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The University of Manchester (UNIMAN)

Impetu Solutions (IMPETU)

Deliverable

D 1.1 Report on state-of-the-art and policy recommendations

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1. INTRODUCTION

This is the first content deliverable of the FP7-funded project called Personal Health Systems Foresight submitted by a consortium of three partners: the Austrian Institute of Technology, the University of Manchester and impetu solutions Spain. To start, we would like to give our readers a short introduction into the project and work package one, which is the framework of this report.

Personal Health Services (PHS) assist in the provision of continuous, quality controlled and personalised health services to empowered individuals regardless of location. PHS provides a horizontal development area across variety of patients, clinical specialties, technology fields and health services. Hence, the development of PHS requires and can mobilize the emergence of novel cross-disciplinary and -sectoral innovation partnerships. Our project expands across different PHS areas of application such as chronic disease management, life-style management, independent living and emergency services within and beyond the European Union up to 2030. With this project we want:

- to achieve a deeper understanding of mismatches between the potential of PHS and current policy and innovation initiatives and framework conditions;
- to support more mobilized and networked innovation communities, promoting PHS around jointly formulated issues which support pooling resources and streamlining diverse innovation initiatives;
- to tackle future opportunities and alternative trajectories, aligning actor perspectives for the development of a joint strategic action plan, including recommendations for a possible new European Innovation Partnership (EIP);
- to achieve a transparent, open and inclusive engagement of stakeholders, and targeted dissemination of results in society.

Work package 1 (WP 1) in particular aims at an overview of the state-of-the-art, the key challenges and policy responses: In this report we provide the result of our investigation on PHS research, innovation and policy areas to attain deeper understanding of mismatches between the potential of, and need for, PHS, and current policy and innovation initiatives and framework conditions. The thorough analyses are based on the extensive use of available databases and project documentations, specialized publications on the regional, national and international level.

This report takes stock on the wide range of initiatives in the area of PHS. We examine the PHS research, innovation and policy areas to attain deeper understanding of mismatches between the potential of, and need for, PHS, and current policy and innovation initiatives and framework conditions. Relevant databases as the European Foresight Platform (EFP), the AIT-owned database EU-PRO (detailed and standardized information on all funded projects from FP1 to FP7), the internal AIT-owned database on Forward Looking Activities (FoLA), and other available regional, national and international sources were scanned for state-of-the-art. This was pursued along three strands: (i) European activities, especially FP7 projects and reports of EU agencies, (ii) national activities, and (iii) studies and reports of non-governmental organisations (OECD, EHTEL, etc).

Former research in the area of personal health systems has often given little account of special patterns of innovation in the PHS sector (Cunningham, Grant-Pearce et al. 2005: 5), as the knowledge and experience about how to implement research results into concrete policy and strategy development in health is still in its infancy, particularly with regard to the specific needs of the European level. We intend to bring the research findings to the closer attention of users and administrations, and systematise them for the purpose of further research in this project.

We examine the PHS research, innovation and policy areas to attain deeper understanding of mismatches between the potential of, and need for, PHS, and current policy and innovation initiatives and framework conditions (e.g. in terms of future technological opportunities and societal demands). The main objectives of this report are:
- Define rationale for and the demarcation of the thematic target area in view of the suitability for a future innovation partnership.
- Gap analysis between the potential of the area and the policy and innovation initiatives
- Gap analysis between PHS inventions and new products put on the PHS market
- Identify new forms of innovation or needs for new forms of innovation (e.g. user integration, integration of service providers etc.)
- Mapping of key sources and initiatives on PHS.

To give our readers a better basis for the recent situation of the PHS sector we will continue this report with some background information. In the subsequent chapter we will point to the significance of the service systems approach and explain why this can improve the holistic understanding of the PHS sector. Chapter 2 is dedicated to the review and characterisation of recent and ongoing activities in the PHS sector and includes also a description of our methodological approach. Especially the last part of this chapter, 2.6 attempts a typology for PHS activities. Chapter 3 discusses key issues in personal health services with regard to culture and values, markets and user needs, products and services and technological development and deployment. Finally, in the last chapter, we will draw conclusion on the framework conditions and policy issues for further innovation and development for PHS.

As this report is to be considered a working document the findings and statements here have to be considered preliminary and subject for discussion between the European Commission, the PHS stakeholders and the PHS Foresight consortium.

1.1. BACKGROUND

Health care systems in Europe confront many well-known challenges in an economic environment of cost-control and limited public expenditure, for instance rising costs, ageing population, increasing demand and shortage of health care professionals. Within this context the Lead Market Initiative (LMI) for Europe has identified eHealth as one of six key areas of focus (JPI-MYBL 2011):

- for strategic reasons, i.e. improvement in competitiveness and interoperability leading to technology advances,
- for economic reasons, i.e. scale economies and
- for social reasons, i.e. improvements in service level and access to health services.

The development of Personal Health Systems (PHS) within the eHealth area appears particularly significant for delivering home care and related services (remote monitoring, emergency responses) to patients. PHS can enhance public and private health service delivery and provide new business opportunities in Europe and globally. PHS are also expected to improve quality of care, support quality of life more generally, and increase the cost efficiency of health care processes (See Box 1 for the definition of PHS).

Box 1: Definition of Personal health System.

The ‘PHS Foresight’ consortium has defined PHS to consist of:

- Ambient, wearable and/or in-body devices, which acquire, monitor and communicate physiological and other health-related data
- Intelligent processing of the acquired information (data analytics), and coupling it with expert biomedical knowledge and in some cases, knowledge of social circumstances and living conditions
- Action based on the processing of acquired information, either applied to the individuals being monitored, or to health practice more generally, concerning information provision and/or more active engagement in anything from disease and disability prevention (for example through diet and lifestyle management) to diagnosis, treatment and rehabilitation.
“Personal Health Systems” assist in the provision of continuous, quality controlled and personalised health services to empowered individuals regardless of location (PHS2020 project) (Codagnone 2009a). The systems combine people, organizations and technology. The health system has to incorporate human agency to interpret and act upon the data that devices provide, which requires a service system design that fosters acceptability and empowerment on part of the patients.

PHS are not limited to dealing with aging and eldercare, though PHS communities contribute to the European Innovation Partnership (EIP) on Active and Healthy Aging. PHS provides a horizontal development area across variety of patients, clinical specialties, technology fields and health services.

Around PHS there has emerged an active stakeholder community. Different EU instruments are already addressing this topic (e.g. Framework Programme, Competitiveness & Innovation Programme, Public Health Programme, Article 185 initiative on Ambient Assisted Living (Kuneva, Dózsa et al. 2010) with 23 countries and the EU, lead market on e-health, infrastructure projects such as the on-going application for a European Research Infrastructure Consortium ERIC SHARE ‘Survey of Health, and several ESFRI projects in the biomedical field) and there is no doubt scope for improving synergies between them. In addition multiple initiatives have been launched at Member State and regional levels. Moreover, important work has already been done to map out the obstacles, which prevent – or delay – time-to-market and scaling up of solutions across the EU.

However, despite many concerted European PHS pilot projects initiated since FP5, lack of succession of pilots and of overall coordination have led to a dynamic but fragmented PHS innovation landscape that hinder the attainment of ambitious targets (Kuneva, Dózsa et al. 2010). There is therefore both a solid basis and urgent need to build further stakeholder cooperation and innovation governance. Furthermore, there is need to pay due attention to the warnings outlined in the SWAMI studies (2010), that many scenario and roadmap analyses of new AAL technologies have failed to pay sufficient attention to risks and problematic developments. Previous findings in the area of personal health systems have also often lacked impact on transfer from R&D to the market and have given little account on innovation patterns in this sector, particularly with regard to European-wide developments and related coordination efforts for enhanced market penetration.

1.2. FOCUS ON A SERVICE SYSTEMS APPROACH

Personal Health Systems (PHS) arguably amount to a step change in how health and related services are created and delivered. This is extremely attractive prospect to many observers, because of the growth of the elderly and/or dependent population in many countries, the rising costs of health and social care (HSC), and dissatisfaction with the ways in which services are currently provided. (This dissatisfaction may focus on various issues – inequalities in access to services; lack of support for independent living and overuse of hospitalisation; impersonal and overstandardised care; etc.)

However, the concept of PHS is often collapsed into the specific information systems that are constructed to support new HSC servicers; or even into the specific devices that are employed within these information systems, such as wearable sensors to monitor health conditions and/or behaviour patterns. We shall argue that this fails to take into account the importance of a wider systems view, one which situates PHS within HSC service systems. Such a wider approach takes into account the need to design complex architectures relating together people (recipients of care, caregivers, and others), organisational structures and processes (that determine divisions of labour and responsibilities, flow of resources, etc.) and technologies (especially the information technologies, but also other HSC-related devices and software). But it also highlights some of the problems that a transition between service systems can involve – the challenge of system innovation. This typically requires more than just excellent technological solutions, but also a multi-stakeholder process of service system design.

SERVICE SYSTEMS APPROACHES

Services are often thought of as essentially person-to-person interactions, where the service “product” is coproduced in the course of a service relationship. But we have become familiar with technology-to-person
services, where instead of interacting with a member of staff of a service organisation, the client interacts with technology – often through online and even mobile communications, sometimes through devices based at the premises of service organisations. These are often described as customer self-services, basic considerations are relevant in the area of PHS. For instance do examples of transactional self-services indicate that typical the service is provided within a “service system”, a concept that has gained considerable traction in the last ten years. As well as the customer/client and the devices (and software) they are using, there is the service organisation which they are reaching through these interfaces, the personnel of this organisation – some of whom they may interact with (front-office staff) and others who provide unseen support services (back-office staff). Information flows are a universal feature of such systems, in which the organisations (often using technologies) link people; some other transformations may be effected by specialist people or technologies too (such as surgery and other medical interventions, physical transport, and classic personal services such as hairdressing and help with daily life).

The concept of Service Systems is one that has evolved quite rapidly, with some specialist versions (often coming from the information systems community) being rather elaborate and restrictive. One well-known definition introduces the notion of POTI – Service Systems are “dynamic configurations of resources (people, technologies, organisations and shared information) that can create and deliver value to customers, providers and other stakeholders” (IfM and IBM 2008: 18). Various authors, such as Karni and Kaner (2006) stress the service element of such systems, with customers/clients being much more important parts of the “P” in this framework (as compared to many other Sociotechnical systems) - they are participants who often provide important effort, information, and the like into the service design and provision. They may well place limits upon what the (formal) service provider can do, and set standards for what should be achieved. In many cases, health and social care included, the customers/clients may not be just the recipients of care, but also other stakeholders (such as family members) who may have their own demands upon, and inputs into, the service. (Maglio 2010) sees these four key building blocks of service systems as varying on two dimensions: physical versus non-physical, possessing or not possessing rights. This characterises the various four resources of Service Systems as follows: People (physical, with rights); Technologies (physical, without rights); Organisations (non-physical, with rights); and Information (nonphysical, without rights).

**SYSTEM INNOVATION AND TRANSITIONS**

Rotmans (2006) has described system innovations as “organization-transcending innovations that drastically alter the relationship between the companies, organizations and individuals involved in the system”. Such a ambitious type of innovation is required to address many of society’s grand challenges, including those associated with active independent living and the introduction of PHS. It is often related to the need for “transition management”, an approach that enables breaking out of various locked-in heritages and organisational routines; there are costs as well as benefits in such changes, and there are liable to be protracted learning processes and negotiations undertaken.

This sort of perspective is introduced to account for what are often seen as the barriers and obstacles to progress, often encountered when technically effective innovations are introduced into social systems. (cf. Schot and Geels 2008) The transitions approach argues for the need to take the interests and perspectives of numerous stakeholders into account (for example, hospital management may not benefit from the reduction of in-patient stays associated with the use of PHS – but hospitals are still an important part of the HSC chain). The approach suggests particular types of experimentation and development of strategic niche markets; of determining “boundary objects” through which stakeholders can gain their own appreciation of the innovation; and to develop transition pathways through which the new service system can be constructed.

The shift to PHS may be understood as a system transition in the sorts of terms established in transition management accounts, and which draw on ideas from the approaches developed in Social Construction of Technology and similar approaches to innovation studies.¹

¹ Broch (2011) provides an example of multilevel analysis of innovation around care services for the elderly.
2. A REVIEW AND CHARACTERIZATION OF PHS ACTIVITIES

2.1. EMPIRICAL APPROACH

The purpose of this document is to present the state of the art and get an overview of the dynamics in the PHS area. Hence, in the first phase of the PHS Foresight project we scanned different types of information to cover personal health systems’ dynamics in various aspects. From this we derive key issues in the development, diffusion and implementation phases of personal health systems, which shall deliver structured information and a basis for further future-oriented analysis.

In the PHS Foresight project, we do not only consider sources which actually use the term personal health systems, instead we use this as an umbrella term for a variety of notions, activities headed under various terms (mHealth, remote patient monitoring and treatment etc) which will be elaborated on in the typology chapter of this report.

Table 1 gives an overview of the different types of analysis that were applied in this first phase of PHS Foresight project. Our first approach was to get a comprehensive overview of the various kinds of PHS projects through web-based research. Apart from the purely technical research projects, PHS projects exist on different levels of aggregation and analysis:

- **Meta level PHS projects**: These are mainly research projects which have made considerable efforts in defining and demarcating the PHS area. They are academic projects which follow an analytical approach in their occupation with the field. They are mostly publicly financed and well documented. Examples are PHS 2020, SIMPHS 1 and SIMPHS 2, MovingLife.

- **Meso level PHS projects**: These projects combine an analytical approach with a strong focus towards application. Typically the project partners involved are from research and consulting organizations, also academic organisations on the one side, and on the other side are based on various case studies distributed over Europe where actors from private, public and third sectors are involved in implementing local personal health systems. These projects are well documented, especially on the single case level. Examples are various PHS projects financed through the CIP ICT-PSP programme like Renewing Health or Independent.

- **Micro level PHS projects**: These are national/regional local bottom-up projects, only focused on application. They are PHS cases according to the definition applied here in the PHS Foresight project. Project partners develop out of their eco-systems and receive financing at some points in time. Typically projects and follow-ups develop over at least one decade, it is often difficult to demarcate the start and end of these undertakings. These projects exist in a wide variety on the national and local levels, they are not well documented, in most cases there does not even exist a project website.

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Table 1: Types of analysis in the first phase of PHS Foresight

<table>
<thead>
<tr>
<th>Phase in innovation process</th>
<th>R&amp;D</th>
<th>Distribution/diffusion</th>
<th>Application/implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Literature review</td>
<td></td>
<td></td>
<td>Comparative case analysis</td>
</tr>
<tr>
<td>(PHS projects meta and meso level)</td>
<td></td>
<td></td>
<td>(PHS projects micro level = cases)</td>
</tr>
<tr>
<td>Patent analysis</td>
<td></td>
<td></td>
<td>Network analysis</td>
</tr>
<tr>
<td>Bibliometric analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: By authors

The types of analysis we apply roughly correspond to phases in the innovation process (see Table 1), which naturally interact with each other. So are the case studies which present and analyze cases of personal health systems implemented the basis for further PHS projects on the meta level, which focus on the wider patterns of the personal health systems under application and gaps in their implementation. Patents as indicators of technological invention as well as scientific papers are commonly used as outputs of research and development processes. The literature review of meta and meso level PHS projects are on the one hand part of research and development processes, on the other hand they also mark diffusion processes of best practices. Network analysis on the basis of PHS projects implies flows of information among the components of a social network, and hence sheds further light on how knowledge about PHS diffuses, these flows of information occur in all phases of the innovation process, in R&D, distribution /diffusion and in the application/implementation phase.

Social network analysis

Tools and concepts of Social network analysis (SNA) were used in this study to visualize R&D collaboration networks and central actors in the area of PHS on the European level. A SNA perspective focuses not on the individual social actors, but on the broader interaction contexts within which the actors are embedded.

Mapping of cases

To extend the focus towards a more systemic approach we considered case studies as a valuable research method to provide in-depth understanding on PHS around Europe.

2.2. BIBLIOMETRIC ANALYSIS FOR PHS

Bibliometric analysis aims to provide an understanding of present state and future trends on a particular topic. Scientific and patent databases, media and other electronic sources of information can be used for the purpose of bibliometric analysis. The analysis is typically conducted with the use of a special software developed for this purpose. For instance, Vantage Point, which was used in this study, is a powerful desktop bibliometric analysis tool. It helps to quickly navigate through large volumes of structured text such as in electronic databases, to see patterns and relationships between terms and concepts to give a better understanding of past, present and future developments. In the context of Foresight studies, it is proving to be a useful method for the identification of early indications of potential emerging new and disruptive technologies.

