAP/APAP devices′ response.

Second Test Phase

In the second test phase, all data sent to the server via GPRS were successfully received and analyzed. The percentage difference between the treatment duration estimated by NOWAPI and actual values was never higher than 1.25% (3 min) and never lower than -0.42% (-1 min).

The difference in absolute values between the AHI estimated by NOWAPI and the actual values, 0.9±1.6 events/hour (mean±SD), was not significantly different from the difference in absolute

value between the AHI estimated by the CPAP/APAP machines and the actual values, 0.9 ± 1.0 events/hour (p=0.171). This good agreement was confirmed by Bland-Altman analysis of AHI values estimated by NOWAPI in each test versus the actual ones (Fig. 5.9).

Also, AHI values estimated by NOWAPI showed a very good correlation with the actual values (R^2=0.97), slightly better than the ones estimated by PAP machines (R^2=0.88) (Fig. 5.10).

CPAP/APAP machine	Absolute difference with NOWAPI/without NOWAPI (mean$\pm$SD)	
	T_{10} (min)	P_{max} (cmH$_2$O)
S9 Autoset (Resmed) with CPR	0.40$\pm$0.43	0.50$\pm$0.77
S9 Autoset (Resmed) without CPR	0.19$\pm$0.29	0.11$\pm$0.14
Remstar Auto (Respironics) with CPR	1.23$\pm$0.98	0.78$\pm$1.54
Remstar Auto (Respironics) without CPR	1.50$\pm$1.75	1.26$\pm$1.41

Table 5.3. Absolute differences of T_{10} and P_{max} values between test setting of NOWAPI sensor unit in the circuit and test setting without NOWAPI in the circuit. The results were obtained for CPAP/APAP machines S9 Autoset (Resmed) and Remstar Auto (Respironics) with and without CPR.

CPAP/APAP machine	T_{10} (min) Absolute difference between rounds (mean$\pm$SD)		
	Round 1 – Round 2	Round 1 – Round 3	Round 2 – Round 3
S9 Autoset (Resmed)	0.77$\pm$1.34	0.62$\pm$0.79	0.87$\pm$1.12
Remstar Auto (Respironics)	4.47$\pm$7.11	5.1$\pm$6.54	2.6$\pm$4.30

Table 5.4. Absolute differences between test rounds of T_{10} without NOWAPI sensor unit in the circuit. The results were obtained for CPAP/APAP machines S9 Autoset (Resmed) and Remstar Auto (Respironics).

CPAP/APAP machine	P_{max} (cmH$_2$O) Absolute difference between rounds (mean$\pm$SD)		
	Round 1 – Round 2	Round 1 – Round 3	Round 2 – Round 3
S9 Autoset (Resmed)	0.36$\pm$0.47	0.32$\pm$0.40	0.26$\pm$0.56
Remstar Auto (Respironics)	0.87$\pm$0.41	0.69$\pm$0.54	0.80$\pm$0.56

Table 5.5. Absolute differences between test rounds of P_{max} without NOWAPI sensor unit in the circuit. The results were obtained for CPAP/APAP machines S9 Autoset (Resmed) and Remstar Auto (Respironics).
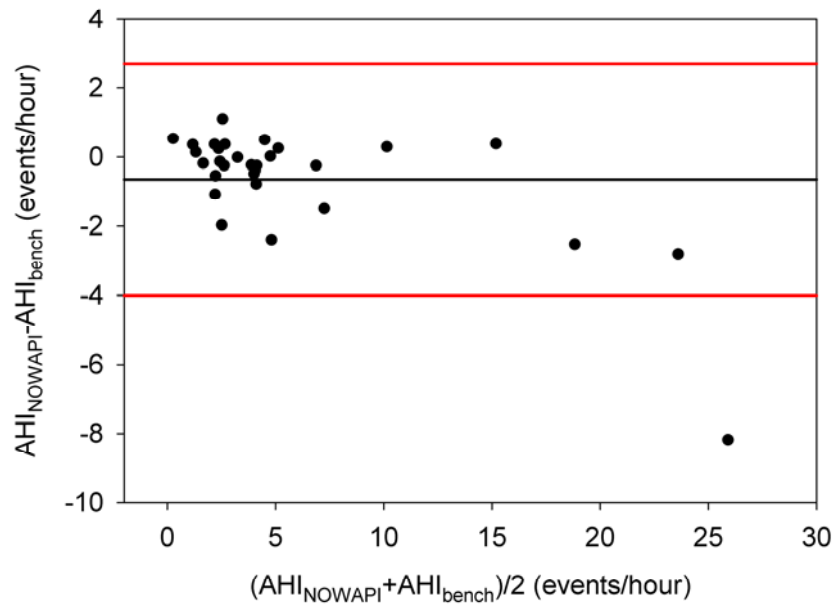
Figure 5.9. Bland-Altman analysis of AHI values estimated by NOWAPI in each test versus the actual ones.
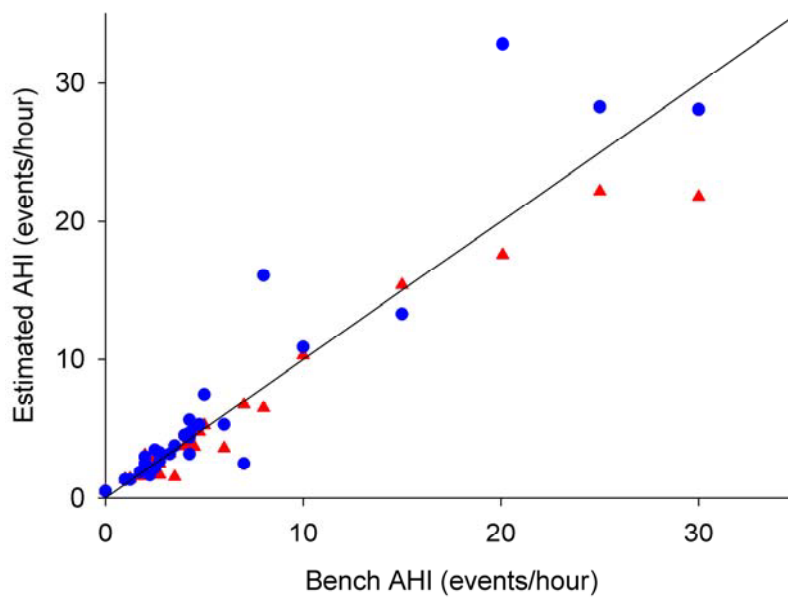
Figure 5.10. Apnea-hypopnea index (AHI) values estimated by NOWAPI (red triangles) and the PAP machines (blue circles) versus the actual values generated by the bench for each test. Solid line is identity line.

5.6 DISCUSSION

Main results

NOWAPI is a novel telemedicine system that provides remote monitoring of CPAP/APAP treatment of OSAS patients at home. It detects critical parameters to evaluate the patient's adherence (treatment duration), and the effectiveness of the treatment (residual respiratory events) and sends them via GPRS to a secure server. In this way the data can be easily downloaded and revised by the physician or the health professional providing CPAP, who can perform a closer patient's monitoring and timely intervene to improve his/her treatment compliance. In this study, NOWAPI system was evaluated in the bench. In a first test phase, two different CPAP/APAP machines were subjected to a previously validated set of disturbed breathing patterns [9;10] with or without NOWAPI device connected between the CPAP/APAP and the simulated patient. The results of this phase showed that the slight difference of the machines' responses with or without the connection of NOWAPI sensor unit can be caused by the machines' intrinsic variability, so that the geometry of NOWAPI does not influence the CPAP treatment. In the second test phase, NOWAPI was subjected to 30 different breathing patterns simulating OSAS patients especially built for this study by assembling real respiratory flow signals recorded during polysomnography. The telemedicine system under test successfully sent the recorded data to the central server and showed an excellent performance in estimating the CPAP treatment duration and in detecting residual respiratory events.

Few systems in the market provide the remote monitoring of the CPAP therapy efficacy parameters, which is usually integrated in the CPAP/APAP devices and implemented with a different algorithm for each manufacturer. Since NOWAPI is a stand-alone system, it can be compatible with all the commercially available CPAP/APAP devices currently in clinical use. This fact is particularly remarkable and would make easy to remotely monitor any patient under treatment, regardless of the specific CPAP device he/she uses. Additionally, the use of a wireless data transmission through a SIM card integrated in the GPRS module of NOWAPI device provide an even more equal service, making possible the treatment monitoring of patients who do not have an Internet connection in their homes.

The results of this work have been effectively transferred to the healthcare system since they have been carried out within the framework of a formal contract between University of Barcelona

(represented by Fundació Bosch i Gimpera) and Air Liquide, the company developing and commercializing NOWAPI system.

Comparison with previous studies

In recent times, it has been recognized that telemedicine could have a valuable role in improving CPAP therapy adherence [11]. In fact, telemedicine has been used in various studies to promote and reinforce CPAP treatment. In most of them a cognitive behavioural intervention was applied to OSAS patients at home, by telephone [6], the Internet [12] and videoconference [13]. Despite mixed results were achieved in terms of significant improvement of CPAP compliance, the potential of telemedicine to be integrated into the care of OSAS patients was confirmed.

Two recent randomized studies [14;15] combined elements of psychoeducational interventions together with technological innovation. Usual care was compared to a wireless telemonitoring of CPAP compliance and efficacy data, which physicians were able to daily monitor through a secure web browser and thus contact the patient if needed. Both studies resulted in higher CPAP adherence and improved OSAS outcomes and demonstrated that continuous monitoring of patient's compliance could be useful to early detect underuse and to properly address possible problems.

Limitations

Since this validation study was performed on a bench test and not in real patients, it could be argued that the results could lead to limited conclusions. Indeed, subjecting NOWAPI to reference breathing patterns at the bench was a first step for evaluating the performance of the hardware/software implemented in the system. The results of the study should subsequently be confirmed on patients in the clinical routine. A bench test is a useful tool to validate new systems such as NOWAPI, because it allows the comparison of different devices response when they are subjected to exactly the same patterns of disturbed breathing, which is not possible in patients, due to the biological variability in their disturbed breathing patterns [9]. Actually, bench tests and clinical studies are both useful and should be considered complementary when evaluating a specific system [10].

5.6.1   Conclusion

NOWAPI showed good compatibility with the CPAP machines and an excellent performance in estimating the duration of the CPAP treatment and in detecting residual respiratory events in simulated OSAS patients and in transmitting them to a dedicated server. The results of this study demonstrated that NOWAPI system could be a valuable tool for telemonitoring the treatment of obstructive sleep apnea.

5.6.2   Acknowledgements

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Chapter 6

CONCLUSIONS

This thesis was aimed at developing and evaluating novel telemedicine applications for the support of patients' homecare. Two of the studies focused on the development of Internet-based systems to support the follow-up of newborn patients after discharge (Chapter 3) and of the continuous positive airway pressure (CPAP) treatment of patients with obstructive sleep apnea syndrome (OSAS) (Chapter 4). The third study aimed at assessing the performance in a bench test of a new telemedicine system for the remote monitoring of CPAP treatment in OSAS patients (Chapter 6). The results of these studies could contribute to the extensive application of the telemedicine as a reliable method to deliver high-quality care and encourage the establishment of new and cost-effective homecare strategies based on ICTs. Although the specific conclusions of each study are discussed in each chapter, in the following sections the major conclusions of this thesis report have been briefly summarized.

6.1 COST-EFFECTIVENESS OF A NEW INTERNET-BASED MONITORING TOOL FOR NEONATAL POST DISCHARGE HOME CARE

- A new Internet-based monitoring tool for the neonatal home care after discharge was successfully developed;

- This new monitoring approach resulted in a high level of parental satisfaction with the service;

- Using a societal perspective, the cost of the Internet-based follow-up resulted much lower than that of the conventional hospital-based follow-up. Additionally, ED visits in the first month of patients' life decreased with the use of the Internet-based monitoring system. This telemedicine follow-up strategy proved absolute dominance (both more clinically effective and less costly) over the standard follow-up based on hospital visits;

- This Internet-based tool has been effectively transferred to the health system since it is in routine clinical use at the Hospital de Sant Pau in Barcelona (www.petitsacasa.santpau.cat).

6.2 A Multicenter Support System for Continuous Positive Airway Pressure Therapy Follow-up in Obstructive Sleep Apnea

- The opinion of the interviewed patients and medical staff about the helpfulness and satisfaction of the telemedicine monitoring approach indicated that the web-based support tool together with the televisit are potentially useful to support the home follow-up of CPAP treatment in OSAS patients;

- The high patients' compliance to the remote monitoring through the online questionnaire suggested this strategy to be helpful and practical for the long-period CPAP therapy control;

- The multicenter support system we developed represents a new telemedicine approach to CPAP therapy follow-up for OSAS patients, which seeks enforcing patients' confidence and improving therapy adherence;

- The developed telemedicine support system has been effectively transferred to the health system since it is in use in a multinational clinical trial currently involving 18 hospitals (www.mi-cpap.com).

6.3 Validation of a Telemonitoring System for Obstructive Sleep Apnea Treatment

- The geometry of the telemonitoring device (NOWAPI) does not influence the CPAP treatment;

- NOWAPI showed good compatibility with the CPAP machines and an excellent performance in estimating the duration of the CPAP treatment and in detecting residual respiratory events in simulated OSAS patients. The results of this study demonstrated that NOWAPI system could be a valuable tool for telemonitoring the treatment of obstructive sleep apnea;

- The results of this work have been effectively transferred to the healthcare system since they have been carried out within the framework of a formal contract between University of Barcelona (represented by Fundació Bosch i Gimpera) and Air Liquide, the company developing and commercializing NOWAPI system.

Appendix A

PUBLICATIONS AND COMMUNICATIONS TO CONGRESSES

Journal publications:

- V. Isetta, C. Lopez-Agustina, E. Lopez-Bernal, M. Amat, m. Vila, C. Valls, D. Navajas, R. Farré. Cost-Effectiveness of a New Internet-based Monitoring Tool for Neonatal Post-Discharge Home Care. J Med Internet Res 2013; 15(2):e38.

- G. Li Bassi, O. Tavares, J.D. Marti, V. Giunta, N. Luque, V. Isetta, M. Ferrer, R. Farré, G. Leite, A. Torres. An in-vitro study to assess determinant features associated with fluid sealing in the design of endotracheal tube cuffs and exerted tracheal pressures. Critical Care Med 2013; 41(2):518-526.

- A. Iranzo, V. Isetta, J. Molinuevo, M. Serradell, D. Navajas, R. Farre, J. Santamaria, EEG slowing heralds mild cognitive impairment in idiopathic REM sleep behavior disorder. Sleep Medicine 2010; 11(6):534-539.

Peer-reviewed publications in congress proceedings:

- V. Isetta, J.M. Montserrat, G. Thiebaut, C. Weber, D. Navajas, R. Farré. Validation of a Telemonitoring System for Sleep Apnea Treatment. eTELEMED 2013, Nice, France, February 24 – March 1, 2013. ISBN: 978-1-61208-252-3: in press.

- L. Govoni, V. Isetta, P. Giacomelli, R. Rosso, R. Farré, R. Dellacà. Long Term Monitoring of Breathing Pattern Parameters by a Wearable System at COPD Patient's Home. eTELEMED 2013, Nice, France, February 24 – March 1, 2013. ISBN: 978-1-61208-252-3; in press.

- V. Isetta, J.M. Montserrat, D. Fonollosa, J. Roca, C. Leon and R. Farré. Multicenter Support Network for CPAP Therapy Follow-up in Sleep Apnea. eTELEMED 2012, Valencia, Spain, January 30 - February 4, 2012. ISBN: 978-1-61208-179-3; IARIA XPS press, 2012.

- V. Isetta, C. López-Agustina, M. Vila, A. Clemente, M. Cucala and R. Farré. Telenursing Service for Neonatal Post-discharge Home Care. eTELEMED 2012, Valencia, Spain, January 30 - February 4, 2012. ISBN: 978-1-61208-179-3; IARIA XPS press, 2012.

Abstracts to international congresses:

- V. Isetta, G. Carlos, D. Navajas, R. Farré. Validation of a device for telemonitoring continuous positive airway pressure treatment: Bench test. 21st Congress of the European Sleep Research Society, Paris, France, 4-8 September 2012.

- V. Isetta, C. Leon, C. Embid, L. Nunez, D. Navajas, F. Masa, R. Farre, J.M. Montserrat. Web-based Videoconference System For The Management Of CPAP Therapy In Sleep Apnea Patients. American Thoracic Society International Conference, San Francisco, USA, 18-23 May 2012.

- V. Isetta, C.León, J. M. Montserrat and R. Farré. Web-based follow-up of CPAP compliance in Obstructive Sleep Apnea Syndrome: a pilot study. European Respiratory Society Annual Congress, Amsterdam, Netherlands, 24-28 September 2011.

- V. Isetta, J. M. Montserrat and R. Farré. Web-based follow-up of CPAP compliance in Obstructive Sleep Apnea Syndrome: a pilot study. 12th International Symposium Sleep and Breathing, Barcelona, Spain, 7-9 April 2011.

- R. Farré, A. Papadopoulos, V. Isetta, G. Munaro, R. Rosso. CHRONIOUS: A Multinational and Interdisciplinary European Project for Innovative E-Health Management of Chronic Patients at Home. 13th International Congress on Medical Informatics, Cape Town, South Africa, 13-16 September 2010.

- L. Estrada, J. Santamaría, V. Isetta, A. Iranzo, D. Navajas, R. Farré. Validation of an EEG-Based Algorithm for Automatic Detection of Sleep Onset in the Multiple Sleep Latency Test. World Congress on Engineering, London, UK, 30 June – 2 July 2010. (Oral presentation)

- R. Farre, A. Papadopoulos, G. Munaro, V. Isetta, R. Rosso. CHRONIOUS: A Telemonitoring Platform for the Management of COPD Patients at Home. International Conference of the American Thoracic Society, New Orleans, USA, 14-19 May 2010.

Appendix B

PARTICIPATION TO PROJECTS

During the development of this bioengineering thesis on home telemedicine, the PhD candidate has participate in the following financed projects involving translational research through collaboration agreements between the University and the industry:

<u>CHRONIOUS: An Open, Ubiquitous and Adaptive Chronic Disease Management Platform for COPD and Renal Insufficiency. (2008-2012, FP7-ICT-2007-1– ICT-1-5.1, PI: R. Farré)</u>

CHRONIOUS was a European Project that aimed at creating a home platform for the monitoring of people with chronic health conditions. CHRONIOUS provides a continuous patient's monitoring by using selected environmental and social context sensors, while at the same time tracking their medical condition via a sensorized T-shirt which collects patient's vital signs. In addition, the platform offers a touch screen interface for monitoring drug intake, dietary habits, weight and glycaemia values. Healthcare professionals are provided with full access to the patient's information and data continuously stored in the CHRONIOUS central server coming from the platform, in order to perform the offline remote monitoring of patient's conditions.

After a successful phase of system integration, technical tests and then ease of use, efficacy and usability assessment of the system in a completely controlled setting, the hospital, CHRONIOUS system and services functioning were assessed in their goal setting, the patient's home. Namely, the system capability to manage chronic patients and their acceptance of the system and satisfaction were evaluated in a multicenter clinical trial. The trial was designed as a 4-month observational study, with 60 patients (30 COPD and 30 CKD) all monitored at home by the CHRONIOUS system and, at the same time, also periodically monitored by clinicians. The University of Barcelona (UB), together with the Hospital Clinic Pneumology Department, was a pilot centre of the clinical trial for the CHRONIOUS system validation on 10 COPD patients, being Prof. Ramon Farré, the PhD supervisor, the PI of the Spanish partner.

Valentina Isetta, the PhD candidate, was in charge of the project management for UB as consortium partner. She was responsible for all documents and reports preparation throughout

the project as well as the communication with project coordinator and partners. She actively participated to the consortium scientific activities to design the clinical validation protocol and she was in charge of the documents preparation and submission to the Hospital Clinic Ethics Committee and the Spanish Agency for Medicines and Health Products (AEMPS) to obtain the approval to carry out the trial. She conducted the trial execution in the Barcelona pilot centre and was responsible for the technical follow-up and the support to the included patients. The project consortium is still processing all the data gathered from the trial.

SIBEL: Design and development of a Fleisch type transducer for spirometric measures. (Collaboration agreement between UB – Fundació Bosch i Gimpera and SIBEL SA, Spain, 2008-2013, PI: R. Farré)

Valentina Isetta was in charge of the activity management within the collaboration agreement with SIBEL SA, a Spanish company that is a leader manufacturer of electromedical devices, to design and develop a new Fleisch type transducer for spirometric measures. She actively participated to all the scientific research activities to fulfill the agreement goals.

AIR LIQUIDE: Performance evaluation and validation on a bench test of a CPAP telemonitoring device for OSAS patients (Collaboration agreement between UB – Fundació Bosch i Gimpera and AIR LIQUIDE, France, 2010-2013, PI: R. Farré)

The PhD candidate was in charge of the management of this collaboration project, from the scientific to the operational point of view. The test protocol description, results and conclusions are described in detail in Chapter 5 of this thesis report.

Appendix C

SOURCE CODE OF THE IMPLEMENTED APPLICATIONS

C.1   BABIES AT HOME INTERNET-BASED APPLICATION

In this section the screenshots and html/php scripts of the 3 different areas of "Babies at home" website (Free access, Staff and Parents' areas) are shown. By using the *include()* php function, which takes a file name and simply inserts that file's contents into the script that issued the include command, each page of the website was composed by 4 main structure elements (see Screenshot C.1.1): header, main menu, content and foot. In each website area, the structure elements header, menu and foot are common for all pages and just the content changes.

Screenshot C.1.1 "Babies at home" Home page structure. Translation from original version in Catalan: Header: "Babies at home". Menu-bar: "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". Content: "Congratulations, parents, and thank you for your visit to 'Babies at home'! You as parents, and we as health professionals, know that the most important thing is the health of your children. In the Neonatal Unit at the Hospital de la Santa Creu i Sant Pau we have created a page where the babies are the stars and you will find tips, links and answers to frequently asked questions regarding baby care. Use the menu to navigate to different sections of the website.", "Project developed with the collaboration of the Unit of Biophysics and Bioengineering, Faculty of Medicine, University of Barcelona."

C.1.1 Free access area

This area contains free-access documents and information about neonatal care. The core of each page of this area is the file "index_petits.php", which contains all the structure elements of the page recalled by the include command. By selecting a tab of the main menu, a different content is included in the page.

"index_petits.php" file script:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Petits a casa</title>
<script src="Scripts/swfobject_modified.js"
      type="text/javascript"></script>
<script type="text/javascript"
      src="javascript/verificacion.js"></script>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php @include("include_petits/cabecera_petits.php");?>
<?php @include("include_petits/menu_principal_petits.php");?>
<div id="contenido">
<?php
if (isset($_GET['p'])){
$pagina=$_GET['p'];
if($pagina<=""){
$pagina="pagina_principal_petits";}}
else {include("include_petits/pagina_principal_petits.php");} ?>
<?php @include("include_petits/".$pagina. ".php");?>
</div>
<?php
if (isset($pagina)){
if ($pagina=="pagina_principal_petits" || $pagina<="") {
 @include("include_petits/pie_petits.php");}
else {@include("include/pie.php");}
}
else {@include("include_petits/pie_petits.php");}
?>
</body>
</html>
```

"cabecera_petits.php" file script:

```
<div id="cabecera">
  <div id="logosantpau"><img src="imagenes/logo_santpau_tr.png"
      width="200" /></div>
  <div id="titulowebpetits"><img src="imagenes/logo_petits.png"
      width="480"/></div>
```

```
   <div id="imagotipo"><img src="imagenes/imagotipo_petits.png"
      width="300" /></div>
</div>
```

"menu_principal_petits.php" file script:

```
<ul class="Menu">
  <li><a
      href="index_petits.php?p=pagina_principal_petits">Inici</a></li>
  <li><a href="index_petits.php?p=consells">Consells per cuidar el
      nad&oacute;</a></li>
  <li><a href="index_petits.php?p=enlaces">Enlla&ccedil;os
      &uacute;tils</a></li>
  <li><a href="acceso.php">Seguiment on line del nad&oacute;</a></li>
  <li><a href="index_petits.php?p=qui_som">Qui som</a></li>
 </ul>
```

"pie_petits.php" file script:

```
<p class="pie">Petits a casa - Hospital de Sant Pau - Barcelona 2011 -
      <a href="../avis_legal.php">Av&iacute;s legal</a><br />

<a href="http://www.mozilla.com" target="_blank"><img
      src="imagenes/logo_firefox.png" height="30" border="0"/></a> <a
      href="http://www.google.com/chrome?brand=CHKZ&amp;hl=es"
      target="_blank"><img src="imagenes/logo_chrome2.png" height="30"
      border="0"/></a> <a href="http://windows.microsoft.com/es-
      ES/internet-explorer/products/ie/home" target="_blank"><img
      src="imagenes/logo_explorer.png" height="30"  border="0"/></a>
      <a href="http://www.opera.com/" target="_blank"><img
      src="imagenes/logo_opera.png" height="30"  border="0"/></a><a
      href="http://www.apple.com/es/safari/"><img
      src="imagenes/logo_safari.png" height="30" border="0" /></a></p>
```

Here below, each page of the free access area is presented by showing the page screenshot and the corresponding script.

"Babies at home" home page

See Screenshot C.1.1.

"pagina_principal_petits.php" script:

```
<P class="titulo_contenido">Enhorabona pares, i gràcies per la vostra
      visita a "Petits a casa"!
</P>
<br />
```

```
<img src="../imagenes/FOTOSLUCAS.jpg" width="255" height="190"
      hspace="15" vspace="10" align="left" class="foto" />
<P class="texto">Com a pares, i nosaltres com a professionals de la
      salut, sabem que el més important és la salut dels vostres
      fills. </P>

<P class="texto">Des de la Unitat Neonatal de l'Hospital de la Santa
      Creu i Sant Pau hem elaborat una pàgina on els bebès són els
      protagonistes i on trobareu  consells, enllaços i respostes a
      les preguntes més freqüents relacionades amb la cura del
      nadó.</P>
<br />
<P class="formulario2">Feu servir el menú per navegar per les
      diferents seccions del lloc web. </P>
<br />
<br />
<br />
<table width="75%" border="0">
  <tr>
    <td><span class="texto_peque">Projecte desenvolupat amb la
    col·laboració de la Unitat de Biof&iacute;sica i Bioenginyeria,
    Facultat de Medicina</span></td>
    <td><img src="imagenes/logoUB_blanco.png" alt="" height="70"
      /></td>
  </tr>
</table>
```

"Tips for baby care" page

Screenshot C.1.2. "Tips for baby care" page in the free access area of "Babies at home" website. In this page the parents can find informative documents on baby care in both Spanish and Catalan. Translation from original version in Catalan and Spanish: *Header:* "Babies at home". *Menu-bar:* "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". *Content:* "Tips for baby care". "Breastfeeding: Why breastfeeding?; When breastfeeding?; How should you do it?; Most frequent problems; Lactation of premature babies; Lactation of twins; Milk extraction and conservation; Toxic substances which pass to breast milk;

References; Support groups, videos and interesting websites". "Artificial lactation: Feeding bottle preparation". "Sensory stimulation: Recommended activities in the first month of life". "Avoiding dangers: How to avoid dangers (infections, going out, traveling by car, pets, prevent falls, aspiration or choking, burns)". "Massage: Optimal for neurodevelopment". "Crying: How to soothe it". "Baby care: discharge, weight control and sleep; Bath; Temperature, clothes and home; Care of navel, hydration and nails; Cramping and depositions; Pacifier: how to use it and recommendations; FAQ: When you call a doctor; Early diagnosis / Sleeping position / Cramps / Jaundice; Rash / Acne / Mongolian Spot / Stain on face and neck / Tremors / Twitching arms; Muguet / Ear wax / Cradle cap / Colic symptoms; Otitis / Diarrhea / Constipation / Vaccine / Hydration / Baby doesn't sleep / Cryptorchidism; Vitamin D / Cream for diaper area / Diaper dermatitis / Fever / Cheeks pimples.

"consells.php" script:

