HEARTWAYS Report Summary

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Final Report Summary - HEARTWAYS (HeartWays - Advanced Solutions for Supporting Cardiac Patients in Rehabilitation)

Executive Summary:
Coronary artery disease (CAD) is caused by an accumulation of plaques within the walls of the arteries that supply the myocardium with oxygen and nutrients. After decades of progression, some of these plaques may rupture and along with the activation of the blood clotting system limit blood flow to the myocardium, resulting in an acute coronary syndrome (ACS). This may be either a heart attack (myocardial infarction) meaning that muscle cell necrosis in the affected regions of the myocardium has occurred) or unstable angina (meaning that the patient has persistent or recurrent chest pain at rest but without evidence of myocardial necrosis). Risk factors comprise age, sex, family history but also lifestyle-related aspects such as smoking habits, physical inactivity, overweight/obesity etc. Despite the advantages, utilization of cardiac rehabilitation phase III remains low. Recent research is supportive of the beneficial effects of cardiac rehabilitation in patients with heart failure as well as in older patients. Unfortunately, cardiac rehabilitation continues to be considerably underutilized with poor referral and enrollment rates. Implementing quality performance measures, automated referral systems, and the option of home-based cardiac rehabilitation for some patients may all help to increase participation. In addition, innovative exercise training regimens may help to enhance the beneficial effects of cardiac rehabilitation.

HEARTWAYS has the objective to develop an advanced modular solution for supporting cardiac patients in rehabilitation outside a medicalized centre with the aid of wearable sensors and intelligent algorithms that personalize the management and the follow-up for patients and professionals.

Project Context and Objectives:

CONTEXT:
Chronic diseases are diseases of long duration and generally slow progression which are by far the leading cause of mortality in the world. Among all chronic illnesses, cardiovascular diseases (CVDs) are the number one cause of global deaths (more people die annually from CVDs than from any other cause). Furthermore, studies related to economic burden of cardiovascular diseases reveal that CVDs costs to the Health Care Systems of the EU just under 110 billion € in 2006, representing around 10% of the total EU Health Care expenditure.

Recent research is supportive of the beneficial effects of exercise based cardiac rehabilitation in patients with heart failure as well as in older patients. Unfortunately, exercise based cardiac rehabilitation continues to be considerably underutilized with poor referral and enrolment rates, especially in phase III of the rehabilitation model. Implementing quality performance measures, automated referral systems, and the option of home-based cardiac rehabilitation for some patients may all help to increase participation. In addition, innovative exercise training regimens may help to enhance the beneficial effects of cardiac rehabilitation.

OBJECTIVES:
HEARTWAYS has the objective to develop an advanced modular solution for supporting cardiac patients in rehabilitation outside a medicalized centre with the aid of wearable sensors and intelligent algorithms that personalize the management and the follow-up for patients and professionals.

The proposed solution is structured in three different layers. The first one, the monitoring layer, is composed of a combination
of smart and wearable sensors, specialized in the monitoring of the vital signs needed for the diagnosis of targeted patients; the second level implements a multiparametric analysis and processing layer that augments the information provided by the standalone monitoring modules and allows a multiparametric assessment of the patient’s status, evolution, performance and predicted CV risk. The last layer is devoted to improve the way patients are managed by healthcare professionals and to create those mechanisms that enable the personalized support to the patient. On the first case, the focus is on enabling a simpler control of patients without reducing the quality of care, increasing the possibilities of handling more patients at the same time and allowing a better adjustment of the available resources to the concrete needs of the individual patients. On the second case, the aim is in increasing the capabilities of the solution to combine the medical needs with the patient’s preferences as well as incorporating a comprehensive motivation and psychological support strategy that complements and reinforces the treatment guidelines.

Project Results:
HEARTWAYS has the objective to develop an advanced modular solution for supporting cardiac patients in rehabilitation outside a medicalized centre with the aid of wearable sensors and intelligent algorithms that personalize the management and the follow-up for patients and professionals. The proposed solution is structured in three different layers:

A. Monitoring Layer:
- Wearable Multiparametric Exercise Shirt: new smart garment that monitors patient’s physiological status while practicing exercise: ECG, heart rate, HR variability, respiration rate, movement, calories burned and VO2. The data is transferred in real time to a third device wirelessly.
- Wearable Multiparametric Vital Signs Monitor: it measures and wirelessly reports the patient’s ECG, heart rate, skin surface temperature and activity, and pulsioximetry with a portable easy device optimised for minimum motion artefacts.

B. Intelligent Analysis Layer:
- Intelligent Multiparametric Analysis Middleware: it is composed by:
  o Algorithm for the assessment of the physiological response to physical activity.
  o Algorithm for the multiparametric analysis for continuous monitoring of vital signs in cardiac patients.
  o Algorithm for the analysis of the quality of the performed exercise.
  o Rehabilitation evaluation index: providing an overall assessment of the progress and evolution of the patient in relation to his exercise plan and performance.
- Personalized CV Risk Predictor indicates overall CV short-medium term risk, stratifies patients in groups according to their healthcare needs and their predicted evolution.