Bibliometric analysis

A bibliometric analysis aimed to provide an understanding of present state and future trends on the PHS topic.

Patent analysis

An additional small study was conducted to analyse the patents in the field of PHS. Patent information was obtained from “Derwent Innovation Index” and “Patent Citation Index”.

Social network analysis

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In the present study, the bibliometric analysis aims at searching for publications on PHS. The study presented here aims to demonstrate the uses and benefits of this methodology for the PHS field. The analysis was conducted using Web of Science, which is a research platform for information in the sciences, social sciences, arts and humanities. The analysis in Web of Science with the use of “personal health system*” term generated 55 results, which are directly related to the topic. The results indicate how PHS as a field evolved over time (Table 2). As Figure 1 illustrates, PHS was mentioned in 1979 for the first time and “hypertension” was the first related concept to it. After a long break the term started taking off from 2004 onwards with “wellness systems” in 2004.

Figure 1: Evolution of the PHS field

The smaller number of terms in 2012 is because not all publications have been entered into the Web of Science database as of the beginning of 2013, therefore does not reflect the full set of publications in that year.
### Table 2: The evolution of PHS and related areas over time

<table>
<thead>
<tr>
<th>Year</th>
<th>1979</th>
<th>2004</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Terms</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

- **HYPERTENSION** [1 of 1]
- wellness systems [1 of 1]
- distributed shared data space [1 of 1]
- biomedicine [1 of 1]
- personal health services [1 of 1]
- information technology [1 of 1]
- User-Friendly Personal Health Information Systems [1 of 1]
- occupational health care [1 of 2]
- successful research reach implementation [1 of 1]
- value creation mechanisms [1 of 1]
- wide scale adoption [1 of 1]
- workplace health promotion [1 of 1]

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Terms</td>
<td>16</td>
<td>11</td>
<td>22</td>
<td>8</td>
</tr>
</tbody>
</table>

- cardiovascular diseases [2 of 2]
- Cardiology [1 of 2]
- Patient Self-management [2 of 2]
- clinical decisions [1 of 1]
- chronic ischemia detection [1 of 1]
- chronic cardiovascular diseases [1 of 1]
- clinical Preventive Services [1 of 1]
- discriminating stress [1 of 1]
- Classification Tree Approach [1 of 1]
- Older Adults [1 of 1]
- medication treatment management [1 of 1]
- Closed-Loop Personal Health Systems [1 of 1]
- Personal Health Care [1 of 1]
- multidimensional view [1 of 1]
- Cloud [1 of 1]
- Personal Health System architecture [1 of 1]
- homecare systems [1 of 1]
- Personal Health Society [1 of 1]
- coaching platform [1 of 1]
- Public Health Services [1 of 1]
- Infusion [1 of 1]
- Personalized Framework [1 of 1]
- enabling personalized management [1 of 1]
- stress [1 of 1]
- Medicine [1 of 1]
- special Section [1 of 1]
- Funding [1 of 1]
- Nardu Experience [1 of 1]
- underserved populations [1 of 1]
- HeartCycle Approach [1 of 1]
- optical Fibre Sensing Networks [1 of 1]
- Wearable EDA Device [1 of 1]
- Implantable Medical Devices [1 of 1]
- patient interaction [1 of 1]
- integrated advanced communication [1 of 1]
- personal Health Promotion [1 of 1]
- MOBILE PERSONAL HEALTH SYSTEM ENABLING PERVERSIVE HEALTHCARE Smartphone [1 of 1]
- Personalized Health Technologies [1 of 1]
- mobile Personal Health Systems [1 of 1]
- self Care System [1 of 1]
- Patient Stratification [1 of 1]
- Pervasive Information Logging [1 of 1]
- Risk Assessment [1 of 1]
- Social Networks [1 of 1]
- Spatialtemporal Information [1 of 1]
- Three Standard ECG Leads [1 of 1]
- Smart Home [1 of 1]
- Personal Health Programs [1 of 1]
- Ubiquitous Mobile Personal Health System [1 of 1]
As Figure 1 illustrates, the number of terms and concepts has increased continuously since 2004 and the breadth and coverage of PHS has increased since then. A closer analysis of the Table 1 indicates PHS related technologies, application areas and its key uses. Besides some of the familiar terms, there are new ones which may be the first indications of the future PHS application areas. Among those, ubiquitous mobile PHS, wearable devices, optical fibre sensing, clouds, and smart phones are associated with technologies for PHS. Cardiovascular diseases appear to be one of the most frequently used application area. The results also indicate that elderly, workplace health, public health services, risk assessment, and medication are among the key uses of technologies.

### 2.3. PATENT ANALYSIS FOR PHS

Patent analysis is a unique management tool for addressing the strategic management of technology and product or service development process. Translating patent data into competitive intelligence allows gauging current technical competitiveness, planning for potential competition based on new technologies, and forecasting technological trends. An additional study was conducted to analyse the patents in the field of PHS. Patent information was obtained from “Derwent Innovation Index” and “Patent Citation Index”. The search for the term “Personal Health System*” produced only 4 records. The search of the term “personal health” produced much higher results (561). However, it was seen that most of personal health refers to “personal health records,” which is not always directly associated with PHS. As the number is too small, it was not possible to do a full bibliometric Analysis with the use of Vantage Point software. Therefore, below only a list of patents in PHS is given (Table 3). The results show some of the technologies which are available or at a near-market stage.

<table>
<thead>
<tr>
<th>Patent no</th>
<th>Title</th>
<th>Assignee</th>
<th>Inventor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-C09388 CN102332061-A</td>
<td>Method for tracking personal health file, involves saving and updating tracking information at personal health system after confirming whether tracking information is real</td>
<td>UNIV ZHEJIANG</td>
<td>CHEN Y, SHEN Y, LAI M, et. al</td>
</tr>
<tr>
<td>2008-H29512 US2008147439-A1</td>
<td>Personal health system for gathering patient data readings, has speaker identification module for identifying patient via his or her voice, and patient management application authorizing patient to use system when successfully identified</td>
<td>MALISZEWSKI R L</td>
<td>MALISZEWSKI R L</td>
</tr>
<tr>
<td>2008-D66250 WO2008014154-A2; WO2008014154-A3; EP2050034-A2; ...</td>
<td>Medical data e.g. heart rate, acquisition, storage and access system for use in exercise development and maintenance program, has acquisition instructions acquiring and storing time-stamped samples in heart rate data stream</td>
<td>KONINK PHILIPS ELECTRONICS NV, US PHILIPS CORP</td>
<td>STUT W J J, WARTENA F, STUT W, et. al</td>
</tr>
<tr>
<td>2008-A46173 US2007260489-A1</td>
<td>Portable terminal for managing personal information of diabetic patient, has inhaler changing parameter associated with discharging medicine within predetermined period of time in which user executes inhalation</td>
<td>CANON KK</td>
<td>SASAKI T, SUGAMA S, TSUTSUMI T</td>
</tr>
</tbody>
</table>

Overall, bibliometric analysis is considered to be a useful method. If the search in databases can be extended by using the emerging keywords and their combinations produced from the analysis presented above, then it is expected that a number of other
striking results with new trends, application areas and uses of PHS will emerge.

2.4. A SOCIAL NETWORK ANALYSIS ON PHS IN EUROPE

Tools and concepts of Social network analysis (SNA) were used in this study to visualize R&D collaboration networks and central actors in the area of PHS on the European level. A SNA perspective focuses not on the individual social actors, but on the broader interaction contexts within which the actors are embedded (see, for instance, Scott 2000). It is assumed that network actors showing a more central network position more likely benefit from network advantages in terms of preferential information and knowledge access within the network (Wasserman and Faust 1994; Borgatti 2005). Direct contacts and more intensive interactions dispose actors to better information, greater awareness, and higher susceptibility to influencing or being influenced by others. Indirect relations through intermediaries also bring exposure to new ideas and access to useful resources that may be acquired through interactions with others.

For networks in general, this implies that organizations involved in several collaborative arrangements are well interlinked to other organizations, show short pathways to diverse sets of nodes, and therefore, take up a central position within the whole knowledge network. They may act as hubs or gatekeepers for knowledge diffusion, spreading knowledge throughout several actors in the entire network. In this sense, not only the organizations own knowledge bases, but also the knowledge to which the respective organization has direct or indirect access through its network links determines its prestige in the network (Powell, White et al. 2005).

This section starts with a brief description of the different PHS initiatives on the EU-level and their main characteristics in terms of their objectives, the number of identified projects and the organizational structure of the consortia in these initiatives. Thereafter, the PHS networks based on joint project participation are introduced and discussed in more detail. We will characterise the different initiatives by presenting central actors in terms of their degree centrality and identify those actors that take part in more than one initiative and are able to act as information provider between different initiatives.

DESCRIPTION OF INITIATIVES AT THE EU-LEVEL

We identified 67 projects that focus on PHS issues, 64 of them take or took part in five different European R&D initiatives and 3 of them are conducted by the Joint Research Centre Institute for Prospective Technological Studies (JRC IPTS). Table 4 gives an overview about the number of selected projects in each initiative, the duration of the selected projects and the number of participating organizations.

<table>
<thead>
<tr>
<th>Initiative/programme</th>
<th>Duration of identified projects</th>
<th>Number of projects</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAL JP</td>
<td>2009-2012</td>
<td>17</td>
<td>130</td>
</tr>
<tr>
<td>CIP-ICT PSP</td>
<td>2008-2013</td>
<td>12</td>
<td>144</td>
</tr>
<tr>
<td>FP7-ICT_2007</td>
<td>2008-2012</td>
<td>9</td>
<td>121</td>
</tr>
<tr>
<td>FP7-ICT_2009</td>
<td>2010-2014</td>
<td>10</td>
<td>94</td>
</tr>
<tr>
<td>FP7-ICT_2011</td>
<td>2011-2015</td>
<td>16</td>
<td>124</td>
</tr>
<tr>
<td>JRC IPTS</td>
<td>2009-2017</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>67</td>
<td>513</td>
</tr>
</tbody>
</table>
AMBIENT ASSISTED LIVING JOINT PROGRAMME (AAL JP)

AAL JP is a funding activity with the aim of enhancing the quality of life of older people and strengthening the industrial base in Europe through the use of Information and Communication Technologies (ICT). Within this programme four calls were announced, we screened the projects in Call 1: ICT based solutions for Prevention and Management of Chronic Conditions of Elderly People and identified 17 projects focussing on PHS.

The AAL JP projects are application-oriented (validation of existing tools, development of business cases) and often include universities, research organizations and end-users (health-care organizations). Public authorities virtually never take part in these consortia (see Figure 2).

COMPETITIVENESS AND INNOVATION PROGRAMME (CIP) - ICT POLICY SUPPORT PROGRAMME (ICT PSP)

The ICT Policy Support Programme (ICT PSP) – one of the three specific programmes within the Competitiveness and Innovation Programme (CIP) – aims at stimulating innovation and competitiveness through the wider uptake and best use of Information and Communication Technologies (ICT) by citizens, governments and businesses and in particular SMEs. 12 projects under the topic “ICT for health, ageing well and inclusion” focussing on PHS are included in the further analysis.

Most of the CIP-ICT PSP projects are large projects that focus on the validation of already existing PHS solutions in various pilot sites including a number of end-users. The consortia consist of different stakeholder of the health system: public health organizations and regional governments besides partners from research and industry (see Figure 2).

EUROPEAN FRAMEWORK PROGRAMMES FP7 – ICT

We screened the ICT work programmes for 2007-2008, 2009-2010 and 2011 and identified in Challenge 5: Towards sustainable and personalised healthcare/ ICT for Health, Ageing Well, Inclusion and Governance the objective/subprogramme “Personal Health systems”. All projects within this subprogramme are included in this analysis.

Apart from two projects dealing with roadmapping for technological research, implementation practice and policy support in the PHS field (PHS2020 and MOVINGLIFE), most projects focus on the development of ICT-based monitoring systems. The consortia mainly consist of universities, research organizations and companies (see Figure 2).

JRC IPTS PROJECTS

JRC IPTS conducted two studies (SIMPHS 1 and 2) analysing the market innovation dynamics of PHS, focusing on the Remote Patient Monitoring and Treatment (RMT) segment of the market as well as on needs, demands and experiences made with PHS by healthcare producing units, healthcare professionals, healthcare authorities and patients amongst others. A third project deals with a Monitoring and Assessment Framework for the European Innovation Partnership on Active and Healthy Ageing. According to the project websites, only two public authorities - the Directorate-General for Information Society (DG INFSO) and the Directorate-General for Health and Consumers (DG SANCO) – took part in the project.

ANALYSIS OF THE PHS NETWORKS

Based on the joint participation of organizations in PHS projects on the European level, we construct an affiliation network of collaborative research projects and participating organization (Roediger-Schluga and Barber 2008). An affiliation network can be represented by a bipartite graph, which consists of two subsets of nodes – projects and organizations – with edges existing only between the two sets. Figure 3 presents the bipartite network of projects in the
different initiatives (displayed as yellow, green, red, blue, pink and orange nodes) and participating organizations (grey nodes). The size of each node is its degree in the bipartite graph, e.g. a project comprising ten organizations has size ten, as does an organization participating in ten projects. The degree is defined as the number of direct neighbours in a graph.

Figure 2: Distribution of organization types
Figure 3: Network of PHS projects and participants at the EU-level
Figure 3 shows that projects within the same initiative are often grouped together in the same part of the network. E.g. the projects in the CIP-ICT PSP programme (green nodes) are positioned at the bottom, AAL JP projects are mainly grouped at the left side of the network and projects in FP7-ICT_2009 are positioned at the top of the network. This indicates that in general the majority of organizations, which participate in one of these initiatives don’t participate in any of the other two initiatives. In contrast, projects of the very first call in FP7-ICT PHS (FP7-ICT_2007) are close to AAL JP and CP-ICT PSP projects. This implies that at the beginning of PHS project funding on the European level several organizations participated simultaneously in each of these three initiatives and several new actors were involved in PHS research on the European level by the second call in FP7-ICT PHS (FP7-ICT_2009).

Table 5 lists organizations, which participate in more than two PHS projects. The German research organization Fraunhofer Gesellschaft is the most active player in the area of PHS research and development on the European level and takes part in ten projects. Six out of 66 different Fraunhofer-Institutes are involved in five projects in AAL JP, one CIP-ICT PSP project and four PHS projects in FP7-ICT. The Universidad Politecnica de Madrid UPM is another active player in the PHS field with seven project participations ranging from R&D projects in FP7 to more validation-oriented projects in AAL JP and CIP-ICT PSP. Life Supporting Technologies (LifeSTech), a research, development and innovation group of the Universidad Politécnica de Madrid-UPM takes part in five of these projects, in the remaining two projects it was not possible to identify the participating entity of the university. Further organizations with a broad project portfolio are e.g. INTRACOM SA, University of Twente and Philips NV (NLD), whereas other organizations either focus on R&D projects (e.g. ETH Zürich, University of Padova, CSEM and CNR) or on validating existing tools (like Telefónica, CETEMMESA Technological Centre, TicSalut or Budapest University of Technology and Economics).