```
<p class="titulo_contenido">Consells per cuidar el nad&oacute; </p>
<P class="texto">
<table width="95%"  border="0" cellspacing="5" bordercolor="#CCCCCC">
  <tr>
    <td><span class="titulo_consells">Lact&agrave;ncia amb llet
      materna</span></td>
    <td><span class="titulo_consells">Lactancia con leche
      materna</span></td>
  </tr>
  <tr>
    <td>Per qu&egrave; donar el pit?</td>
    <td><a href="openfile.php?p=archivos/Porquedarelpecho.pdf"
      target="_self" onClick="javascript:
      pageTracker._trackPageview('/downloads/porque_pecho');
      ">&iquest;Por qu&eacute; dar el pecho?</a></td>
  </tr>
  <tr>
    <td>Quan donar el pit?</td>
    <td><a href="openfile.php?p=archivos/Cuandodarelpecho.pdf"
      target="_self">&iquest;Cuando dar el pecho?</a></td>
  </tr>
  <tr>
    <td>Com s'ha de fer? <a href="index_petits.php?p=video_1"
      target="_self">V&iacute;deo 1</a></td>
    <td><a href="openfile.php?p=archivos/Comohayquehacerlo.pdf"
      target="_self">&iquest;C&oacute;mo hay que hacerlo?</a> <a
      href="index_petits.php?p=video_1" target="_self">V&iacute;deo
      1</a></td>
  </tr>
  <tr>
    <td>Problemes m&eacute;s freq&uuml;ents</td>
    <td><a href="openfile.php?p=archivos/Problemasmasfrecuentes.pdf"
      target="_self">Problemas m&aacute;s frecuentes</a></td>
  </tr>
  <tr>
    <td>Lact&agrave;ncia en nadons prematurs <a
      href="index_petits.php?p=video_2" target="_self">V&iacute;deo
      2</a></td>
    <td><a href="openfile.php?p=archivos/LactanciaNinosPrematuros.pdf"
      target="_self">Lactancia en ni&ntilde;os prematuros</a> <a
      href="index_petits.php?p=video_2" target="_self">V&iacute;deo
      2</a></td>
  </tr>
  <tr>
    <td>Lact&agrave;ncia en bessons i t&agrave;ndem</td>
```

```
  <td><a href="openfile.php?p=archivos/LactanciaGemelosyTandem.pdf"
    target="_self">Lactancia en gemelos y tandem</a></td>
</tr>
<tr>
  <td>Extracci&oacute; i conservaci&oacute; de la llet materna</td>
  <td><a href="openfile.php?p=archivos/ExtraccionyConservacion.pdf"
    target="_self">Extracci&oacute;n y conservaci&oacute;n de la
    leche materna</a></td>
</tr>
<tr>
  <td>Subst&agrave;ncies t&ograve;xiques que passen a la llet
    materna</td>
  <td><a href="openfile.php?p=archivos/SustanciasToxicas.pdf"
    target="_self">Sustancias t&oacute;xicas que pasan a la leche
    materna</a></td>
</tr>
<tr>
  <td>Bibliografia</td>
  <td><a
    href="openfile.php?p=archivos/BibliografiaAgradecimientos.pdf"
    target="_self">Bibliograf&iacute;a</a></td>
</tr>
<tr>
  <td>Grups d'ajuda, videos i webs d'inter&egrave;s</td>
  <td><a
    href="openfile.php?p=archivos/GruposapoyoLibrosVideosWebsInteres
    .pdf" target="_self">Grupos de apoyo, v&iacute;deo y webs de
    inter&eacute;s</a></td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Lact&agrave;ncia amb llet
    artificial</span></td>
  <td><span class="titulo_consells">Lactancia con leche
    artificial</span></td>
</tr>
<tr>
  <td><a href="openfile.php?p=archivos/alletament_artificial.pdf"
    target="_self">Preparaci&oacute; de formules i
    biber&oacute;</a></td>
  <td><a href="openfile.php?p=archivos/lactancia_artificial.pdf"
    target="_self">Preparaci&oacute;n de formulas y
    biber&oacute;n</a></td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Estimulaci&oacute;
    sensorial</span></td>
  <td><span class="titulo_consells">Estimulaci&oacute;n
    sensorial</span></td>
</tr>
</tr>
<tr>
```

```
  <td><a href="openfile.php?p=archivos/Estimulacio.pdf"
    target="_top">Activitats recomanades pel primer mes de
    vida</a></td>
  <td>Actividades recomendadas para los primeros meses de vida</td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Evitar perills</span></td>
  <td><span class="titulo_consells">Evitar peligros</span></td>
</tr>
<tr>
  <td><a href="openfile.php?p=archivos/Evitar_perills.pdf"
    target="_self">Com evitar perills</a> (infeccions, sortir al
    carrer, viatjar en cotxe, animals dom&egrave;stics, prevenir
    caigudes, aspiraci&oacute; o ennuegaments, cremades)</td>
  <td>C&oacute;mo evitar peligros (infecciones, salir a la calle,
    viajar en coche, animales dom&eacute;sticos, prevenir
    ca&iacute;das, aspiraciones o   atragantamientos,
    quemaduras)</td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Massatge</span></td>
  <td><span class="titulo_consells">Masaje</span></td>
</tr>
<tr>
  <td><a href="openfile.php?p=archivos/Massatge.pdf"
    target="_self">&Ograve;ptim pel neurodesenvolupament</a></td>
  <td>&Oacute;ptimo para el neurodesarrollo</td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Plor</span></td>
  <td><span class="titulo_consells">Llanto</span></td>
</tr>
<tr>
  <td><a href="openfile.php?p=archivos/Plor.pdf" target="_self">Com
    calmar-lo</a></td>
  <td>C&oacute;mo calmarlo</td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Cures del
    nad&oacute;</span></td>
  <td><span class="titulo_consells">Cuidados del
    beb&eacute;</span></td>
</tr>
```

```html
<tr>
  <td><a
    href="openfile.php?p=archivos/Cures_del_nado/alta_pes_son.pdf"
    target="_self">Alta i control del pes, el son</a></td>
  <td><a
    href="openfile.php?p=archivos/Cuidados_del_bebe/alta_peso_sueno.
    pdf" target="_self">Alta y control del peso, el
    sue&ntilde;o</a></td>
</tr>
<tr>
  <td><a href="openfile.php?p=archivos/Cures_del_nado/bany.pdf"
    target="_self">Bany</a></td>
  <td><a href="openfile.php?p=archivos/Cuidados_del_bebe/bano.pdf"
    target="_self">Ba&ntilde;o</a></td>
</tr>
<tr>
  <td><a
    href="openfile.php?p=archivos/Cures_del_nado/temperatura_roba_ca
    sa.pdf" target="_self">Temperatura, roba i casa</a></td>
  <td><a
    href="openfile.php?p=archivos/Cuidados_del_bebe/tempe_ropa_casa.
    pdf" target="_self">Temperatura, ropa y casa</a></td>
</tr>
<tr>
  <td><a
    href="openfile.php?p=archivos/Cures_del_nado/melic_hidratacio_un
    gles.pdf" target="_self">Cura del melic, hidrataci&oacute; i
    ungles</a></td>
  <td><a
    href="openfile.php?p=archivos/Cuidados_del_bebe/ombligo_hidratac
    ion_unas.pdf" target="_self">Cuidado del ombligo,
    hidrataci&oacute;n y u&ntilde;as</a></td>
</tr>
<tr>
  <td><a
    href="openfile.php?p=archivos/Cures_del_nado/colics_deposicions.
    pdf" target="_self">Colics i deposicions</a></td>
  <td><a
    href="openfile.php?p=archivos/Cuidados_del_bebe/colicos_deposici
    ones.pdf" target="_self">C&oacute;licos y deposiciones</a></td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
<tr>
  <td><span class="titulo_consells">Xumet</span></td>
  <td><span class="titulo_consells">Chupete</span></td>
</tr>
<tr>
  <td><a href="openfile.php?p=archivos/xumet.pdf"
    target="_self">&Uacute;s del xumet i recomanacions</a></td>
  <td><a href="openfile.php?p=archivos/chupete.pdf"
    target="_self">Uso del chupete i recomendaciones</a></td>
</tr>
<tr>
  <td> </td>
  <td> </td>
</tr>
```

```
<tr>
  <td> </td>
  <td><span class="titulo_consells">FAQ</span></td>
</tr>
<tr>
  <td> </td>
  <td><a href="openfile.php?p=archivos/FAQ/avisar_medico.pdf"
    target="_self">Cuando avisar al m&eacute;dico</a></td>
</tr>
<tr>
  <td> </td>
  <td><a
    href="openfile.php?p=archivos/FAQ/diagnosticoprecoz_posturadormi
    r_colicos_ictericia.pdf" target="_self">Diagnostico precoz /
    Postura para dormir / C&oacute;licos / Ictericia</a></td>
</tr>
<tr>
  <td> </td>
  <td><a
    href="openfile.php?p=archivos/FAQ/exantema_acne_mancha_mongolica
    _cara_cuello_temblores_sacudidas_brazos.pdf"
    target="_self">Exantema / Acne / Mancha mong&oacute;lica /
    Manchas cara y nuello / Temblores / Sacudidas brazos</a></td>
</tr>
<tr>
  <td> </td>
  <td><a
    href="openfile.php?p=archivos/FAQ/muguet_cera_costralactea_colic
    os.pdf" target="_self">Muguet / Cera o&iacute;dos / Costra
    l&aacute;ctea / S&iacute;ntomas c&oacute;licos</a></td>
</tr>
<tr>
  <td> </td>
  <td><a
    href="openfile.php?p=archivos/FAQ/otitis_diarreas_estrenimiento_
    deshidrat_vacunas_sueno_criptorquidia.pdf" target="_self">Otitis
    / Diarrea / Estre&ntilde;imiento / Vacuna / Hidrataci&oacute;n /
    No duerme / Criptorquidia</a></td>
</tr>
<tr>
  <td> </td>
  <td><p><a
    href="openfile.php?p=archivos/FAQ/vitaminad_crema_dermatitispana
    l_fiebre_alergia.pdf" target="_self">Vitamina D / Crema zona
    pa&ntilde;al / Dermatitis pa&ntilde;al / Fiebre / Granitos
    mejillas</a></p></td>
</tr>
</table>
</p>
```

"Useful links" page

Screenshot C.1.3. Useful links page in the free access area of "Babies at home" website. In this page the parents can find links to website of national and international support groups for breastfeeding and infant care. Translation from original version in Catalan and Spanish: *Header:* "Babies at home". *Menu-bar:* "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". *Content:*"Useful links". "Spanish Federation for Breastfeeding, www.fedalma.org". "ACPAM (Catalan Association for Breastfeeding), www.acpam.org". "The International League of La Leche, www.lalecheleague.org". "Alba Breastfeeding, www.albalactanciamaterna.org". "Denia Hospital, www.e-lactancia.org". "NadoCAt (Catalan Initiative for comprehensive care of the baby and the family), www.nadocat.org". "Spanish Association of Infant Massage, www.masajeinfantil.es".

"enlaces.php" script.

```
<p class="titulo_contenido">Enlla&ccedil;os útils</p>
<table width="90%" border="0">
  <tr>
    <td><span class="texto">Federación Española de Asociaciones pro
      Lactancia Materna</span></td>
    <td><span class="texto"><a href="http://www.fedalma.org/"
      target="_blank">www.fedalma.org</a></span></td>
  </tr>
  <tr>
    <td><span class="texto">ACPAM (Asociación Catalana Pro Lactancia
      Materna)</span></td>
    <td><span class="texto"><a href="http://www.acpam.org/"
      target="_blank">www.acpam.org</a></span></td>
  </tr>
  <tr>
    <td>La Liga de la Leche Internacional</td>
    <td><a href="http://www.lalecheleague.org"
      target="_blank">www.lalecheleague.org</a></td>
  </tr>
  <tr>
    <td>Alba Lactancia Materna</td>
    <td><a href="http://www.albalactanciamaterna.org"
      target="_blank">www.albalactanciamaterna.org</a></td>
  </tr>
  <tr>
    <td>Hospital de Denia</td>
```

```
    <td><a href="http://www.e-lactancia.org" target="_blank">www.e-
      lactancia.org</a></td>
  </tr>
  <tr>
    <td><span class="texto">NadoCAt (Iniciativa catalana per
      l'assistència integral del nadó i la família)</span></td>
    <td><span class="texto"><a href="http://www.nadocat.org"
      target="_blank">www.nadocat.org</a></span></td>
  </tr>
  <tr>
    <td><span class="texto">Asociación Española de Masaje
      Infantil</span></td>
    <td><span class="texto"><a href="http://www.masajeinfantil.es"
      target="_blank">www.masajeinfantil.es</a></span></td>
  </tr>
</table>
```

<u>"Who we are" page</u>

Screenshot C.1.4. "Who we are" page in the free access area of "Babies at home" website. In this page the medical and nursing staff in charge of the Internet-based monitoring is presented. Translation from original version in Catalan: *Header:* "Babies at home". *Menu-bar:* "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". *Content:* "Who we are". "The home care program (PAD) service Neonatology of the Hospital de la Santa Creu i Sant Pau, was born from the need to early

integrate the baby into the family. The experience of this program, designed and managed by nurses for over 6 years, has proved to be effective both in reducing readmissions and emergency visits as for the advantages in terms of families' emotion. A group of professionals of the Neonatal Unit, supported by the Head Nurse and with the collaboration of the Biophysics and Bioengineering Unit, Faculty of Medicine, University of Barcelona, have begun a pilot study to extend the program through an Internet-based support system based on a specific website and managed by the PAD nurses. The team is comprised of professionals with experience between 20 and 30 years and extensive expertise in the field of neonatology, Carmen Lopez (PAD nurse), Maribel and Cristina Amat Ferret (neonatal nurses) and Esther Lopez (neonatal pediatrician). Parents have access to a set of informative documents, electronic monitoring and personalized baby online consultation system." "Acknowledgements. To the mothers of the infants admitted to our neonatal unit, having collaborated so generously letting our cameras capture their intimacy. To Roser Capdevila who illustrated with his pencil our website."

"qui_som.php" script:

```
<P class="titulo_contenido">Qui som</P>
<div class="texto"><p>El programa d'assistència domiciliaria (PAD) del
     servei de Neonatologia de l'Hospital de la Santa Creu i Sant
     Pau, va néixer de la necessitat d'integrar el nadó al nucli
     familiar el més aviat possible.</p>
<p>L'experiència d'aquest programa, dissenyat i gestionat per
     infermees des de fa més de 6 anys, ha demostrat la seva eficàcia
     tant en el seguiment dels nadons en la reducció dels reingressos
     i visites a urgències,  com pels avantatges a nivell emocional
     de les famílies.</p>
<p>Un grup de professionals de la Unitat Neonatal format per
     infermeres i una neonatòloga, recolzat per la Direcció Infermera
     i amb la col·laboració de la Unitat de Biofísica i Bioenginyeria
     de la Facultat de Medicina de la Universitat de Barcelona,  han
     iniciat un estudi pilot per ampliar el programa mitjançant un
     sistema de suport telemàtic basat en un lloc web específica per
     aquests pacients i gestionada per la infermera a càrrec del
     PAD.</p>
<p>L'equip està constituït per professionals amb una experiència de
     entre 20 i 30 anys i una àmplia expertesa en el camp de la
     neonatologia, Carme López (infermera del PAD), Maribel Amat  i
     Cristina Ferret (infermeres neonatals) i  Esther López (pediatra
     neonatòloga).</p>
<p>Als pares oferim l'accés a un conjunt de documents informatius, el
     seguiment telemàtic individualitzat del nadó i un sistema de
     consulta on line.</p>
</div>
  <table width="80%" border="0" align="center">
    <tr>
      <td><img class="foto" src="../imagenes/foto_carmen.png"
      width="180" height="180" /></td>
      <td><img class="foto" src="../imagenes/foto_maribel.png"
      width="180" height="180" /></td>
      <td><img src="../imagenes/foto_cristina_3.png" width="180"
      height="180" class="foto" /></td>
      <td><img class="foto" src="../imagenes/foto_ester_2.png"
      width="180" height="180" /></td>
    </tr>
    <tr align="center">
      <td>Carmen L&oacute;pez</td>
      <td>Maribel Amat</td>
      <td>Cristina Ferret</td>
      <td>Esther L&oacute;pez</td>
    </tr>
```

```
    </table>
<P class="titulo_contenido">Agraïments</P>
<p class="texto">A les mares dels nadons ingressats en la nostra
      Unitat Neonatal, per haver col.laborat tan generosament deixant
      que les nostres càmeres captessin la seva intimitat.<br />
A Roser Capdevila per haver il.lustrat amb el seu llapis el nostre
      lloc web.</p>
```

Parents' area access page

Screenshot C.1.5. Parents' area access page. By logging in, parents can access to their exclusive area. Nurses and healthcare professionals can access to their special area by clicking to the link in the lower right corner of the page. Translation from original version in Catalan: *Header:* "Babies at home". *Menu-bar:* "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". *Content:*"Online baby follow-up. Access to this section is exclusively for parents registered to the online baby follow-up service.", "Login. Your e-mail address. Your password. Enter.", "Forgot your password?", "Healthcare professionals".

"acceso.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);
  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
```

```
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}}
// *** Validate request to login to this site.
session_start();
$loginFormAction = $_SERVER['PHP_SELF'];
if (isset($_GET['accesscheck'])) {
  $_SESSION['PrevUrl'] = $_GET['accesscheck'];
}
if (isset($_POST['usuario_email'])) {
  $loginUsername=$_POST['usuario_email'];
  $password=$_POST['contrasena'];
  $fecha= date ( "Y-m-d" , time() );
  $MM_fldUserAuthorization = "";
  $MM_redirectLoginSuccess = "index.php?p=pagina_principal";
  $MM_redirectLoginFailed = "acceso.php?l=error";
  $MM_redirecttoReferrer = false;
  mysql_select_db($database_conexion, $conexion);

  //consulta base de datos para ver si el paciente tiene acceso o no
  mysql_select_db($database_conexion, $conexion);
$query_consulta_acceso = "SELECT acceso FROM usuarios WHERE
    email='$loginUsername'";
$consulta_acceso = mysql_query($query_consulta_acceso, $conexion) or
    die(mysql_error());
$row_consulta_acceso = mysql_fetch_assoc($consulta_acceso);
$totalRows_consulta_acceso = mysql_num_rows($consulta_acceso);
$LoginRS__query=sprintf("SELECT email, contrasena FROM usuarios WHERE
    email='%s' AND contrasena='%s'",
  get_magic_quotes_gpc() ? $loginUsername :
    addslashes($loginUsername), get_magic_quotes_gpc() ? $password :
    addslashes($password));
  $LoginRS = mysql_query($LoginRS__query, $conexion) or
    die(mysql_error());
  $loginFoundUser = mysql_num_rows($LoginRS);
  if ($loginFoundUser) {
    $loginStrGroup = "";
//declare session variables and assign them
    $_SESSION['MM_Username'] = $loginUsername;
$_SESSION['MM_UserGroup']="";
$_SESSION['MM_fecha']= $fecha;

    if (isset($_SESSION['PrevUrl']) && false) {
      $MM_redirectLoginSuccess = $_SESSION['PrevUrl'];
    }
  if ($row_consulta_acceso['acceso']=="actiu"){
```

```
  header("Location: " . $MM_redirectLoginSuccess );
  }
  else {
echo "<script type=text/javascript>
alert ('usuari donat de baixa');
document.getElementById('usuario_email').focus(); </script>";
}
    }
  else {
    header("Location: ". $MM_redirectLoginFailed );
  }
mysql_free_result($consulta_acceso);}
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Acceso</title>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php // google analytics
include_once("analytics.php") ?>
<?php include("include_petits/cabecera_petits.php") ?>
<?php include("include_petits/menu_principal_petits.php");?>
<div id="contenido">
<P class="titulo_contenido">Seguiment on line del nadó</P>
<P class="texto">L'accés a aquesta secció és exclusiu pels pares
      registrats al servei de seguiment on line.</P>
<form name="form1" method="POST" action="<?php echo $loginFormAction;
      ?>">
    <table width="85%" border="0" align="center" cellpadding="0"
      cellspacing="3">
    <tr>
      <td width="19%"></td>
      <td width="81%" class="titulo">Accedir</td>
    </tr>
    <tr>
      <td align="right" class="formulario">El seu correu
      electr&ograve;nic:</td>
      <td><input type="text" name="usuario_email" id="usuario_email"
      class="caja_texto"></td>
    </tr>
    <tr>
      <td align="right" class="formulario">La seva contrasenya:</td>
      <td><input type="password" name="contrasena" id="contrasena"
      class="caja_texto"></td>
    </tr>
    <tr>
      <td> </td>
      <td class="formulario"><input name="acceso" type="submit"
      id="acceso" value="Entrar" align="bottom">
     <a href="contrasena_olvidada.php" target="_self">&iquest;No
      recorda la seva contrasenya?</a></td>
    </tr>
    <tr>
      <td colspan="2"> </td>
```

```
      </tr>
      <tr>
        <td> </td>
        <td class="formulario2"> </td>
      </tr>
      <tr>
        <td> </td>
        <td class="formulario2"></td>
      </tr>
    </table>
    </form>
<p align="right"><a href="acceso_enfermera.php">Professionals</a></p>
<?php
if (isset($_GET['l'])){
$login=$_GET['l'];
if($login=="error"){
echo "<script type=text/javascript>
alert ('correu electrònic i/o contrasenya incorrectos');
document.getElementById('usuario_email').focus(); </script>";
}}?>
</div>
<?php @include("include/pie.php");?>
</body>
```

Retrieve password page

Screenshot C.1.6 Retrieve password page. Inserting their e-mail address, the parents receive automatically an e-mail which contains their password to access the Parents' area of "Babies at home". Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Content: "Retrieve your password"; "E-mail address"; "Submit".

"contrasena_olvidada.php" script:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Recuperació contrasenya</title>
```

```
<script type="text/javascript"
      src="javascript/verificacion.js"></script>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php include("include/cabecera.php") ?>
<div id="contenido">
<form name="form1" method="POST" action="envio_email_contrasena.php"
      onsubmit="return validacion_email_contrasena(this)">
  <p> </p>
  <table width="85%" border="0" align="center" cellpadding="0"
      cellspacing="3">
    <tr>
      <td width="19%"> </td>
      <td width="81%" class="titulo">Recuperació contrasenya</td>
    </tr>
    <tr>
      <td align="right" class="formulario">Correu electrónic:</td>
      <td><input type="text" name="usuario_email" id="usuario_email"
      class="caja_texto"></td>
    </tr>
    <tr>
      <td> </td>
      <td class="formulario"><input type="submit" name="button"
      id="button" value="Enviar" /></a>
       </td>
    </tr>
    <tr>
      <td colspan="2"> </td>
    </tr>
    <tr>
      <td> </td>
      <td class="formulario2"> </td>
    </tr>
    <tr>
      <td><input name="quest_satisfaccio" type="hidden" value="no"
      /></td>
      <td> </td>
    </tr>
  </table>
  </form>
</div>
</body>
</html>
```

"envio_mail_contrasena.php" script:

```
<?php require_once('Connections/conexion.php');
if (isset($_POST['usuario_email'])) {

$usuario = $_POST['usuario_email'];
$questionari_satisfaccio=$_POST['quest_satisfaccio'];

mysql_select_db($database_conexion, $conexion);
$query_consulta_contrasena ="SELECT contrasena FROM usuarios WHERE
      email = '$usuario'";
```

```php
$consulta_contrasena = mysql_query($query_consulta_contrasena,
      $conexion) or die(mysql_error());
$row_consulta_contrasena = mysql_fetch_assoc($consulta_contrasena);
$totalRows_consulta_contrasena = mysql_num_rows($consulta_contrasena);
}?>
<?php
require_once('PHPMailer_v5.1/class.phpmailer.php');
$mail= new PHPMailer();
$body = "La seva contrasenya per accedir a la web PETITS A CASA és: ".
      $row_consulta_contrasena['contrasena'];
//$mail->AddReplyTo("contrasenyapetitsacasa@santpau.cat","PETITS A
      CASA");
$mail->SetFrom('noreplypetitsacasa@santpau.cat', 'PETITS A CASA');
//$mail->AddReplyTo("contrasenyapetitsacasa@santpau.cat","PETITS A
      CASA");
$address =$usuario;
$mail->AddAddress($address, "USUARI");
$mail->Subject    = "Recuperació contrasenya accés PETIS A CASA";
$mail->AltBody    = "To view the message, please use an HTML
      compatible email viewer!"; // optional, comment out and test
$mail->MsgHTML($body);
if(!$mail->Send()) {
  echo "Mailer Error: " . $mail->ErrorInfo;
}

//va a pagina de acceso
if ($questionari_satisfaccio=='si'){?>
<script type="text/javascript">
    alert('Su contraseña se ha enviado a su correo electrónico.');
    document.location.href="acceso_questionari_satisfaccio.php";
</script>
<?php }
else {?>
<script type="text/javascript">
    alert('Su contraseña se ha enviado a su correo electrónico.');
    document.location.href="acceso.php";
</script>
<?php }
mysql_free_result($consulta_contrasena);
?>
```

Staff area access page

Screenshot C.1.7. Staff area access page. By logging in, neonatal nurses and physician in charge of the Internet-based monitoring can access to their personal area. Translation from original version in Catalan: Header: "Babies at home". Menu-bar: "Home", "Tips for baby care", "Useful links", "Online baby follow-up", "About us". Content :"Staff area access. Username; Password; Login".

"acceso_enfermera.php" script:

```php
<?php require_once('Connections/conexion.php');
// *** Validate request to login to this site.
if (!isset($_SESSION)) {
  session_start();
}

$loginFormAction = $_SERVER['PHP_SELF'];
if (isset($_GET['accesscheck'])) {
  $_SESSION['PrevUrl'] = $_GET['accesscheck'];
}
if (isset($_POST['usuario'])) {
  $loginUsername=$_POST['usuario'];
  $password=$_POST['contrasena'];
  $fecha= date ( "Y-m-d" , time() );
  $hora= date ( "G:i" , time() );
  $MM_fldUserAuthorization = "";
  $MM_redirectLoginSuccess = "lista_nadons.php";
  $MM_redirectLoginFailed = "acceso_enfermera.php?l=error";
  $MM_redirecttoReferrer = false;
  mysql_select_db($database_conexion, $conexion);
  $LoginRS__query=sprintf("SELECT usuario, contrasena FROM enfermeras
      WHERE usuario=%s AND contrasena=%s",
    GetSQLValueString($loginUsername, "text"),
      GetSQLValueString($password, "text"));

  $LoginRS = mysql_query($LoginRS__query, $conexion) or
      die(mysql_error());
  $loginFoundUser = mysql_num_rows($LoginRS);
  if ($loginFoundUser) {
```

```php
    $loginStrGroup = "";

    //declare two session variables and assign them
    $_SESSION['MM_Username'] = $loginUsername;
    $_SESSION['MM_UserGroup'] = $loginStrGroup;
$_SESSION['MM_fecha']= $fecha;
$_SESSION['MM_hora']= $hora;
    if (isset($_SESSION['PrevUrl']) && false) {
      $MM_redirectLoginSuccess = $_SESSION['PrevUrl'];
    }
    header("Location: " . $MM_redirectLoginSuccess );
  }
  else {
    header("Location: ". $MM_redirectLoginFailed );
  }
}
?>
```

```html
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Acc&eacute;s professionals</title>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php include("include_petits/cabecera_petits.php") ?>
<?php include("include_petits/menu_principal_petits.php");?>
<div id="contenido">
<form action="<?php echo $loginFormAction; ?>" method="POST"
      name="form1" id="form1">
  <p> </p>
  <table width="85%" border="0" align="center" cellpadding="0"
     cellspacing="3">
    <tr>
      <td width="19%"></td>
      <td width="81%" class="titulo_contenido">Acc&eacute;s
      professionals</td>
    </tr>
    <tr>
      <td align="right" class="formulario">Nom d'usuari:</td>
      <td><input type="text" name="usuario" id="usuario"
      class="caja_texto" /></td>
    </tr>
    <tr>
      <td align="right" class="formulario">Contrasenya:</td>
      <td><input type="password" name="contrasena" id="contrasena"
      class="caja_texto" /></td>
    </tr>
    <tr>
      <td> </td>
      <td class="formulario"><input name="acceso" type="submit"
      id="acceso" value="Entrar" align="bottom" />
        </td>
    </tr>
    <tr>
      <td colspan="2"> </td>
    </tr>
```