C. Management Layer:
- On the Move Patient Support: continuous and ubiquitous support to the patient during his normal day activities and while practicing the personalized exercise prescriptions, by means of a mobile device with a specific interface for easy communication while exercising.
- Patient Portal & Social Communities: patients’ access to their Personal Health Record, and channel for connecting and sharing experiences with peer patients and promote healthy competitiveness and team cooperation between fellow patients.
- Health Professional Management Platform: tool for professionals to easily follow-up the patients in rehabilitation. It highlights the relevant information and it is also able to handle dynamic care and exercise plans, that can automatically adjust to the patient’s performance, and that provide the professional with treatment and adjustment suggestions.

Potential Impact:
POTENTIAL IMPACT:
Despite the documented evidences of the benefits of cardiac rehabilitation only about 33% of patients in developed countries participate in such programs and only about one third maintains attendance after 6 months. It is also known that those who receive and practice cardiac rehabilitation at home are more likely to stick to their rehabilitation regime. HeartWays impacts in the following way:

1. Availability of an acceptable, safety, cost-effective health care solution for managing CVD patients at home and covering
outdoor experiences reducing physical inactivity, as one of the major modifiable risk factors (inactivity increases risk of heart
disease and stroke by 50%).
2. Reintegration of CVDs patients and their families into the society
3. Reduction of stress associated to the management of the disease.
4. Family, friends and other fellow patients could be more involved providing support to the patient (social support).
5. Economic savings thanks to the reduction of hospitalizations and acute events, as a result of the continuous monitoring
which is less expensive.

MAIN DISSEMINATION ACTIVITIES
In all dissemination activities, partners on the HeartWays project have systematically promoted the project as a part of the
European Union (EU) supported research activities. Also, collaboration of academia and industry, in case of HeartWays SMEs,
has been highlighted in order to demonstrate that research activities have strengthened the technological base of involved SMEs
and that this project in particular can be used as an example of usefulness of such collaboration. The partners made a lot of
efforts to ensure wide use and dissemination of the knowledge generated by the project. The activities of the partners raised
interest for further scientific developments in collaboration within the consortium and with other stakeholders. Foundation for
sustainable use of project results with possible impact on health of EU citizen, in particular those in CV rehabilitation, and an
impact to further development of growth of the SMEs as well as for further scientific activities have been pointed out in the
dissemination activities during the project and in dissemination plans for the future.

Description and list of stakeholders
Phases of dissemination
1. Presentation of the project itself – project becoming well known in the community
2. Presentation of the project results – moving from general to solutions
3. Presentation of final results, recommendations for use and future development

The partners made all efforts to identify stakeholders, health institutions or organizations, groups and individuals who have
interest to be:
- involved with the implementation and outcomes of the project,
- affected by project activities either directly or indirectly,
- able to influence the implementation of the project results and facilitate them,
- involved in further funding,
- using benefits from project results,
- using data and evaluation outcomes for further research and education.

All consortium partners used their wide demonstrated experience and know-how regarding the domain of application in
building new strategic relations with the local and national relevant stakeholders in the healthcare sector. Stakeholders form
the healthcare sector with interests in the healthcare delivery fields and in science and research field have been identified.
These stakeholders were informed on the project and were involved in order to support dissemination and reinforce the
dissemination activities.

The benefits for the stakeholders are the following:
a) Patients: improvement of the perceived quality of life by improvement of their recovery after acute events and of health
outcomes reducing risk of exacerbations, de-compensation and hospital readmissions.

b) Health care providers (public): improvement of their care processes management of chronic patients reducing the overall
cost of health care delivery up to 70%.

c) Health care providers (private): in addition to offering the patients the latest technology in treating their burdens caused by
CV event they suffered, the private providers enable creation of new business opportunities and new revenue streams
providing one-stop-shop continued advanced care, i.e. diagnostic-treatment-secondary prevention-long term health
management, which enables reinforcing patient’s adherence and loyalty.

d) Health insurance companies: increasing their service portfolio with premium services that reduce the overall cost per
patient, reduce client churn rates and improve competitive advantages.

IT is important to highlight two main special sessions in international events of ICHI2013 organized in Vilamoura by the IFMBE, and EMBC 2014 organized in Dubrovnik. Apart from that, Heartways has been disseminating results in several congresses by means of public scientific presentations and has applied to two journals with Peer-review process:

1) An efficient strategy for evaluating similarity between time series based on wavelet/Karhunen-Loève transforms with application to telemonitoring data. Pattern Recognition Journal (Elsevier). Teresa Rocha, PhD; Simão Paredes, PhD; Paulo Carvalho, PhD; Manuel Antunes, PhD, MD; João Morais, PhD, MD; Joerg Habetha, PhD.