---

6 Fraunhofer-Institute for Biomedical Engineering IBMT (St. Ingbert; AAL JP: 1 project; FP7-ICT-2011: 2 projects); Fraunhofer Institute for Open Communication Systems FOKUS (Berlin; AAL JP: 1 project); Fraunhofer Portugal (AAL JP: 2 projects; CIP-ICT PSP: 1 project); Fraunhofer-Institut für Integrierte Schaltungen IIS (Erlangen; FP7-ICT-2007: 1 project); Fraunhofer-Institute for Computer Graphics Research IGD (Darmstadt; AAL JP: 1 project); Fraunhofer-Institute for Experimental Software Engineering IESE (Kaiserslautern; AAL JP: 2 projects)
Organization | Type | Country | AAL IP | CIP-ICT PSP | FP7-ICT_2007 | FP7-ICT_2009 | FP7-ICT_2011 | JRC IPTS | Total
--- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Fraunhofer-Gesellschaft | ROR | DEU/PRT | 5 | 1 | 1 | 3 | 10
Universidad Politécnica de Madrid UPM | EDU | ESP | 1 | 1 | 3 | 1 | 10
Telefónica | IND | ESP | 2 | 3 | 1 | 6
INTRACOM SA | IND | GRC | 1 | 1 | 1 | 2 | 5
University of Twente | EDU | NLD | 1 | 1 | 1 | 2 | 5
CETEMMSA Technological Centre | ROR | ESP | 3 | 1 | 4
Eidgenössische Technische Hochschule Zürich (ETH) | EDU | CHE | 2 | 2 | 4
empirica | IND | DEU | 2 | 1 | 1 | 4
Medtronic Iberica S.A. | IND | ESP | 3 | 1 | 4
Philips NV (NLD) | IND | NLD | 1 | 1 | 1 | 1 | 1 | 4
Roessingh Research and Development BV | ROR | NLD | 1 | 1 | 2 | 4
TicSalut | OTH | ESP | 4 | 4
Universitat Politècnica de València | EDU | ESP | 1 | 1 | 2 | 4
University of Padova | EDU | ITA | 1 | 2 | 1 | 4
AGE - The European Older People’s Platform | OTH | BEL | 1 | 2 | 3
Budapest University of Technology and Economics | EDU | HUN | 3 | 3
Centre for Research and Technology Hellas (CERTH) | ROR | GRC | 1 | 1 | 1 | 3
Centre Suisse d’Electron. et de Microtechn. (CSEM) | ROR | CHE | 1 | 1 | 1 | 3
Consiglio Nazionale delle Ricerche - CNR | ROR | ITA | 1 | 1 | 1 | 3
DG INFSO | GOV | BEL | 3 | 3
Fondazione Santa Lucia | ROR | ITA | 1 | 2 | 3
FORTH - Foundation for Research & Technol. Hellas | ROR | GRC | 1 | 1 | 1 | 3
Global Security Intelligence | ROR | GRC | 1 | 1 | 1 | 3
Hospital Clinic I Provincial de Barcelona | ROR | ESP | 1 | 1 | 1 | 3
Hospital Comarcal Sant Antoni Abat | OTH | ESP | 2 | 1 | 3
Institut für Mikrotechnik Mainz | ROR | DEU | 2 | 1 | 3
Instituto de Engenharia de Sistemas e Computadores do Porto (INESC Porto) | ROR | PRT | 1 | 1 | 1 | 3
JRC IPTS | ROR | ESP | 3 | 3
National Technical University of Athens (NTUA) | EDU | GRC | 2 | 1 | 3
Smart Homes | OTH | NLD | 3 | 3
STMicroelectronics | IND | ITA | 2 | 1 | 3
Universitat Politècnica de Catalunya (UPC) | EDU | ESP | 1 | 1 | 1 | 3
University of Hull | EDU | GBR | 1 | 1 | 1 | 3
University of Linköping | EDU | SWE | 2 | 1 | 3
University of Pisa | EDU | ITA | 2 | 1 | 3
University of Southampton | EDU | GBR | 1 | 2 | 3

Table 5: List of organizations participating in more than two PHS projects

Based on the bipartite graph, we construct the PHS collaboration network of organizations (Figure), i.e. a unipartite or one-mode projection of the bipartite graph that preserves only one type of node—organizations—and connects all nodes that share a common neighbour in the bipartite graph.
In this case an edge between two organizations exists if and only if these organizations participate in the same R&D project. As in the case of the bipartite graph, the degree is defined as the number of direct neighbours.

Figure 4 shows the collaboration network of organizations participating in PHS projects at the EU-level. The network consists of a large main component (sub-network) comprising the majority of organizations and two small components, which indicates that nearly all PHS network actors are connected by direct or indirect links. The collaboration intensity is rather low - only about 10% of the organizations collaborate in more than one project – but this might be due to the fact that only projects after 2008 are included in the analysis and this period is too short for establishing and identifying stable collaboration structures between organizations.
Figure 4: Collaboration network of organizations participating in PHS projects at the EU-level
Finally, Table 6 displays the most central organizations in the PHS network in terms of degree centrality. Again, Frauenhofer-Gesellschaft takes the lead with a degree centrality of 0.1770, which means that Fraunhofer is directly connected to 17.7% of the actors in the PHS network. Universidad Politecnica de Madrid UPM is also centrally positioned and collaborates with 17.1% of the other organisations. TicSalut, the Spanish Foundation, which promotes the development and use of information and communication technologies (ICT) and networking in the health sector, is positioned on rank 3.

Table 6: Top 20 organizations with highest degree centrality

<table>
<thead>
<tr>
<th>Rank</th>
<th>Degree Centrality</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1770</td>
<td>Fraunhofer-Gesellschaft</td>
</tr>
<tr>
<td>2</td>
<td>0.1712</td>
<td>Universidad Politecnica de Madrid UPM</td>
</tr>
<tr>
<td>3</td>
<td>0.1187</td>
<td>TicSalut</td>
</tr>
<tr>
<td>4</td>
<td>0.1070</td>
<td>Philips NV (NLD)</td>
</tr>
<tr>
<td>5</td>
<td>0.1012</td>
<td>University of Hull</td>
</tr>
<tr>
<td>6</td>
<td>0.0973</td>
<td>Telefónica</td>
</tr>
<tr>
<td>7</td>
<td>0.0953</td>
<td>Medtronic Ibérica S.A.</td>
</tr>
<tr>
<td>8</td>
<td>0.0934</td>
<td>INTRACOM SA</td>
</tr>
<tr>
<td>11</td>
<td>0.0895</td>
<td>University of Padova</td>
</tr>
<tr>
<td>11</td>
<td>0.0895</td>
<td>Universitat Politècnica de València</td>
</tr>
<tr>
<td>11</td>
<td>0.0875</td>
<td>University of Twente</td>
</tr>
<tr>
<td>12</td>
<td>0.0837</td>
<td>empirica</td>
</tr>
<tr>
<td>13</td>
<td>0.0817</td>
<td>National Technical University of Athens (NTUA)</td>
</tr>
<tr>
<td>14</td>
<td>0.0798</td>
<td>Institut für Mikrotechnik Mainz</td>
</tr>
<tr>
<td>15</td>
<td>0.0778</td>
<td>AGE - The European Older People’s Platform</td>
</tr>
<tr>
<td>18</td>
<td>0.0739</td>
<td>University of Linköping</td>
</tr>
<tr>
<td>18</td>
<td>0.0739</td>
<td>Eidgenössische Technische Hochschule Zürich</td>
</tr>
<tr>
<td>18</td>
<td>0.0739</td>
<td>eTrikala SA</td>
</tr>
<tr>
<td>19</td>
<td>0.0720</td>
<td>Centre Suisse d’Electronique et de Microtechnique (CSEM)</td>
</tr>
<tr>
<td>20</td>
<td>0.0661</td>
<td>Landeskrankenanstalten Betriebsgesellschaft Kärnten (KABEG)</td>
</tr>
</tbody>
</table>

2.5. MAPPING OF PHS CASES

It is characteristic that the PHS research projects are usually pre-occupied with the exploring the possibilities of a particular technologically focussed system thus giving information mainly about its purpose, application areas, service and technology solutions envisaged or targeted. They are to a lesser degree dealing with issues that are important in the exploitation phase of a particular system, service or technology like the scale of the system in terms of potential users or cost of production or the business model best to be adopted. This is natural to a certain extent as these projects are usually funded through programmes supporting pre-competitive research. These limitations guided the search for PHS cases to select and map for the stock-taking task. As a result the search was oriented towards other sources than those including research projects (like provider organisations, websites of related products or business alliances, or databases of national PHS projects).

While in several cases an assessment of the PHS system was present (either as user assessment or assessment through clinical trials) most of the PHS cases lacked a clear identification of factors of success and failure. This limitation was overcome by reviewing available literature including also past PHS projects like PHS2020 and SIMPHS. This review complemented the information that was provided by some of the mapped PHS cases.
The criteria for the selection of cases was based upon the observation that investigations of personal health systems are often concentrated on the introduction of technological devices, i.e. the development of sensors, devices and interfaces for (technological) networks issues (see for example Roca 2009). While technological aspects are of course highly important the success and failure of PHS can often depend as much on non-technical aspects; service delivery, organizational and institutional conditions and user experience, for instance.

Hence, to extend the focus towards a more systemic approach we considered case studies as a valuable research method to provide in-depth understanding on PHS around Europe. In view of this comprehensive and systemic approach the following criteria for selecting cases for comparative case analysis were applied in PHS Foresight. Selected PHS cases necessarily had to

- include service systems: Focus on the important issue of social organization of PHS, including business models in order to capture the key processes and key actors in the implementation of personal health systems in national/regional/local health care services. According to Table 7 this is the highest form of implementation of PHS products/ solutions and is apt to cover all aspects of drivers and barriers in the different implementation phases.

AND

- be financed in EU level programmes focusing on personal health systems. The European projects typically offer comprehensive documentation valuable for case studies but also allow further support for the European-wide coordination of PHS.

OR

- were identified through web research based on a list of keywords (see Annex I for list of keywords). The realm of PHS is rather young and unestablished. It reaches to a number of other areas of work. Hence, the systemic use of keywords provides orientation for the search and improved understanding on the whole field and related emerging community of actors. In particular, the following web sources were searched:
  - CORDIS databases for PHS projects
  - www.healthcompetence.eu for relevant PHS projects

Table 7: A hierarchy of personal health system solutions

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>Definition of the PHS product / solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Sensor</td>
</tr>
<tr>
<td>Technological system</td>
<td>Sensor + Device + Network</td>
</tr>
<tr>
<td>Health application</td>
<td>Solution (Sensor + Device + Implementation)</td>
</tr>
<tr>
<td>Health care service system</td>
<td>Service (Solution + Management + Business model – Clinical)</td>
</tr>
</tbody>
</table>

Source: Based on Frost & Sullivan (2009), adapted by authors.
Also a review was carried out and the SIMPHS 2 country reports and the PHS projects/cases included were mapped for the stock-taking task of PHS Foresight. Following the methodology described in Section 1.2 PHS case studies were identified, namely by mapping EU projects and the structured web search with defined keywords (discussed in above in this Section 2.1. 39 cases in total were examined around Europe (see Table 8).

Table 8: Examined PHS Cases.

<table>
<thead>
<tr>
<th>No</th>
<th>Name of the initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P4Well (Pervasive Personal and PsychoPhysiological management of WELLness)</td>
</tr>
<tr>
<td>2</td>
<td>Biotronik Home Monitoring</td>
</tr>
<tr>
<td>3</td>
<td>Boston Scientific Latitude</td>
</tr>
<tr>
<td>4</td>
<td>Caalyx-MV Complete Ambient Assisted Living, Market Validation</td>
</tr>
<tr>
<td>5</td>
<td>CardioConsult system</td>
</tr>
<tr>
<td>6</td>
<td>CLEAR- Clinical Leading Environment for the Assessment and Validation of Rehabilitation Protocols in Home Care</td>
</tr>
<tr>
<td>7</td>
<td>CommonWell-Improved quality of life for older people</td>
</tr>
<tr>
<td>8</td>
<td>COPDdotCOM system</td>
</tr>
<tr>
<td>9</td>
<td>Diraya, Health Care Information and Management Integrated System</td>
</tr>
<tr>
<td>10</td>
<td>DREAMING, Elderly Friendly Alarm handling and monitoring</td>
</tr>
<tr>
<td>11</td>
<td>e-NEFRO: Arquitectura modular adaptable para la teleasistencia integral de paciente renales&quot; (Modular customisable architecture for complete kidney)</td>
</tr>
<tr>
<td>12</td>
<td>eCare Network in Bologna</td>
</tr>
<tr>
<td>13</td>
<td>FoSIBLE - Fostering Social Interaction for a Better Life of the Elderly.</td>
</tr>
<tr>
<td>14</td>
<td>Health Buddy</td>
</tr>
<tr>
<td>15</td>
<td>Home security and Home comfort - Limousin (ESOPPE)</td>
</tr>
<tr>
<td>16</td>
<td>home security and service staff coordination in mobility - Y-DOM</td>
</tr>
<tr>
<td>17</td>
<td>HSH- Home Sweet Home</td>
</tr>
<tr>
<td>18</td>
<td>inCasa- Integrated Network for Completely Assisted Senior Citizen’s Autonomy</td>
</tr>
<tr>
<td>19</td>
<td>INDEPENDENT- ICT enabled service integration for independent living</td>
</tr>
<tr>
<td>20</td>
<td>ISIMED- Intelligent System for Independent Living and Self-Care of Seniors with Cognitive Problems or Mild Dementia</td>
</tr>
<tr>
<td>21</td>
<td>iStopFalls - ICT-based system to predict and prevent falls</td>
</tr>
<tr>
<td>22</td>
<td>Medtronic CareLink for cardiac rhythm management</td>
</tr>
<tr>
<td>23</td>
<td>Medtronic CareLink for diabetes patients with implanted insulin pumps</td>
</tr>
<tr>
<td>24</td>
<td>MyDoctor@home</td>
</tr>
<tr>
<td>25</td>
<td>NEXES-Supporting Healthier and Independent Living for Chronic Patients and Elderly</td>
</tr>
<tr>
<td>26</td>
<td>ODUM Health System</td>
</tr>
<tr>
<td>27</td>
<td>Online Predictive Tools for Intervention in Mental Illness (OPTIMI)</td>
</tr>
<tr>
<td>28</td>
<td>REMOTE</td>
</tr>
<tr>
<td>29</td>
<td>Renewing Health - REGioNs of Europe WorkI NG toGether for HEALTH</td>
</tr>
<tr>
<td>30</td>
<td>Renewing Health - REGioNs of Europe WorkI NG toGether for HEALTH</td>
</tr>
<tr>
<td>31</td>
<td>SOCIABLE-Motivating platform for elderly networking, mental reinforcement and social interaction</td>
</tr>
<tr>
<td>32</td>
<td>St. Judes Medical Merlin</td>
</tr>
<tr>
<td>33</td>
<td>systemic approach for living at home – e-care @ home - DOMOCARE</td>
</tr>
<tr>
<td>34</td>
<td>Tactive</td>
</tr>
<tr>
<td>35</td>
<td>Telemaco - Nuove Reti Sanitarie (NRS)</td>
</tr>
<tr>
<td>36</td>
<td>Telemmedicine in ALS VCO</td>
</tr>
<tr>
<td>37</td>
<td>The “Gesundheitsdialog” – Advanced Therapy Management for Diabetes Patients based on mHealth</td>
</tr>
<tr>
<td>38</td>
<td>The Patient Briefcase</td>
</tr>
<tr>
<td>39</td>
<td>University College London Hospital (telemedicine)</td>
</tr>
</tbody>
</table>
It is worth noting that 25 out of 39 identified cases are on-going activities, and only 6 out of 39 cases had started in 2005 or before (See Annex I for more details on start and end year and geographical focus of identified PHS cases). Further analysis of the maturity of cases reveals that most of them are in the pilot phase as illustrated in Figure 5. These findings give reason to conclude that the realm of PHS is an active emerging field.

**Figure 5: Maturity of the system – Distribution of Cases**

This observation that most of the cases identified are pilots is directly connected to the small scale of many examined cases as illustrated in figures 6 and 7 on user base and budget.

**Figure 6: User base of the system – Distribution of cases**

**Figure 7: Budget of the system – Distribution of Cases**

Each one of the case descriptions are available in the Annex I including key findings, further resources and contact details. The key findings of these cases are also integrated in different sections of this report, in particular in the two following sections and in the chapter on Key Issues in PHS activities.

### 2.6. TYPOLOGIES OF PHS FORESIGHT

**OVERVIEW OF TYPOLOGIES IN THE PHS AREA**

In the variety of projects focusing on PHS there have been different ways to structure personal health systems in order to understand their various functions and levels and to better understand drivers and inhibitors on different levels. The typologies vary according to the perspective on the personal health system pursued.

Codagnone (2009) provides a typology of personal health systems which building on application areas (see next section). The SIMPHS1 project acknowledges that typologies existing at the time were increasingly shared and used by the PHS community, but criticizes that these existing typologies do not adequately capture the market reality. Admitting the difficulties of regrouping all the existing labels in the PHS market into clear-cut segments, they propose a ‘hybrid’ typology comprising the following types (of services) (Abadie, Codagnone et al. 2011a: p20f):

- Sophisticated solutions (still in domain of R&D)
- First generation remote patient monitoring and treatment (RMT) and telecare
  - Pure RMT stand alone services
  - Disease management integrated RMT services
- Integrated home-based telemanagement
- Out-of-pocket mobile health for worrying well and fitness

Apart from developing the above typology of PHS, the SIMPHS1 project focused on RMT market
development and prospects. In the following, the SIMPHS2 project continued with this focus and observed that revenues in the RMT market are likely to continue to grow in 2015 with an expected market size of €489 million, i.e. a market double the size of 2009. Main drivers for these developments according to Frost & Sullivan (2009) are i) increased awareness about RMT, ii) customization of products and services, and iii) furthermore governments’ initiatives and funding.

In the SIMPHS2 project, the above typology was condensed and changed and the further analysis was built on a typology of PHS markets, i.e. market segments of the PHS market (Baum and Abadie 2012).