```
        <tr>
          <td> </td>
          <td class="formulario2"> </td>
        </tr>
        <tr>
          <td> </td>
          <td> </td>
        </tr>
      </table>
  </form>
<?php
if (isset($_GET['l'])){
$login=$_GET['l'];
if($login=="error"){
echo "<script type=text/javascript>
alert ('usuari i/o contrasenya incorrectos');
document.getElementById('usuario').focus(); </script>";
}}?>
</div>
<?php @include("include/pie.php");?>
</body>
</html>
```

C.1.2 Staff area

From this area the medical staff can perform the remote monitoring of the patients registered to the "Babies at home" website. The access is permitted only after a login with correct credentials. If the username and/or password inserted are incorrect, the user is automatically redirected to the Staff area access page.

In this case, a core file was not used since all the webpages of this area contain the include command which recall the main structure elements of each page. The header and foot are similar to the ones in the free access area pages, while the main menu has different tabs.

"menu_enfermera.php" script:

```php
<?php
//initialize the session
if (!isset($_SESSION)) {
  session_start();
}
// ** Logout the current user. **
$logoutAction = $_SERVER['PHP_SELF']."?doLogout=true";
if ((isset($_SERVER['QUERY_STRING'])) && ($_SERVER['QUERY_STRING'] !=
      "")){
  $logoutAction .="&". htmlentities($_SERVER['QUERY_STRING']);
}
if ((isset($_GET['doLogout'])) &&($_GET['doLogout']=="true")){
  //to fully log out a visitor we need to clear the session variables
  $_SESSION['MM_Username'] = NULL;
  $_SESSION['MM_UserGroup'] = NULL;
  $_SESSION['PrevUrl'] = NULL;
  unset($_SESSION['MM_Username']);
  unset($_SESSION['MM_UserGroup']);
  unset($_SESSION['PrevUrl']);
  $logoutGoTo = "index_petits.php";
  if ($logoutGoTo) {
    header("Location: $logoutGoTo");
    exit;
  }
}
?>
<ul class="Menu">
  <li><a href="lista_nadons.php">Historial nadons</a></li>
  <li><a href="lista_accesos.php">Finalització accés a la web</a></li>
  <li><a href="registro.php">Inscripció nou pacient</a></li>
  <li><a href="cambio_contrasena_enf.php">Canvi contrasenya</a></li>
  <li><a href="<?php echo $logoutAction ?>">Tancar sessió</a></li>
 </ul>
```

Here below, each page of the Staff area is presented by showing the page screenshot and the corresponding script.

Babies' records page

Screenshot C.1.8 Babies' records page in the Staff area. In this page professionals can find the list of the babies registered to "Babies at home" website and, by selecting the records one by one, they can monitor parents' answers to the questionnaires retrieved from the database, shown in dynamic Flash charts, and contact via e-mail with the families. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar: "Baby's record", "Deregister a baby", "Register a baby", "Log out". Content: "Babies' records. History number. Initials. E-mail. Registration date. Gestational age. Last answer. Last report. Access." Button: "See baby's record".

"lista_nadons.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}
$MM_restrictGoTo = "index_petits.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
?>
<?php
$maxRows_lista_nens = 50;
$pageNum_lista_nens = 0;
if (isset($_GET['pageNum_lista_nens'])) {
  $pageNum_lista_nens = $_GET['pageNum_lista_nens'];
```

```
}
$startRow_lista_nens = $pageNum_lista_nens * $maxRows_lista_nens;

mysql_select_db($database_conexion, $conexion);
$query_lista_nens = "SELECT usuarios.historial, usuarios.iniciales,
      usuarios.email, usuarios.edad_gestacional, usuarios.acceso,
      usuarios.fecha_alta, usuarios.fecha_ultima_respuesta, sub.fecha
      FROM (SELECT * FROM respuestas ORDER BY fecha DESC)sub RIGHT
      JOIN usuarios ON usuarios.email=sub.usuario_email group by
      usuarios.email ORDER BY usuarios.fecha_alta DESC";
$query_limit_lista_nens = sprintf("%s LIMIT %d, %d",
      $query_lista_nens, $startRow_lista_nens, $maxRows_lista_nens);
$lista_nens = mysql_query($query_limit_lista_nens, $conexion) or
      die(mysql_error());
$row_lista_nens = mysql_fetch_assoc($lista_nens);

if (isset($_GET['totalRows_lista_nens'])) {
  $totalRows_lista_nens = $_GET['totalRows_lista_nens'];
} else {
  $all_lista_nens = mysql_query($query_lista_nens);
  $totalRows_lista_nens = mysql_num_rows($all_lista_nens);
}
$totalPages_lista_nens =
      ceil($totalRows_lista_nens/$maxRows_lista_nens)-1;
?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
      "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Llista nadons</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1">
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php // google analytics
include_once("analytics.php") ?>
<?php include("include/cabecera.php") ?>
<?php include("menu_enfermera.php") ?>
<div id="contenido">
<p class="titulo_contenido">Historial dels nadons</p>
<form name="form1" method="post" action="respuestas.php">
<table width="100%"  border="0">
      <tr>
       <td class="formulario2">N&deg; de historial</td>
       <td align="center" class="formulario2">Inicials </td>
       <td align="center" class="formulario2">E-mail</td>
       <td align="center" class="formulario2">Inscripci&oacute;</td>
       <td align="center" class="formulario2">Edat gestacional</td>
       <td align="center" class="formulario2">&Uacute;ltima
     resposta</td>
       <td align="center" class="formulario2">&Uacute;ltim
     informe</td>
       <td align="center" class="formulario2">Acc&eacute;s</td>
      </tr>
     <?php do { ?>
     <tr class="texto_lista">
   <td><label><input name="u" type="radio" value="<?php echo
     $row_lista_nens['email']?>">
```

```php
      <?php echo $row_lista_nens['historial']; ?></label></td>
      <td align="center"><?php echo $row_lista_nens['iniciales'];
        ?></td>
      <td align="center"><?php echo $row_lista_nens['email']; ?></td>
      <td align="center"><?php echo $row_lista_nens['fecha_alta'];
        ?></td>
      <td align="center"><?php echo $row_lista_nens['edad_gestacional'];
        ?></td>
      <td align="center"><?php echo $row_lista_nens['fecha']; ?></td>
      <td align="center"><?php echo
        $row_lista_nens['fecha_ultima_respuesta']; ?></td>
      <td align="center"><?php echo $row_lista_nens['acceso']; ?></td>
       </tr>
    <?php } while ($row_lista_nens = mysql_fetch_assoc($lista_nens)); ?>
    <tr>
      <td><input type="submit" name="Submit" value="Veure
        historial"></td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
    </tr>
    </table>
</form>
</div>
<?php include("include/pie.php");?>
</body>
</html>
<?php
mysql_free_result($lista_nens);
?>
```
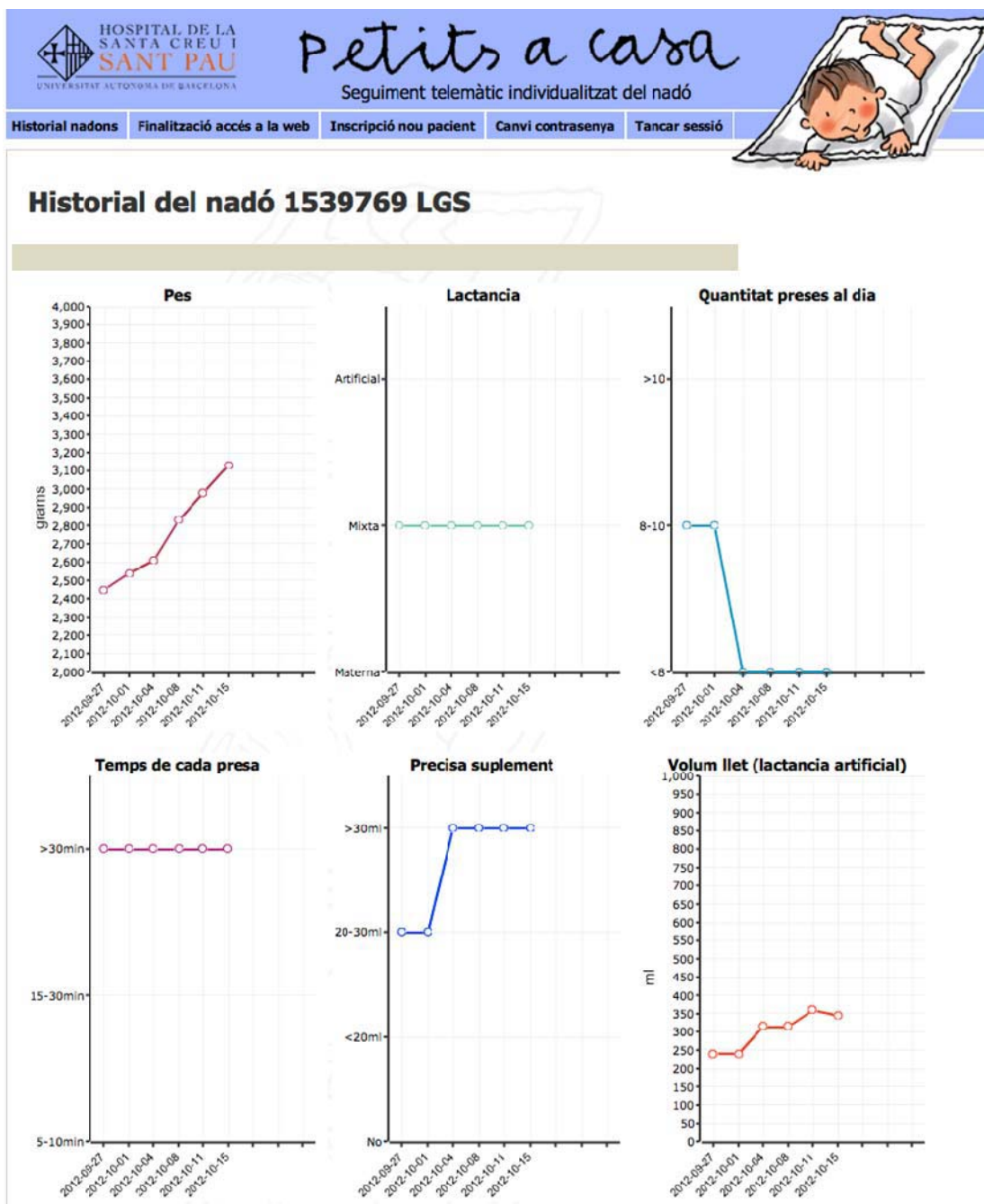
123

<u>Baby's record page</u>

This page retrieves the parents' answers to the questionnaire and displays them in Flash charts. Each Flash chart is issued by a different script in which all the graphical settings are stored. Since these scripts are quite similar among each other, as an example the script corresponding to the "Weight trend" graph is reported.
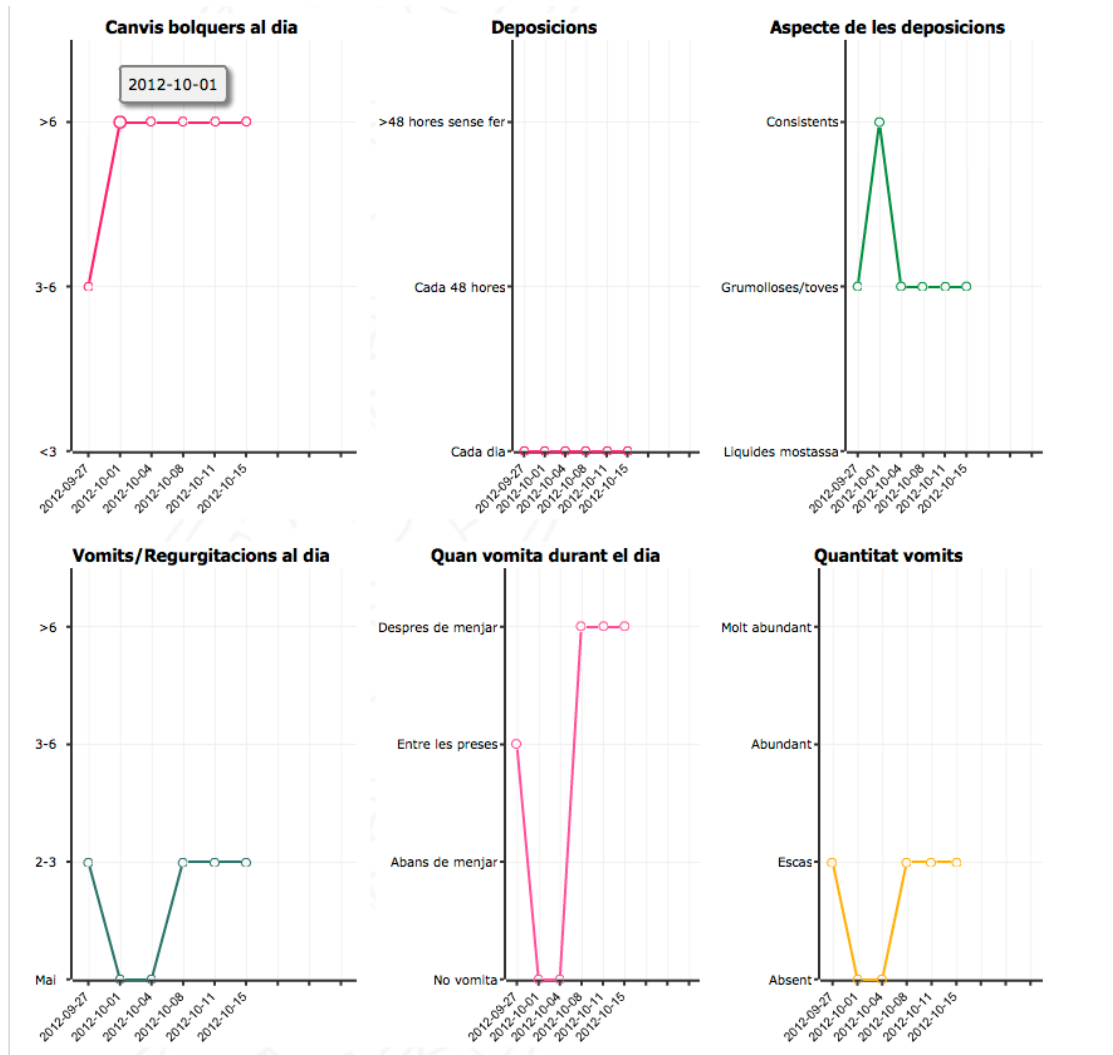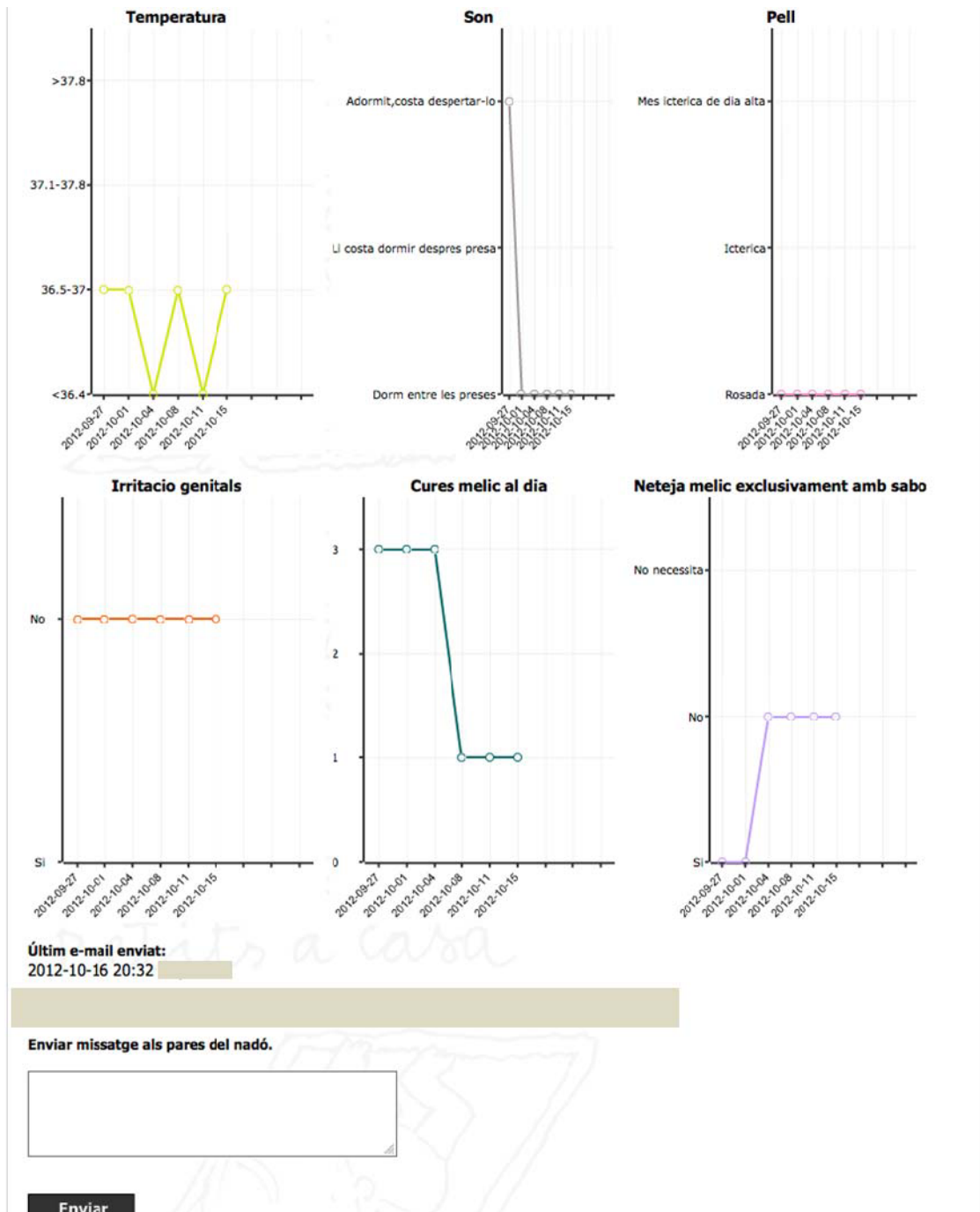
Screenshot C.1.9 Baby's record page. Visualization of the parents' answers to the periodic questionnaire by dynamic Flash charts. Some information has been censored to protect patients confidentiality. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar: "Babies' records", "Deregister a baby", "Register a baby", "Log out". Content: "Record of baby …". Graphs: "Weight, Feeding, Intakes per day, Intake duration, Supplement, Artificial feeding amount, Diapers change amount, Depositions, Depositions appearance, Vomiting/regurgitation per day, Vomiting timing, Vomiting amount, Temperature, Sleep, Skin, Genitals irritation, Navel care per day, Navel cleaning with soap". "Last sent e-mail: 2012-10-16 20:32. Send a message to the baby's parents. Send".

"respuestas.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();
}
$fecha=$_SESSION['MM_fecha'];
//$hora=$_SESSION['MM_hora'];

$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}
$MM_restrictGoTo = "index_petits.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup']))))  {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
```

```php
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}
}
$usuario=$_POST['u'];
//consulta en la BBDD si hay comentarios iniciales sobre el bebé
mysql_select_db($database_conexion, $conexion);
$query_consulta = "SELECT historial, iniciales, comentario FROM
      usuarios WHERE email = '$usuario'";
$consulta = mysql_query($query_consulta, $conexion) or
      die(mysql_error());
$row_consulta = mysql_fetch_assoc($consulta);
$totalRows_consulta = mysql_num_rows($consulta);

//consulta si hay e-mails de la enfermera a los padres
mysql_select_db($database_conexion, $conexion);
$query_consulta_email_enfermera = "SELECT enfermera, consulta, fecha,
      hora FROM consultas_enfermera WHERE usuario = '$usuario' ORDER
      BY fecha DESC, hora DESC";
$consulta_email_enfermera =
      mysql_query($query_consulta_email_enfermera, $conexion) or
      die(mysql_error());
$row_consulta_email_enfermera =
      mysql_fetch_assoc($consulta_email_enfermera);
$totalRows_consulta_email_enfermera =
      mysql_num_rows($consulta_email_enfermera);

$dataurl=urlencode("?u=".$usuario);
?>

<script type="text/javascript" src="include/js/swfobject.js"></script>
```

```
<script type="text/javascript">

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_peso",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "peso_enf-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_lactancia",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "lactancia-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_preses",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "preses-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_temps_presa",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "temps_presa-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_suplement",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "suplement-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_volum_llet",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "volum_llet-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_pipi",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "pipi-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_deposicions",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "deposicions-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_aspecte_deposicions",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "aspecte_deposicions-chart.php".$dataurl;
      ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_vomits",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "vomits-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_moment_vomits",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "moment_vomits-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
```

```
  "include/open-flash-chart.swf", "chart_quantitat_vomits",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "quantitat_vomits-chart.php".$dataurl; ?>"}
      );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_temperatura",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "temperatura-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_son",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "son-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_pell",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "pell-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_irritacio_genitals",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "irritacio_genitals-chart.php".$dataurl;
      ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_cures_melic",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "cures_melic-chart.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "include/open-flash-chart.swf", "chart_sabo_melic",
  "300", "450", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "sabo_melic-chart.php".$dataurl; ?>"} );
</script>

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
      "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Dades nad&oacute;</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1">
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php // google analytics
include_once("analytics.php") ?>
<?php include("include/cabecera.php") ?>
<?php include("menu_enfermera.php") ?>
<div id="contenido">
<p class="titulo_contenido">Historial del nad&oacute; <?php echo
      $row_consulta['historial']." ".$row_consulta['iniciales'];?
      ></p>
<p class="texto"><?php echo $row_consulta['comentario']; ?></p>
<p><div id="chart_peso"></div>
<div id="chart_lactancia"></div>
<div id="chart_preses"></div></p>
```

```
<p><div id="chart_temps_presa"></div>
<div id="chart_suplement"></div>
<div id="chart_volum_llet"></div></p>
<p><div id="chart_pipi"></div>
<div id="chart_deposicions"></div>
<div id="chart_aspecte_deposicions"></div></p>
<p><div id="chart_vomits"></div>
<div id="chart_moment_vomits"></div>
<div id="chart_quantitat_vomits"></div></p>
<p><div id="chart_temperatura"></div>
<div id="chart_son"></div>
<div id="chart_pell"></div></p>
<p><div id="chart_irritacio_genitals"></div>
<div id="chart_cures_melic"></div>
<div id="chart_sabo_melic"></div></p>
<p><span class="formulario2">Últim e-mail enviat:</span><br>
<?php echo $row_consulta_email_enfermera['fecha'];?> <?php echo
      $row_consulta_email_enfermera['hora'];?> <?php echo
      $row_consulta_email_enfermera['enfermera'];?><br><br>
<?php echo $row_consulta_email_enfermera['consulta'];?></p>
<p><span class="formulario2">Enviar missatge als pares del
      nad&oacute;.</span><form name="form1" method="post"
      action="envio_email_enfermera.php">
  <p>
    <textarea name="consulta" id="consulta" cols="45" rows="5"
    class="caja_texto_2"></textarea>
  </p>
  <p>
    <input name="hiddenField" type="hidden" id="hiddenField"
      value="<?php echo $usuario;?>">
    <br>
    <input name="acceso" type="image" id="enviar" value="Enviar"
      src="imagenes/boton_enviar.gif" align="bottom"></p>
</form>
</p></div>
<?php @include("include/pie.php");?>
</body>
</html>
<?php
mysql_free_result($consulta);
mysql_free_result($consulta_email_enfermera);
?>
```

"peso_enf-chart.php" script:

```
<?php require_once('Connections/conexion.php'
include_once 'include/php-ofc-library/open-flash-chart.php';
$db = mysql_select_db('web_neonats', $conexion);

//paso parametro u de usuario
if (isset($_GET['u'])) {$u=$_GET['u'];}

//recoge datos de la base de datos
$result = mysql_query("select * from respuestas where
      usuario_email='$u' order by fecha");
$data = array();
while($row = mysql_fetch_array($result))
```

```
{
  $data[] = intval($row['peso']);}

//recoge fecha de las bases de datos
$result_fecha = mysql_query("select * from respuestas where
      usuario_email='$u' order by fecha");
$fecha = array();
while($row = mysql_fetch_array($result_fecha))
{
  $fecha[] = ($row['fecha']);}

//creo chart
$chart = new open_flash_chart();

//titulo
$title = new title( 'Pes' );
$title->set_style( "{font-size: 14px; font-family: Tahoma; font-
      weight: bold; text-align: center;}" );
$chart->set_title( $title );
$chart->set_bg_colour( '#FFFFFF' );

//line and dots
$d = new hollow_dot();
$d->colour('#AD234B')->size(4)->halo_size(0);
$area = new area();
$area->set_width( 2 );
$area->set_default_dot_style($d);
$area->set_colour( '#AD234B' );
$area->set_values( $data );
$chart->add_element( $area );

//x axis
$x_labels = new x_axis_labels();
$x_labels->rotate(315);
$x_labels->set_labels( $fecha );
$x_axis = new x_axis();
$x_axis->set_colour( '#333333' );
$x_axis->set_range( 0, 8, 1 );
$x_axis->set_grid_colour( '#F0F0F0' );
$x_axis->set_labels( $x_labels );
//$x_axis->offset(false)->steps(1);

//y axis and legend
$y_legend = new y_legend( 'grams' );
$y_legend->set_style( '{font-size: 14px; font-family: Tahoma}' );
$chart->set_y_legend( $y_legend );
$y_axis = new y_axis();
$y_axis->set_colour( '#333333' );
$y_axis->set_range( 2000, 4000, 100 );
$y_axis->set_grid_colour( '#F0F0F0' );

//adding new x & y axis
$chart->set_x_axis( $x_axis );
$chart->add_y_axis( $y_axis );

echo $chart->toPrettyString();?>
```

Deregistration page

Screenshot C.1.10 Deregistration page in the Staff area. In this page professionals, by picking out a record from the list, can deregister a patient from "Babies at home" website when the Internet-base follow-up has finalized. They can also send an invitation by e-mail to the parents to fill out the final satisfaction questionnaire. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar: "Baby's record", "Deregister a baby", "Register a baby", "Log out". Content: "Deregistration. History number. Initials. E-mail. Registration date. Last answer. Access. Satisfaction questionnaire". "Deregister".

"lista_accesos.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();
}
```

```php
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;
  // When a visitor has logged into this site, the Session variable
       MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
       variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}
$MM_restrictGoTo = "index_petits.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
?>
<?php
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);
```

```php
  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}}
$maxRows_lista_nens = 50;
$pageNum_lista_nens = 0;
if (isset($_GET['pageNum_lista_nens'])) {
  $pageNum_lista_nens = $_GET['pageNum_lista_nens'];
}
$startRow_lista_nens = $pageNum_lista_nens * $maxRows_lista_nens;

mysql_select_db($database_conexion, $conexion);
$query_lista_nens = "SELECT usuarios.historial, usuarios.iniciales,
      usuarios.email, usuarios.acceso, usuarios.fecha_alta, sub.fecha,
      questionari_satisfaccio.fecha_quest FROM (SELECT * FROM
      respuestas ORDER BY fecha DESC)sub RIGHT JOIN (usuarios LEFT
      JOIN questionari_satisfaccio ON
      usuarios.email=questionari_satisfaccio.usuario) ON
      sub.usuario_email=usuarios.email group by usuarios.email ORDER
      BY usuarios.fecha_alta DESC";
$query_limit_lista_nens = sprintf("%s LIMIT %d, %d",
      $query_lista_nens, $startRow_lista_nens, $maxRows_lista_nens);
$lista_nens = mysql_query($query_limit_lista_nens, $conexion) or
      die(mysql_error());
$row_lista_nens = mysql_fetch_assoc($lista_nens);

if (isset($_GET['totalRows_lista_nens'])) {
  $totalRows_lista_nens = $_GET['totalRows_lista_nens'];
} else {
  $all_lista_nens = mysql_query($query_lista_nens);
  $totalRows_lista_nens = mysql_num_rows($all_lista_nens);
}
$totalPages_lista_nens =
      ceil($totalRows_lista_nens/$maxRows_lista_nens)-1;
?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
      "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Llista nadons</title>
```