Apart from that, Heartways has produced impact at general level by means of the following material:
- Article in eu*Research on Cardiac rehabilitation based on exercise, Issue 33, in June 2014.
- Video of the project in Youtube channels of coordinator and partners http://youtu.be/tDyuGehjRuA

EXPLOITATION OF RESULTS:

“HeartWays” is a powerful software, hardware and service platform created to implement Exercise based Programs for the Prevention and Cardiac Rehabilitation which is low cost for the companies operating the health services compared to traditional programs, and to provide continuous attention and support to patients that have suffered from acute cardiovascular events, and are currently in the recovery process. “HeartWays” enables remote rehabilitation for patients in phase II and III of rehabilitation.

a) Target market

Value for Public Hospitals: Heartways contributes to increase productivity and save costs for hospitals who already have a cardiac rehabilitation unit.

Value for assistive private care and wellness centres (rehabilitation clinics, gyms...): The goal here is to promote in this type of organizations the adoption of a seal of quality (“Heartways seal”) that enables them to apply the care guidelines and technologies identified in Heartways project by establishing a new business with doctors and other professionals that offer the service in phase III (up to 6 months after the acute event) and phase IV (years).

Value for independent individual cardiologists: Heartways is a powerful tool to be prescribed in order to complement and empower the pharmacology of treatment and rehabilitation for ischemia, which is one of the eligible cardiac patients for rehabilitation programs.

b) Main benefits for our customers

For “General Managers or economic management” in hospitals the return of investment, profitability and competitive advantage offered by Heartways is well appreciated.

For “Heads of public hospitals” aspects like a better service, wider portfolio, reduction of waiting lists and cost-benefit of our solution is relevant.

“Head of private hospitals” and “Owners of private rehabilitation centres” are more interested in the business vision and Heartways helps on this by helping to reuse rehabilitation infrastructures, cover more patients, and reduce the cost of treatments thanks to a better management of the post-acute event period.

“Private individual doctors” are interested in the clinical benefit of the patient that is the main motivation behind the creation of a system like Heartways.

Finally, “patients” are interested in improving their Quality of Life (QoL) by receiving not only support at the health side but also broadening the effect by the incorporation of other services like social connection, influence in having a healthier lifestyle, which in the end results in a better Quality of Life.

c) Size of the market and opportunities
In Europe, only 46% of eligible patients were referred to rehabilitation programs. It means that there is a huge potential for Heartways results to impact if this is developed.

In Spain, only between 3 and 5% of eligible patients are prescribed with rehabilitation program based on exercising. There is huge potential for Heartways here.

In countries like US, Ireland, UK and Germany the adoption is higher. There are centres every 100 patients. For instance in Ireland there are 5,000 users in rehabilitation, but not at home. In UK, the uptake was 43% and a total of 59,000 patients. In countries like Argentina, Colombia, and USA, the market is around 10 million patients.

d) Competitive position
Main strengths of TSB exercise based rehabilitation product based on endurance are:
- Very limited number of dedicated products in the specific domain of Cardiac Rehabilitation at home as Heartways is. More limited even in home environment.
- Most competitors lack from exercise plans that are synchronized with your mobile app, and all of them lack from a way to check that the exercise is being done according to the plan, for endurance. They are not prepared to ne moved from hospital to the home.

Main drawbacks of our position are:
- There is a risk of lack of regulation in the App sector which needs to have a certification process as medical devices have.
- There is a need to observe the recent pop-up of platforms for smart phones related to health and how they will influence the management of health diseases in the world.
- One drawback compared to other systems working inside hospitals is that the current system does not offer a 12-lead ECG while exercising. However, it has a positive effect: users don’t have to deal with managing several cables and electrodes every time they have to exercise. In case a patient requires to have ECG while running we recommend to do this activity at the hospital with one of the products identified for such purpose.

e) Distribution channels
Customers are accessed by a specialized sales force that let cardiologists specialized in the rehabilitation to know about our product. In a first approach, they will access to video, promotional material and demo that the specialized sales force show them. After this first phase, there is the need to convince the hospital management unit of the benefits of the system. The process is long and requires that different roles in the hospital take a decision together. The goal will be to reduce the decision time for the hospital so we acquire customers faster.

In European context, the best thing is to contact distributors of solutions who should have a demonstrator installed at their premises, and sell this product as other products of their offer to hospitals. Whenever possible distributors should have experience in other cardiac rehabilitation products.

f) Revenue model:
The revenue model is based on a fee per user and month, where the maintenance of the system is included. The fee should be between 5 and 15€/patient and month. Devices for the exercising as well as tablets or mobile phones are not part of the deal and should be acquired separately.

List of Websites:
Video in Youtube: http://youtu.be/tDyuGehjRuA

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