- Remote patient monitoring and treatment market
- Telecare market
- Wellness and fitness market
- mHealth market

The definition of market segments is also a target of consulting firms or industrial firms which operate on the PHS market. Therefore a variety of market segment definitions exist:


- Ericsson (2009) defines the following health target markets and value propositions:
  1. Hospitals, where mobile patient monitoring of early discharged patients in complete safety is the goal, and at the same time reduce costs and comply with cost cutting.
  2. Homecare / Elderly Care, where mobile and in-home patient monitoring may increase patients’ quality-of-life and piece-of-mind. This is going to reduce care costs and formal operational burdens for care companies.
  3. Public Healthcare as a means for mobile disease management (e.g. less disease related costs and better quality-of-life for chronic disease patients).
  4. Pharmaceutical industry for mobile clinical trials (fast and high-quality clinical data for shorter time-to-market and safer medicine) and direct-to-patient communication.

### TYPOLOGIES USED IN THE PHS FORESIGHT PROJECT

#### PURPOSE AND APPLICATION AREAS

In the present project we build parts of our analysis on the typology developed in the PHS2020 project (Codagnone 2009b: 31ff). This typology has the twofold advantage of being increasingly known and diffused in the PHS community (cf Continua Health Alliance⁷), and of defining its application areas close to patients needs. A substantial limitation of the PHS2020 typology is that it is no robust and clear-cut segmentation in the sense that the variety of labels and technologies which make up personal health systems cannot in an unambiguous way be attributed to one application area. However, this seems the case in all of the above mentioned typologies (Abadie, Codagnone et al. 2011a: 11).

Codagnone (2009) provides a typology of personal health systems which builds on different areas of application to differentiate between various kinds of services. These different areas of application are:

- Chronic disease management

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A chronic disease has one or more of the following characteristics: It is permanent; leaves residual disability; is caused by nonreversible pathological alternation. It requires special training of the patient for rehabilitation or may be expected to require a long period of supervision, observation or care (WHO Centre for Health Development, 2004). Chronic diseases relevant in the present context are especially diabetes, cardio-vascular diseases, respiratory diseases, neurological diseases.

Chronic diseases are among the main causes for the continuous and substantial rise of public health care expenditures worldwide. A substantial growth of chronic diseases can be observed and projected in relation to at least two phenomena. The first is the progressive deferral of mortality from many chronic diseases, partly attributable to better medical care. This has contributed to extending life expectancy in OECD countries, but also to an increased incidence of age-related chronic diseases. The second factor is rising age-specific incidence of some chronic diseases as a consequence of poor lifestyles. Risky lifestyles play a big part in the incidence of many chronic diseases and whereas some lifestyle trends, such as reduced smoking, are favourable in most OECD countries, others, such as consumption of poor diets, adoption of sedentary behaviour and the resulting obesity, are adversely affecting population health. Obesity and the prevalence of chronic diseases linked to obesity, such as diabetes and cardio-vascular disease, have been increasing consistently across OECD countries in the last decades (Sassi and Hurst 2008: 9).

- **Life-style management** (Prevention, early detection, well-being and fitness)

Lifestyle is the set of habits and customs that is influenced, modified, encouraged or constrained by the lifelong process of socialization. These habits and customs include dietary habits and exercise, but also the use of substances, such as alcohol, tobacco, tea or coffee (WHO Centre for Health Development 2004).

- **Independent living** (Telecare, AAL)

Living at home without the need for continuous help and with a degree of self determination or control over one’s activities (WHO Centre for Health Development, 2004).

The 39 ‘PHS Foresight’ case studies can be categorized in these application areas as described in Figure 8.

**Figure 8: Application Areas – Distribution of Cases**

Two cases that are categorized also as ‘other’ are:

- Home security and Home comfort - Limousin (ESOPPE) is categorized as assisted living and fall prevention (other).
- Home security and service staff coordination in mobility is categorized as ‘Health care service staff management’ (other). Y-DOM aims to help monitor, manage and coordinate service staff coming to the home of elderly patient. Due to the focus on service staff it is considered more suitable to categorize the case in ‘other’ rather than ‘assisted living’, which would have been the case if the main users of the system were patients.

Hence, the results of the case studies indicate that the chosen categorization of application areas seem to be suitable for characterization of PHS cases.

In addition to the above application areas we defined cross-cutting issues in order to complement the PHS2020 typology. These cross-cutting issues add layers to the application areas, they are issues of general health care services as emergency and treatment, and furthermore approaches of comparable novelty (e.g. empowerment and an increased focus on prevention).

- **Emergency**

An emergency is a sudden unexpected onset of illness or injury which requires immediate care. Emergency services, which are provided in response to the perceived individual need for immediate treatment or care (WHO Centre for
Health Development, 2004). Emergency services put health care under particular strain due to the necessity of a seamless network of services in order to meet time restrictions.

- Treatment

Under medical treatment we understand comprehensive health services, as generally defined under some national (or state) laws and statutes, which include inpatient care, outpatient care, day care and other partial hospitalization services.

- Prevention

The concept of prevention or preventive medicine is important where measures are designed and introduced in order to avoid complications and sequelae from existing diseases. This is a new model to approach health care services in a modern society, in contrast to the traditional model of curative or palliative medicine where symptoms are treated, once they arise and physical deterioration becomes evident. In many cases, the damage then may be irreversible.

- Empowerment

Patient empowerment is a relatively new concept in health care where the patient by means of information and participation improves his/her psychosocial self-efficacy and attitudes toward a chronic disease, which consequently results in an improvement of physical parameters and in an increase of well-being (Mitchell Funnel and Anderson 2000).

Three cases out of 39 were categorized as other, including the above mentioned case on home security and service staff coordination in mobility. Hence, the results of the case studies indicate that the chosen categorization of purpose areas seem to be suitable for characterization and mapping of PHS cases.

Many cases address multiple purposes as indicated in the figure above. For, instance, Medtronic CareLink for cardiac rhythm management deals with emergency, prevention and treatment services. During standard care of implants for cardiac rhythm management, follow-ups for checking the implant’s status are necessary in regular intervals. Remote Monitoring in this PHS addresses prevention by reducing the number of in-clinic follow-ups by automatically sending information concerning the status of the implant to a backend system. Treatment is improved thanks to the received data, which are analyzed and presented to the physician in a concise way. Furthermore, the established system provides means to inform medical staff in case of emergency.

**SERVICE AND TECHNOLOGY SOLUTIONS**

In order to provide different kinds of services, personal health systems have to involve a variety of technologies related to data gathering, data processing, data transmission and furthermore those related to interfaces. From a technological point of view, the most relevant aspect for all of them is the need for flexibility and usability, i.e. the technological ability to adapt to each setting and to personalize to each user if required (IPTS 2012b: 34). From a patient-centered view, what matters is the degree of invasiveness of how the technical device gathers information and the associated means of mobility. In a personal health system, where not the patient needs to be the one who moves, information exchange processes can be achieved by two different means. Technical devices can be stationary and the patient mobile or both the patient and the supporting equipment is mobile (The Capital Region of Denmark and Health Care Innovation Centre 2011: 5).
In the PHS Foresight, we take a patient-centred view analyzing technical solutions according the position of the technical device gathering information about the patient, which allows assumptions about the degree of invasiveness. The position of the data gathering device relates to where the device is positioned with respect to the patient’s body. The following categories are taken from Codagnone (2009b: 34f):

- **Stationary**, i.e. the data acquisition is achieved through a stationary device which the patient periodically connects to in some form.

- **Portable**, i.e. the data acquisition is achieved through a portable device which the patient periodically connects to in some form. Mobile communication centered devices would mostly be in this category.

- **Wearable**, i.e. wearable gadgets centered, where data acquisition is achieved through a wearable device.

- **Implantable**, i.e. devices (sensors) for in-body monitoring and treatment.

Naturally, the degree of invasiveness is highest for implantable devices, although the necessity for actual invasive surgery may also vary in this category. The patients’ level of comfort may also be incriminated by wearable devices that require large or uncomfortable contact areas and hence impede body movements (Codagnone 2009b: 35).

Within the dimensions of service and technology solutions the 39 ‘PHS Foresight’ case studies can be categorized in these data acquisition modes as described in Figure 10.

**Figure 10: Data Acquisition – Distribution of Cases**

Five cases that are categorized also as ‘other’ are provided further details of the modes of data acquisition, for instance the use of web-based portal and telephone. Hence, the results of the case studies indicate that the chosen categorization of application areas seem to be suitable for characterization and mapping of PHS cases. It is worth noting here that while in most of the cases the introduction of new gadgets plays a crucial role where, in some cases it more about the new ways of using existing available technology, for instance the phone in case of eCare Network in Bologna.

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**TYPOLOGY OF BUSINESS MODELS AND SERVICE SYSTEMS**

The increasing use of ICT in health care shall eventually lead to better services and increases in quality of health care. Changes of health service provision with application of ICTs is a challenge to existing forms of organisation in the health care sector which has a large public component in Europe. It implies organisational changes of considerable extent, as the introduction of technical innovations is to a large extent associated with organisational innovation in order to exert a noticeable impact on efficiency and quality of health care services. This is counteracted as the implementation of new modes of service provision into practice is always a serious challenge to governance and management. The pervasion of personalized health care services is dependent on business models which include the public, private and voluntary sectors. Synergies need to be developed between organisations providing health care services and industrial firms or organisations developing and applying technological solutions. The state has a critical role to play in opening up opportunities and making arrangements for allocating resources as well as co-ordinating the concerted efforts of all actors involved (Braun, Constantelou et al. 2004: 45).

Organizational innovation processes in turn require new payment models and in the relevant health care (sub-) systems. In the PHS Foresight, we therefore lay a particular focus on how new services integrating personal health systems are organized and on the associated business models.
In our context, business model analysis should be based on the

- contents of service deliveries
- organization of services in the value chain, i.e. the network character of service delivery
- analysis of payment modes: Who pays for what kind of services? What part of financial burden has to be carried by the consumer?

In order to analyse business models in PHS cases we use the following basic typology (see also Frost & Sullivan 2009).

- The public sector business models refer to the integration of personalized health care services into public health care system structures. These mainly relate to the extension of the service portfolio in existing systemic structures. In this matter, different levels of public health care are relevant in different countries depending on institutional set up of public health care (Abadie, Codagnone et al. 2011b: 57) (UK: NHS, Germany, Austria: social health care insurance, Spain: local level providers of health and social care, Italy: regions).

- Private sector business models can take a variety of forms. Often existing private firms take on additional roles, hereby extending their traditional value chain: i) Private health insurance firms take on role of medical providers. This is mainly focused on costly chronic diseases and disease management concepts. However, legal constraints may apply here. ii) New service providers (e.g. a telephone company) may take on a new role in combining medical service provision and IT support. iii) Private market –out of pocket payment model: Customer/patient shops in free health market for best services available.

- A combined option where some services are undertaken by public sector while others by private insurance.

The above typology of business models roughly corresponds to the channels which Continua Health Alliance sells its products through. Continua Certified products are sold through multiple channels:

- Direct to consumers through retail channels (private sector model).
- To providers of goods and services through business-to-business channels (private sector model).
- To patients through prescriptions written by healthcare providers (public sector model).
- Through governments, health plans, and service providers to their constituents (combined option).

In this project we tested the following categorization in the analysis of the 39 PHS case studies.

- Combined models
- Private insurance
- Private market
- Public sector
- Peer to peer (e.g. social networks)
- Other.

Within the dimensions of service systems and business models the cases can be categorized in these categories as described in Figure 11.

**Figure 11: Business Model – Distribution of Cases**

Here, it is worth noting that information on public sector funded national and European cases were

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rather well documented compared to many private sector initiatives. This bias led to the orientation in combined models and public sector driven systems in the case collection. Having said that it is expected that further analysis of other types of models would provide more comprehensive view on the richness of different types of business models applied in PHS.

For instance, businesses are developing growing number of mobile applications tailored for personal health management (see Figure 12 for some examples). In the Apple Store alone a quick search gives the following results:

- Health – 7311 apps
- Personal health – 148 apps
- Personal trainer – 224 apps
- Health record – 178 apps.

Figure 12: Examples of Mobile Applications in PHS.

Source: eHealth apps, Pinterest

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As a showcase of private sector initiatives in the PHS sector the continua alliance is worth mentioning. Continua Health Alliance is a non-profit, open industry organization of healthcare and technology companies, currently more than 200 members, joining together in collaboration to improve the quality of personal healthcare. The alliance promotes a Connected Health Vision oriented towards creating a rich eco-system of interoperable health and fitness devices that will:

- Empower individuals and patients to better manage their health by providing them with information regarding their fitness and health through personal medical devices and services.
- Allow loved ones and professional care givers to more accurately monitor and coach chronic disease patients and elderly individuals living independently.
- Enable medical and fitness device manufacturers to rapidly develop interoperable devices and services using industry developed connectivity standards.
- Enable health care providers to offer better quality care through personalized health solutions assembled from a rich marketplace of interoperable health care devices and services.\(^{11}\)

Continua has its own certification process supported by own test labs and certification experts. All certified products are included in an open database which is searchable on-line by anyone through several criteria like devise type, manufacturer, certification date, certification version, interface, disease state, regulatory clearance, or transport type.\(^{12}\)

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Box 2: Definition of stakeholder groups, developed in BRAID project.

Primary stakeholders – Private users
The primary stakeholder category comprises private users of ICT for ageing products and services. Among the private users, we include senior citizens who use the solutions and people who need assistive technologies. Also persons working with people in need for assistive technologies are included in this category; these are private caregivers and very often members of the family of the person who needs care.

Secondary stakeholders – Professional users
Among the secondary group of stakeholders, we analyse persons who use ICT for ageing solutions from a professional viewpoint. These persons or organisations do closely work with private users – or in other words: the private user is the subject of their work. Professional users are employing “ICT for Ageing” solutions in the course of the provision of services for primary stakeholders, i.e., the usage of the “ICT for Ageing” solution is an integral element of their value creation.

Tertiary stakeholders - Suppliers
The tertiary category includes suppliers of ICT and ageing solutions – again in a very broad sense. Following the value creation chain from the bottom to the top, the following suppliers are distinguished:

- Research labs that cooperate intensively with commercial actors (e.g. contract research), offer access to pilot sites for testing ICT for ageing solutions or run demonstration sites in order to support future collaboration projects
- Enterprises that produce and/or commercialise ICT for ageing devices
- Service providers that integrate solutions into their services (boundaries to stakeholders summarised within the secondary stakeholders are not strictly rigid in this case)
- Enablers, i.e. ICT infrastructure suppliers: Telecom and database providers
- Solution packagers and system integrators
- Distribution and vendor channels

Quaternary stakeholders - Supporters
This last category is made up of representatives of organisations and authorities who may have an impact on the dissemination and uptake of ICT for ageing solutions. This similarly wide definition incorporates persons who define the socio-economic and legal context for exploiting ICT and ageing: policy-makers, insurance companies, employers, public administrations, standardisation organisations, civil society organisations, the media, etc.

In the ‘PHS Foresight’ case studies the stakeholder categories defined in the BRAID project were applied and attested as suitable and useful for structuring the analysis (see Box 2 for the detailed description of categories). Detailed stakeholder descriptions in the case studies are available in Annex I of this report. In some cases wider stakeholder implications and engagements may be important for the system, however, such connections may not be always easy to exemplify. In case of Diraya: Andalusian Integrated Health Care Information and Management System, for instance, private health insurance companies benefit indirectly from the system by reaping different types of benefits, such as avoided costs due to fraud prevention and improved risk management of the Andalusian health case system at large.

Personal Health Systems are diverse and multifaceted systems. Hence their characterization benefits from the application of multiple perspectives and rigorous development of typologies. This also supports the development of common framing and shared vocabulary for the emerging PHS community. In this section we have
elaborated further characterization of PHS by combining different perspectives addressed in earlier research. The constructed typology was preliminary tested in the examination of 39 PHS case studies around Europe. This exploration provides some evidence of the feasibility of the developed typology and gives reason for further refinement, in particular in the development of service system and business models characterizations.
3. KEY ISSUES IN PERSONAL HEALTH SYSTEMS

The nature and types of PHS devices and their applications are set out elsewhere in this and other reports of the present project. A few summary points are in order: first, there are a great many applications and a great many technological solutions that are emerging (and in many cases being experimented with) here. Second, these are often subject to quite rapid technological change, as information capture, processing and communication methods are improved, as techniques such as big data analytics are refined, as understanding of the nature of diseases and treatments is advanced. Third, there is considerable scope for PHS to piggyback upon devices that are becoming prevalent in everyday life – from smart phones and digital TVs, to consumer-purchased security and alarm systems and personal training aids. Fourth, as a result of these factors, there is liable to be continuing uncertainty about choices, and continuing efforts by one player or another to establish standards and design paradigms. How soon “stabilisation” and “maturity” of designs takes to be established is very hard to predict, and which particular players exert dominant influence – in markets that are to greater or lesser extents internationalised - remains a matter of speculation.