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```
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1">
<script type="text/javascript"
      src="javascript/verificacion.js"></script>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php // google analytics
include_once("analytics.php") ?>
<?php include("include/cabecera.php") ?>
<?php include("menu_enfermera.php") ?>
<div id="contenido">
<p class="titulo_contenido">Finalitzaci&oacute; accés a la web</p>
<form name="form1" method="post" action="cambio_acceso.php"
      onsubmit="return confirmacion_cambio_acceso()">
  <table width="100%"  border="0">
    <tr align="center">
      <td align="left" class="formulario2">N&deg; de historial</td>
      <td class="formulario2">Inicials</td>
      <td class="formulario2">E-mail</td>
      <td class="formulario2">Inscripci&oacute;</td>
      <td class="formulario2">&ugrave;ltima resposta</td>
      <td class="formulario2">Accés</td>
      <td class="formulario2"> </td>
      <td class="formulario2">Q&uuml;est satisfacci&oacute;</td>
    </tr>
    <?php do { ?>
    <tr align="center" class="texto_lista">
      <td align="left"><label>
        <input name="u" type="radio" value="<?php echo
      $row_lista_nens['email']?>">
        <?php echo $row_lista_nens['historial']; ?></label></td>
      <td align="center"><?php echo $row_lista_nens['iniciales'];
      ?></td>
      <td align="center"><?php echo $row_lista_nens['email']; ?></td>
      <td align="center"><?php echo $row_lista_nens['fecha_alta'];
      ?></td>
      <td align="center"><?php echo $row_lista_nens['fecha']; ?></td>
      <td align="center"><?php echo $row_lista_nens['acceso']; ?></td>
      <td align="center"><?php if ($row_lista_nens['acceso']!='actiu')
      {?>
        <a href="envio_email_questionari_final.php?m=<?php echo
      $row_lista_nens['email']?>">Enviar qüest satisfacció</a>
        <?php }; ?></td>
      <td align="center"><?php echo $row_lista_nens['fecha_quest'];
      ?></td>
      </tr>
    <?php } while ($row_lista_nens = mysql_fetch_assoc($lista_nens));
      ?>
    <tr>
      <td><input type="submit" name="Submit" value="Actualitzar
      accés"></td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
      <td> </td>
```

```
    </tr>
  </table>
</form>
</div>
<?php @include("include/pie.php");?>
</body>
</html>
<?php
mysql_free_result($lista_nens);
?>
```

Registration page

Screenshot C.1.11. Registration page in the Staff area. In this page the professionals can register a new patient to the Internet-based follow-up. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:* "Baby's record", "Deregister a baby", "Register a baby", "Log out". *Content:*"Register a new baby. In case of twins, register them with different e-mail addresses". "History number. Initials. E-mail address. Repeat e-mail address. New password. Gestational age. Comment. Register the baby".

"registro.php" script:

```php
<?php require_once('Connections/conexion.php'); ?>
<?php
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";
// *** Restrict Access To Page: Grant or deny access to this page
```

```php
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
     MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
     variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}
$MM_restrictGoTo = "index_petits.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup']))))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
```

```
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;}}

$editFormAction = $_SERVER['PHP_SELF'];
if (isset($_SERVER['QUERY_STRING'])) {
  $editFormAction .= "?" . htmlentities($_SERVER['QUERY_STRING']);}

$fecha=$_SESSION['MM_fecha'];
mysql_select_db($database_conexion, $conexion);
$query_verificar_nuevo_usuario = "SELECT usuarios.email FROM
      usuarios";
$verificar_nuevo_usuario = mysql_query($query_verificar_nuevo_usuario,
      $conexion) or die(mysql_error());
$row_verificar_nuevo_usuario =
      mysql_fetch_assoc($verificar_nuevo_usuario);
$totalRows_verificar_nuevo_usuario =
      mysql_num_rows($verificar_nuevo_usuario);
$comprobar='OK';
do {
if (isset($_POST['usuario_email'])){
      if
      ($row_verificar_nuevo_usuario['email']==$_POST['usuario_email'])
      {
            $comprobar='error';}}
}
while ($row_verificar_nuevo_usuario =
      mysql_fetch_assoc($verificar_nuevo_usuario));
if ($comprobar=='error') {
echo '<script type="text/javascript">
alert("El correu electrònic introduit ja està registrat.");
document.location.href="registro.php";
</script>';}

if ($comprobar!='error') {
if ((isset($_POST["MM_insert"])) && ($_POST["MM_insert"] == "form1"))
      {
  $insertSQL = sprintf("INSERT INTO usuarios (historial, iniciales,
      email, contrasena, edad_gestacional, comentario, acceso,
      fecha_alta) VALUES (%s, %s, %s, %s, %s, %s,'actiu','$fecha')",
                        GetSQLValueString($_POST['historial'], "text"),
                        GetSQLValueString($_POST['iniciales'], "text"),
                        GetSQLValueString($_POST['usuario_email'],
      "text"),
                        GetSQLValueString($_POST['contrasena'],
      "text"),
```

```
                        GetSQLValueString($_POST['edad_gestacional'],
    "int"),
                        GetSQLValueString($_POST['comentario'],
    "text"));

  mysql_select_db($database_conexion, $conexion);
  $Result1 = mysql_query($insertSQL, $conexion) or die(mysql_error());
$insertGoTo = "lista_nadons.php";
  if (isset($_SERVER['QUERY_STRING'])) {
    $insertGoTo .= (strpos($insertGoTo, '?')) ? "&" : "?";
    $insertGoTo .= $_SERVER['QUERY_STRING'];
  }

  //envio email de ALTA usuario
require_once('PHPMailer_v5.1/class.phpmailer.php');
$mail = new PHPMailer(); // defaults to using php "mail()"
$body = "Benvingut a Petits a casa!<br />";
$body.="Les seves credencials per accedir a la web son:<br /><br />";
$body.="nom d'usuari: ".$_POST['usuario_email']."<br />";
$body.="contrasenya: ".$_POST['contrasena']."<br /><br />";
$body.="Sisplau cliqui <a
      href='http://www.petitsacasa.santpau.cat'><strong>aquí</strong><
      /a> i visiti la secció SEGUIMENT ON LINE DEL NADÓ<br />";
$body.="Agraïm la vostra participació.<br />";
$mail->AddReplyTo("infermerapetitsacasa@santpau.cat","PETITS A CASA");
$mail->SetFrom('infermerapetitsacasa@santpau.cat', 'PETITS A CASA');
$mail->AddReplyTo("infermerapetitsacasa@santpau.cat","PETITS A CASA");
$address = $_POST['usuario_email'];
$mail->AddAddress($address);
$mail->Subject    = "ALTA PETITS A CASA";
$mail->MsgHTML($body);
if(!$mail->Send()) {
  echo "Mailer Error: " . $mail->ErrorInfo;}
  header(sprintf("Location: %s", $insertGoTo)); // Salto a pag.
      principal
}}
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Registro</title>
<script type="text/javascript"
      src="javascript/verificacion.js"></script>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php // google analytics
include_once("analytics.php") ?>
<?php include("include/cabecera.php") ?>
<?php include("menu_enfermera.php") ?>
<div id="contenido">
<form action="<?php echo $editFormAction; ?>" method="POST"
      name="form1" id="form1" onsubmit="return
      validacion_registro(this)">
  <p> </p>
```

```html
<table width="85%" border="0" align="center" cellpadding="0"
   cellspacing="3">
  <tr>
    <td width="19%"> </td>
    <td width="81%" class="titulo_contenido"><p>Inscripci&oacute;
    nou nad&oacute;</p>        </td>
  </tr>
  <tr>
    <td align="right" class="formulario"> </td>
    <td align="left" class="formulario">Si son bessons,
      registra'ls amb correus electrònics diferents</td>
  </tr>
  <tr>
    <td align="right" class="formulario">N&deg; historial del
    nad&oacute;:</td>
    <td><input type="text" name="historial" id="historial"
    class="caja_texto" /></td>
  </tr>
  <tr>
    <td align="right" class="formulario">Inicials del
    nad&oacute;:</td>
    <td><input name="iniciales" type="text" class="caja_texto"
    id="iniciales" maxlength="3" /></td>
  </tr>
  <tr>
    <td align="right" class="formulario">Correu
    electr&ograve;nic:</td>
    <td class="formulario"><input type="text" name="usuario_email"
    id="usuario_email" class="caja_texto" /></td>
  </tr>
  <tr>
    <td align="right" class="formulario">Torna a escriure el correu
    electr&ograve;nic:</td>
    <td><input type="text" name="email_confirmacion"
    id="email_confirmacion" class="caja_texto" /></td>
  </tr>
  <tr>
    <td align="right"class="formulario">Nova contrasenya:</td>
    <td class="formulario"><input type="password" name="contrasena"
    id="contrasena" class="caja_texto" /></td>
  </tr>
  <tr>
    <td align="right"class="formulario">Edat gestacional:</td>
    <td class="formulario"><input name="edad_gestacional"
    type="text" class="caja_texto" id="edad_gestacional"
    maxlength="2" /></td>
  </tr>
  <tr>
    <td align="right"class="formulario">Comentari:</td>
    <td class="formulario"><textarea name="comentario" cols="50"
    rows="5" class="texto" id="comentario"></textarea></td>
  </tr>
  <tr>
    <td> </td>
    <td><p>
      <input type="submit" value="Inscriu el nadó" name="registro"
    id="registro"/>
      </p></td>
  </tr>
```

```
    </table>
    <input type="hidden" name="MM_insert" value="form1" />
</form>
</div>
<?php @include("include/pie.php");?>
</body>
<?php
mysql_free_result($verificar_nuevo_usuario);
?>
```

Password change page

Screenshot C.1.12. Password change page in the Staff area. In this page the professionals can change their password to access to their personal area anytime. By clicking to "Export data" they can also export data from the database in MS Excel format. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:* "Baby's record", "Deregister a baby", "Register a baby", "Log out". *Content:*"Password change. Your username. Your password. Your new password. Send". "Export data".

"cambio_contrasena_enf.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
```

```php
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid; }

$MM_restrictGoTo = "index_petits.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
      "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Llista nadons</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1">
<script type="text/javascript"
      src="javascript/verificacion.js"></script>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>

<body>
<?php include("include/cabecera.php") ?>
<?php include("menu_enfermera.php") ?>
<div id="contenido">
<form name="form1" method="POST"
      action="envio_cambio_contrasena_enf.php" onsubmit="return
      validacion_contrasena_nueva_enf(this)">
  <p> </p>
  <table width="85%" border="0" align="center" cellpadding="0"
      cellspacing="3">
    <tr>
      <td width="24%"> </td>
      <td width="76%" class="titulo">Canvi contrasenya</td>
```

```
        </tr>
        <tr>
          <td align="right" class="formulario">El seu nom d'usuari:</td>
          <td><input type="text" name="usuario_email" id="usuario_email"
          class="caja_texto"></td>
        </tr>
        <tr>
          <td align="right"><span class="formulario">La seva contrasenya
          antiga:</span></td>
          <td class="formulario"><input type="password" name="contrasena"
          id="contrasena" class="caja_texto" /></td>
        </tr>
        <tr>
          <td align="right"><span class="formulario">La seva nova
          contrasenya:</span></td>
          <td class="formulario"><input type="password"
          name="nueva_contrasena" id="nueva_contrasena" class="caja_texto"
          /></td>
        </tr>
        <tr>
          <td> </td>
          <td class="formulario"><input type="submit" name="button"
          id="button" value="Enviar" /></a>
          </td>
        </tr>
        <tr>
          <td colspan="2"> </td>
        </tr>
    </table>
</form>
</div>
<?php @include("include/pie.php");?>
</body>
</html>
```

C.1.3 Parents' area

In this area parents can find the questionnaire about their baby's conditions which are asked to answer twice a week. From this personal area they can also send a message to the nurse in charge of the Internet-based baby's monitoring. This area can be accessed by login just by parents registrated to "Babies at home" web application. If the username and/or password inserted are incorrect, the user is automatically redirected to the Parents' area access page.

As for the Free access area, the core of each page of this area is the file "index.php", which contains all the structure elements of the page recalled by the include command. By selecting a tab of the main menu, a different content is included in the page. The header and foot are similar to the ones in the two areas previously described showed, while the main menu has different tabs.

"index.php" script:

```php
<?php
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";
$loginUsername=$_SESSION['MM_Username'];
$UserGroup=$_SESSION['MM_UserGroup'];
// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
     MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
     variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
```

```
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}

$MM_restrictGoTo = "index_petits.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;}?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Petits a casa</title>
<script type="text/javascript"
      src="javascript/verificacion.js"></script>
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php $pagina=$_GET['p'];
if($pagina<=""){
$pagina="acceso";
}?>
<?php @include("include/cabecera.php");?>
<?php @include("include/menu_principal.php");?>
<div id="contenido">
<?php @include("include/".$pagina. ".php");?>
</div>
<?php @include("include/pie.php");?>
</body>
</html>
```

"menu_principal.php" script:

```
<?php
//initialize the session
if (!isset($_SESSION)) {
  session_start();}
// ** Logout the current user. **
$logoutAction = $_SERVER['PHP_SELF']."?doLogout=true";
if ((isset($_SERVER['QUERY_STRING'])) && ($_SERVER['QUERY_STRING'] !=
      "")){
  $logoutAction .="&". htmlentities($_SERVER['QUERY_STRING']);
}
```

```php
if ((isset($_GET['doLogout'])) &&($_GET['doLogout']=="true")){
  //to fully log out a visitor we need to clear the session varialbles
  $_SESSION['MM_Username'] = NULL;
  $_SESSION['MM_UserGroup'] = NULL;
  $_SESSION['PrevUrl'] = NULL;
  unset($_SESSION['MM_Username']);
  unset($_SESSION['MM_UserGroup']);
  unset($_SESSION['PrevUrl']);
  $logoutGoTo = "index_petits.php";
  if ($logoutGoTo) {
    header("Location: $logoutGoTo");
    exit;
  }
}
?>
<ul class="Menu">
  <li><a href="index.php?p=pagina_principal">Introducció</a></li>
  <li><a
      href="index.php?p=inicio_cuestionario">Q&uuml;estionari</a></li>
  <li><a href="su_historial.php">Evoluci&oacute; del pes</a></li>
  <li><a href="index.php?p=consulta_enfermeria">Consulta a la
      infermera</a></li>
  <li><a href="index.php?p=consulta_webmaster">Ajuda tècnica</a></li>
  <li><a href="<?php echo $logoutAction ?>">Tancar sessió</a></li>
 </ul>
```

Here below, each page of the Parents' area is presented by showing the page screenshot and the corresponding script.

Welcome page

Screenshot C.1.13 Welcome page of the Parents' area. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content: "Welcome! The home care program of the Neonatal Unit of Hospital de la Santa Creu i Sant Pau welcomes you to its website for the Internet-based baby follow-up. This personal space, to which only you can access, is a support tool for monitoring your child after discharge from the neonatal unit or hospitalization unit. The aim of the website is online monitor your baby through a questionnaire which you should complete regularly and we will evaluate. Use the menu to browse the different sections of the website. To change your password click here."

"pagina_principal.php" script:

```
<P class="titulo_contenido">Benvinguts!</P>
<P class="texto"><img src="imagenes/nenescasa143.JPG" width="255"
      height="190" hspace="10" align="right" class="foto" />El
      programa d'assistència domiciliaria de la Unitat de Neonatologia
      del Hospital de la Santa Creu i Sant Pau us dóna la benvinguda a
      la seva pàgina de seguiment dels nadons. Aquest espai personal,
      al què només vosaltres podeu accedir, és una eina de suport per
      al seguiment del vostre fill un cop donat d'alta de la Unitat
      Neonatal o de la Unitat d'Hospitalització.
</P>
<P class="texto">L'objectiu de la pàgina web del nadó en línia és fer
      el seguiment del bebè mitjançant un qüestionari que haureu
      d'omplir i que nosaltres avaluarem.
```

```
</P>
<br/>
<P class="formulario2">Feu servir el menú per navegar per les
     diferents seccions del lloc web. </P>
<br/>
<P class="texto">Per canviar la seva contrasenya cliqui <a
     href="index.php?p=cambio_contrasena">aquí</a>.<br/><span
     class="instruccion">Para cambiar su contraseña clique <a
     href="index.php?p=cambio_contrasena">aquí</a>.</span>
</P>
```

Questionnaire start page

From this page the parents can start to answer the questionnaire about their baby's status. Each answer is temporary saved and all answers are sent as an array at the end of the questionnaire.

Screenshot C.1.14. Questionnaire start page in the Parents' area. From this page, the parents can start to fill out the periodical questionnaire about their baby's status. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*"Questionnaire about your baby. From this page you can access a questionnaire that you should fill out twice a week (Mondays and Thursdays). You will find questions about your baby, feeding, urination and bowel movements, vomiting, control of temperature, navel care, state of the diaper area, sleep, etc..The nurse in charge of the home care program will evaluate and monitor the baby through your answers and see whether the evolution of the baby is adequate. If necessary, the nurse will indicate whether to make any changes in your baby care. Remember to fill out the questionnaire every Mondays and Thursdays. Start".

"inicio_questionario.php" script:

```
<p class="titulo_contenido">Q&uuml;estionari sobre el nad&oacute;</p>
<p class="texto">En aquesta pàgina podeu accedir a un qüestionari que
     haureu de contestar dues vegades per setmana (dilluns i dijous).
     Trobareu preguntes relacionades amb el nadó, la seva
     alimentació, les miccions i deposicions, si presenta vòmits, el
```

```
        control de la temperatura, la cura del melic, l'estat de la zona
        del bolquer, el son, etc.</p>
<p class="texto">La infermera responsable del programa d'assistència
        domiciliària avaluarà i farà el seguiment del nadó mitjançant
        les vostres respostes i us informarà de si l'evolució del bebè
        és l'adequada. Si cal, indicarà si s'ha de fer algun canvi en la
        seva cura.
</p>
<P class="formulario2"> Recordeu-vos d'omplir el q&uuml;estionari
        dilluns i dijous de cada setmana.</P>
<P><table width="100%" border="0" cellspacing="0" cellpadding="0">
  <tr>
    <td align="center"><a
        href="index.php?p=pregunta_1"/>Comen&ccedil;ar</a>
    </td>
  </tr></table></P></form>
```

Question #1

Screenshot C.1.15 Question #1. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 1) What is the weight of the baby? Remember to weigh the baby every 4 days for the duration of the monitoring. You can do this on a scale at home with the naked baby or at the pharmacy with the dressed baby, trying to do with the same or similar clothes and always in the same way. Please, put the weight in grams. Next".

"pregunta_1.php" script:

```
<p><span class="pregunta">1) Quin és el pes del nadó? </span><span
      class="instruccion">¿Cual es el peso del recién
      nacido?</span></p>
<p><span class="pregunta">Recordeu que heu de pesar al nadó cada 4
      dies mentre duri el seguiment. Ho podeu fer en una bàscula a
      casa amb el bebè despullat o a la farmàcia amb el nen vestit,
      procurant fer-ho amb la mateixa roba o similar i sempre de la
      mateixa manera.</span><br/><img src="imagenes/DSC02609.JPG"
```

```
      width="255" height="190" hspace="20" vspace="20" align="right"
      class="foto" /></p>
<span class="instruccion">Recuerden que deben pesar al bebé cada 4
      días mientras dure el seguimiento. Pueden hacerlo en una báscula
      en casa con el bebé desnudo o en la farmacia con el niño
      vestido, procurando hacerlo con la misma ropa o similar y
      siempre de la misma manera.</span>
<p><span class="pregunta">Sisplau, poseu el pes en grams. </span><span
      class="instruccion">Por favor, pongan el peso en gramos.
      </span></p>
<form id="form1" name="form1" method="post"
      action="envio_respuesta.php?pregunta=1">
  <p class="texto">
    <input name="respuesta" type="text" id="peso" tabindex="1"
      size="4" maxlength="4" class="caja_texto_2"/>
     grams
  </p>
  <p><input type="button" name="button" id="button" value="Següent"
      onclick="validar_1()" />
  </p>
</form>
```

Question #2

Screenshot C.1.16 Question #2. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 2) How do you feed the baby? Exclusive breastfeeding. Mixed feeding or breastfeeding with supplements. Artificial feeding. Next".

"pregunta_2.php" script:

```
<p><span class="pregunta">2) Quina alimentació fa el nadó?
      </span><span class="instruccion">¿Qué alimentación hace su
      hijo?</span></p>
<form id="form2" name="form2" method="post"
      action="envio_respuesta.php?pregunta=2">
```

```
<p>
  <label>
    <input type="radio" name="respuesta" value="0"  />
  <span class="pregunta">Lactància materna exclusiva. </span><span
    class="instruccion">Lactancia materna exclusiva.</span>
    </label><img class="foto" src="imagenes/DSC02512.JPG"
    width="255" height="190" hspace="10" vspace="10" align="right"
    />
  <br />
  <label>
    <input type="radio" name="respuesta" value="1"  />
  <span class="pregunta">Lactància mixta o alletament matern amb
    suplements.</span><br />    <span
    class="instruccion">   Lactancia mixta o lactancia materna con
    suplementos.</span></label>
  <br />
  <label>
    <input type="radio" name="respuesta" value="2"  />
  <span class="pregunta">Lactància artificial. </span><span
    class="instruccion">Lactancia artificial.</span></label>
  <br />
  <p>
  <input type="button" name="button" id="button" value="Següent"
    onclick="validar_2(form2)" /></p>
</form>
```

Question #3

Screenshot C.1.17 Question #3. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 3) How many intakes he/she does in 24 hours? Under 8. Between 8 and 10. Over 10. Next".

"pregunta_3.php" script:

```
<p><span class="pregunta">3) Quantes preses fa en 24 hores?
    </span><span class="instruccion">¿Cuántas tomas hace en 24
    horas?</span></p>
<form id="form3" name="form3" method="post"
    action="envio_respuesta.php?pregunta=3" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Menys de 8. </span><span
      class="instruccion">Menos de 8.</span></label>
    <img src="imagenes/DSC02637.JPG" width="255" height="190"
      hspace="10" vspace="10" align="right" class="foto" />    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
      <span class="pregunta">Entre 8 i 10. </span><span
      class="instruccion">Entre 8 y 10.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
      <span class="pregunta">Més de 10. </span><span
      class="instruccion">Más de 10.</span></label>
    <br />
    <p>
  <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form3)" /></p>
</form>
```

Question #4

Screenshot C.1.18. Question #4. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*" 4) How long each intake takes on average? Between 5 and 10 minutes. Between 10 and 30 minutes. More than 30 minutes. Next.".

"pregunta_4.php" script:

```
<p><span class="pregunta">4) Quanta estona triga cada presa en promig?
    </span><span class="instruccion">¿Cuánto tiempo tarda en cada
    toma en promedio?</span></p>
<form id="form4" name="form4" method="post"
    action="envio_respuesta.php?pregunta=4" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Entre 5 i 10 minuts. </span><span
      class="instruccion">Entre 5 y 10 minutos.</span></label><img
      src="imagenes/DSC02509.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" class="foto" />
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
    <span class="pregunta">Entre 10 i 30 minuts. </span><span
      class="instruccion">Entre 10 y 30 minutos.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
    <span class="pregunta">Més de 30 minuts. </span><span
      class="instruccion">Más de 30 minutos.</span></label>
    <br />
    <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form4)" /></p>
</form>
```

Question #5

Screenshot C.1.19 . Question #5. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 5) What amount of milk your baby takes as supplement? No need of supplement. Less than 20 ml. Between 20 and 30 ml. More than 30 ml. Next."

"pregunta_5.php" script:

```
<p><span class="pregunta">5) Quina quantitat de llet  pren de
      suplement? </span><span class="instruccion">¿Qué cantidad de
      leche toma de suplemento?</span></p>
<form id="form5" name="form5" method="post"
      action="envio_respuesta.php?pregunta=5" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">No precisa suplement. </span><span
      class="instruccion">No precisa suplemento.</span></label><img
      src="imagenes/DSC02637.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" class="foto" />
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
      <span class="pregunta">Menys de 20 ml. </span><span
      class="instruccion">Menos de 20 ml.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
      <span class="pregunta">Entre 20 i 30 ml. </span><span
      class="instruccion">Entre 20 y 30 ml.</span></label>
    <br />
<label>
      <input type="radio" name="respuesta" value="3"  />
      <span class="pregunta">Més de 30 ml. </span><span
      class="instruccion">Más de 30 ml.</span></label>
    <br />
    <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form5)" /></p></form>
```

Question #6

Screenshot C.1.20 Question #6. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 6) If

your baby's feeding is only artificial, what is the total volume of milk the baby takes in 24 hours? (For exclusive breastfeeding write 0). Next".

"pregunta_6.php" script:

```
<p><span class="pregunta">6) Si pren biberó, quin és el volum total de
      llet que pren el nadó durant 24 hores? (Si pren només pit poseu
      0)</span><br />
  <span class="instruccion">Si toma biberón ¿Cuál es el volumen total
      de leche que toma el bebé durante 24 horas? (Si toma sólo pecho
      pongan 0).</span></p><img src="imagenes/DSC02637.JPG"
      width="255" height="190" hspace="10" vspace="10" align="right"
      class="foto" />
<form id="form1" name="form1" method="post"
      action="envio_respuesta.php?pregunta=6">
  <p class="texto">
    <input name="respuesta" type="text" id="peso" tabindex="1"
      size="4" maxlength="4" class="caja_texto_2"/>
     ml
  </p>
  <p><input type="button" name="button" id="button" value="Següent"
      onclick="validar_1()" /></p>
</form>
```

Question #7

Screenshot C.1.21. Question #7. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*" 7) How many diapers with pee a day do you change? Less than 3. Between 3 and 6. Over 6. Next."

"pregunta_7.php" script:

```
<p><span class="pregunta">7) Quants bolquers amb pipi li canvieu al
      dia? </span><span class="instruccion">¿Cuántos pañales con pipi
      le cambian al día? </span></p>
```

```
<form id="form7" name="form7" method="post"
    action="envio_respuesta.php?pregunta=7" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Menys de 3. </span><span
      class="instruccion">Menos de 3.</span></label><img class="foto"
      src="imagenes/DSC02619.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" />
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
      <span class="pregunta">Entre 3 i 6. </span><span
      class="instruccion">Entre 3 y 6.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
      <span class="pregunta">Més de 6. </span><span
      class="instruccion">Más de 6.</span></label>
    <br />
    <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form7)" /></p>
</form>
```

Question #8

Screenshot C.1.22. Question #8. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*" 8) How many depositions your child does? Every day. Every 48 hours. More than 48 hours without. Next".