What is clear is that the PHS ideas and experiments are developing in the context of pressure upon health and social care systems in most Western countries to reform themselves in order to contain expenses and meet new social challenges. How far PHS can be used as part of the argument for system redesign in particular ways is something that is liable to vary across countries – and even within them, in some instances.

3.1 CULTURE AND VALUES

THE TREND TOWARDS INDIVIDUALIZATION IN HEALTH CARE

Each patient makes an individual diagnosis and therapy necessary, even if patients suffer from a similar affliction, their detailed needs for healthcare may be highly differentiated. Hodgson (2008: 10) argues that highly standardized mass-production of healthcare services may satisfy needs only in a limited number of cases, instead healthcare services have to be heterogeneous in order to reflect individual needs. In European health care systems, demand for health care services is derived from patients’ needs, according to the severity of the affliction, complications and sequelae. Per definitionem needs must be satisfied for human beings in order to avoid serious physical or mental harm, where harm also comprises barriers to individual aspirations or social inclusion.

These arguments for heterogeneous patients’ needs and hence demand for health care services underpin the desirability of personalized health care services on the individual level as well as the general implementation on the health care systems level.

INCREASED TECHNOLOGY –AFFINITY AS A DRIVER

Drivers on the general level are the global dissemination of sophisticated technologies and mobile phones and consequently the use of these devices (internet applications, smart phones and application (app) development). This trend is reinforced as increasingly the senior part of the population will be familiar with advanced ICT as they have used it already in their professional and private lives (MOVING LIFE project, The Capital Region of Denmark and Health Care Innovation Centre 2011: 6).

TECHNOLOGY SKEPTICISM AS A BARRIER

In case 28, REMOTE project, a basic skepticism was identified for the individuals surveyed as concerns technical devices (cf. (Gkaitatzi, Bekiaris et al.
There is a general fear of operating errors or hard to control alarms. Elderly individuals also show uncertainties as to new technologies, e.g. they frequently commented that they are unable to use Touchscreens. Information and understanding of the technology is obviously lacking. There is lack of trust in technical devices, as such can fail, either due to an operating error or due to a technical defect. Family and friends seem to be the foremost advisors, as they have time and understand the fears of the individual concerned and are best able to provide adequate information as to the benefits of Tele-Healthcare. Family and friends are also the individuals best suited to assuage the fears concerning loss of personal contact through increased use of technology. They can also be a crucial factor in helping the concerned individual make realistic assessments of their personal health status. Substantial backlog exists as concerns informational sourcing as well as in regards to further education on the technological possibilities available on the side of stakeholders. However, existing informational sources are not accessible to many individuals (Gkaitatzi, Bekiaris et al. 2010).

A regular and comprehensive informational exchange between physicians, therapists, health care personnel, health insurance organisations and elderly or disabled individuals and their family and friends plays an important role in the development and acceptance of Tele-Healthcare possibilities (Gkaitatzi, Bekiaris et al. 2010).

Social acceptance of the technology includes also acceptance on behalf of professionals. The Netherlands SIMPHS Country report states that innovation-mindedness on a lower management level can be of vital importance for eHealth innovations. Multiple interviewees put forward that a positive attitude of care professionals is also seen as vital (van der Plas and van Lieshout 2012).

3.2 MARKETS AND USER NEEDS

CHARACTERISTICS OF MARKETS FOR PERSONALIZED HEALTH SYSTEMS

It seems to a characteristic of the PHS markets that users are on the one hand clients and may on the other hand be patients, in which case the client may be a different kind of person/organisation. This depends of course on the type of PHS service solution (see also section on Typologies of PHS Foresight). Accordingly, the literature on PHS markets is torn between the focus on users (ICT focus) and on patients (health focus).

One of the empirical results of the SIMPHS 1 project is that the market for PHS will not rise substantially on the basis of out-of-pocket money from patients or on the basis of private insurances who acquire additional services for their clients. Instead, there will have to be clear financing and/or spending decisions on the part of public health care bodies. However, there seems to be only anecdotal evidence of PHS market players negotiating agreements with public health care bodies, and these were the results of longstanding, resource-consuming individual efforts (Abadie, Codagnone et al. 2011b: 57).

Which public health care bodies to address depends on the institutional set-up of the public health care systems, implementation processes have a high degree of fuzziness with regard to the relevant public decision making authorities as well as with regard to (the lack of) a clear public procurement process. Entering the health care market at the level of providers also proved to be difficult as health care organizations are a difficult market who are reluctant to accept “outsider” suppliers (Abadie, Codagnone et al. 2011b: 57) due to a variety of reasons, data security, health risks and liability issues among them (Borowiecki, Budde et al. 2011).

Also the MOVING LIFE project (The Capital Region of Denmark and Health Care Innovation Centre 2011) states that although the uptake of smartphones is moving fast and the speed of the software development (especially the application development) is pushing boundaries for what can be done in the clinical world, the healthcare consumer market (i.e. healthcare services developed by private providers without legal healthcare authority) has not taken off yet. At the same time, clinicians (doctors, nurses and other healthcare professionals) are illegitimately or
legitimately using their own consumer devices (iPhones or android smartphones etc.) with installed medical apps for clinical purposes.\textsuperscript{13}

Another aspect of the PHS market is its limited possibility of cross-border operations up to date. Both SMEs as well as large companies operate locally and nationally for a long period of time before they make attempts to extend to international markets (Abadie, Codagnone et al. 2011b: 58). This may change now as a consequence of the Cross-Border Healthcare directive 2011/24/EU, which is supposed to make it easier to cross-border market a PHS service which has already been established in an EU member state.

**SOCIAL ACCEPTANCE OF PHS-RELATED INNOVATION**

An important aspect in the innovation process is the acceptance of the innovation by relevant stakeholders on an individual as well as on an organizational level. In the Netherlands, based on the SIMPHS II Country Report, interviewees unanimously describe a high acceptance among patients and care professionals of the PHS systems examined. Initial hesitation and fear about losing personal contact with patients or that the carers’ work would change substantially due to the increased use of ICT were withdrawn after experiencing how it is to work with personal health systems. In fact, the care professionals received much more data about the patient and were able to make better diagnoses, while also having a more personal relationship with the patient, as they talked to them on the phone on a very personal level (van der Plas and van Lieshout 2012).

A crucial factor for the acceptance of personal health systems is also that the system should work properly at all times: care professionals have to be able to trust the technology. In this regard, an important factor in the acceptance is the involvement of care professionals (and patients) in the design process of an eHealth innovation. From a patients’ perspective, user-friendliness is vital for the acceptance. The Netherlands SIMPHS Country report states that interviewees reported that as long as the systems are easy to use, and patients are well instructed to work with them, the acceptance is high (van der Plas and van Lieshout 2012).

In Case 9, Diraya: Andalusian Health Information System, some healthcare professionals initially regarded Diraya as impeding their daily routine rather than enhancing their clinical and working practices. In contrast to the present system, Diraya was initially slow, with several downtimes, slowing acceptance and utilisation. Solving the technical problems improved Diraya’s efficiency, and healthcare professionals began to recognise the benefits they could reap and the potential to enhance the quality of clinical outcomes. Now, many healthcare professionals recognise that working without Diraya is unimaginable. Healthcare professionals’ suggestions for improvements to optimise its functionalities proves a sophisticated understanding of health informatics and ICT possibilities, indicating the high level of healthcare professionals’ acceptance of, and response to, working with Diraya. For example, nurses and pharmacists are pressing for extensions to their access and user rights so they can benefit more from Diraya’s full potential as they recognise that the system can improve their overall performance and professionalism.

In Case 33, Tactive, communication between developers and users were established early on to ensure acceptance. Even after the set up of the online platform, senior management monitored the situation regularly and carried out regular feedback sessions and enhancement cycles. Furthermore, the design and delivery of the online system saw the continuous engagement of professional assistants who received the required training and support. Similar measures were also established and considered crucial for the success of the system in Case 39, University College London Hospital (telemedicine).


Furthermore, as the REMOTE project showed (Case 28), elderly/disabled individuals are confronted with new technology and personal health issues on a daily basis. Social factors are the core determinant, such as integration into a stable social structure and the related personal health assessment for the acceptance or not of telemedicine (Gkaitatzis, Bekiaris et al. 2010).

From PHS project reports (e.g. CommonWell (2012)) it may be derived that the acceptance of patients of PHS related services and their associated utility varies according their mode of coping with the disease. Whether patients cope with their disease by engaging with their disease, or by ignoring and not focusing on a routine basis is likely to make a difference in using PHS technologies and taking part in a personal health system that induces patients to deal with their disease on a routine basis. For patients accepting their disease overall satisfaction with the CommonWell project was high, key benefits by clients included a sense of reassurance, a sense of security, feeling looked after and the presence of someone who can help. For others the increase of information caused anxiety either because they did not want to be reminded of their illness, did not trust the technology or had unrealistic expectations of the equipment and what it could do (CommonWell 2012: 160).

**CONTEXTUALISATION AND ASSESSMENT**

It is important to classify each individual element of a medical monitoring device or system, e.g. blood glucose monitoring device in its overall context, including costs of the device, its acquisition and maintenance as well as the experience of others with the device. This type of information is an essential component in the assessment of the device, its' benefit s and thus its acceptance by the concerned individuals. However, more detailed information on costs or the experience of third parties with such technologies is generally lacking (Gkaitatzis, Bekiaris et al. 2010).

**3.3 PRODUCTS AND INTEGRATED SERVICE SOLUTIONS**

Especially integrated service solutions are hinged to the health care reimbursement and financing models which are - according to expert interviews in the SIMPHS 1 project – regardless of the differences in EU countries' institutional set-ups of public health care. Basically, there are two models of reimbursement in public health care: fee for service (DRG14 based reimbursement), and fee per capita (number of patients treated, regardless of measures taken, typical for general practitioners). One result in the SIMPHS1 report is that both models for reimbursement applied in public health care run against the implementation of personal health systems. Keeping patients out of hospital – through successful implementation of PHS – reduces the fee for services which hospital receive, and hence their incentives to adopt PHS. On the contrary, general practitioners who receive fees per capita may be unwilling to accept extra (and maybe unpaid) work which is associated with the additional PHS services (Abadie, Codagnone et al. 2011b: 58).

This put the focus on introducing additional fees (for PHS services) which may often be associated with organizational and system innovation and hence come with an enormous effort. To adapt existing structures and to pursue a common aim (i.e. provision of a general service) by relevant public health care bodies often in coordination with other actors in the health care system (like medical societies, medical chambers etc) may be a major achievement. Often established actors in the system have to leave a bit of their predefined and expected role, which is always likely to cause resistance. Social insurance funds have a culture of financing health services once the damage is done -providing health care services to prevent further damages is increasingly the role that is expected from them, but has not always been. Physicians may be reluctant to engage in further services and training in order to empower patients and treat them as equals, as experts themselves, which may prevent the implementation and use of personal health system (Schartinger 2009; Schartinger 2010; Abadie, Codagnone et al. 2011b. Another major

14 DRG diagnosis related group – this is a classification of hospital cases.
barrier is the rigid division between health care practices and home care practices. This is typical for the Dutch situation (though other countries show similar divisions) and has severe consequences for the widespread introduction and adoption of PHS. This is an organisational and socio-cultural barrier rather than a technological one, and one which does not show easy solutions yet (van der Plas and van Lieshout 2012).

Although these opportunistic considerations are the results from various interviews, it has to be noted as well that health work itself is much more than a source of reimbursement and remuneration. Typically, health professionals apart from meeting objective healthcare needs, also deploy deep-seated motivations to care for the welfare of others. Hence there exist a variety of non-pecuniary motivations in the health sector, which is also documented in empirical studies of healthcare professionals (Hodgson 2008). In case studies of health care service innovations it turned out to be crucial that there were key people who saw the advantages for the improvement in health care and for their organisation and disposed of the necessary intrinsic motivation, personality, preferences and communication skills in order to draw the innovation projects forward in their home organisation and in negotiations with others (Schartinger 2009; Schartinger 2010).

For instance, the Whole Systems Demonstrators (WSD) Programme initiated by the UK Department of Health from 2008 to 2010 aimed at finding out how technology can help people to manage their own health while maintaining their independence. The preliminary results indicate that the technology only represents 10% of the solution and the remaining and most challenging 90% are about getting the organisation turned around the system working. Some of the key lessons learned through the project are:

- Stakeholders involved underlined that telehealth requires much more patient commitment, participation and self-management than telecare
- Telehealth can work effectively through a full reorganisation of care delivery
- Using patient champions to diffuse the innovation was considered but due to ethical issues this alternative was not applicable as people did not want to share their private health issues with others
- The role of matrons and specialised nurses was key to deliver the service; dismantling personal care takers and these roles within them may result in losing competences and know-how for large-scale IPHS deployment
- Dealing with huge amounts of data represented a challenge for data sharing. The lack of awareness about the need for standards on how to accumulate and manage large datasets was a problem. In addition, there was no database able to manage the huge amount of information and data given the size of the trial.

In Case 38, University College London Hospital (telemedicine), the continuous evaluation of the progress is considered a key factor in the development of the service system. The development and implementation of the system is underpinned by repetitive quantitative and qualitative evaluation cycles. This facilitates regular performance evaluation of the system and identification of potential organisation and technical corrective actions.

ORGANISATIONAL HINDANCES

Widespread introduction and adoption of PHS systems also faces organisational obstacles. One of these is the primary mono-disease orientation of medical professionals. This leads to less awareness for and medical experience with co-morbidity patterns and treatment, which of crucial importance especially in chronic diseases (van der Plas and van Lieshout 2012).

JOB SATISFACTION OF HEALTH PROFESSIONALS DUE TO SERVICE SOLUTION

It has to be noted that health professionals themselves often feel highly dissatisfied with situations of health care, especially of chronically ill patients. Traditional public health care services often cannot meet the various needs of longterm chronically ill patients as health professionals lack
the resources in terms of time. Service solutions that provide a chance for increasing service quality for patients in the eyes also of their health professionals provides a potential for increased job satisfaction for health professionals. In Case 7, the CommonWell project, an increase of job satisfaction with the introduction of PHS related services was attributed to improved distribution of workload, more efficient handling of emergency situations, increased reliability of client information, seeing the benefits for their clients, and having time to talk and get to know their patients (CommonWell 2012: 163).

ACCOMPANYING EMPIRICAL STUDIES TO PROVIDE EVIDENCE - EVIDENCE BASED MEDICINE

Provision of complementing statistical research (evidence-based medicine): Evaluation and validation of the impacts of successful personal health system solutions should be explicitly incorporated in PHS implementation projects and pilots from the beginning in order to be able to provide evidence for the proposed improvement of health care. Empirical foundation of improvements is likely to reduce opposition by health care providers or other health professionals and to increase the willingness of payers to sustain funding such programmes.

According to EHTEL (2008: 6) the implementation of incident reporting procedures would also be welcome – similar to those employed by the pharmaceutical industry. Associated with such incident reporting should be the control that all eHealth information systems have been properly implemented and audit trails managed, which should be the subject of constant monitoring for incorrect operation or abuse. This is a standard for medical products on the basis of the Medical Device Directive (MDD), however apparently there are gaps with respect to service packages based on PHS technologies.

In case of PHS statistical research, it is also important to include not only indicators on clinical outcomes, but also on psychological outcomes, especially those indicators which reflect on a sense of security, reassurance and above all, reduced depression (see arguments on indicators like SF-12, BASDEC in CommonWell (2012: 160f).

DEVELOPING THE BUSINESS MODEL

The P4WELL project, Case 1, noted that there are several questions related to the business model to be solved: (1) who is the customer of the concept, (2) who pays and to whom, (3) who provides the service, (4) which kinds of relationships exist between the different actors participating in the service orchestration, (5) who are the beneficiaries, and (6) how does the money and value flow between the stakeholders. These challenges of complex earning logic, complex dependability on several stakeholders, and immature market, probably are slowing the successful introduction of the integrated PHS solutions to the market. One important challenge is to make the concept generic enough so that it can be easily adapted by many organizations to their models of care. This requires flexibility and efficient package for training the care providers, consultants, or personal trainers supporting the user (Happonen, Mattila et al. 2009).

In Case 34, Tactive, the sustainability of the online service was achieved by setting up a franchise model, wherein Tactive gains revenue from franchisees. This provided the stepping stone for future roll-out of a similar online system to address other forms of addiction in the Netherlands and in other countries.