"pregunta_8.php" script:

```
<p><span class="pregunta">8) Quantes deposicions fa el vostre nen?
    </span><span class="instruccion">¿Cuántas deposiciones hace su
    bebé?</span></p>
```

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```
<form id="form8" name="form8" method="post"
     action="envio_respuesta.php?pregunta=8" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Cada dia. </span><span
      class="instruccion">Cada día.</span></label><img class="foto"
      src="imagenes/DSC02620.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" />
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Cada 48 hores. </span><span
      class="instruccion">Cada 48 horas.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
      <span class="pregunta">Més de 48 hores sense fer. </span><span
      class="instruccion">Más de 48 horas sin hacer.</span></label>
    <br />
    <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form8)" /></p>
</form>
```

Question #9

Screenshot C.1.23. Question #9. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*" 9) How are the stools? Mustard-colored liquid. Lumpy/soft. Consistent. Next".

"pregunta_9.php" script:

```
<p><span class="pregunta">9) Com son les deposicions? </span><span
     class="instruccion">¿Cómo son las deposiciones?</span></p>
```

```
<form id="form9" name="form9" method="post"
    action="envio_respuesta.php?pregunta=9" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Líquides de color mostassa. </span><span
      class="instruccion">Líquidas de color
      mostaza.</span></label><img class="foto"
      src="imagenes/DSC02620.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" />
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Grumolloses/toves. </span><span
      class="instruccion">Grumosas/blandas.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
      <span class="pregunta">Consistents. </span><span
      class="instruccion">Consistentes.</span></label>
    <br />
  <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form9)" /></p>
</form>
```

Question #10

Screenshot C.1.24 Question #10. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 10) How often does your baby regurgitate/ vomit during the day? Remember that we define the regurgitation as the discharge of stomach contents without effort, they are frequent when the baby burps or during the diaper change. Instead vomiting usually is preceded by nausea and discomfort, the stomach contents can come out through the mouth and nose and look like they are more abundant. Never. 2-3 times. 3 to 6 times. More than 6 times. Next".

"pregunta_10.php" script:

```
<p><span class="pregunta">10) Quantes vegades regurgita/vomita durant
      al dia? </span><span class="instruccion">¿Cuántas veces
      regurgita / vomita durante el día?</span></p>
<p><span class="pregunta">Recordeu que entenem com regurgitacions la
      sortida sense esforç del contingut gàstric, son freqüents al fer
      el rotet o al canviar-li els bolquers. En canvi els vòmits solen
      anar precedits de nàusees i molèsties, el contingut gàstric pot
      sortir a través de la boca i el nas i semblen més abundants dels
      que son.</span></br>
<span class="instruccion"> Recuerden que entendemos como
      regurgitaciones la salida sin esfuerzo del contenido gástrico,
      son frecuentes al hacer el eructo o cambiarle los pañales. En
      cambio los vómitos suelen ir precedidos de náuseas y molestias,
      el contenido gástrico puede salir a través de la boca y la nariz
      y parecen más abundantes de lo que son.</span></p>
<form id="form10" name="form10" method="post"
      action="envio_respuesta.php?pregunta=10" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Mai. </span><span
      class="instruccion">Nunca.</span><img class="foto"
      src="imagenes/DSC02527.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" /></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">2-3 vegades. </span><span
      class="instruccion">Entre 2 y 3 veces.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Entre 3 i 6 vegades. </span><span
      class="instruccion">Entre 3 y 6 veces.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
     <span class="pregunta">Més de 6 vegades. </span><span
      class="instruccion">Más de 6 veces.</span></label>
    <br />
  <p>
    <input type="button" name="button" id="button" value="Següent"
    onclick="validar_2(form10)" /></p>
</form>
```

Question #11

Screenshot C.1.25 Question #11. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 11) Usually vomits are: Do not vomit. Before eating. Between takes. After eating. Next".

"pregunta_11.php" script:

```
<p><span class="pregunta">11) Normalment els vòmits son: </span><span
     class="instruccion">Normalmente los vómitos son:</span></p>
<form id="form11" name="form11" method="post"
     action="envio_respuesta.php?pregunta=11" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">No vomita. </span><span
      class="instruccion">No vomita.</span></label><img class="foto"
      src="imagenes/DSC02527.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" />
    <br />
    <label>
    <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Abans de menjar. </span><span
      class="instruccion">Antes de comer.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
     <span class="pregunta">Entre les preses. </span><span
      class="instruccion">Entre las tomas.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="3"  />
     <span class="pregunta">Després de menjar. </span><span
      class="instruccion">Después de comer.</span></label>
    <br />
  <p>
```

```
        <input type="button" name="button" id="button" value="Següent"
        onclick="validar_2(form11)" /></p>
</form>
```

Question #12

Screenshot C.1.26 . Question #12. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 12) How much do you think you baby vomits? Absent vomiting. Scarce vomiting. Abundant vomiting. Abundant vomiting. Next".

"pregunta_12.php" script:

```
<p><span class="pregunta">12) Quina quantitat us sembla que vomita?
    </span><span class="instruccion">¿Qué cantidad les parece que
    vomita?</span></p>
<form id="form12" name="form12" method="post"
    action="envio_respuesta.php?pregunta=12" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Vòmit absent. </span><span
      class="instruccion">Vómitos ausentes.</span></label><img
      class="foto" src="imagenes/DSC02527.JPG" width="255"
      height="190" hspace="10" vspace="10" align="right" />
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Vòmit escàs. </span><span
      class="instruccion">Vómitos escasos.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
     <span class="pregunta">Vòmit abundant. </span><span
      class="instruccion">Vómitos abundantes.</span></label>
```

```
    <br />
    <label>
      <input type="radio" name="respuesta" value="3"  />
     <span class="pregunta">Vòmit molt abundant. </span><span
      class="instruccion">Vómitos muy abundantes.</span></label>
    <br />
  <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form12)" /></p>
    </form>
```

Question #13

Screenshot C.1.27. Question #13. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*" 13) What is the baby's axillary temperature? (Control the temperature in the morning.) Less than 36.4 °C. Between 36.5 and 37 °C. Between 37.1 and 37.8 °C. More than 37.8 °C. Next".

"pregunta_13.php" script:

```
<p><span class="pregunta">13) Quina és la temperatura axil.lar del
      bebè? (controleu la temperatura al matí.) </span><span
      class="instruccion">¿Cuál es la temperatura axilar del bebé?
      (Controlen la temperatura por la mañana)</span></p>
<form id="form13" name="form13" method="post"
      action="envio_respuesta.php?pregunta=13" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Menys de 36,4 °C. </span><span
      class="instruccion">Menos de 36,4 °C.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Entre 36,5 y 37 °C. </span><span
      class="instruccion">Entre 36,5 y 37 °C.</span></label>
    <br />
    <label>
```

```
        <input type="radio" name="respuesta" value="2"  />
     <span class="pregunta">Entre 37,1 i 37,8 °C. </span><span
     class="instruccion">Entre 37,1 y 37,8 °C.</span></label>
      <br />
<label>
        <input type="radio" name="respuesta" value="3"  />
     <span class="pregunta">Més de 37,8 °C.  </span><span
     class="instruccion">Más de 37,8 °C.</span></label>
      <br />
  <p>
     <input type="button" name="button" id="button" value="Següent"
       onclick="validar_2(form13)" /></p>
</form>
```

Question #14

Screenshot C.1.28 . Question #14. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 14) Generally, how does your baby sleep? He sleeps between takes. Has trouble sleeping after eating. It is very numb and it is difficult waking him to eat. Next".

"pregunta_14.php" script:

```
<p><span class="pregunta">14) Generalment, com dorm el vostre bebè?
     </span><span class="instruccion">¿Cómo duerme su
     bebé?</span></p>
<form id="form14" name="form14" method="post"
     action="envio_respuesta.php?pregunta=14" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Dorm entre les preses. </span><span
      class="instruccion">Duerme entre las tomas.</span><img
      class="foto" src="imagenes/DSC02462.JPG" width="255"
      height="190" hspace="10" vspace="10" align="right" /></label>
```

```
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">Li costa dormir després de menjar.
      </span><span class="instruccion">Le cuesta dormir después de
      comer.</span></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
     <span class="pregunta">Està molt adormit i costa despertar-lo per
      menjar. </span><span class="instruccion">Está muy dormido y
      cuesta despertarlo para comer.</span></label>
    <br />
  <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form14)" /></p>
</form>
```

Question #15

Screenshot C.1.29 Question #15. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 15) What is the colour of the baby's skin and mucous membranes? Dew. Jaundice (yellowish tinge). Jaundice has increased since the date of discharge. Next".

"pregunta_15.php" script:

```
<p><span class="pregunta">15) Quina &eacute;s la coloraci&oacute; de
      la pell i de les mucoses del nad&oacute;? </span><span
      class="instruccion">¿Cuál es la coloración de la piel y de las
      mucosas del bebé? </span></p>
<form id="form15" name="form15" method="post"
      action="envio_respuesta.php?pregunta=15" >
  <p>
```

```
   <label>
     <input type="radio" name="respuesta" value="0"  />
     <span class="pregunta">Rosada. </span><span
     class="instruccion">Rosada.</span><img class="foto"
     src="imagenes/DSC02526.JPG" width="255" height="190" hspace="10"
     vspace="10" align="right" /></label>
   <br />
   <label>
     <input type="radio" name="respuesta" value="1"  />
    <span class="pregunta">Ictèrica (tint groguenc). </span><span
     class="instruccion">Ictérica (tinte amarillento).</span></label>
   <br />
   <label>
     <input type="radio" name="respuesta" value="2"  />
    <span class="pregunta">Ha aumentat la ictericia des del dia de
     l'alta hospitalària. </span><span class="instruccion">Ha
     aumentado la ictericia desde el día del alta
     hospitalaria.</span></label>
   <br />
 <p>
   <input type="button" name="button" id="button" value="Següent"
     onclick="validar_2(form15)" /></p>
</form>
```

Question #16

Screenshot C.1.30 Question #16. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 16) Does the baby show irritation in the area of the genitals? Yes. No. Next".

"pregunta_16.php" script:

```
<p><span class="pregunta">16) Presenta  irritació a la zona dels
     genitals? </span><span class="instruccion">¿Presenta irritación
     en la zona de los genitales?</span></p>
```

```
<form id="form16" name="form16" method="post"
    action="envio_respuesta.php?pregunta=16" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
      <span class="pregunta">Sí.</span><img class="foto"
      src="imagenes/DSC02633.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" /></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">No.</span></label>
    <br />
  <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form16)" /></p>
</form>
```

Question #17

Screenshot C.1.31 Question #17. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 17) How many times a day you care your baby's belly button? 0. 1. 2. 3. Next".

"pregunta_17.php" script:

```
<p><span class="pregunta">17) Quants cops al dia cureu el melic del
    nadó? </span><span class="instruccion">¿Cuántas veces al día
    curan el ombligo del bebé?</span></p>
<form id="form17" name="form17" method="post"
    action="envio_respuesta.php?pregunta=17" >
  <p>
    <label>
      <input type="radio" name="respuesta" value="0"  />
```

```
      <span class="pregunta">0</span><img class="foto"
      src="imagenes/DSC02618.JPG" width="255" height="190" hspace="10"
      vspace="10" align="right" /></label>
    <br />
    <label>
      <input type="radio" name="respuesta" value="1"  />
     <span class="pregunta">1</span></label>
 <br />
    <label>
      <input type="radio" name="respuesta" value="2"  />
     <span class="pregunta">2</span></label>
 <br />
<label>
      <input type="radio" name="respuesta" value="3"  />
     <span class="pregunta">3</span></label>
    <br />
   <p>
    <input type="button" name="button" id="button" value="Següent"
      onclick="validar_2(form17)" /></p>
</form>
```

Question #18

Screenshot C.1.32. Question #18. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:" 18) Do you take care of the belly button with soap and water only? Yes. No. No need. Finalize".

"pregunta_18.php" script:

```
<p><span class="pregunta">18) Feu la cura del melic amb aigua i sabó
      exclusivament? </span><span class="instruccion">¿Hacen la cura
      umbilical con agua y jabón exclusivamente?</span></p>
<form id="form18" name="form18" method="post"
      action="envio_respuesta.php?pregunta=18&stop=true" >
  <p>
```

```
  <label>
    <input type="radio" name="respuesta" value="0"  />
    <span class="pregunta">Sí.</span></label>
  <br />
  <label>
    <input type="radio" name="respuesta" value="1"  />
  <span class="pregunta">No.</span></label>
  <br />
  <label>
    <input type="radio" name="respuesta" value="2"  />
  <span class="pregunta">No necessita de cures.</span><span
    class="instruccion">No necesita de curas.</span></label>
  <br />
  <p>
  <input type="button" name="button" id="button" value="Finalitzar"
    onclick="validar_2(form18)" /></p>
</form>
```

Questionnaire end page

To avoid unecessary communication with the data base and a consequent slowdown of the process, the web application was designed to verify that all the questions were answered and then send them all together to the data base.

Screenshot C.1.33. Questionnaire end page in the Parents' area. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*"The questionnaire was sent correctly. Thank you very much for your collaboration!"

"envio_respuesta.php" script:

```php
<?php require_once('Connections/conexion.php');
session_start();
$loginUsername=$_SESSION['MM_Username'];
$fecha=$_SESSION['MM_fecha'];
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
```

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```
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }
  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}}
mysql_select_db($database_conexion, $conexion);
$pregunta=$_GET['pregunta'];
$respuesta= $_POST['respuesta'];
//situa cada respuesta en la columna correcta de la base de datos
$stop='false';
if (isset($_GET['stop'])) {$stop=$_GET['stop'];}
$posicion_registro=$pregunta;
$posicion_registro--;
$_SESSION['MM_registro'][$posicion_registro]=$respuesta;
//envia registro a base de datos solo si es completo
if ($stop=='true') {
$peso=$_SESSION['MM_registro'][0];
$lactancia=$_SESSION['MM_registro'][1];
$quantitat_preses=$_SESSION['MM_registro'][2];
$temps_presa=$_SESSION['MM_registro'][3];
$suplement=$_SESSION['MM_registro'][4];
$volum_llet=$_SESSION['MM_registro'][5];
$pipi=$_SESSION['MM_registro'][6];
$deposicions=$_SESSION['MM_registro'][7];
$aspecte_deposicions=$_SESSION['MM_registro'][8];
$vomits=$_SESSION['MM_registro'][9];
$moment_vomits=$_SESSION['MM_registro'][10];
$quantitat_vomits=$_SESSION['MM_registro'][11];
$temperatura=$_SESSION['MM_registro'][12];
$son=$_SESSION['MM_registro'][13];
$pell=$_SESSION['MM_registro'][14];
$irritacio_genitals=$_SESSION['MM_registro'][15];
$cures_melic=$_SESSION['MM_registro'][16];
$sabo_melic=$_SESSION['MM_registro'][17];

//Comprobar si la fila ya existe para actualizarla
```

```php
$colname_consulta = "-1";
if (isset($_SESSION['MM_loginUsername'])) {
  $colname_consulta = $_SESSION['MM_loginUsername'];
    }
mysql_select_db($database_conexion, $conexion);
$query_consulta = sprintf("SELECT fecha FROM respuestas WHERE
        usuario_email = '$loginUsername' ORDER BY fecha DESC LIMIT 1",
        GetSQLValueString($colname_consulta, "text"));
$consulta = mysql_query($query_consulta, $conexion) or
        die(mysql_error());
while($row = mysql_fetch_array($consulta)){
$last_fecha = $row['fecha'];}
if ($last_fecha==$fecha){
        $query_envio_respuesta = "UPDATE respuestas SET peso='$peso',
        lactancia='$lactancia', quantitat_preses='$quantitat_preses',
        temps_presa='$temps_presa', suplement='$suplement',
        volum_llet='$volum_llet',pipi='$pipi',
        deposicions='$deposicions',
        aspecte_deposicions='$aspecte_deposicions', vomits='$vomits',
        moment_vomits='$moment_vomits',
        quantitat_vomits='$quantitat_vomits',
        temperatura='$temperatura', son='$son', pell='$pell',
        irritacio_genitals='$irritacio_genitals',
        cures_melic='$cures_melic', sabo_melic='$sabo_melic'
          WHERE usuario_email= '$loginUsername' AND fecha='$fecha'";
$envio_respuesta = mysql_query($query_envio_respuesta,$conexion) or
        die(mysql_error());
    }
else {

// Si no existe, creamos la fila
$query_envio_respuesta = "INSERT INTO respuestas VALUES
        ('$loginUsername','$fecha','$peso','$lactancia','$quantitat_pres
        es',
'$temps_presa','$suplement','$volum_llet', '$pipi',
        '$deposicions','$aspecte_deposicions', '$vomits',
        '$moment_vomits', '$quantitat_vomits',
'$temperatura', '$son', '$pell', '$irritacio_genitals',
        '$cures_melic', '$sabo_melic')";
$envio_respuesta = mysql_query($query_envio_respuesta,$conexion) or
        die(mysql_error());
    }
?>

<!-- va a pagina final del formulario -->
<script type="text/javascript">
document.location.href="index.php?p=confirmacion_form";
</script>
<?php
}
$pregunta++;
?>
<!-- pasa a siguiente pregunta -->
<script type="text/javascript">
document.location.href="index.php?p=pregunta_<?php echo $pregunta;
        ?>";
</script>
<?php
mysql_free_result($consulta);?>
```

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"confirmation_form.php" script:

```
<p class="texto">El q&uuml;estionari s'ha enviat correctament.<br>
Moltes gr&agrave;cies per la seva col&middot;laboraci&oacute;!</p>
<p class="instruccion">El cuestionario se ha enviado correctamente.<br
    />
¡Muchas gracias por su colaboración!</p>
```

Baby's weight trend page

Screenshot C.1.34. Baby's weight trend page in the Parents' area. In this page the parents can visualize the temporal evolution of their infant's weight. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*"Your baby's weight trend".

The script of this page is the same of the one that issues the "Weight trend" Flash chart in the Staff area.

Contact the nurse page

Screenshot C.1.35. Page to contact the nurse in charge of the Internet-based monitoring. Translation from original version in Catalan: Header: "Babies at home. Internet-based baby follow-up". Menu-bar:"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". Content:"Nursing consultancy. If after reading the tips on baby care you still have questions, you can make your queries here. The nurse responsible for the neonatal home care will answer you. The timetable for neonatal home care program is from Monday to Friday from 8 to 14. Inquiries made outside these hours will be answered the first working day. (You can also directly send an email to the following address infermerapetitsacasa@santpau.cat)"

"consulta_enfermera.php" script:

```
<p class="titulo_contenido">Consulta d'infermeria</p>
<p><span class="texto">Si després de llegir els consells per atendre
      el nadó, encara teniu dubtes sobre les cures del vostre fill,
      podeu feu les vostres consultes aquí. La infermera responsable
      de l'atenció domiciliària neonatal us donarà resposta. L'horari
      del programa d'assistència domiciliària neonatal és de dilluns a
      divendres de 8 hores a 14 hores. Les consultes fetes fora
      d'aquest horari es  contestaran el primer dia
      laborable.<br>(Tamb&eacute; podeu enviar directament un correu a
      la seg&uuml;ent adre&ccedil;a <a
      href="mailto:infermerapetitsacasa@santpau.cat">infermerapetitsac
      asa@santpau.cat</a>)</span><br /><br />
<span class="instruccion">Si después de leer los consejos para atender
      al bebé, aún tiene dudas sobre los cuidados de su hijo, puede
      hacer sus consultas aquí. La enfermera responsable de la
      atención domiciliaria neonatal le dará respuesta. El horario del
      programa de asistencia domiciliaria neonatal es de lunes a
      viernes de 8 a 14 horas. Las consultas realizadas fuera de este
      horario se contestarán el primer día laborable.<br />
(También puede enviar directamente un correo a la siguiente dirección
      <a
```

```
      href="mailto:infermerapetitsacasa@santpau.cat">infermerapetitsac
      asa@santpau.cat</a>)</span></p>
<form name="form1" method="post"
      action="envio_email_consulta.php?c=enfermeria">
  <textarea name="consulta" id="consulta" cols="45" rows="5"
      class="caja_texto_2"></textarea><br><br>

  <input name="acceso" type="image" id="enviar" value="Enviar"
      src="imagenes/boton_enviar.gif" align="bottom">
</form>
```

"envio_email_consulta.php" script:

```php
<?php
if (!isset($_SESSION)) {
  session_start();}
$loginUsername=$_SESSION['MM_Username'];
require_once('PHPMailer_v5.1/class.phpmailer.php');
$mail = new PHPMailer();
$body = $_POST['consulta'];
$mail->AddReplyTo($loginUsername,"USUARI");
$mail->SetFrom($loginUsername,"USUARI");
$mail->AddReplyTo($loginUsername,"USUARI");
$consulta=$_GET['c'];
if ($consulta=="enfermeria")
{$address="infermerapetitsacasa@santpau.cat";}
else {$address="webmasterpetitsacasa@santpau.cat";}
$mail->AddAddress($address, "PETITS A CASA");
$mail->Subject    = "Consulta desde usuario ". $loginUsername;
$mail->AltBody    = "To view the message, please use an HTML
compatible email viewer!"; // optional, comment out and test
$mail->MsgHTML($body);
if(!$mail->Send()) {
  echo "Mailer Error: " . $mail->ErrorInfo;}?>
<!-- va a pagina de confirmacion de envio consulta -->
<script type="text/javascript">
document.location.href="index.php?p=confirmacion_envio_consulta";
</script>
```

Technical support page

Screenshot C.1.36. Page to request technical support about the website functioning. Translation from original version in Catalan: *Header:* "Babies at home. Internet-based baby follow-up". *Menu-bar:*"Introduction", "Questionnaire", "Weight trend", "Contact the nurse", "Technical help", "Logout". *Content:*"If you have questions or problems with the website functioning, make your queries here. In 48 hours you will receive a response to your email address. The consultations held on Saturdays and holidays will be responded on the first working day. (You can also directly send an email to the following address webmasterpetitsacasa@santpau.cat)"

"consulta_webmaster.php" script:

```
<p class="titulo_contenido">Ajuda t&egrave;cnica</p>
<P><span class="texto">Si teniu dubtes o problemes de funcionament de
      la p&agrave;gina web, feu les vostres consultes aqu&iacute;. En
      48 hores rebreu la resposta a la vostra adre&ccedil;a de correu
      electr&ograve;nic. Les consultes fetes el divendres, dissabtes i
      festius es contestar&agrave;n el primer dia laborable.<br>
(Tamb&eacute; pot enviar directament un correu a la seg&uuml;ent
      adre&ccedil;a <a
      href="mailto:webmasterpetitsacasa@santpau.cat">webmasterpetitsac
      asa@santpau.cat</a>)</span><br /><br />

<span class="instruccion">Si tiene dudas o problemas de funcionamiento
      de la página web, haga sus consultas aquí. En 48 horas recibirá
      la respuesta a su dirección de correo electrónico. Las consultas
      realizadas el viernes, sábados y festivos se contestarán el
      primer día laborable.<br/>
(También puede enviar directamente un correo a la siguiente dirección
      <a
      href="mailto:webmasterpetitsacasa@santpau.cat">webmasterpetitsac
      asa@santpau.cat</a>)</span></P>
<form name="form1" method="post"
      action="envio_email_consulta.php?c=webmaster">
```

```
<textarea name="consulta" id="consulta" cols="45" rows="5"
    class="caja_texto_2"></textarea><br><br>
<input name="acceso" type="image" id="enviar" value="Enviar"
    src="imagenes/boton_enviar.gif" align="bottom">
</form>
```

Final online satisfaction survey

Screenshot C.1.37. Final online satisfaction survey. Parents are asked to answer it at the end of their baby's online monitoring. Translation from original version in Catalan: *Header:* "Babies at home. Online baby follow-up". "Satisfaction survey. Please, choose an answer between 0 and 5 for each of the following questions (consider that 0 means "I strongly disagree" and 5 means "I strongly agree")". "In general the Web service 'Babies at home' was helpful. The available information helped me take care of the baby. The information available on the website could clarify my doubts. The e-mail service with nurses available on the website was useful. The files and recommended links were useful. The nurse's answers to my questions were useful. The use of the website avoided visits to the primary care center. The use of the website avoided visits to the emergency department. I would recommend this website. Suggestions. Submit".

"questionari_satisfaccio.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();
```

```php
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}

$MM_restrictGoTo = "acceso_questionari_satisfaccio.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup']))))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Q&uuml;estionari de satisfacci&oacute;</title>
<script src="SpryAssets/SpryValidationRadio.js"
      type="text/javascript"></script>
```

```
<script type="text/javascript"
      src="javascript/verificacion.js"></script>

<link href="SpryAssets/SpryValidationRadio.css" rel="stylesheet"
      type="text/css" />
<link href="estilos/estilo.css" rel="stylesheet" type="text/css">
</head>

<body>
<?php include("include/cabecera.php") ?>
<div id="contenido">
<form id="form1" name="form1" method="post"
      action="envio_questionari_satisfaccio.php"><table width="960"
      border="0" cellspacing="5" class="texto">
  <tr>
    <td colspan="3" class="titulo_contenido"> </td>
  </tr>
  <tr>
    <td colspan="3" class="titulo_contenido">Q&uuml;estionari de
    satisfacci&oacute;<br />
    <span class="instruccion" title="Haz clic para obtener otras
    posibles traducciones"><span
    class="instruccion">Cuestionario</span></span><span
    class="instruccion"><span class="instruccion"> <span
    title="Haz clic para obtener otras posibles traducciones">de
    satisfacci&oacute;n</span></span></span></td>
  </tr>
  <tr>
    <td colspan="3">Puntueu de 0 a 5 les seg&uuml;ents preguntes
    (tenint en compte que 0 &eacute;s el grau m&eacute;s baix de
    satisfacci&oacute; i que 5 &eacute;s el grau m&eacute;s alt).
    <br />
    <span class="instruccion">Puntúe de 0 a 5 las siguientes preguntas
    (teniendo en cuenta que 0 es el grado más bajo de satisfacción y
    que 5 es el grado más alto).</span></td>
    </tr>
  <tr>
    <td width="25"> </td>
    <td width="497"> </td>
    <td width="400"> </td>
  </tr>
  <tr>
    <td bgcolor="#CCCCCC" class="pregunta">1.</td>
    <td bgcolor="#CCCCCC"><span class="pregunta">La valoraci&oacute;
    general del servei PAD via Web "PETITS A CASA" ha estat
    &uacute;til en un grau de:</span><br />
    <span class="instruccion">La valoración general del servicio PAD
    vía Web "PETITS A CASA" ha sido útil en un grado de:</span></td>
    <td width="300" bgcolor="#CCCCCC" class="pregunta"><span
    id="spryradio1" class="pregunta">
    <label>
      <input type="radio" name="pregunta1" value="0" id="pregunta1_0"
      />
      0</label>
    <label>
      <input type="radio" name="pregunta1" value="1" id="pregunta1_1"
      />
      1</label>
    <label>
```

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```
        <input type="radio" name="pregunta1" value="2" id="pregunta1_2"
        />
        2</label>
      <label>
        <input type="radio" name="pregunta1" value="3" id="pregunta1_3"
        />
        3</label>
      <label>
        <input type="radio" name="pregunta1" value="4" id="pregunta1_4"
        />
        4</label>
      <label>
        <input type="radio" name="pregunta1" value="5" id="pregunta1_5"
        />
        5</label>

      <span class="radioRequiredMsg">Realice una
        selecci&oacute;n.</span></span><br /></td>
  </tr>
  <tr>
    <td class="pregunta">2.</td>
    <td><span class="pregunta">La informaci&oacute; exposada us ha
      servit per tenir cura del beb&egrave; en un grau de: </span><br
      />
    <span class="instruccion">La información expuesta le ha servido
      para cuidar del bebé en un grado de:</span></td>
    <td width="300" class="pregunta"><span id="spryradio2"
      class="pregunta">
    <label>
      <input type="radio" name="pregunta2" value="0" id="pregunta2_0"
      />
      0</label>
    <label>
      <input type="radio" name="pregunta2" value="1" id="pregunta2_1"
      />
      1</label>
    <label>
      <input type="radio" name="pregunta2" value="2" id="pregunta2_2"
      />
      2</label>
    <label>
      <input type="radio" name="pregunta2" value="3" id="pregunta2_3"
      />
      3</label>
    <label>
      <input type="radio" name="pregunta2" value="4" id="pregunta2_4"
      />
      4</label>
    <label>
      <input type="radio" name="pregunta2" value="5" id="pregunta2_5"
      />
      5</label>

    <span class="radioRequiredMsg">Realice una
      selecci&oacute;n.</span></span><br /></td>
  </tr>
  <tr>
    <td bgcolor="#CCCCCC" class="pregunta">3.</td>
```

```
<td bgcolor="#CCCCCC"><p><span class="pregunta">La
  informaci&oacute; exposada a trav&eacute;s del lloc web us ha
  servit per aclarir els dubtes en un grau de:</span><br />
  <span class="instruccion" title="Haz clic para obtener otras
  posibles traducciones">La informaci&oacute;n</span><span
  class="instruccion"> <span title="Haz clic para obtener
  otras posibles traducciones">expuesta</span> <span
  title="Haz clic para obtener otras posibles traducciones">a
  trav&eacute;s del sitio</span> <span title="Haz clic para
  obtener otras posibles traducciones">web le</span> <span
  title="Haz clic para obtener otras posibles traducciones">ha
  servido</span> <span title="Haz clic para obtener otras
  posibles traducciones">para aclarar</span> <span title="Haz
  clic para obtener otras posibles traducciones">las
  dudas</span> <span title="Haz clic para obtener otras
  posibles traducciones">en un grado de:</span></span></p></td>
<td width="300" bgcolor="#CCCCCC" class="pregunta"><span
  id="spryradio3">
<label>
  <span class="pregunta">
  <input type="radio" name="pregunta3" value="0" id="pregunta3_0"
  />
  0</span></label>
<span class="pregunta">
<label>
  <input type="radio" name="pregunta3" value="1" id="pregunta3_1"
  />
  1</label>
<label>
  <input type="radio" name="pregunta3" value="2" id="pregunta3_2"
  />
  2</label>
<label>
  <input type="radio" name="pregunta3" value="3" id="pregunta3_3"
  />
  3</label>
<label>
  <input type="radio" name="pregunta3" value="4" id="pregunta3_4"
  />
  4</label>
<label>
  <input type="radio" name="pregunta3" value="5" id="pregunta3_5"
  />
  5</label>
</span>
<label></label>

<span class="radioRequiredMsg">Realice una
  selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td class="pregunta">4.</td>
  <td><span class="pregunta">El servei de consultes obertes on-line
  ha estat satisfactori en un grau de:</span><br />
  <span class="instruccion" title="Haz clic para obtener otras
  posibles traducciones">El servicio</span><span
  class="instruccion"> <span title="Haz clic para obtener
  otras posibles traducciones">de consultas</span> <span
  title="Haz clic para obtener otras posibles
```

```
    traducciones">abiertas</span> <span title="Haz clic para
    obtener otras posibles traducciones">on-line
    ha</span> <span title="Haz clic para obtener otras posibles
    traducciones">sido</span> <span title="Haz clic para
    obtener otras posibles
    traducciones">satisfactorio</span> <span title="Haz clic
    para obtener otras posibles traducciones">en un grado
    de:</span></span></td>
  <td width="300" class="pregunta"><span id="spryradio4">
  <label>
    <span class="pregunta">
    <input type="radio" name="pregunta4" value="0" id="pregunta4_0"
    />
    0</span></label>
  <span class="pregunta">
  <label>
    <input type="radio" name="pregunta4" value="1" id="pregunta4_1"
    />
    1</label>
  <label>
    <input type="radio" name="pregunta4" value="2" id="pregunta4_2"
    />
    2</label>
  <label>
    <input type="radio" name="pregunta4" value="3" id="pregunta4_3"
    />
    3</label>
  <label>
    <input type="radio" name="pregunta4" value="4" id="pregunta4_4"
    />
    4</label>
  <label>
    <input type="radio" name="pregunta4" value="5" id="pregunta4_5"
    />
    5</label>
  </span>
  <span class="radioRequiredMsg">Realice una
    selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td bgcolor="#CCCCCC" class="pregunta">5.</td>
  <td bgcolor="#CCCCCC"><span class="pregunta">Els arxius i
  enlla&ccedil;os recomanats han resultats &uacute;tils en un grau
  de:</span><br />
  <span class="instruccion" title="Haz clic para obtener otras
  posibles traducciones">Los archivos</span><span
  class="instruccion"> <span title="Haz clic para obtener
  otras posibles traducciones">y enlaces</span> <span
  title="Haz clic para obtener otras posibles
  traducciones">recomendados</span> <span title="Haz clic
  para obtener otras posibles traducciones">han</span> <span
  title="Haz clic para obtener otras posibles
  traducciones">resultados</span> <span title="Haz clic para
  obtener otras posibles traducciones">&uacute;tiles
  en</span> <span title="Haz clic para obtener otras posibles
  traducciones">un grado de:</span></span></td>
  <td width="300" bgcolor="#CCCCCC" class="pregunta"><span
    id="spryradio5">
  <label>
```