ROLE OF INTERMEDIARIES AND INSURANCE COMPANIES

In some PHS systems (like Koala and Hartmotief) in the Netherlands, the medical service centre involved as an intermediary between the care professionals and the patients led to more work for the care professionals and made the communication more complex. This, together with the time it took to install the tele-monitoring devices, discouraged the health care professionals. In addition, in making the step from dissemination to implementation, the care insurance companies play a vital role. They have to be fully committed to eHealth, as they are the ones that have to make personal health systems part of their
reimbursement programs and with that enable care professionals to make personal health systems part of regular healthcare and patients to ask for personal health systems (van der Plas and van Lieshout 2012).

Home Telehealthcare Pods for patients with COPD (Chronic obstructive pulmonary disease), which was conducted by the NHS Highland in 2010 concluded that it is important for NHS IT services to be involved in the selection of technology providers and they cooperate together so that solutions are developed in line with their standards and are compatible with the current information systems in place for health and social care.

3.4 TECHNOLOGY DEVELOPMENT AND DEPLOYMENT

A direct link of patients with the healthcare system is a pivotal element of personalised healthcare. Today, plenty of technology is potentially available that can be utilized to overarch the “last mile”, i.e. to give almost anyone a way to actively participate in their care. With the ubiquitous availability of mobile and smart phones, such a communication can take place anywhere. Store-and-forward type of PHS infrastructures also provide for asynchronous communication between patients and carers in a sense of anytime. Finally, emerging wireless communication technologies like Near Field Communication (NFC) Technology allow initiating communication between people, between people and sensors and between wearable and portable sensors themselves in the sense of “the Internet of Things” (Morak, Kumpusch et al. 2012).

However, despite all those technological possibilities, implementing tailored ICT infrastructures for healthcare remains a difficult task. Projects driven primarily by a technology push may fail to provide sufficient added value or lack the necessary adaptation to the healthcare domain, even if successful in other industries.

Cross system link-ups remain a serious problem according to OECD (2010: 60f). Although ICT products and systems are increasingly installed in health care organizations, interfaces remain a main problem. The integration of personalized data in the clinical settings without frictions, i.e. interoperability, must be attained in order to be of value in the organization of health care. Although many of the standards necessary for interoperability are already existent, there is a lack of international consensus around which standards should be adopted and exactly how they are implemented. The development, approval, and adoption of standards for health ICT are proving a difficult and drawn out process (OECD 2010: 62f).

Healthcare processes are complex since they potentially comprise of many system players in different organisations. One way of dealing with interfaces and complexity is promoting interoperability, i.e. the capability of systems to exchange data in a plug-and-play like fashion. Interoperability is generally thought to have at least 3 distinct levels, i.e.:

- Syntactic interoperability (e.g. Bluetooth, USB, ...)
- Semantic interoperability (IEEE X73, HL7 CDA, ...)
- Pragmatic interoperability.

Most standards widely in use today are concerned primarily with the syntactic layer, i.e. they deal with data communication protocols and message composition. Standards for the semantic layer, which are concerned with the “meaning” of the data, are much harder to use and less mature today. Such standards are essential though when it comes to making systems to understand each other, for example if one would like to apply decision support on a multi-modal data basis, taking into account information from clinical documents and data provided by patients directly via PHS.

To achieve pragmatic interoperability, finally, means to be able to orchestrate (the ICT infrastructures of) different healthcare providers into a continuous caring process, spanning the borders of healthcare organisations or even whole

healthcare systems in case of cross-border healthcare.

It turns out that standards are often not enough to achieve higher levels of interoperability. This requires initiatives that guide the utilisation of standards in the context of well-defined use cases. Major interoperability initiatives in the field of healthcare are the “Integrating the Healthcare Enterprise” (IHE)\textsuperscript{16}, and the “Continua Health Alliance” (CHA)\textsuperscript{17} initiatives. IHE is an initiative by healthcare professionals and industry to improve the way IT systems in healthcare share information. IHE promotes the coordinated use of established standards to address specific clinical need in support of optimal patient care. CHA’s mission is to “establish an ecosystem of interoperable personal connected health systems that empower individuals and organizations to better manage their health and wellness.” (Carroll, R. et al. 2007)

Both are not-for profit open organisations with the aim to facilitate a high degree of interoperability. They closely collaborate and share some ICT systems architecture elements so as to make sure that information can flow from a personal healthcare device (like a blood pressure device) via some intermediate structures and defined interfaces all the way to the Electronic Health Record (HER) at the end of the chain. Both organisations do not create standards themselves but promote clearly defined use cases in which existing standards are deployed.

Whereas IHE is primarily healthcare system focused and becomes relevant mostly in the last step while sending healthcare related data to EHR systems, CHA is taking care of systems and devices close to the patient. CHA’s mission is broader and includes not only telehealth in terms of remote monitoring of vital signs but includes systems more dedicated to wellness and fitness as well as to support elderly people in terms of independent living (Ambient Assisted Living) and also those being cared for at home (telecare). As such, CHA is of prime importance to the PHS domain. IHE, however, is also essential in cases where PHS systems are to be linked to healthcare professionals and are not confined just to the patients themselves, informal care or consumer oriented systems (“gadgets”).

Both organisations provide guidelines for system development, and an environment for interoperability testing as well as certification for solutions that successfully showcase their interoperability readiness. The ultimate goal is to cater to a plug-and-play ecosystem with clear rules for both device manufacturers and system integrators.

As of today, numerous medical devices have been successfully certified by CHA and many ICT products for the hospital environment have already been successfully tested to support dedicated interoperability use cases (“Profiles”) in so called IHE connotations. IHE profiles are often part of public tenders, and increasingly the basis for national HER projects like the Austrian ELGA project. CHA certification has only recently started to be required in procurements. Although this expected to change, PHS systems deployed today are rarely full interoperable with existing ICT infrastructures and, therefore, often force users like doctors to operate one more non-standard system.

On the patients’ side simple systems can collect and forward health data in fully automated ways (eg. sending blood glucose readings to a web-based diabetes diary automatically by means of Bluetooth connection to a stationary broadband internet hub). In many cases, however, a sort of a dialogue with the patient is needed, for example to ask for symptoms or collect subjective information on e.g. the physical well-being. In these cases, patient terminal devices are needed. It turns out that those elements are still crucial in terms of patient acceptance (Schreier, Eckmann et al. 2012) and may benefit from technological progress and the availability of new user interface concepts based on NFC or natural language processing.

In conclusion, technological challenges and issues like patient interfaces and interoperability remain

\textsuperscript{16} http://www.ihe.net/ [accessed: 2013-02-24]

\textsuperscript{17} http://www.continuaalliance.org/ [accessed: 2013-02-24]
despite dramatic progress and the advent of smartphones and Apps in recent years.

As the Netherlands SIMPHS Country Report confirms, interoperability is seen as a major challenge. The systems were not interoperable with the electronic patient records, causing even more work for the care professionals. PHS providers in the Netherlands try to interconnect their systems to existing health information exchange systems, or aim to do so in a later stage. This leads to a fragmented innovation landscape (van der Plas and van Lieshout 2012).
Processes of ICT implementation in health care systems are notoriously complex and expensive undertakings which are subject to a number of framework conditions and policy concerns.

**DISTRIBUTION OF FINANCIAL GAINS**

It seems a significant barrier to investment in ICT that any resulting cost savings may not always be incurred by the investor/implementer, but may accrue to a third party, so that benefits and cost commitments appear in different budgets to a considerable extent (OECD 2010: 53ff). This is the case in particular for PHS services if those are intended to move healthcare services across organisational boundaries, i.e. from highly specialized hospital care to general practitioners which often are funded from different budgets. Hence, health care providers' incentives differ in implementing ICT in health care services to the extent that there may even be disincentives to invest (OECD 2010: 56f).

Basically there are three ways of governmental intervention in order to promote the adoption of ICTs in health and counteract disincentives: direct regulation, economic instruments and persuasive measures (OECD 2010: 74ff). With direct regulatory measures, government stipulates a specific target or result and/or the process by which it has to be achieved. Economic instruments include financial incentives as well as market stimuli. They may also involve disincentives, such as withholding payments in case of non-adoption or non-compliance. Persuasive instruments are often combined with economic instruments and comprise the provision of education and training as well as the use of social or peer pressure and recognition.

Concerning economic instruments, there are four main types of financial incentive programmes and combinations of these in operation today. Direct subsidy through private or public grant programmes, payment differentials, which are buni add-on payments which reward providers for adopting and diffusing ICTs, payment for electronically-delivered care (e.g. consultations by email), and withholding payments from providers, i.e. financial penalties for poor compliance (OECD 2010: 75ff).

**E-INCLUSION AND E-HEALTH POLICIES FROM A DEMAND SIDE: THE SOCIAL SHAPING OF TECHNOLOGY**

Selwyn, Gorard and Furlong (2003), cited in the BRAID project, make a strong case that technology, to a great extent, is socially shaped and determined. It would therefore be a better approach when developing a technology to ensure that older adults are more involved in adapting or changing the technology they want to use, so that the innovation will be more attractive, interesting an present more useful solutions. Whereas the newer generations are used to ICT devices in almost all spheres of their daily life, the patterns of older adults’ use of ICTs are likely to prove much more complex than the customary portrayal of the dichotomy between successful users and unsuccessful non-users. It is the task of policy makers to promote research projects on personalized health systems that not necessarily start from the technology but take a co-evolutionary approach and recognizing the changes occurring within society and how these shape technologies. If innovation policy in the personalized health area is not considering this approach, there is the risk of too much technology push resulting in inappropriate applications and negative outcomes to the disadvantage of the patients or users as well as to the longer term prospects for the market as a whole (Empirica 2010).

This is confirmed by (IPTS 2012a: 47) who in their survey found a gap among various population age groups in Europe concerning their purposes of using ICT in health. They state that there is a ned for additional action in terms of facilitating access
to and awareness about ICT for health services and devices including on their benefits.

**PATIENT EMPOWERMENT**

Patient empowerment means information, participation of patients, collaboration between health professionals and patients and a redefinition of roles and responsibilities (Mitchell Funnel and Anderson 2000: 1709). According to the Continua Health Alliance a critical shift in perspective has taken place in that people are now more aware that they can manage health risks at a personal level (Continua Health Alliance 2012). Here personal health systems in our definition are important as they incorporate a connection with medical professionals, where data acquired from patients is coupled with health expert knowledge which causes action based on new insights, either from health professionals or directly from the devices. The patient empowerment trend however is contested as this constitutes a change in paradigms for public health service systems. For these services patient empowerment equires systemic reorganization which may act as an inhibitor in the uptake of eHealth related projects (The Capital Region of Denmark and Health Care Innovation Centre 2011).

The question of patient empowerment is also a question of inclusion. This means if policy makers want to make modern healthcare solutions and the services attached to it accessible to all levels of European society they are facing a big challenge. Not only does the technical infrastructure need to be provided all over Europe and operationability guaranteed at a reliable and fast mode. Of the same importance is the e-literacy. Even though the new generations in Europe grow up with smart phone applications and similar progressive features there are still regions and social groups in Europe who are remote from such advances or have no access for economic reasons. After all, each member of society is a potential patient and therefore, empowerment begins at a basic societal level and needs to be continued once we become patients as well.

The Moving Life project explores the situation in personalized health care with regard to the deployment of the so called mHealth (mobile health) solutions and assess drivers and inhibitors for their further uptake and possible future developments. The authors point out, for example, that interoperability of health systems is not only a technical requirement but “also plays a role in a socio-economic context” (MovingLife 2012: 5). Therefore, at policy level, i.e. between Member States, interoperability of healthcare systems needs to be guaranteed. Persisting differences within and between health care systems lead to a lack of coordination and cooperation and this will be at the expenses of the patient and at the end harms society as whole in one way or the other.

**WORKFORCE, TRAINING AND EDUCATION**

As the Moving Life project and others correctly point out “healthcare will no longer be provided only by traditional caregivers like nurses or physicians” (MovingLife 2012). Many other qualifications have entered this sector changing also the social stratification. Policy makers are challenged to assess these developments and take the right decisions in order to maintain a critical workforce of service providers on the one hand and guarantee high quality healthcare for every member of our society on the other hand. The developments witnessed in this sector concerning workforce requirements, training and education are manifold. With new technologies we will need technically skilled experts able to implement, run, and maintain the systems and at the same time train the users (patients, nurses, doctors, relatives, etc.) for daily usage of such systems. At the same token many care givers who originally are not affiliated with modern technologies are facing new challenges when needing to adapt to their daily usage. Different patients might need different technologies. In every home there might be another technological device to help the patient and in many cases it is actually the care giver and not the patient who is using the technical device. All player in the health sector will need to think how these additional skills can be achieved by the care givers and according to what mode they will need to be reimbursed. One thing becomes clear when analyzing the recent reports on personal health systems: the will not make health care any
cheaper but they will ensure a better quality, safety and efficiency. As the Braid project report points out, “all savings in time consumption should benefit aging adults” (2010:56).

Further, the EU will need guidelines for the education of health care staff, especially with regard to new qualifications, when employees or patients are moving across Europe. A standardised format for such guidelines and certification of skills that are acknowledged in all Member States is therefore preferable.

Authors of Moving Life point out further that caregiving across the Member States is ruled according to very diverse laws, not only at national bases but in some countries even at regional basis (e.g. Germany). The authors thus call for harmonization of regulation concerning the new profession at the EU level so that personal health systems can operate across borders and according to the demands of European citizens. By the same token, reimbursement for new and traditional qualifications is of crucial importance for the success of personal health systems and further innovation in health care. One policy issue related to that is need for harmonisation of payments for the same services to meet general standards of living. One of the Grand Challenges European policymakers are facing with regard to demographic change is the provision of sufficient health care personal and meeting the large deficit – a trend we see practically all over Europe.

LEGAL AND ETHICAL ISSUES

How health care organizations deal with their accumulated digital information is crucial for the uptake of health ICTs. Sharing sensitive patient data in a large heterogeneous environment complemented by the use of web-based applications raises a number of privacy and security concerns. Case study evidence by OECD (2010) suggests that appropriate privacy protections must be integrated in the design of new health ICT systems from the beginning as these proved to be difficult to be introduced ex-post (OECD 2010: 66f).

According to (Braun, Constantelou et al. 2004) there are a number of legal and ethical issues that need to be dealt with for the efficient implementation of eHealth related projects (see Box 3)

Box 3: Legal and ethical issues of eHealth related projects

- Liability. The application of eHealth on a broad scale requires a clear legal and regulatory framework of practice. The lack of such a framework may discourage health professionals from introducing technology-based procedures in their standard medical practice. More specifically, standards need to be developed for the delivery of uniform medical practice across Europe, including procedures to be followed in case of malpractice and who should be deemed liable in such an event. Also standards need to be established for the provision of common medical information in electronic patient records.

- Security and confidentiality of patient’s data. There have been increased privacy concerns among patients regarding medical data and fears that it can be misused. In most countries with national health systems, efforts to co-ordinate medical records have been very limited due to concerns that the use of unique patient identifiers may put patient privacy at risk. However, the transformation of the current paper-based medical record in electronic form makes it accessible to healthcare providers and to the patient, and thus contributes to a reduction in administrative costs, prevents treatment duplication, and reduces medical errors.

- Licensing and accreditation of healthcare professionals engaged in some form of
telemedicine/ telecare. A special licensing procedure needs to be established for the accreditation of healthcare professionals engaging in forms of telemedicine/ telecare. Telemedicine and telecare are new and rapidly growing specialty areas, so those directly involved in the provision of such services (i.e. health professionals, care providers, administrators) must be educated on how to integrate new technologies into their daily practice. For example, the actors involved need to obtain the technical knowledge about how to install, calibrate, and operate the equipment and the interpersonal and managerial skills required so that they are able to develop problem-solving techniques. An accreditation system needs to be developed so that health professionals who wish to provide quality healthcare from afar are adequately qualified to do so.

- The need for ‘informed consent’, i.e. patient involvement in decisions over their own treatment and the danger of removing choice and control from the patient. eHealth applications can also increase the patient’s awareness of his/her own health thereby encouraging some degree of self-care. It has been found that care recipients appreciate being more involved in disease management and taking more responsibility for their own health. By having access to medical information and being able to track their health status patients and other recipients of care can become more involved in decision making over their treatment. Similarly, telecare can increase the awareness and education of informal carers about the health conditions of persons in need, thereby increasing their understanding of symptoms and their ability to recognise treatable diseases.