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```
  <span class="pregunta">
  <input type="radio" name="pregunta5" value="0" id="pregunta5_0"
  />
  0</span></label>
<span class="pregunta">
<label>
  <input type="radio" name="pregunta5" value="1" id="pregunta5_1"
  />
  1</label>
<label>
  <input type="radio" name="pregunta5" value="2" id="pregunta5_2"
  />
  2</label>
<label>
  <input type="radio" name="pregunta5" value="3" id="pregunta5_3"
  />
  3</label>
<label>
  <input type="radio" name="pregunta5" value="4" id="pregunta5_4"
  />
  4</label>
<label>
  <input type="radio" name="pregunta5" value="5" id="pregunta5_5"
  />
  5</label>
</span>
<label></label>

<span class="radioRequiredMsg">Realice una
  selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td class="pregunta">6.</td>
  <td><span class="pregunta">Les respostes de la infermera les
    valoreu en un grau de:</span><br />
    <span class="instruccion" title="Haz clic para obtener otras
    posibles traducciones">Las</span><span
    class="instruccion"> <span title="Haz clic para obtener
    otras posibles traducciones">respuestas</span> <span
    title="Haz clic para obtener otras posibles traducciones">de la
    enfermera</span> <span title="Haz clic para obtener otras
    posibles traducciones">las</span> <span title="Haz clic
    para obtener otras posibles
    traducciones">valora</span> <span title="Haz clic para
    obtener otras posibles traducciones">en un grado
    de:</span></span></td>
  <td width="300" class="pregunta"><span id="spryradio6">
  <label>
    <span class="pregunta">
    <input type="radio" name="pregunta6" value="0" id="pregunta6_0"
    />
    0</span></label>
  <span class="pregunta">
  <label>
    <input type="radio" name="pregunta6" value="1" id="pregunta6_1"
    />
    1</label>
  <label>
```

```html
      <input type="radio" name="pregunta6" value="2" id="pregunta6_2"
      />
      2</label>
    <label>
      <input type="radio" name="pregunta6" value="3" id="pregunta6_3"
      />
      3</label>
    <label>
      <input type="radio" name="pregunta6" value="4" id="pregunta6_4"
      />
      4</label>
    <label>
      <input type="radio" name="pregunta6" value="5" id="pregunta6_5"
      />
      5</label>
    </span>
    <label></label>

    <span class="radioRequiredMsg">Realice una
      selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td bgcolor="#CCCCCC" class="pregunta">7.</td>
  <td bgcolor="#CCCCCC"><span class="pregunta">L&rsquo;&uacute;s
    d&rsquo;aquesta web ha evitat consultes als professionals del
    CAP:</span><br />
    <span class="instruccion" title="Haz clic para obtener otras
    posibles traducciones">El uso</span><span
    class="instruccion"> <span title="Haz clic para obtener
    otras posibles traducciones">de esta web</span> <span
    title="Haz clic para obtener otras posibles traducciones">ha
    evitado</span> <span title="Haz clic para obtener otras
    posibles traducciones">consultas a los</span> <span
    title="Haz clic para obtener otras posibles
    traducciones">profesionales</span> <span title="Haz clic
    para obtener otras posibles traducciones">del
    CAP:</span></span></td>
  <td width="300" bgcolor="#CCCCCC" class="pregunta"><span
    id="spryradio7">
    <label>
      <input type="radio" name="pregunta7" value="1"
    id="pregunta7_0" />
      <span class="pregunta">      si</span></label>
    <span class="pregunta">
    <label>
      <input type="radio" name="pregunta7" value="0"
    id="pregunta7_1" />
      no</label>
    </span>
    <label></label>

    <span class="radioRequiredMsg">Realice una
    selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td class="pregunta">8.</td>
  <td><span class="pregunta">L&rsquo;&uacute;s d&rsquo;aquesta web
    ha evitat visites a un centre
    d&rsquo;urg&egrave;ncies:</span><br />
```

```
    <span class="instruccion" title="Haz clic para obtener otras
    posibles traducciones">El uso</span><span
    class="instruccion"> <span title="Haz clic para obtener
    otras posibles traducciones">de esta web</span> <span
    title="Haz clic para obtener otras posibles traducciones">ha
    evitado</span> <span title="Haz clic para obtener otras
    posibles traducciones">visitas a</span> <span title="Haz
    clic para obtener otras posibles traducciones">un
    centro</span> <span title="Haz clic para obtener otras
    posibles traducciones">de urgencias:</span></span></td>
  <td width="300" class="pregunta"><span id="spryradio8">
  <label>
    <input type="radio" name="pregunta8" value="1" id="pregunta8_0"
    />
    <span class="pregunta">      si</span></label>
  <span class="pregunta">
  <label>
    <input type="radio" name="pregunta8" value="0" id="pregunta8_1"
    />
    no</label>
  </span>

  <span class="radioRequiredMsg">Realice una
    selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td bgcolor="#CCCCCC" class="pregunta">9.</td>
  <td bgcolor="#CCCCCC"><span class="pregunta">Recomanar&iacute;eu
  aquesta web?</span><br />
    <span class="instruccion" title="Haz clic para obtener otras
    posibles traducciones">Recomendar&iacute;a</span><span
    class="instruccion"> <span title="Haz clic para obtener
    otras posibles traducciones">esta web?</span></span></td>
  <td width="300" bgcolor="#CCCCCC" class="pregunta"><span
    id="spryradio9">
  <label>
    <input type="radio" name="pregunta9" value="1" id="pregunta9_0"
    />
    <span class="pregunta">      si</span></label>
  <span class="pregunta">
  <label>
    <input type="radio" name="pregunta9" value="0" id="pregunta9_1"
    />
    no</label>
  </span>
  <label></label>

  <span class="radioRequiredMsg">Realice una
    selecci&oacute;n.</span></span><br /></td>
</tr>
<tr>
  <td class="pregunta">10.</td>
  <td><span class="pregunta">Suggeriments</span><br />
    <span class="instruccion">Sugerencias</span><br /></td>
  <td width="300"> </td>
</tr>
<tr>
  <td> </td>
```

```html
      <td><textarea name="pregunta10" id="pregunta10" cols="80"
        rows="5"></textarea></td>
      <td width="300"> </td>
    </tr>
    <tr>
      <td> </td>
      <td><input type="submit" name="enviar" id="enviar" value="Enviar"
        /></td>
      <td width="300"> </td>
    </tr>
</table>
</form>
</div>
<script type="text/javascript">
<!--
var spryradio1 = new Spry.Widget.ValidationRadio("spryradio1");
var spryradio2 = new Spry.Widget.ValidationRadio("spryradio2");
var spryradio3 = new Spry.Widget.ValidationRadio("spryradio3");
var spryradio4 = new Spry.Widget.ValidationRadio("spryradio4");
var spryradio5 = new Spry.Widget.ValidationRadio("spryradio5");
var spryradio6 = new Spry.Widget.ValidationRadio("spryradio6");
var spryradio7 = new Spry.Widget.ValidationRadio("spryradio7");
var spryradio8 = new Spry.Widget.ValidationRadio("spryradio8");
var spryradio9 = new Spry.Widget.ValidationRadio("spryradio9");
//-->
</script>
<?php @include("include/pie.php");?>
</body>
</html>
```

"envio_questionari_satisfaccio.php" script:

```php
<?php require_once('Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();
}
$usuario=$_SESSION['MM_Username'];
$fecha=$_SESSION['MM_fecha'];
$pregunta1=$_POST['pregunta1'];
$pregunta2=$_POST['pregunta2'];
$pregunta3=$_POST['pregunta3'];
$pregunta4=$_POST['pregunta4'];
$pregunta5=$_POST['pregunta5'];
$pregunta6=$_POST['pregunta6'];
$pregunta7=$_POST['pregunta7'];
$pregunta8=$_POST['pregunta8'];
$pregunta9=$_POST['pregunta9'];
$pregunta10=$_POST['pregunta10'];
//envio a bbdd
mysql_select_db($database_conexion, $conexion);
$query_envio_questionari_satisfaccio = "INSERT INTO
      questionari_satisfaccio VALUES ('$usuario', '$fecha',
      '$pregunta1', '$pregunta2', '$pregunta3', '$pregunta4',
      '$pregunta5', '$pregunta6', '$pregunta7', '$pregunta8',
      '$pregunta9', '$pregunta10')";
```

```php
$envio_questionari_satisfaccio =
      mysql_query($query_envio_questionari_satisfaccio,$conexion) or
      die(mysql_error());
//envio mail a enfermera
require_once('PHPMailer_v5.1/class.phpmailer.php');
$mail = new PHPMailer();
$body = "L'usuari ".$usuario." acaba de contestar al qüestionari final
de satisfacció de la web PETITS A CASA.<br>";
$body.= "Les seves respostes han sigut:<br><br>";
$body.= "1. La valoració general del servei PAD via Web PETITS A CASA
      ha estat útil en un grau de: ".$pregunta1."<br>";
$body.= "2. La informació exposada us ha servit per tenir cura del
      bebè en un grau de: ".$pregunta2."<br>";
$body.= "3. La informació exposada a través del lloc web us ha servit
      per aclarir els dubtes en un grau de: ".$pregunta3."<br>";
$body.= "4. El servei de consultes obertes on-line ha estat
      satisfactori en un grau de: ".$pregunta4."<br>";
$body.= "5. Els arxius i enllaços recomanats han resultats útils en un
      grau de: ".$pregunta5."<br>";
$body.= "6. Les respostes de la infermera les valoreu en un grau de:
      ".$pregunta6."<br>";
$body.= "7. L'ús d'aquesta web ha evitat consultes als professionals
      del CAP: ".$pregunta7."<br>";
$body.= "8. L'ús d'aquesta web ha evitat visites a un centre
      d'urgències: ".$pregunta8."<br>";
$body.= "9. Recomanaríeu aquesta web? ".$pregunta9."<br>";
$body.= "10. Suggeriments: ".$pregunta10."<br>";
$mail->AddReplyTo($usuario,"USUARI");
$mail->SetFrom($usuario,"USUARI");
$mail->AddReplyTo($usuario,"USUARI");
$address="infermerapetitsacasa@santpau.cat";
$mail->AddAddress($address);
$mail->Subject    = "Resposta qüestionari satisfacció";
$mail->AltBody    = "To view the message, please use an HTML
compatible email viewer!"; // optional, comment out and test
$mail->MsgHTML($body);
if(!$mail->Send()) {
  echo "Mailer Error: " . $mail->ErrorInfo;}?>
<!-- va a pagina final del formulario -->
<script type="text/javascript">
alert ("Qüestionari enviat correctament. Gràcies per la seva
      col·laboració!");
document.location.href="acceso_questionari_satisfaccio.php";
</script>
```

C.2 Mɪ-cᴘᴀᴘ ᴍᴜʟᴛɪᴄᴇɴᴛᴇʀ ᴡᴇʙ ᴀᴘᴘʟɪᴄᴀᴛɪᴏɴ

As the multicenter system for the remote CPAP follow-up was developed on the basis of the "Babies at home" website architecture, they partially share their code structure. Therefore, to avoid any repetition, in this section we showed only the screenshots/scripts of the completely new functionalities of the web-based application described in this chapter respect to the previous one.

C.2.1 Patient's area

The patients included in the intervention group of the multicenter study can access to the remote CPAP therapy follow-up web-based application by login with their personal credentials. In their personal area they can find the questionnaire they are asked to answer twice a month and visualize their answer in a graphical format. Furthermore, they can find informative links and documents about CPAP therapy and OSAS. They can also contact the sleep center staff by sending an e-mail directly from the website.

<u>Televisit page</u>

In this page patients can check the televisits scheduled with their sleep center staff. They can also an automatic e-mail with date and time of the televisit.

Screenshot C.2.38. Televisit page in the patients' area of the web application. Here the scheduled televisits are listed. *Header:* "Remote CPAP treatment follow-up". *Menu-bar:* "Welcome page, Questionnaire, Your record, Useful links and files, FAQ, Televisit, Contact your sleep center staff, Technical support, Logout". *Content:* "Scheduled televisits. To perform a televisit with you sleep center staff you should have installed the free videoconference software Skype. If you have not done it yet, click here to install the programm. Title, televisit date, hour".

"televisita.php" script:

```php
<?php require_once('Connections/conexion.php'); ?>
<?php
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}
}
if (isset($_SESSION['MM_fecha'])) {
$fecha=$_SESSION['MM_fecha'];
}

$colname_consulta_televisitas = "-1";
if (isset($_SESSION['MM_Username'])) {
  $colname_consulta_televisitas = $_SESSION['MM_Username'];
}
mysql_select_db($database_conexion, $conexion);
$query_consulta_televisitas = sprintf("SELECT * FROM televisitas WHERE
      paciente = %s AND fecha_televisita>='$fecha' ORDER BY
      fecha_televisita, hora_televisita",
      GetSQLValueString($colname_consulta_televisitas, "text"));
$consulta_televisitas = mysql_query($query_consulta_televisitas,
      $conexion) or die(mysql_error());
$row_consulta_televisitas = mysql_fetch_assoc($consulta_televisitas);
$totalRows_consulta_televisitas =
      mysql_num_rows($consulta_televisitas);
?>
```

```
<p class="titulo_contenido">Televisitas programadas<img
    src="../imagenes/teleoperadora.jpg" height="135" hspace="60"
    vspace="20" align="right"/></p>
<p class="texto">Para poder llevar a cabo una televisita con su
    clínica del sueño tiene que haber instalado en su ordenador el
    programa gratuito de vídeoconferencia Skype. Si aun no lo ha
    hecho, clique <a href="http://www.skype.com/intl/es-es/get-
    skype/" target="_blank">aquí</a> para instalar el programa.</p>
<?php if ($row_consulta_televisitas['fecha_televisita']) {?>
<table width="50%" border="0">
  <tr>
    <td><span class="formulario2">Titulo</span></td>
    <td><span class="formulario2">Fecha televisita</span></td>
    <td><span class="formulario2">Hora</span></td>
  </tr>
   <?php do { ?>
  <tr>
    <td><?php echo $row_consulta_televisitas['titulo']; ?></td>
    <td><?php echo $row_consulta_televisitas['fecha_televisita'];
      ?></td>
    <td><?php echo $row_consulta_televisitas['hora_televisita'];
      ?></td>
  </tr>
   <?php } while ($row_consulta_televisitas =
      mysql_fetch_assoc($consulta_televisitas)); ?>
</table><?php } else {?><p class="texto">Ninguna televisita
    programada</p><?php };
mysql_free_result($consulta_televisitas);?>
```

C.2.2   Sleep center staff area

From this area the medical staff of each sleep center can perform the remote monitoring of the patients registered to the web-based support system. The access is permitted only after a login with credentials. If the username and/or password inserted are incorrect, the user is automatically redirected to the "Sleep center staff area" access page.

"Schedule a new televisit" page

In this page the sleep center staff member in charge of the patient's follow-up can schedule a new televisit. The staff member can select a date from a pop-up calendar. If the date and/or hour are already occupied by another televisit, the system warns him/her and another day/time can be selected.

Screenshot C.2.39 "Schedule a new televisit" page of the staff area. *Header:* "Staff area". *Menu-bar:* "Patients' record, Register a new patients, Televisit scheduling, Deregister a patient, Access to data collection website, Logout". *Content:* "Schedule a new televisit. Patient code, Select date and time of the televisit. Televisit title, Starting time, Save".

"televisita_staff.php" script:

```php
<?php require_once('../Connections/conexion.php'); ?>
<?php
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";
// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
```

```php
  }
  return $isValid;
}
$MM_restrictGoTo = "acceso_enfermera.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup']))))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
// recupera variables de sesion
 $loginUsername=$_SESSION['MM_Username'];
$fecha=$_SESSION['MM_fecha'];
$id_centro=$_SESSION['MM_id_centro'];

//recupera paciente seleccionado
if (isset($_GET['u'])) {$usuario=$_GET['u'];}

//consulta pacientes del centro seleccionado
mysql_select_db($database_conexion, $conexion);
$query_consulta_pacientes = "SELECT codigo FROM usuarios WHERE
      email='$usuario'";
$consulta_pacientes = mysql_query($query_consulta_pacientes,
      $conexion) or die(mysql_error());
$row_consulta_pacientes = mysql_fetch_assoc($consulta_pacientes);
$totalRows_consulta_pacientes = mysql_num_rows($consulta_pacientes);
?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Crear cita</title>
<script type="text/javascript" src="../javascript/jquery.js"></script>
<script type="text/javascript" src="../javascript/date.js"></script>
<script type="text/javascript"
      src="../javascript/jquery.datePicker.js"></script>
<script type="text/javascript"
      src="../javascript/verificacion.js"></script>
<script src="../SpryAssets/SpryValidationTextField.js"
      type="text/javascript"></script>
<script>
$(function()
          {
                $('.date-pick').datePicker({autoFocusNextInput:
      true});
          });
</script>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1">
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css">
<link href="../estilos/datePicker.css" rel="stylesheet"
      type="text/css" />
```

```
<link href="../SpryAssets/SpryValidationTextField.css"
      rel="stylesheet" type="text/css">
</head>
<body>
<?php include("cabecera_enf.php");?>
<?php include("menu_enfermera.php");?>
<div id="contenido">
<p class="titulo_contenido">Crear nueva televisita</p>
<p class="formulario2">Paciente <?php echo
      $row_consulta_pacientes['codigo']; ?>
<form action="envio_televisita.php" name="chooseDateForm"
      id="chooseDateForm" method="POST">
  <fieldset>
                        <legend>Escoja fecha y hora de la
      televisita</legend>
                              <p><span id="sprytextfield1">
                        <input name="fecha_televisita"
      class="date-pick" id="date" value="dd/mm/aaaa" />
                        <span class="textfieldRequiredMsg">Se
      necesita un valor.</span><span
      class="textfieldInvalidFormatMsg">Formato no
      válido.</span></span><span class="formulario2">T&iacute;tulo
      televisita:</span>
                              <input name="titulo_televisita"
      type="text" id="titulo_televisita" value="televisita" size="10"
      maxlength="20">
                              <span class="formulario2"> Hora
      inicio:</span>
                              <select name="hora_televisita"
      id="hora_televisita">
                                <option value="8"
      selected>8</option>
                                <option value="9">9</option>
                                <option value="10">10</option>
                                <option value="11">11</option>
                                <option value="12">12</option>
                                <option value="13">13</option>
                                <option value="14">14</option>
                                <option value="15">15</option>
                                <option value="16">16</option>
                                <option value="17">17</option>
                                <option value="18">18</option>
                                <option value="19">19</option>
                                <option value="20">20</option>
                              </select>
:
<select name="minutos_televisita" id="minutos_televisita">
  <option value="00">00</option>
  <option value="15">15</option>
  <option value="30">30</option>
  <option value="45">45</option>
</select>
<input name="usuario" type="hidden" id="usuario" value="<?php echo
      $usuario;?>">
    </p>
  <p> <input type="submit" name="submit" id="submit" value="Guardar"
      ></p>
  </fieldset>
  <input type="hidden" name="MM_insert" value="chooseDateForm" />
```

```
</form>

<script>
$(function()
{
$('.date-pick').datePicker();
});
$(function()
{
$('.date-pick')
     .datePicker(
          {
               createButton:false,
               renderCallback:function($td, thisDate, month, year)
               {
                    if (thisDate.isWeekend()) {
                         $td.addClass('weekend');
                         $td.addClass('disabled');
                    }

                    var day = thisDate.getDay();
                    //if (day == 2 || day == 4) {
                    //$td.addClass('disabled');
}
               }
          }
     )
     .bind('click',
          function()
          {
               $(this).dpDisplay();
               this.blur();
               return false;
          }
     )
     .bind('dateSelected',
          function(e, selectedDate, $td)
          {
               console.log('You selected ' + selectedDate);
          }
     );
});
</script>
</div>
<?php @include("pie.php");?>
<script type="text/javascript">
<!--
var sprytextfield1 = new
     Spry.Widget.ValidationTextField("sprytextfield1", "date",
     {format:"dd/mm/yyyy", validateOn:["change"]});
//-->
</script>
</body>
</html>
<?php mysql_free_result($consulta_pacientes);?>
```

"List of televisits" page

In this page the staff member can visualize the list of the scheduled televisits. He/she has the possibility to eliminate them if necessary and by clicking the green icon can directly start the Skype videoconference with the selected patient.

Screenshot C.2.40. "List of televisits" page of the sleep center staff area. To protect the patients' confidentiality, some data were censored. *Header:* "Staff area". *Menu-bar:* "Patients' record, Register a new patients, Televisit scheduling, Deregister a patient, Access to data collection website, Logout". *Content:* "Scheduled televisits. ID, Patient, Title, Date, Starting time, Eliminate".

"televisits_list.php" script:

```php
<?php require_once('../Connections/conexion.php'); ?>
<?php
if (!isset($_SESSION)) {
  session_start();
}
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
```

```php
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}
}
if (isset($_SESSION['MM_fecha'])) {
$fecha=$_SESSION['MM_fecha'];
}

if ((isset($_POST['id_televisita'])) && ($_POST['id_televisita'] !=
      "")) {
  $deleteSQL = sprintf("DELETE FROM televisitas WHERE
      id_televisita=%s",
                       GetSQLValueString($_POST['id_televisita'],
      "int"));

  mysql_select_db($database_conexion, $conexion);
  $Result1 = mysql_query($deleteSQL, $conexion) or die(mysql_error());

  $deleteGoTo = "lista_televisitas.php";
  if (isset($_SERVER['QUERY_STRING'])) {
    $deleteGoTo .= (strpos($deleteGoTo, '?')) ? "&" : "?";
    $deleteGoTo .= $_SERVER['QUERY_STRING'];
  }
  header(sprintf("Location: %s", $deleteGoTo));
}
//consulta lista televisitas
$colname_consulta_televisitas = "-1";
if (isset($_SESSION['MM_Username'])) {
  $colname_consulta_televisitas = $_SESSION['MM_Username'];
}

mysql_select_db($database_conexion, $conexion);
$query_consulta_televisitas = sprintf("SELECT * FROM televisitas INNER
      JOIN usuarios ON televisitas.paciente=usuarios.email WHERE
      ponent = %s AND fecha_televisita>='$fecha' ORDER BY
      fecha_televisita, hora_televisita ASC",
      GetSQLValueString($colname_consulta_televisitas, "text"));
$consulta_televisitas = mysql_query($query_consulta_televisitas,
      $conexion) or die(mysql_error());
$row_consulta_televisitas = mysql_fetch_assoc($consulta_televisitas);
$totalRows_consulta_televisitas =
      mysql_num_rows($consulta_televisitas);
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
```

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```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
     1" />
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css">
<title>Lista televisitas</title>
</head>
<body>
<?php @include("cabecera_enf.php");?>
<?php @include("menu_enfermera.php");?>
<div id="contenido">
<p class="titulo_contenido">Lista televisitas</p>
<?php if ($row_consulta_televisitas['fecha_televisita']) {?>
<table width="100%" border="1" class="tabla">
  <tr>
    <td class="formulario2">ID</td>
    <td><span class="formulario2">Paciente</span></td>
    <td><span class="formulario2">Titulo</span></td>
    <td><span class="formulario2">Fecha televisita</span></td>
    <td><span class="formulario2">Hora inicio</span></td>
    <td> </td>
    <td> </td>
  </tr>
  <?php do { ?>
    <tr>
      <td><span class="texto"><?php echo
      $row_consulta_televisitas['id_televisita']; ?></span></td>
      <td><span class="texto"><?php echo
      $row_consulta_televisitas['paciente']; ?></span></td>
      <td><span class="texto"><?php echo
      $row_consulta_televisitas['titulo']; ?></span></td>
      <td><span class="texto"><?php echo
      $row_consulta_televisitas['fecha_televisita']; ?></span></td>
      <td><span class="texto"><?php echo
      $row_consulta_televisitas['hora_televisita']; ?></span></td>
      <td><!-- Skype 'Skype Me™!' button
      http://www.skype.com/go/skypebutton -->
<script type="text/javascript"
      src="http://download.skype.com/share/skypebuttons/js/skypeCheck.
      js"></script>
<a href="skype:<?php echo $row_consulta_televisitas['usuario_skype'];
      ?>?call"><img
      src="http://download.skype.com/share/skypebuttons/buttons/call_b
      lue_transparent_34x34.png" style="border: none;" width="34"
      height="34" alt="Skype Me™!" /></a>
</td>
      <td><form id="form1" name="form1" method="post" action="">
        <span class="texto">
        <input type="submit" name="eliminar" id="eliminar"
      value="Eliminar" />
        <input name="id_televisita" type="hidden" value="<?php echo
      $row_consulta_televisitas['id_televisita']; ?>" />
        </span>
      </form></td>
    </tr>
    <?php } while ($row_consulta_televisitas =
    mysql_fetch_assoc($consulta_televisitas)); ?>
</table><?php } else {?><p class="texto">Ninguna televisita
      programada</p><?php };?>
```

```
</div>
<?php @include("pie.php");?>
</body>
</html>
<?php mysql_free_result($consulta_televisitas);?>
```
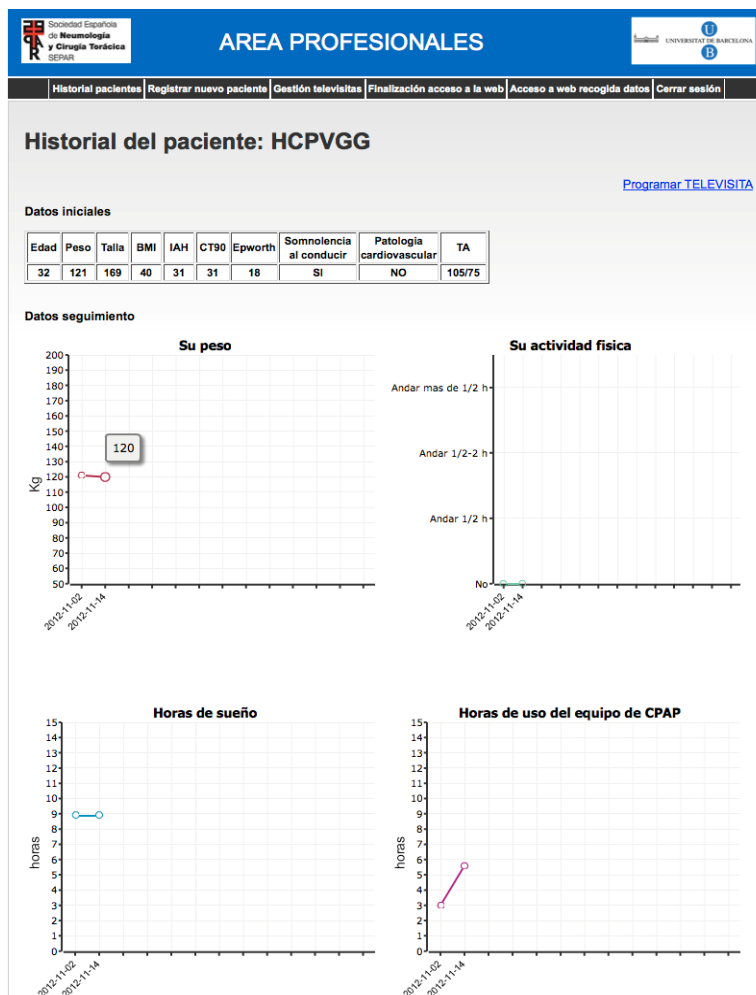
Patient's record page

This page retrieves the patients' answers to the questionnaire and displays them in Flash charts. Each Flash chart is issued by a different script in which all the graphical settings are stored. To help the medical staff rapidly indentifying the patient's profile, this page was designed to retrieve also some baseline data and summarized them in a table in the upper part of the screen.