Source: Taken from Braun, Constantelou et al. (2004: 46f)

In the matter of privacy and security, EHTEL\(^\text{18}\) (European Health Telematics Association) has a patients’ and citizens’ task force who developed principles which pay respect to fact the monitoring technologies are *per se* invasive in that they are installed in private residences whether they are rooms in a care institution or in a private home.

\[^{18}\text{http://www.ehtel.org/} \text{[accessed: 2013-02-24]}\]
Box 4: EHTEL principles for installing monitoring technologies in private residences

- The patient must have the right to refuse to use the technology with no repercussions regarding the quality of treatment they receive.
- The patient needs to be in control of the technology and to be able to switch it off when necessary. This is particularly important when considering the area of privacy.
- Patients need support in managing eHomecare technology preferably through a single point of contact for all elements.
- Controlling authorities need to be clear about ownership and legal responsibilities relating to the technology and to make this clear to the patient.
- The benefits and risks associated with the use of eHomecare need to be made transparent to the patient.
- The views and needs of the patient need to be taken seriously. Others cannot normally assume this responsibility.
- Education and training for the patient, the professional, carer and, where relevant, family members are essential in order to gain acceptance by the user.
- Training needs to encompass not just the use of the technology but also the interactions between professional and patient and, indeed, the support staff who maintain the equipment. Respect and sensitivity are key components in the acceptance of eHomecare.
- Socio-economic considerations including ICT literacy, relationships within the family household and the potential for others to assume responsibility for any monitoring and consultation need to be taken into account.
- The need for direct human contact needs to be considered very carefully.
- Telecommunication networks carrying personal medical information need to be properly secured and appropriate audit trails showing who has accessed such information should be maintained.
- Access controls need to be implemented in items of equipment that could be used by other members of the household.
- All equipment installed in the home should be suitable accredited to recognised safety standards and installed to a professional level and in accordance with health and safety directives.

Source: Taken from EHTEL (2008: 9).

The REMOTE project, Case 28, notes that the development and maintenance of ethical standards as well as the strengthening of methodological and media competence in the field of professional health care would produce a high potential for improvement of the quality of care provided individuals (Gkaitatzi, Bekiaris et al. 2010). At the same time P4WELL, Case 1, stresses that several ethical and juridical issues are dependent on whether the service is considered as a wellness service or health service. Whether a concept is considered as a wellness service or health service may depend eventually on the potential service provider and related business model. The brand and promise that the service gives are central issues; these must be valid and ethical, e.g. the information and data provided by the user for the service are always handled as they were with user identification, and cannot be accessed outside without the user’s permission (Happonen, Mattila et al. 2009).

Nevertheless, there were other cases (as in the Netherlands SIMPHS Country Report, van der Plas and van Lieshout (2012)) were although privacy was often mentioned as an issue in the context of PHS innovation, interviewees reported that the patients valued safety and independence over the decrease of privacy.
The Ethical Frameworks for Telecare Technologies for older people at home (EFORTT) project found that telecare does not offer a ‘technological fix’ to replace either traditional health care services or informal care networks: it is not an easy solution to demographic ageing, ‘care crises’, personnel crises, or budget crises in ageing societies. Telecare does not perform care on its own. Project respondents expressed grave concerns that telecare technologies might be used to replace face-to-face or hands-on care in order to cut costs (OS: please send citation).

A policy challenge with regard to the progress of technology for personal health systems as well as to their organization and assessment is the issue of trust of the users.

This is also stressed by the authors of the Moving Life report. It might be a contested opinion but they think that it is problematic that health data is still centrally stored instead of using a distributed data storage and sharing platform such as in cloud computing and thus making data available across borders all over the EU (MovingLife 2012: 4). It cannot be mentioned often enough that privacy of health data is a very critical issue and that any reason for distrust in a new system will ruin the success of a new innovation. As pointed out in the Moving Life report, the “current legislation of the Medical Device Directive (MDD) does not sufficiently address this emerging market”. The authors thus advise the EU to take special care of this area during its current revision. In addition, trustworthy certification should make it easy for the patient to select and use the technology s/he needs.
Health care systems in Europe are under strain for a variety of well-known reasons. Personal health systems can enhance public and private health service delivery and provide new business opportunities in Europe and globally. PHS are also expected to improve quality of care, support quality of life more generally, and increase the cost efficiency of health care processes.

Research and innovation are key issues in the further development of a PHS area although plenty of PHS technology has already been developed and is potentially available to technically provide virtually everyone with an access to actively participate in personalized health care. Still, challenges like user interfaces and interoperability remain key issues despite enormous technological progress. Furthermore, research undertakings driven primarily by a technology push may fail as they do not situate PHS within the wider health and social care systems they have to form a part of.

Hence we argue for a wider systems approach in the analysis of PHS, which takes into account the need to design complex architectures relating together first, people who are recipients of care, care-givers, and others, second, organisational structures and processes that determine divisions of labour and responsibilities, flow of resources, etc., and third, technologies, especially the information technologies, but also other health and social care-related devices and software. An important realization here is that basically there are two models of reimbursement in public health care, fee for service and fee per capita, and apparently both models run against the implementation of personal health systems. Keeping patients out of hospital – through successful implementation of PHS – reduces the fee for services which hospital receive, and hence their incentives to adopt PHS. On the contrary, general practitioners who receive fees per capita may be unwilling to accept extra (and maybe unpaid) work, which is associated with the additional PHS services. Hence a wider systems approach also highlights some of the problems that a transition between service systems can involve – the challenge of system innovation. This typically requires more than just excellent technological solutions, but also a multi-stakeholder process of service system design.

This report captures various aspects of the scattered PHS research and innovation landscape and markets: In reviewing and characterizing research and innovation efforts in PHS we deployed various kinds of analyses. A bibliometric analysis and a patent analysis provide results directly associated with the term personal health system. The number of terms and concepts associated with personal health systems in the Web of Science has risen continuously since 2004 and the breadth and coverage of PHS has also increased since then. Instead, a search for patents addressing personal health systems only provided a few results. The reason for this is that there are a huge variety of labels, which can be subsumed under the umbrella term personal health system. In this first report we put considerable efforts in getting an overview of the scattered topics and labels in the PHS area. First, we provide a social network analysis on R&D collaboration networks financed by different recent PHS initiatives on the EU level. Secondly, we developed a list of key words and labels and used it to search for projects and cases of application in the PHS area. Thirdly, the section on typologies of PHS scanned projects and analyses of PHS with respect to their way to structure and capture personal health systems. These typologies of personal health systems vary according to the perspective on the PHS pursued.

Concerning markets for PHS it seems to be a characteristic that clients are on the one hand users and may on the other hand be patients, in which case the client may be a different kind of person/organisation. A pivotal aspect for the uptake of the PHS market will be whether it may substantially increase its volume mainly on the basis of out-of-pocket money from users/patients or private insurances, or if instead, there will have to be clear financing decisions on the part of public health care bodies. Which public health care
bodies to address depends on the institutional set-up of the public health care systems. The differences in EU countries’ institutional set-ups of public health care makes this a scattered and difficult to access market for industry, which hence operated predominately nationally or regionally for a long time. A further relevant aspect of PHS markets is the acceptance of the service solutions by relevant stakeholders on an individual as well as on an organizational level.

Various results in this report indicate that there is an important role for governments and public action in the PHS area. In other words, increases in market volumes would not be achieved at all, or lack the necessary speed, scale and sustainability without public action. First, it seems a significant barrier to investment in PHS that any resulting cost savings may not always be incurred by the investor, but may accrue to a third party, so that benefits and cost commitments appear in different budgets to a considerable extent. Hence, health care providers’ incentives differ in implementing ICT in health care services to the extent that there may even be disincentives to invest. To overcome these there are different forms of governmental intervention in order to promote the adoption of ICTs in health care services to the extent that there may even be disincentives to invest. To overcome these there are different forms of governmental intervention in order to promote the adoption of ICTs in health care services to the extent that there may even be disincentives to invest. Second, public funding of pilots and public procurement in health care seems a major leverage for establishing PHS. Third, the public role in pushing for higher levels of interoperability has to be further analysed and discussed, in particular the interaction of governmental activities with industry driven and not-for profit interoperability initiatives in the field of PHS. Fourth, there are a number of legal and ethical issues to be solved for the efficient implementation of PHS related projects, like liability, security and confidentiality as well as regulatory issues like the question whether or which part of a given PHS is a medical device or not. These are a policy challenge as the issue of trust will be key for the acceptance of PHS service solutions by users.

Associated with this public added value, there seem to be first indications of a EU-level public added value and rationale for establishing European Innovation Partnership for the development of PHS markets. First, EU-level financing plays an important role in the meta and meso level PHS projects: These are on the one hand research projects which have made considerable efforts in defining and demarcating the PHS area. On the other hand these are projects, which combine an analytical approach with a strong focus towards application. These pilots in application are distributed over Europe where actors from private, public and third sectors are involved in implementing local personal health systems. Hence, they have also a focus on the internationalization of the PHS service solutions, which would not come easily without the EU contribution. Thus these projects prove that many PHS service solutions are apt to be implemented in different national settings. Second, if there is a public role in defining interoperability standards these would be a European role otherwise PHS solutions are forced to remain national or regional. Third, also the legal, ethical and regulatory issues are a European policy challenge if the implementation of PHS solutions shall not be limited by national borders.

There is an apparent need to coordinate efforts and develop mechanisms for international mutual learning and streamlining framework conditions. This is indeed one of the objectives of ‘PHS Foresight’ and some other on-going European initiatives. Even further, more overarching and all inclusive initiatives like EIP could well make the difference and generate the required momentum for European PHS breakthroughs.


ANNEX I: PHS KEYWORDS

V0.5, 2013-02

General keywords / search items (1st Level)

- personal health system OR PHS OR personalized health
- Personal health record (PHR) / (Historia Clínica Electrónica)
- Electronic Health Record System
- Personalised treatment;
- personalised care
- personalised medicine (as part of PHS)
- eHealth OR e-Health OR ehealthcare
- mobile health - mhealth
- home care systems
- personal guidance systems
- personal health information monitoring
- pervasive health monitoring
- integration system / (Sistema de integración)
- HIS (Healthcare Integration System) / (SIH (Sistema Integrado Sanitario)
- Healthy EU (http://ec.europa.eu/health/index_en.htm)
- Enabling assistive technologies
- Integrated health OR integrated health services

Specific keywords / search items (2nd / 3rd Level if appropriate)

- Chronic disease management (especially diabetes, cardio-vascular diseases, respiratory diseases, neurological diseases)
- Telemedicine
- Telecare
  - Telemonitoring
    - Home monitoring
    - Health monitoring
    - Heart telemonitoring
    - Medication reminder
    - Examination reminder
    - Closed loop treatment
    - Therapy feedback
  - Electronic Diary / eDiary
    - Diabetes diary
    - Heart failure diary
    - COPD diary
    - Blood pressure diary
  - Sensors
    - Mobile ECG
    - ECG monitoring
    - ECG card
    - ECG / Life west
- Liquid level sensor (insulin vial)
- Oedema sensor
  - Decision support
    - Dosage calculator
    - Pocket guideline

- Life-style management (Prevention for chronic disease, early detection, well-being and fitness)
  - Nutrition
  - Activity diary

- Independent living (Telecare, AAL)
- Remote patient monitoring treatment OR RMT
- Ambient assisted living OR AAL
  - Fall prevention
  - Room monitoring
  - Care support app
  - Energy monitoring
  - Robotic

**Cross-cutting issues**

- Emergency
  - Pacemaker
  - Implantable cardioverter defibrillator (ICD)
  - Mobile defibrillator
  - Emergency button
  - Fall detection
  - Pill in the pocket

- Prevention
  - Smoking prevention
  - Obesity prevention
  - Decubitus prevention
  - Diabetes prevention
  - Heart failure prevention

- Empowerment
  - Senior mobile phones
  - Smartphone applications for the elderly
- disease management applications
- social integration platform
- support group
- support network
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INTRODUCTION TO PHS CASE DESCRIPTIONS

Following the methodology described in Section 1.2 PHS case studies were identified, namely by mapping EU projects and the structured web search with defined keywords in Section 2.1. In total of 39 cases were examined around Europe that are ordered alphabetically in this attachment. Herein, few statistical illustrations provide an overview of the set of cases examined.

Maturity of the system

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Pilot project</td>
<td>22</td>
<td>56%</td>
</tr>
<tr>
<td>Roll-over implementation</td>
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</tr>
<tr>
<td>Mature established system</td>
<td>9</td>
<td>23%</td>
</tr>
</tbody>
</table>

![Pie chart showing maturity of the system]

Ongoing / Finalised activity

<table>
<thead>
<tr>
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<tbody>
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</tr>
<tr>
<td>2005 or before</td>
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</tr>
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<tr>
<td>2008</td>
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<td>21%</td>
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<tr>
<td>2009</td>
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<tr>
<td>2010</td>
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<tr>
<td>2013</td>
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</tr>
<tr>
<td>2015 and beyond</td>
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</tr>
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</table>
Until further notice: 0 0%

End Year

<table>
<thead>
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<tr>
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<tr>
<td>2006</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
2009   |  0   | 0%
2010   |  2   | 5%
2011   |  0   | 0%
2012   |  4   | 10%
2013   |  3   | 8%
2014   |  1   | 3%
2015 and beyond | 1   | 3%
Until further notice | 6   | 15%

Geographical focus (countries covered by the analysed case studies)

Spain   | 17   | 55%
<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Italy</td>
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<td>45%</td>
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<tr>
<td>Other</td>
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<tr>
<td>Greece</td>
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<td>29%</td>
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<td>Denmark</td>
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</tr>
<tr>
<td>Austria</td>
<td>5</td>
<td>16%</td>
</tr>
<tr>
<td>France</td>
<td>5</td>
<td>16%</td>
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<tr>
<td>Finland</td>
<td>4</td>
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</tr>
<tr>
<td>Ireland</td>
<td>4</td>
<td>13%</td>
</tr>
<tr>
<td>Sweden</td>
<td>4</td>
<td>13%</td>
</tr>
<tr>
<td>Belgium</td>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td>Estonia</td>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td>Brasil</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Hungary</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Iceland</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Japan</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Mexico</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Poland</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Portugal</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Romania</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Country</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>Russia</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Turkey</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Netherlands</td>
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<td>23%</td>
</tr>
<tr>
<td>United Kingdom</td>
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<tr>
<td>Switzerland</td>
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<td>6%</td>
</tr>
<tr>
<td>Czech Republic</td>
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<tr>
<td>European Union</td>
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</tr>
<tr>
<td>Luxemburg</td>
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<td>3%</td>
</tr>
<tr>
<td>United States</td>
<td>1</td>
<td>3%</td>
</tr>
</tbody>
</table>

In the mapping of the geographical coverage of the case it was possible to select more than one country, so percentages add up to more than 100%.
1. “P4WELL” (PERVASIVE PERSONAL AND PSYCHOPHYSIOLOGICAL MANAGEMENT OF WELLNESS)

Geographical focus

<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>Finalised Pilot project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start year:</td>
<td>Not defined</td>
</tr>
<tr>
<td>End year:</td>
<td>Not defined</td>
</tr>
</tbody>
</table>

Summary

Chronic health problems related to mental wellbeing are rapidly growing, calling for novel solutions focusing on individual as a psychophysiological being. We describe a novel technology-based concept for empowering citizen towards holistic self-management of her wellbeing: “P4Well” (Pervasive Personal and PsychoPhysiological management of WELLness). The primary focus of the concept is on management of stress and recovery from stress caused by daily life through improved health management strategies. The P4Well concept combines modern psychological methods with personal health technologies. The technologies include a web-portal and web-based tools, mobile phone with mobile client applications, wearable health monitoring devices, and different analysis methods based on physiological models for interpretation and feedback. The concept supports secured private expert consultation and peer support through social media.

Purpose and application areas

Prevention, Treatment, Empowerment

Chronic diseases

we propose a technology-based concept to empower self-management of psychophysiological wellbeing through management of stress and recovery from stress. The proposed P4Well concept integrates several personal health technologies, including web-based tools and software, wearable monitoring devices, mobile phone with special software, and various analysis methods to interpret the gathered and acquired data and to provide feedback. These technologies are used along with modern psychological mini-intervention methods, such as CCBT, to help people manage stress, sleep and mental problems by encouraging them to adopt a healthier and more active lifestyle. The focus of the concept is on early prevention or intervention on mental and health problems. The concept is based on self-management with potential expert consultation through the Internet with a low barrier for seeking information and possible treatment. The devices, software, and psychophysiological theories and methods are integrated into a web portal providing a novel, coherent, and interactive Personal Health System (PHS).

Content focus: stress, recovery from stress, and mental wellbeing (including signs of mild to moderate depression).

Methods: the intervention and management methods include stress management and recovery strategies, physical activity, exercising, sleep, and psychological methods.