Screenshot C.2.41. Patient's record page. Visualization of some of the patients' answers to the periodic questionnaire by dynamic Flash charts. *Header:* "Staff area". *Menu-bar:* "Patients' record, Register a new patients, Televisit scheduling, Deregister a patient, Access to data collection website, Logout". *Content:* "Patient's record nº..., Baseline data: age, weight, height, BMI, AHI, CT90, Epworth, sleepiness when driving, cardiovascular disease, arterial blood pressure. Follow-up data: weight, physical activity, sleep time, CPAP use time".

"historial_paciente.php" script:

```php
<?php require_once('../Connections/conexion.php');
if (!isset($_SESSION)) {
  session_start();}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
     MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
     variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;}

$MM_restrictGoTo = "acceso_enfermera.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
if (isset($_POST['u'])) {
$usuario=$_POST['u'];
mysql_select_db($database_conexion, $conexion);
$query_consulta_datos_iniciales = "SELECT * FROM datos_iniciales WHERE
      usuario = '$usuario'";
$consulta_datos_iniciales =
      mysql_query($query_consulta_datos_iniciales, $conexion) or
      die(mysql_error());
```

```php
$row_consulta_datos_iniciales =
      mysql_fetch_assoc($consulta_datos_iniciales);
$totalRows_consulta_datos_iniciales =
      mysql_num_rows($consulta_datos_iniciales);

mysql_select_db($database_conexion, $conexion);
$query_consulta_paciente = "SELECT codigo FROM usuarios WHERE email =
      '$usuario'";
$consulta_paciente = mysql_query($query_consulta_paciente, $conexion)
      or die(mysql_error());
$row_consulta_paciente = mysql_fetch_assoc($consulta_paciente);
$totalRows_consulta_paciente = mysql_num_rows($consulta_paciente);
$BMI=intval(($row_consulta_datos_iniciales['peso']/(($row_consulta_dat
      os_iniciales['talla']/100)^2)));
$dataurl=urlencode("?u=".$usuario);
}
else {?>
                  <script type="text/javascript">
                  alert("Seleccione un paciente.")
                  document.location.href="lista_pacientes.php";
                  </script>
<?php  }
?>
<script type="text/javascript"
      src="../OpenFlashChart/js/swfobject.js"></script>
<script type="text/javascript">

swfobject.embedSWF(
  "../OpenFlashChart/open-flash-chart.swf", "chart_peso",
  "470", "400", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "peso-chart_enf.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "../OpenFlashChart/open-flash-chart.swf", "chart_actividad",
  "470", "400", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "actividad-chart_enf.php".$dataurl; ?>"} );

swfobject.embedSWF(
  "../OpenFlashChart/open-flash-chart.swf", "chart_horas_sueno",
  "470", "400", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "horas_sueno-chart_enf.php".$dataurl; ?>"}
      );

swfobject.embedSWF(
  "../OpenFlashChart/open-flash-chart.swf", "chart_horas_CPAP",
  "470", "400", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "horas_CPAP-chart_enf.php".$dataurl; ?>"}
      );

swfobject.embedSWF(
  "../OpenFlashChart/open-flash-chart.swf", "chart_somnolencia",
  "470", "400", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "somnolencia-chart_enf.php".$dataurl; ?>"}
      );

swfobject.embedSWF(
  "../OpenFlashChart/open-flash-chart.swf", "chart_efectos",
  "470", "400", "9.0.0", "expressInstall.swf",
  {"data-file":"<?php echo "efectos-chart_enf.php".$dataurl; ?>"} );
```

```
</script>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
      "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Historial pacientes</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1">
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php @include("cabecera_enf.php") ?>
<?php @include("menu_enfermera.php") ?>
<div id="contenido">
<p class="titulo_contenido">Historial del paciente: <?php echo
      $row_consulta_paciente['codigo'];?></p><p align="right"><a
      href="televisita_enf.php?u=<?php echo $usuario;?>">Programar
      TELEVISITA</a></p>
<p class="formulario2">Datos iniciales</p>
<table width="604" border="1" align="left"  class="formulario">
  <tr align="center" bgcolor="#FFFFFF">
    <td width="40">Edad</td>
    <td width="40">Peso</td>
    <td width="40">Talla</td>
    <td width="40">BMI</td>
    <td width="40">IAH</td>
    <td width="40">CT90</td>
    <td width="40">Epworth</td>
    <td width="100">Somnolencia al conducir</td>
    <td width="100">Patologia cardiovascular</td>
    <td width="60">TA</td>
    </tr>
  <tr align="center" bgcolor="#FFFFFF">
    <td width="40"><?php echo $row_consulta_datos_iniciales['edad'];
      ?></td>
    <td width="40"><?php echo $row_consulta_datos_iniciales['peso'];
      ?></td>
    <td width="40"><?php echo $row_consulta_datos_iniciales['talla'];
      ?></td>
    <td width="40"><?php echo $BMI; ?></td>
    <td width="40"><?php echo $row_consulta_datos_iniciales['IAH'];
      ?></td>
    <td width="40"><?php echo $row_consulta_datos_iniciales['CT90'];
      ?></td>
    <td width="40"><?php echo
      $row_consulta_datos_iniciales['epworth']; ?></td>
    <td width="100"><?php if
      ($row_consulta_datos_iniciales['somnolencia']==0) {echo 'NO';}
      else {echo 'SI';};?></td>
    <td width="100"><?php if
      ($row_consulta_datos_iniciales['cardio']==0) {echo 'NO';} else
      {echo 'SI';}; ?></td>
    <td width="60"><?php echo $row_consulta_datos_iniciales['TA_max'];
      ?>/<?php echo $row_consulta_datos_iniciales['TA_min']; ?></td>
    </tr>
</table>
<p class="formulario2">Datos seguimiento</p>
<div id="chart_peso"></div>
```

```
<div id="chart_actividad"></div>
<p> </p>
<p><br>
</p>
<div id="chart_horas_sueno"></div>
<div id="chart_horas_CPAP"></div>
<p> </p>
<p><br>
</p>
<div id="chart_somnolencia"></div>
<div id="chart_efectos"></div>
<p>Enviar e-mail al paciente.<form name="form1" method="post"
    action="envio_email_enfermera.php">
  <p>
    <textarea name="consulta" id="consulta" cols="45" rows="5"
      class="caja_texto_2"></textarea>
  </p>
  <p>
    <input name="hiddenField" type="hidden" id="hiddenField"
      value="<?php echo $usuario;?>">
    <input name="acceso" type="image" id="enviar" value="Enviar"
      src="../imagenes/boton_enviar.gif" align="bottom">
  </p>
</form>
</p>
</div>
<?php @include("pie.php");?>
</body>
</html>
<?php mysql_free_result($consulta_datos_iniciales);
mysql_free_result($consulta_paciente);?>
```

C.2.3   Administrator area

The access to this area is restricted to the multicenter system administrator. The main functions of this area are the registration of a new center and new staff member to the system.

New center registration page

The page is composed by a simple form to fill in with the contact information of the new participant center to the trial.

Screenshot C.2.42. New center registration page. Translation from the original version in Spanish. *Header:* "Administrator area". *Menu-bar:* "Register a new center, Register a new staff member". *Content:* "Register a new center, Data: Name, E-mail, Confirm E-mail, Telephone, City, Register".

"alta_centro.php" script:

```php
<?php require_once('../Connections/conexion.php'); ?>
<?php
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
```

```php
      // Or, you may restrict access to only certain users based on
        their username.
      if (in_array($UserGroup, $arrGroups)) {
        $isValid = true;
      }
      if (($strUsers == "") && true) {
        $isValid = true;
      }
    }
    return $isValid;
  }
}

$MM_restrictGoTo = "admin.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup']))))  {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
?>
<?php
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
```

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```
  }
  return $theValue;
}
}

$editFormAction = $_SERVER['PHP_SELF'];
if (isset($_SERVER['QUERY_STRING'])) {
  $editFormAction .= "?" . htmlentities($_SERVER['QUERY_STRING']);
}

// verifica que el centro no esté ya registrado
mysql_select_db($database_conexion, $conexion);
$query_verificar_nuevo_usuario = "SELECT centros.email FROM centros";
$verificar_nuevo_usuario = mysql_query($query_verificar_nuevo_usuario,
      $conexion) or die(mysql_error());
$row_verificar_nuevo_usuario =
      mysql_fetch_assoc($verificar_nuevo_usuario);
$totalRows_verificar_nuevo_usuario =
      mysql_num_rows($verificar_nuevo_usuario);

$comprobar='OK';
do  {
if (isset($_POST['usuario_email'])) {
      if
      ($row_verificar_nuevo_usuario['email']==$_POST['usuario_email'])
      {
            $comprobar='error';}}
}
while ($row_verificar_nuevo_usuario =
      mysql_fetch_assoc($verificar_nuevo_usuario));

//centro ya registrado
if ($comprobar=='error') {
echo '<script type="text/javascript">
alert("Centro ya registrado.");
document.location.href="alta_centro.php";
</script>';

    }
//centro no registrado --> se procede a insertar datos en bbdd
if ($comprobar!='error') {

  // Asignar variables de sesion
  $fecha=$_SESSION['MM_fecha'];
if ((isset($_POST["MM_insert"])) && ($_POST["MM_insert"] == "form1"))
      {

      //inserta registro en tabla centros
      $insertSQL = sprintf("INSERT INTO centros (fecha_alta,
      id_centro, ciudad, telefono, email) VALUES ('$fecha', %s, %s,
      %s, %s)",
                        GetSQLValueString($_POST['id_centro'], "text"),
                            GetSQLValueString($_POST['ciudad'], "text"),
                        GetSQLValueString($_POST['telefono'], "int"),
                        GetSQLValueString($_POST['usuario_email'],
      "text"));

      mysql_select_db($database_conexion, $conexion);
```

```php
      $Result1 = mysql_query($insertSQL, $conexion) or
      die(mysql_error());

  $insertGoTo = "alta_centro.php";
  if (isset($_SERVER['QUERY_STRING'])) {
    $insertGoTo .= (strpos($insertGoTo, '?')) ? "&" : "?";
    $insertGoTo .= $_SERVER['QUERY_STRING'];
  }

  header(sprintf("Location: %s", $insertGoTo)); // Salto a pag.
      principal
}}
?>
```

```html
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Alta centro</title>
<script type="text/javascript"
      src="../javascript/verificacion.js"></script>
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php @include("cabecera_admin.php");?>
<?php @include("menu_principal_admin.php");?>
<div id="contenido">
<form action="<?php echo $editFormAction;?>" method="POST"
      name="form1" id="form1" onsubmit="return
      validacion_alta_centro(this)">
  <p> </p>
  <table width="85%" border="0" align="center" cellpadding="0"
      cellspacing="3">
    <tr>
      <td width="44%"> </td>
      <td width="56%" class="titulo">Alta nuevo centro</td>
      </tr>
    <tr>
      <td> </td>
      <td> </td>
    </tr>
    <tr>
      <td> </td>
      <td class="formulario">Datos</td>
      </tr>
    <tr>
      <td align="right" class="formulario">Nombre:</td>
      <td><input name="id_centro" type="text" class="caja_texto"
      id="id_centro" maxlength="50" /></td>
    </tr>
    <tr>
      <td align="right" class="formulario">E-mail:</td>
      <td class="formulario"><input type="text" name="usuario_email"
      id="usuario_email" class="caja_texto" /></td>
    </tr>
    <tr>
      <td align="right" class="formulario">Confirmar e-mail:</td>
      <td><span class="formulario">
```

```
        <input type="text" name="email_confirmacion"
      id="email_confirmacion" class="caja_texto" />
      </span></td>
    </tr>
    <tr>
      <td align="right" class="formulario">Tel&eacute;fono:</td>
      <td><input type="text" name="telefono" id="telefono"
      class="caja_texto" /></td>
      </tr>
    <tr>
      <td align="right"class="formulario">Ciudad:</td>
      <td class="formulario"><input type="text" name="ciudad"
      id="ciudad" class="caja_texto" /></td>
      </tr>
    <tr>
      <td align="right" class="formulario"> </td>
      <td> </td>
    </tr>
    <tr>
      <td> </td>
      <td><p>
        <input type="image" src="../imagenes/boton_registro.gif"
      name="registro" id="registro"/>
        </p></td>
    </tr>
  </table>
  <input type="hidden" name="MM_insert" value="form1" />
</form>
</div>
<?php @include("../pie.php");?>
</body>
<?php
mysql_free_result($verificar_nuevo_usuario);
?>
```

<u>New staff member registration page</u>

Filling in this form, the administrator can register a new staff member of a participant center.

Screenshot C.2.43. New center registration page. Translation from the original version in Spanish. *Header:* "Administrator area". *Menu-bar*: "Register a new center, Register a new staff member". *Content:* "Register a new staff member, Personal data: Username, Center, E-mail, Confirm E-mail, New password".

"alta_profesional.php" script:

```php
<?php require_once('../Connections/conexion.php'); ?>
<?php
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
        certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
```

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```php
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}

$MM_restrictGoTo = "admin.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}
?>
<?php
if (!function_exists("GetSQLValueString")) {
function GetSQLValueString($theValue, $theType, $theDefinedValue = "",
      $theNotDefinedValue = "")
{
  if (PHP_VERSION < 6) {
    $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) :
      $theValue;
  }

  $theValue = function_exists("mysql_real_escape_string") ?
      mysql_real_escape_string($theValue) :
      mysql_escape_string($theValue);

  switch ($theType) {
    case "text":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "long":
    case "int":
      $theValue = ($theValue != "") ? intval($theValue) : "NULL";
      break;
    case "double":
      $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
      break;
    case "date":
      $theValue = ($theValue != "") ? "'" . $theValue . "'" : "NULL";
      break;
    case "defined":
```

```
      $theValue = ($theValue != "") ? $theDefinedValue :
      $theNotDefinedValue;
      break;
  }
  return $theValue;
}
}

mysql_select_db($database_conexion, $conexion);
$query_consulta_centro = "SELECT id_centro FROM centros";
$consulta_centro = mysql_query($query_consulta_centro, $conexion) or
      die(mysql_error());
$row_consulta_centro = mysql_fetch_assoc($consulta_centro);
$totalRows_consulta_centro = mysql_num_rows($consulta_centro);

$editFormAction = $_SERVER['PHP_SELF'];
if (isset($_SERVER['QUERY_STRING'])) {
  $editFormAction .= "?" . htmlentities($_SERVER['QUERY_STRING']);
}

// verifica que el centro no esté ya registrado
mysql_select_db($database_conexion, $conexion);
$query_verificar_nuevo_usuario = "SELECT usuarios.email FROM
      usuarios";
$verificar_nuevo_usuario = mysql_query($query_verificar_nuevo_usuario,
      $conexion) or die(mysql_error());
$row_verificar_nuevo_usuario =
      mysql_fetch_assoc($verificar_nuevo_usuario);
$totalRows_verificar_nuevo_usuario =
      mysql_num_rows($verificar_nuevo_usuario);

$comprobar='OK';

do  {
if (isset($_POST['usuario_email'])) {
      if
      ($row_verificar_nuevo_usuario['email']==$_POST['usuario_email'])
      {
            $comprobar='error';}}
}
while ($row_verificar_nuevo_usuario =
      mysql_fetch_assoc($verificar_nuevo_usuario));

//centro ya registrado
if ($comprobar=='error') {
echo '<script type="text/javascript">
alert("Profesional ya registrado.");
document.location.href="alta_profesional.php";
</script>';

    }
//centro no registrado --> se procede a insertar datos en bbdd
if ($comprobar!='error') {

  // Asignar variables de sesion
  $fecha=$_SESSION['MM_fecha'];

if ((isset($_POST["MM_insert"])) && ($_POST["MM_insert"] == "form1"))
      {
```

```php
        //inserta registro en tabla usuarios
        $insertSQL = sprintf("INSERT INTO usuarios (tipo_usuario,
        codigo, id_centro, email, contrasena, acceso, fecha_alta) VALUES
        ('prof', %s, %s, %s, %s, 'activo','$fecha')",
                        GetSQLValueString($_POST['codigo'], "text"),
                            GetSQLValueString($_POST['centro'], "text"),
                        GetSQLValueString($_POST['usuario_email'],
        "text"),
                        GetSQLValueString($_POST['contrasena'],
        "text"));

        mysql_select_db($database_conexion, $conexion);
        $Result1 = mysql_query($insertSQL, $conexion) or
        die(mysql_error());


  $insertGoTo = "alta_profesional.php";
  if (isset($_SERVER['QUERY_STRING'])) {
    $insertGoTo .= (strpos($insertGoTo, '?')) ? "&" : "?";
    $insertGoTo .= $_SERVER['QUERY_STRING'];
  }


  header(sprintf("Location: %s", $insertGoTo)); // Salto a pag.
      principal
}
}
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-
      1" />
<title>Alta profesional</title>
<script type="text/javascript"
      src="../javascript/verificacion.js"></script>
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css">
</head>
<body>
<?php @include("cabecera_admin.php");?>
<?php @include("menu_principal_admin.php");?>
<div id="contenido">
<form action="<?php echo $editFormAction; ?>" method="POST"
      name="form1" id="form1" onsubmit="return
      validacion_alta_profesional(this)">
  <p> </p>
  <table width="85%" border="0" align="center" cellpadding="0"
      cellspacing="3">
    <tr>
      <td> </td>
      <td class="titulo">Alta nuevo profesional</td>
      </tr>
    <tr>
      <td> </td>
      <td> </td>
    </tr>
    <tr>
```

```
        <td> </td>
        <td class="formulario">Datos personales</td>
        </tr>
      <tr>
        <td align="right" class="formulario">Usuario:</td>
        <td><input name="codigo" type="text" class="caja_texto"
        id="codigo" maxlength="10" /></td>
      </tr>
      <tr>
        <td align="right" class="formulario">Centro</td>
        <td class="formulario"><select name="centro" id="centro">
          <?php
do {
?>
          <option value="<?php echo
        $row_consulta_centro['id_centro']?>"<?php if
        (!(strcmp($row_consulta_centro['id_centro'],
        $row_consulta_centro['id_centro']))) {echo
        "selected=\"selected\"";} ?>><?php echo
        $row_consulta_centro['id_centro']?></option>
          <?php
} while ($row_consulta_centro = mysql_fetch_assoc($consulta_centro));
  $rows = mysql_num_rows($consulta_centro);
  if($rows > 0) {
     mysql_data_seek($consulta_centro, 0);
  $row_consulta_centro = mysql_fetch_assoc($consulta_centro);
  }
?>
        </select></td>
      </tr>
      <tr>
        <td align="right" class="formulario">Correo
        electr&oacute;nico:</td>
        <td class="formulario"><input type="text" name="usuario_email"
        id="usuario_email" class="caja_texto" /></td>
        </tr>
      <tr>
        <td align="right" class="formulario">Vuelva a escribir el correo
        electr&oacute;nico:</td>
        <td><input type="text" name="email_confirmacion"
        id="email_confirmacion" class="caja_texto" /></td>
        </tr>
      <tr>
        <td align="right"class="formulario">Nueva
        contrase&ntilde;a:</td>
        <td class="formulario"><input type="password" name="contrasena"
        id="contrasena" class="caja_texto" /></td>
        </tr>
      <tr>
        <td align="right" class="formulario"> </td>
        <td> </td>
      </tr>
      <tr>
        <td> </td>
        <td><p>
          <input type="image" src="../imagenes/boton_registro.gif"
        name="registro" id="registro"/>
          </p></td>
      </tr>
```

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```
    </table>
    <input type="hidden" name="MM_insert" value="form1" />
</form>
</div>
<?php @include("../pie.php");?>
</body>
<?php
mysql_free_result($verificar_nuevo_usuario);
mysql_free_result($consulta_centro);
?>
```

C.2.4 Multicenter data collection website

This application provides an easy tool for the data uploading to the central database for all the clinical centers that participate to the trial. The application was developed as an interactive website with restricted access by login with personal credentials and it essentially consists of forms to be filled in by the centers' staff in charge of the trial. Each page content was inserted in a php template which contained the header and menu-bar of the website.

Since the uploading pages of the different trial phases are similar, only the screenshots and scripts corresponding to the first trial phase (Recruitment) are shown as examples.

Patients' list page

This page displays all the patients included and their status in the trial. The screenshot is shown above in Figure 4.9.

"home.php" script:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"><!-- InstanceBegin
      template="/Templates/plantillaDatos_menu.dwt.php"
      codeOutsideHTMLIsLocked="false" -->
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<!-- InstanceBeginEditable name="doctitle" -->
<title></title>
<!-- InstanceEndEditable -->
<!-- InstanceBeginEditable name="head" -->
<!-- InstanceEndEditable -->
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css" />
</head>

<body>
<table width="990" border="0" align="center" cellspacing="0"
      id="cabecera_datos">
```

```
  <tr class="tabla">
    <td width="228" height="122"><img src="../imagenes/mi-
      cpap_logo.PNG" width="148" height="120" /></td>
    <td width="598"><p><span class="titulo"><span
      class="titulo_contenido">Estudio multicéntrico MI-CPAP<br />
      Sitio web de recogida de datos
      </span></span><br />
    </p></td>
    <td width="158"><img src="../imagenes/logo_separ.jpg" width="157"
      height="66" /></td>
  </tr>
</table>
<div class="Menu_datos"><span class="BotonMenu_datos"><a
      href="home.php">Lista pacientes</a></span> <span
      class="BotonMenu_datos"><a
      href="reclutamiento.php">Reclutamiento</a></span> <span
      class="BotonMenu_datos"><a href="anexos.php">Anexos</a></span>
      <span class="BotonMenu_datos"><a
      href="/datos/home.php?doLogout=true">Salir</a></span></div>
<div id="contenido">
<!-- InstanceBeginEditable name="Contenido" -->
<table width="100%" border="1" cellspacing="0" class="tabla">
  <tr>
    <th scope="col">Cod. Paciente</th>
    <th scope="col">Reclutamiento</th>
    <th scope="col">Visita 1</th>
    <th scope="col">Titulación</th>
    <th scope="col">Randomización</th>
    <th scope="col">Visita 2</th>
    <th scope="col">Visita 3</th>
    <th scope="col">Visita 4</th>
  </tr>  <tr>
    <th scope="row">Paciente_prueba_1</th>
    <td><a
      href="reclutamiento_review.php?p=Paciente_prueba_1">incluido<br
      />2012-10-12</td>
    <td><a href="visita1_review.php?p=Paciente_prueba_1">realizada<br
      />2012-10-22</a></td>
    <td><a
      href="titulacion_review.php?p=Paciente_prueba_1">realizada<br
      />2012-10-23</td>
    <td>Seguimiento web</td>

    <td><a href="visita2_review.php?p=Paciente_prueba_1">realizada<br
      />2012-10-24</td>
    <td><a href="visita3_review.php?p=Paciente_prueba_1">realizada<br
      />2012-12-25</td>
    <td><a href="visita4_review.php?p=Paciente_prueba_1">realizada<br
      />2012-10-30</td>
  </tr>
    <tr>
    <th scope="row">Paciente_prueba_2</th>
    <td><a
      href="reclutamiento_review.php?p=Paciente_prueba_2">incluido<br
      />2012-10-25</td>
    <td><a href="visita1_review.php?p=Paciente_prueba_2">realizada<br
      />2012-11-15</a></td>
    <td>      <a href="titulacion.php?p=Paciente_prueba_2">por
      realizar</td>
```
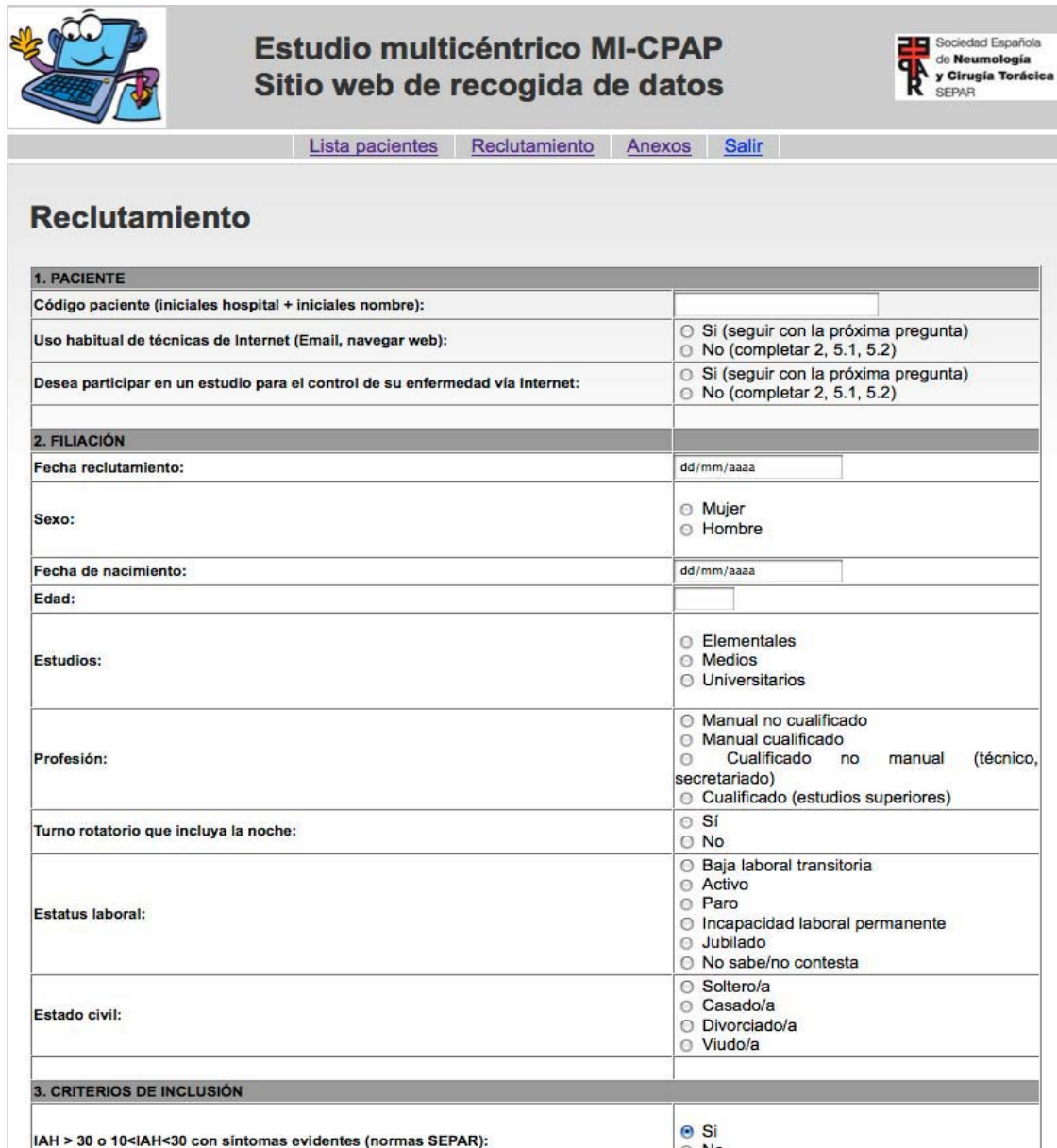
```
    <td> <a href="randomizacion.php?p=Paciente_prueba_2">por
      realizar</td>
    <td> <a href="visita2.php?p=Paciente_prueba_2">por realizar</td>
    <td> <a href="visita3.php?p=Paciente_prueba_2">por realizar</td>
    <td> <a href="visita4.php?p=Paciente_prueba_2">por realizar</td>
  </tr>
    <tr>
    <th scope="row">Paciente_prueba_3</th>
    <td><a
      href="reclutamiento_review.php?p=Paciente_prueba_3">incluido<br
      />2012-11-15</td>
    <td><a href="visita1_review.php?p=Paciente_prueba_3">realizada<br
      />2012-11-15</a></td>
    <td>        <a href="titulacion.php?p=Paciente_prueba_3">por
      realizar</td>
    <td> <a href="randomizacion.php?p=Paciente_prueba_3">por
      realizar</td>
    <td> <a href="visita2.php?p=Paciente_prueba_3">por realizar</td>
    <td> <a href="visita3.php?p=Paciente_prueba_3">por realizar</td>
    <td> <a href="visita4.php?p=Paciente_prueba_3">por realizar</td>
      </tr>
  </table>
<!-- InstanceEndEditable -->
</div>
</body>
<!-- InstanceEnd --></html>
```

Recruitment page

A form that collects all baseline data gathered during the recruitment of the patient composes this page.

Screenshot C.2.44. Part of the recruitment page. Translation from the original version in Spanish. Translation from the original version in Spanish: *Header:* "Multicenter trial MI-CPAP. Data collection website." *Menu-bar:* "Patients list, Recruitment, Annexes, Logout". *Content:* "Recruitment. Patient ID, Use of the Internet: yes/no, Consent to participate: yes/no, Date of recruitment, Gender: male/female, Date of birth, Age, Studies: elementals, intermediate, university, Job: manual not qualified, manual qualified, qualified not manual (technician, secretary), qualified, Night shift: yes/no, Job status: temporary off work, active, stoppage, permanent disability, retired, don't know/don't answer, Civil status: single, married, divorced, widower, Inclusion criteria".

"reclutamiento.php" script:

```php
<?php require_once('../Connections/conexion.php'); ?>
<?php
if (!isset($_SESSION)) {
  session_start();
}
$MM_authorizedUsers = "";
$MM_donotCheckaccess = "true";

// *** Restrict Access To Page: Grant or deny access to this page
function isAuthorized($strUsers, $strGroups, $UserName, $UserGroup) {
  // For security, start by assuming the visitor is NOT authorized.
  $isValid = False;

  // When a visitor has logged into this site, the Session variable
      MM_Username set equal to their username.
  // Therefore, we know that a user is NOT logged in if that Session
      variable is blank.
  if (!empty($UserName)) {
    // Besides being logged in, you may restrict access to only
      certain users based on an ID established when they login.
    // Parse the strings into arrays.
    $arrUsers = Explode(",", $strUsers);
    $arrGroups = Explode(",", $strGroups);
    if (in_array($UserName, $arrUsers)) {
      $isValid = true;
    }
    // Or, you may restrict access to only certain users based on
      their username.
    if (in_array($UserGroup, $arrGroups)) {
      $isValid = true;
    }
    if (($strUsers == "") && true) {
      $isValid = true;
    }
  }
  return $isValid;
}

$MM_restrictGoTo = "acceso_datos.php";
if (!((isset($_SESSION['MM_Username'])) &&
      (isAuthorized("",$MM_authorizedUsers, $_SESSION['MM_Username'],
      $_SESSION['MM_UserGroup'])))) {
  $MM_qsChar = "?";
  $MM_referrer = $_SERVER['PHP_SELF'];
  if (strpos($MM_restrictGoTo, "?")) $MM_qsChar = "&";
  if (isset($QUERY_STRING) && strlen($QUERY_STRING) > 0)
  $MM_referrer .= "?" . $QUERY_STRING;
  $MM_restrictGoTo = $MM_restrictGoTo. $MM_qsChar . "accesscheck=" .
      urlencode($MM_referrer);
  header("Location: ". $MM_restrictGoTo);
  exit;
}

$loginUsername=$_SESSION['MM_Username'];
$id_centro=$_SESSION['MM_id_centro'];
$cod_pac=$_GET['p'];
$editFormAction = $_SERVER['PHP_SELF'];
```

```php
if (isset($_SERVER['QUERY_STRING'])) {
  $editFormAction .= "?" . htmlentities($_SERVER['QUERY_STRING']);
}

$myFile = "random.txt";
$fh = fopen($myFile, 'r');
$theData = fread($fh, 400);
$array = preg_split ('/$\R?^/m', $theData);
$grupo=$array[0];
fclose($fh);

if ((isset($_POST["MM_insert"])) && ($_POST["MM_insert"] == "form1"))
      {
//corre secuencia aleatorizacion
$first=array_shift($array);
array_push($array,$first);
$fh = fopen($myFile, 'w');
$string = implode("\n", $array);
fwrite($fh, $string);
fclose($fh);

//inserta datos
      $insertSQL = sprintf("UPDATE datos SET  grupo='$grupo' WHERE
      cod_pac='$cod_pac'");
      mysql_select_db($database_conexion, $conexion);
      $Result1 = mysql_query($insertSQL, $conexion) or
      die(mysql_error());
      $insertGoTo = "home.php";
  if (isset($_SERVER['QUERY_STRING'])) {
    $insertGoTo .= (strpos($insertGoTo, '?')) ? "&" : "?";
    $insertGoTo .= $_SERVER['QUERY_STRING'];
  }
  header(sprintf("Location: %s", $insertGoTo)); // Salto a pag.
      principal
}
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"><!-- InstanceBegin
      template="/Templates/plantillaDatos_menu.dwt.php"
      codeOutsideHTMLIsLocked="false" -->
<head>
<?php
// ** Logout the current user. **
$logoutAction = $_SERVER['PHP_SELF']."?doLogout=true";
if ((isset($_SERVER['QUERY_STRING'])) && ($_SERVER['QUERY_STRING'] !=
      "")){
  $logoutAction .="&". htmlentities($_SERVER['QUERY_STRING']);
}

if ((isset($_GET['doLogout'])) &&($_GET['doLogout']=="true")){
  //to fully log out a visitor we need to clear the session varialbles
  $_SESSION['MM_Username'] = NULL;
  $_SESSION['MM_UserGroup'] = NULL;
  $_SESSION['MM_id_centro']= NULL;
  $_SESSION['MM_fecha']= NULL;
  $_SESSION['PrevUrl'] = NULL;
  unset($_SESSION['MM_Username']);
  unset($_SESSION['MM_UserGroup']);
```

```
    unset($_SESSION['MM_fecha']);
    unset($_SESSION['MM_id_centro']);
    unset($_SESSION['PrevUrl']);

    $logoutGoTo = "acceso_datos.php";
    if ($logoutGoTo) {
      echo '<script type="text/javascript">
document.location.href="../datos/acceso_datos.php";
</script>';
      exit;
    }
}
?>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<!-- InstanceBeginEditable name="doctitle" -->
<title>randomización</title>
<!-- InstanceEndEditable -->
<!-- InstanceBeginEditable name="head" -->
<!-- InstanceEndEditable -->
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css" />
</head>

<body>
<table width="990" border="0" align="center" cellspacing="0"
      id="cabecera_datos">
  <tr class="tabla">
    <td width="228" height="122"><img src="../imagenes/mi-
      cpap_logo.PNG" width="148" height="120" /></td>
    <td width="598"><p><span class="titulo"><span
      class="titulo_contenido">Estudio multicéntrico MI-CPAP<br />
      Sitio web de recogida de datos
      </span></span><br />
    </p></td>
    <td width="158"><img src="../imagenes/logo_separ.jpg" width="157"
      height="66" /></td>
  </tr>
</table>
<div class="Menu_datos"><span class="BotonMenu_datos"><a
      href="home.php">Lista pacientes</a></span> <span
      class="BotonMenu_datos"><a
      href="reclutamiento.php">Reclutamiento</a></span> <span
      class="BotonMenu_datos"><a href="anexos.php">Anexos</a></span>
      <span class="BotonMenu_datos"><a href="<?php echo $logoutAction
      ?>">Salir</a></span></div>
<div id="contenido">
<!-- InstanceBeginEditable name="Contenido" -->
<p class="titulo_contenido">Randomización</p>
<form id="form1" name="form1" method="post" action="<?php echo
      $editFormAction; ?>">
  <table width="100%" border="1" cellspacing="0"
      bordercolor="#CCCCCC">
    <tr>
      <th align="left" class="formulario">Código paciente: <?php echo
      $cod_pac; ?></th>
    </tr>
    <tr bgcolor="#0099FF">
      <th width="907" align="left" class="formulario">El paciente se
      incluye en el siguiente brazo del estudio randomizado: <?php
```

```
          if($array[0]==1) {echo "Seguimiento telemático";} else {echo
          "Control";};?></th>
      </tr>
      <tr>
        <th align="left" class="formulario"><p>A ambos grupos de
        pacientes se les dan unas normas básicas higieno-dietéticas  del
        sueño y del SAHS (Anexo 13)  y los  consejos que se estimen
        oportunos.<br />
Citar al paciente para dentro de 1 mes.<br />
          <br />
        Si al  paciente le toca el brazo de seguimiento WEB se
        procede:<br />
        1. Crearle una cuenta Skype;<br />
2. Registrarle a la web de seguimiento mi-cpap.com;<br />
3. Programarle 2 televisitas.</p></th>
      </tr>
      <tr>
        <th align="center" class="formulario"><input type="submit"
        name="button" id="button" value="Confirmar" /></th>
        </tr>
      </table>
<input type="hidden" name="MM_insert" value="form1" />
</form>
<!-- InstanceEndEditable -->
</div>
</body>
<!-- InstanceEnd --></html>
```

Recruitment data visualization page

In this page the staff can review the uploaded recruitment data for each patient.

Screenshot C.2.45. Recruitment data visualization page. Translation from the original version in Spanish. Translation from the original version in Spanish: Header: "Multicenter trial MI-CPAP. Data collection website." Menu-bar: "Patients list, Recruitment, Annexes, Logout". Content: "Recruitment. Patient ID, Use of the Internet: yes, Consent to participate: yes, Date of recruitment: 2012-10-12, Gender: male, Date of birth: 1965-12-20, Age: 30, Studies: intermediate, Job: manual qualified, Night shift: no, Job status: active, , Civil status: divorced, Inclusion criteria, AHI>30 o 10<AHI<30 with evident symptoms: yes, Age between 18 and 70 years: yes, Use of the Internet: yes, Signed informed consent: yes, Exclusion criteria, hypersomnia: no, risky job: no, Psychiatric disease: no, Previous CPAP/UPP: no, Severe nasal obstruction: no, No adaptation to CPAP 10-min test: no, Exclusion from the study: no, Reason, If patient is excluded please insert the following data, AHI: 30, CT90: 66%, ID3: 33%, Height: 1.62 m, Epworth: 5, Weight: 30 kg, Diabetes: ADOS, COPD: yes, Cancer: no, Depression: controlled by GP, Cardiovascular disease: yes".

"reclutamiento_review.php" script:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
      "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
```

```
<html xmlns="http://www.w3.org/1999/xhtml"><!-- InstanceBegin
      template="/Templates/plantillaDatos_menu.dwt.php"
      codeOutsideHTMLIsLocked="false" -->
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<!-- InstanceBeginEditable name="doctitle" -->
<title></title>
<!-- InstanceEndEditable -->
<!-- InstanceBeginEditable name="head" -->
<!-- InstanceEndEditable -->
<link href="../estilos/estilo.css" rel="stylesheet" type="text/css" />
</head>


<body>
<table width="990" border="0" align="center" cellspacing="0"
      id="cabecera_datos">
  <tr class="tabla">
    <td width="228" height="122"><img src="../imagenes/mi-
      cpap_logo.PNG" width="148" height="120" /></td>
    <td width="598"><p><span class="titulo"><span
      class="titulo_contenido">Estudio multicéntrico MI-CPAP<br />
      Sitio web de recogida de datos
      </span></span><br />
    </p></td>
    <td width="158"><img src="../imagenes/logo_separ.jpg" width="157"
      height="66" /></td>
  </tr>
</table>
<div class="Menu_datos"><span class="BotonMenu_datos"><a
      href="home.php">Lista pacientes</a></span> <span
      class="BotonMenu_datos"><a
      href="reclutamiento.php">Reclutamiento</a></span> <span
      class="BotonMenu_datos"><a href="anexos.php">Anexos</a></span>
      <span class="BotonMenu_datos"><a
      href="/datos/reclutamiento_review.php?doLogout=true&p=Paciente_p
      rueba_1">Salir</a></span></div>
<div id="contenido">
<!-- InstanceBeginEditable name="Contenido" -->
<p class="titulo_contenido">Reclutamiento</p>
  <table width="100%" border="1" cellspacing="0"
      bordercolor="#CCCCCC">
    <tr bgcolor="#999999">
    <th colspan="6" align="left" class="formulario">1. PACIENTE</th>
    </tr>
    <tr>
    <th colspan="4" align="left" class="formulario">Código
    paciente:</th>
    <td colspan="2" class="formulario">Paciente_prueba_1</td>
    </tr>
    <tr>
    <th colspan="4" align="left" class="formulario">Uso habitual de
    técnicas de Internet (Email, navegar web):</th>
    <td colspan="2" class="formulario">Sí</td>
    </tr>
    <tr>
    <th colspan="4" align="left" class="formulario">Desea participar
    en un estudio para el control de su enfermedad vía
    Internet:</th>
    <td colspan="2" class="formulario">Sí</td>
```

```
    </tr>
<tr>
  <th colspan="4" class="formulario" scope="row"> </th>
  <td colspan="2"> </td>
  </tr>
<tr bgcolor="#999999">
  <th colspan="4" align="left" class="formulario">2.
  FILIACIÓN</th>
  <td colspan="2"> </td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Fecha
  reclutamiento:</th>
  <td colspan="2" class="formulario">2012-10-12</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Sexo:</th>
  <td colspan="2" class="formulario">H</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Fecha de
  nacimiento:</th>
  <td colspan="2" class="formulario">1965-12-20</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Edad:</th>
  <td colspan="2" class="formulario">30</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Estudios:</th>
  <td colspan="2" class="formulario">Medios</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Profesión:</th>
  <td colspan="2" class="formulario">Manual cualificado</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Turno rotatorio
  que incluya la noche:</th>
  <td colspan="2" class="formulario">No</td>
</tr>
<tr>
  <th colspan="4" align="left" class="formulario">Estatus
  laboral:</th>
  <td colspan="2" class="formulario">Activo</td>
</tr>
<tr>
  <th colspan="4" align="left" class="formulario">Estado
  civil:</th>
  <td colspan="2" class="formulario">Divorciado/a</td>
</tr>
<tr>
  <th colspan="4" align="left" class="formulario"> </th>
  <td colspan="2"> </td>
</tr>
<tr bgcolor="#999999">
  <th colspan="6" align="left" class="formulario">3. CRITERIOS DE
  INCLUSIÓN</th>
  </tr>
```

```html
<tr>
  <th colspan="4" align="left" class="formulario">IAH &gt; 30 o
  10&lt;IAH&lt;30 con síntomas evidentes (normas SEPAR):</th>
  <td colspan="2" class="formulario">Sí</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Edad entre 18-70
  años:</th>
  <td colspan="2" class="formulario">Sí</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Uso habitual de
  técnicas de Internet (Email, navegar web) y disponibilidad:</th>
  <td colspan="2" class="formulario">Sí</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Firma
  consentimiento informado (Anexo 1):</th>
  <td colspan="2" class="formulario">Sí</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario"> </th>
  <td colspan="2" > </td>
  </tr>
<tr bgcolor="#999999">
  <th colspan="6" align="left" class="formulario">4.CRITERIOS DE
  EXCLUSIÓN</th>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Hipersomnia
  incapacitante a criterio médico:</th>
  <td colspan="2" class="formulario">No</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Profesión de
  riesgo (conductores, manipulación equipos potencialmente
  peligrosos):</th>
  <td colspan="2" class="formulario">No</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Enfer.
  psiquiátricas/médicas   graves que dificulten su
  participación:</th>
  <td colspan="2" class="formulario">No</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Uso previo de
  CPAP/UPPP:</th>
  <td colspan="2" class="formulario">No</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">Obstrucción
  nasal severa:</th>
  <td colspan="2" class="formulario">No</td>
  </tr>
<tr>
  <th colspan="4" align="left" class="formulario">No adaptación a
  la prueba de CPAP de 10 minutos:</th>
  <td colspan="2" class="formulario">No</td>
```

```
      </tr>
    <tr>
      <th colspan="4" align="left" class="formulario"> </th>
      <td colspan="2" class="formulario"> </td>
    </tr>
    <tr bgcolor="#999999">
      <th colspan="6" align="left" class="formulario">5. EXCLUSIÓN DEL
      ESTUDIO</th>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Exclusión:</th>
      <td colspan="2" class="formulario">No</td>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Motivo:</th>
      <td colspan="2" class="formulario"></td>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Siempre que se
      excluya, insertar los siguientes datos:</th>
      <td colspan="2" class="formulario"> </td>
      </tr>
    <tr>
      <th width="213" align="left" class="formulario">IAH: 30
      </th>
      <th width="224" align="left" class="formulario">CT90: 66
        %</th>
      <th width="225" align="left" class="formulario">ID3: 33 %</th>
      <th width="219" align="left" class="formulario">Talla: 1.62
        m</th>
      <td width="219" align="left" class="formulario">Epworth: 5
    </td>
      <td width="91" align="left" class="formulario">Peso: 30 Kg</td>
      </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Diabetes:</th>
      <td colspan="2" class="formulario">ADOS</td>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">EPOC:</th>
      <td colspan="2" class="formulario">Sí</td>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Neoplasias:</th>
      <td colspan="2" class="formulario">No</td>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Depresión:</th>
      <td colspan="2" class="formulario">Controlada por médico de
      familia</td>
      </tr>
    <tr>
      <th colspan="4" align="left" class="formulario">Patología
      Cardiovascular:</th>
      <td colspan="2" class="formulario">Sí</td>
    </tr>
    <tr>
      <th colspan="4" align="left" class="formulario"> </th>
      <td colspan="2"> </td>
```

```
      </tr>
      <tr>
        <th colspan="4" align="left" class="formulario"> </th>
        <td colspan="2"> </td>
        </tr>
      <tr>
        <th colspan="4" align="left" class="formulario"> </th>
        <td colspan="2"> </td>
        </tr>
      </table>

<!-- InstanceEndEditable -->
</div>
</body>
<!-- InstanceEnd --></html>
```

C.3 VALIDATION OF A NEW CPAP TELEMONITORING SYSTEM

C.3.1 Matlab code of the algorithm implemented for the adaptation of the breathing events

```matlab
function [V]=prepPattern_apnea_dtrend(nombre)

Fm=64;

name=[nombre, '.txt']

f=load(name);


%calculo volumen integrando flujo

vol=cumsum(f)./Fm;


%seleccion de puntos cortar la señal y corte

figure, plot(vol);

[x1,y1]=ginput(2)


vol_cut=vol(x1(1):x1(2));


%quito trend linear

vol_dtrend=detrend(vol_cut);


figure,plot(vol_cut)

hold on

plot(vol_dtrend,'r')


%vuelvo a seleccionar trozo bueno

figure,plot(vol_dtrend)

[x2,y2]=ginput(2)

vol_cut2=vol_dtrend(x2(1):x2(2));
```

```matlab
%resto minimo

minimo=min(vol_cut2);

vol_min=vol_cut2-minimo;


%filtro señal

[B,A] = BUTTER(6,0.8/(Fm/2),'low');

Y = FILTFILT(B, A, vol_min);

figure,plot(vol_min)

hold on

plot(Y,'r')


%empalmo hasta zero

w=windcua(Y,Fm); %construyo ventana

v0=Y.*w;


%ajusto ganancia

V=findgain(v0);


N=round(length(V)/Fm)

L=num2str(N);


%guardo archivo

new_name=[nombre,'_',L,'.dat'];

fid = fopen(new_name,'w');

fprintf(fid,'%6.5f\r\n',64,1,V);

fclose(fid)
```

C.3.2 Matlab code of the algorithm subfunction that adjusts the breathing pattern gain

```matlab
function V=findgain(vector)

m=0.1;

maximos=[];

a=1;

limit=0.7*max(vector);

 while m<0.48 || m>0.5

    vector=vector.*a;

    limit=0.7*max(vector);

    maximos=[];

    for k=2:length(vector)-1

        if    vector(k)>vector(k-1)    &&    vector(k)>vector(k+1)    &&
vector(k)>=limit

        maximos=[maximos;k vector(k)];

        end

    end

    m=mean(maximos(:,2))

    if m>0.48

        a=a-0.001;

    end

    if m<0.5

        a=a+0.001;

    end

end

figure, plot(vector)

hold on

plot(maximos(:,1),maximos(:,2),'*')

V=vector;
```

C.3.3   Matlab code of the algorithm subfunction that applies a smoothing to zero on the signal tails

```
function [wind1]=windcua(v,fs)

N=length(v);

t1=[0:fs-1]/fs;

t2=[fs:2*fs-1]/fs;

ww=2*pi*0.5;

wind1=[0.5*sin(ww*t1-pi/2)+0.5      ones(1,N-2*fs)      0.5*sin(ww*t2-
pi/2)+0.5];

wind1=wind1';
```
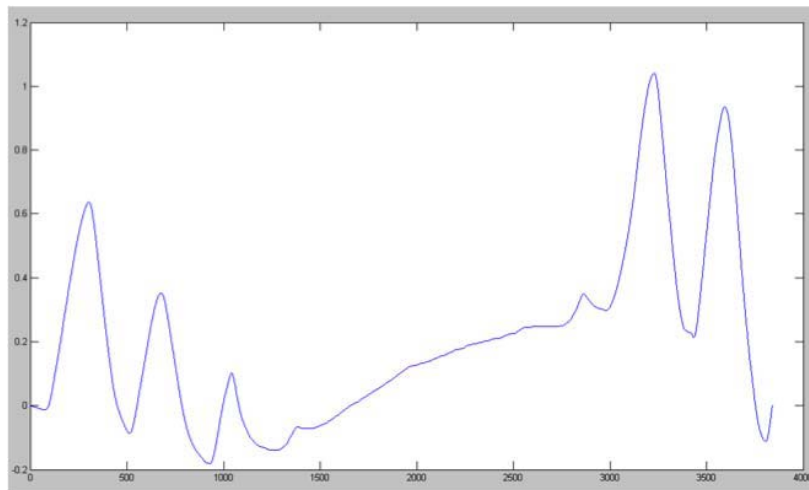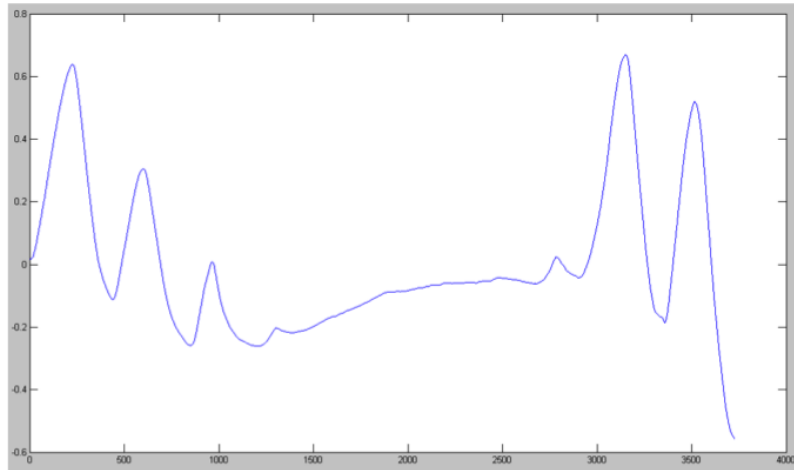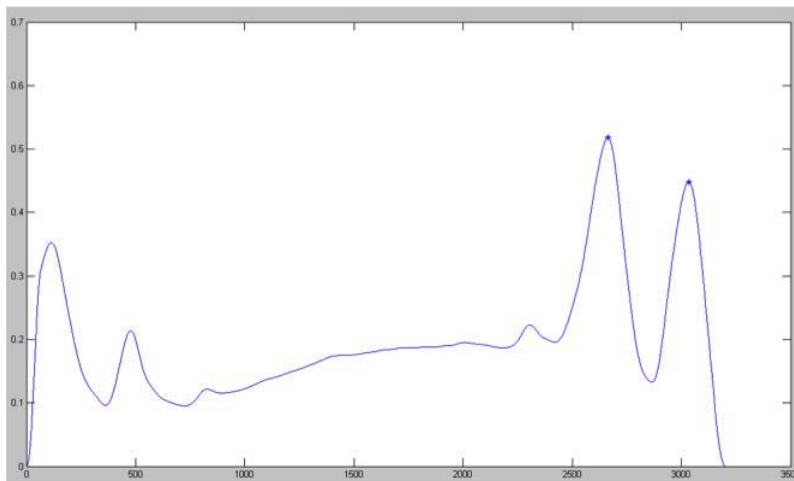
C.3.4   Matlab captions of the three different processing phases of an obstructive apnea pattern selected from a real OSAS patient's PSG recording

Screenshot C.3.46 Matlab caption of a selected apnea event after the integration to volume signal.

Screenshot C.3.47. Matlab caption of a selected apnea event after the detrending.

Screenshot C.3.48. Matlab caption of a selected apnea event after adjusting the minimum to zero and the gain of the two normal breathings to an average value of 0.5.