· Driving principle: the concept was defined so that an individual is seen as the best master of his/her own wellness. We propose a
A technology-based concept to empower self-management of psychophysiological wellbeing through management of stress and recovery from stress. The proposed P4Well concept integrates several personal health technologies, including web-based tools and software, wearable monitoring devices, mobile phone with special software, and various analysis methods to interpret the gathered and acquired data and to provide feedback. These technologies are used along with modern psychological mini-intervention methods, such as CCBT, to help people manage stress, sleep and mental problems by encouraging them to adopt a healthier and more active lifestyle. The focus of the concept is on early prevention of or intervention on mental and health problems. The concept is based on self-management with potential expert consultation through the Internet with a low barrier for seeking information and possible treatment. The devices, software, and psychophysiological theories and methods are integrated into a web portal providing a novel, coherent, and interactive Personal Health System (PHS).

**Business model**

In a scenario the P4WELL is placed as part of an occupational health package. Potential business models and value networks of different stakeholders of the concept were analyzed during the development work. In the long run, a well-designed business model would be vital for commercialization of the P4Well concept (which is currently in research phase). There are several questions related to the business model to be solved: (1) who is the customer of the concept, (2) who pays and to whom, (3) who provides the service, (4) which kinds of relationships exist between the different actors participating in the service orchestration, (5) who are the beneficiaries, and (6) how does the money and value flow between the stakeholders. These challenges of complex earning logic, complex dependability on several stakeholders, and immature market, probably are slowing the successful introduction of the integrated PHS solutions to the market.

**Stakeholders**

Target group: citizen between the ages 30-50 years. The concept should be suitable especially for small company employees/employers (company size less than 10 employees) and for entrepreneurs due to general lack of cost-efficient service access at present.

Nokia Corp., Mawell Ltd., Firstbeat Technologies Ltd., Vivago Ltd., Suunto Ltd., Firstbeat Technologies Ltd., TEKES

**Scale consideration**

**Impacts and factors of success and failure**

The P4Well concept consists of different technologies and psychological approaches. These distinct parts have been tested in clinical practice or verified scientifically. The CBT-based psychological components used in the concept have been also evaluated in clinical studies/practice. The service concept as a whole was evaluated and co-designed with potential users in several user sessions between June and
November 2008. These evaluations suggested that there would be a well-grounded need for this kind of service concept in Finland. The co-design of the concept continues through the P4Well project over the years 2008 and 2009. Currently, an actual user study with 12 middle-aged men is under way. The preliminary results of this study indicate that the participants have started to use the provided technologies. Furthermore, the concept seems to be well-accepted by them. A group of 24 entrepreneurs will participate in the evaluation study of the concept starting in the spring 2009 as well. Expert evaluations suggested:

- positive towards the idea of web-based analysis methods
- makes remote consultation possible
- analyses are modifiable and comparable
- visualization of results and feedback
- however, commented that more complex analyses are hard to do even with therapist help
- saw little utility for people not familiar with the methods
- analysis of values easier to understand than social atom
- emphasized the need for more instructions and guidance.

The feasibility of P4WELL intervention was also assessed in the case of men with stress and mood problems. Results confirm the feasibility of the intervention and suggest that it had positive effects on psychological symptoms, self-rated health, and self-rated working ability. The intervention seemed to have a positive impact on certain aspects of burnout and job strain, such as cynicism and over-commitment.

Several ethical and juridical issues are dependent on whether the service is considered as a wellness service or health service. Currently, the P4Well service concept is considered as a wellness service, but this may depend eventually on the potential service provider and related business model. The content and its management must be designed carefully in the concept. The brand and promise that the service gives were considered as central issues; these must be valid and ethical. Besides, the information and data provided by the user for the service are always handled as they were with user identification, and cannot be accessed outside without the user’s permission.

Further information

- http://www.researchprotocols.org/2013/1/e1/
- http://www.vtt.fi/service/ict3_behaviour_change_management.jsp?lang=en

Contacts

Case contact: Antti P. Happonen, Elina Mattila, antti.happonen@vtt.fi;
PHS Foresight contact: effie.amanatidou@gmail.com
2. BIOTRONIK HOME MONITORING

Geographical focus
Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Luxemburg, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, European Union, Brasil, China, India, Japan, Mexico, Russia, United States

Maturity of the system and timing
On-going Mature established system
Start year: 2005 or before
End year: Not defined

Summary
Biotronik Home Monitoring is an internet-based, automatic remote monitoring system for implantable cardiac rhythm management devices (pacemakers, implantable cardioverter defibrillators, etc.) that uses the cellular phone network to enable physicians to remotely monitor their patients' clinical status and their device status no matter where they happen to be.

Purpose and application areas
Emergency, Prevention, Treatment
Chronic deseases
During standard care of implants for cardiac rhythm management, follow-ups for checking the implant's status are necessary in regular intervals. Biotronik Home Monitoring is intended to reduce the number of in-clinic follow-ups by automatically sending information concerning the status of the implant to a backend system, where they are analysed and presented to the physician in a concise way. During standard care of implants for cardiac rhythm management, follow-ups for checking the implant's status are necessary in regular intervals. Biotronik Home Monitoring is intended to reduce the number of in-clinic follow-ups by automatically sending information concerning the status of the implant to a backend system, where they are analysed and presented to the physician in a concise way.

Business model
Stakeholders
Patients themselves are involved only.
Medial professionals (cardiologists, cardiac surgeons)

Scale considerations
100 001 to 500 000 users
budget

Impacts and factors of success and failure
Home monitoring proved to be beneficial for several indications, especially in case of implantable cardioverter defibrillators.

Further information
http://circep.ahajournals.org/content/3/5/428.full.pdf+html?sid=82159965-fe65-4d98-8bad-b6a89c51dab8
http://circ.ahajournals.org/cgi/content/abstract/122/4/325?maxtoshow=&hits=10&RESULTFORMAT=&fulltext=varma&searchid=1&FIRSTINDEX=

Contacts
Case contact:
PHS Foresight contact: dieter.hayn@ait.ac.at
### 3. BOSTON SCIENTIFIC LATITUDE

#### Geographical focus

**Maturity of the system and timing**
- On-going Mature established system
  - Start year: 2006
  - End year: Not defined

**Summary**
Boston Scientific Latitude is an internet-based, automatic remote monitoring system for implantable cardiac rhythm management devices (pacemakers, implantable cardioverter defibrillators, etc.) that enables physicians to remotely monitor their patients' clinical status and their device status and additionally supports data from body weight scales and blood pressure meters.

**Purpose and application areas**
- *Emergency, Prevention, Treatment*
- *Chronic diseases*
  - During standard care of implants for cardiac rhythm management, follow-ups for checking the implant’s status are necessary in regular intervals. Remote Monitoring is intended to reduce the number of in-clinic follow-ups by automatically sending information concerning the status of the implant to a backend system, where they are analysed and presented to the physician in a concise way. Additionally, due to its interfaces to blood pressure meters and body weight scales, the status of heart failure patients can be monitored.

#### Business model

**Stakeholders**
- Patients themselves are involved only.
- Medial professionals (cardiologists, cardiac surgeons)

**Scale considerations**

**Impacts and factors of success and failure**
- *budget*
  - Remote monitoring proved to be beneficial for several indications, especially in case of implantable cardioverter defibrillators.

#### Further information

**Contacts**
- Case contact: ,
- PHS Foresight contact: dieter.hayn@ait.ac.at
### 4. CAALYX-MV COMPLETE AMBIENT ASSISTED LIVING, MARKET VALIDATION

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Spain, Italy, Netherlands</th>
</tr>
</thead>
</table>
| **Maturity of the system and timing** | On-going Pilot project  
Start year: 2011  
End year: 2014 Not defined |
| **Summary** | The already developed CAALYX-MV solution to be validated is composed by three main subsystems or components:  
The system will be tested and validated under real usability conditions arranged through 3 pilots in different EU countries (Spain, Italy and the Netherlands), and will obtain reliable assessment by gathering real end user’s feedback. The aim of the pilots is double:  
To assess the usability and acceptability of the CAALYX-MV system by a selected target population, operating under real live conditions (the target population is composed by several actors: elderly and/or ill persons over 65 years old, their family, the teleassistance operator, and their doctor).  
To assess the validity and reliability of the system for detecting health problems in the monitored person, avoiding false alarms and decreasing the number of admissions in the hospital, or visits to clinicians, etc.  
The pilots will be implemented during two separated periods of 6 months. Improvements and enhancements will be performed between pilots taking into account user’s feedback. The final solution will be validated in a last three-month evaluation. |
| **Purpose and application areas** | Prevention, Treatment, Empowerment  
Assisted living |
| **Business model** | Combined models |
| **Stakeholders** | |
| **Scale considerations** | Less than 5000 users  
From 2 million to 5 million euros budget  
Present project 3.91m Euros. BUT: this is a series of projects, there have been projects before. |
| **Impacts and factors of success and failure** | |
| **Further information** | |
| **Contacts** | Case contact: Mr. Luis López de Ayala Hidalgo, ayala@tid.es  
PHS Foresight contact: doris.schartinger@ait.ac.at |
5. CARDIOCONSULT SYSTEM

Geographical focus

<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>On-going Pilot project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start year: Not defined</td>
<td></td>
</tr>
<tr>
<td>End year: Not defined</td>
<td></td>
</tr>
</tbody>
</table>

Summary

ICT guided disease management system for patients with health failure. The disease management system functions together with telemedicine devices (weight scale, ECG, health monitor and blood pressure meter). Collected data is transferred automatically by the GPRS network in the disease management system CardioConsult. The system performs disease management in a fully automated manner using periodic interactive dialogs with the patients to obtain health state measurements from the patient to evaluate and assess the progress of the patients' disease, to review and adjust therapy to optimal levels and to give the patient medical advice for administering treatment. The health professional will be informed automatically by mobile phone (SMS) or email when the data of the measurements are out of range and indicate that medical care is necessary.

Purpose and application areas

Empowerment, disease management

Chronic diseases

COPD

Business model

Cavari, a commercial party is the supplier of CardioConsult.

Stakeholders

Health insurance companies play a vital role in the implementation of personal health systems, as they decide whether the systems are reimbursed.

Scale considerations

Budget

The economic effects that were taken into account mainly focus on the changes in use of health care resources (e.g. hospitalizations and use of primary and tertiary care) due to the application of CardioConsult. Furthermore, investments in equipment and use of staff are measured. Although formally analysing the business case is not part of the study, it does provide insight in how the business case could be. For example, if PHS enables discharging a patient a day earlier, 600-700 euro's are saved. Furthermore, hospitals are penalised when a patient comes back within 28 days after first treatment, since the first DTC still serves then and no additional funding is available. Lastly, telecare could decrease the time for finding the optimal medicine combination. Another interesting economic effect mentioned in the interviews is the re-orientation of task differentiation and specialisation between medical and paramedical personnel. As (relatively cheap) paramedical staff can work with PHS, medical staff can focus on other tasks for which medical specialism is necessary. Also the effects on mortality, physical and mental health, quality of life, behaviour outcomes and utilization of health services are included in the study. The innovation process is evaluated as very positive. The innovation has a great relative advantage that is compatible with the needs of care professionals and patients. Care professionals and patients participated in the
design of the innovation, and the innovation is not too complex for them to assimilate. The adoption process was relatively easy, as patients, care professionals were well aware of the innovation and carefully educated. The innovation is seen as sustainable. Opinion leaders are important and champions within the organization were identified. The influence of adopters outside the organization was not considered and formal dissemination did not take place. The organizational context for innovation was positive, meaning that the organization facilitated the innovation and that ICT is seen as a means for to tackle the challenges of health systems. Survey results also show that the organizational structure in terms of decision processes was a stimulating factor for the innovation. Both top and middle management were involved in the innovation process. Intra- and interorganizational networks facilitated the implementation process. Political directives pushed the innovation process. Funding is seen as very relevant for the implementation.

An important factor in the acceptance is the involvement of care professionals (and patients) in the design process of an eHealth innovation. The care sector was often described as a conservative sector. From a patients’ perspective, user-friendliness is vital for the acceptance. Interoperability is seen as a major challenge. A positive attitude of care professionals is also seen as vital.

**Further information**

**Contacts**

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6. CLEAR - CLINICAL LEADING ENVIRONMENT FOR THE ASSESSMENT AND VALIDATION OF REHABILITATION PROTOCOLS IN HOME CARE

**Geographical focus**
Italy, Spain, Poland, Netherlands

**Maturity of the system and timing**
Finalised
Start year: 2008
End year: 2011

**Summary**
The Project proposes the implementation of a Telerehabilitation service in four Member States of the European Union (IT, ES, NL, PL). The ambition is to convert the project, after its completion, to a European platform for Telerehabilitation, and to contribute to the harmonization of e-health services in the EU.

CLEAR is a fundamental step in helping doctors treating patients who seek health treatment in a comfortable environment, including home, under supervision of a specialized team.

It intends to set up an innovative e-Health service based on the development of protocols for rehabilitation and chronic disease management therapies, which can be implemented at home following well defined procedures under the control of the medical staff. Such a service has huge potential to:

a) improve the quality of life of patients (reduced need to go to healthcare centres);

b) improve the effectiveness and use of resources of healthcare centres (increasing the ability to treat more patients at the same time).

This service will lead the healthcare professionals to a significant reduction of time spent per patient and, as a consequence, to a potential savings in money.

The project, based on technological mature applications developed mainly within the “H-CAD” (IST-5th FP) and eTen “HelloDoc” projects, will enhance the deployment of eHealth services and optimize healthcare resources through a European platform for the development of “home treatment protocols”.

Such platform provides health professionals with different tools as a support for the doctors to:

- Define and Assign tele-rehabilitation treatments to the patients.
- Assess the treatments executed by the patients and monitor their status.
- Monitor the patients compliance.
- Communicate with the patients.

The different set of rehabilitation exercises will be designed for common pathologies affecting elders (musculo-skeletal, neurological, chronic pain and pneumonic diseases).

These exercise sets and proactive self care, tailored to the home environment, will allow people to maintain their abilities for a longer period of time. The service is focussed on the “HABILIS” interoperable software platform integrating advanced information management and synchronous and asynchronous communication facilities. Patients perform the therapies at home, execute the specific exercises that are recorded, encrypted and sent to the professionals doctors’ team.

The analysis software, purposely conceived to decrease the necessary time to analyse the data, allows doctors to assess the exercises and update the therapy remotely.
| Purpose and application areas | Treatment  
| Business model | Assisted living |
| Stakeholders |  |
| Scale considerations | From 5 to 10 million euros budget |
| Impacts and factors of success and failure |  |
| Further information |  |
| Contacts | Case contact: ,  
PHS Foresight contact: doris.schartinger@ait.ac.at |
## 7. COMMONWELL-IMPROVED QUALITY OF LIFE FOR OLDER PEOPLE

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Spain, Germany, UK, Netherlands</th>
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<tbody>
<tr>
<td>Maturity of the system and timing</td>
<td>Finalised Pilot project</td>
</tr>
<tr>
<td>Start year:</td>
<td>2008</td>
</tr>
<tr>
<td>End year:</td>
<td>2012 Not defined</td>
</tr>
<tr>
<td>Summary</td>
<td>CommonWell services for integrated eCare were developed and piloted at four sites in Europe: in England, Germany, Holland and Spain. At each site, an integrated service with a distinct profile was implemented, showing how flexible integration can serve different needs and target groups within the population 65+.</td>
</tr>
<tr>
<td>Purpose and application areas</td>
<td>Emergency, Prevention, Treatment, Empowerment, Chronic diseases, Assisted living</td>
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<tr>
<td>Business model</td>
<td>Combined models</td>
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<tr>
<td>Stakeholders</td>
<td></td>
</tr>
<tr>
<td>Scale considerations</td>
<td>Less than 5000 users budget</td>
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<tr>
<td>Impacts and factors of success and failure</td>
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<tr>
<td>Further information</td>
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<tr>
<td>Contacts</td>
<td>Case contact: empirica Gesellschaft für Kommunikations- und Technologieforschung mbH, <a href="mailto:commonwell@empirica.com">commonwell@empirica.com</a></td>
</tr>
<tr>
<td></td>
<td>PHS Foresight contact: <a href="mailto:doris.schartinger@ait.ac.at">doris.schartinger@ait.ac.at</a></td>
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</table>
8. COPDDOTCOM SYSTEM

Geographical focus: Netherlands

<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>Finalised Pilot project</th>
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<tr>
<td>Start year: Not defined</td>
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<td>End year: Not defined</td>
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Summary

Remote monitoring, on daily activity patterns in patients with COPD. COPDDotCOM is part of the program ICT and Disease Management of ZonMW. It is aimed to deal with two issues in the treatment of COPD patients, i.e. the lack of insight in the daily activities and with that the lack of insight in the impact of physical training on the patient's health and wellbeing and the lack if inter-professional communication in chronic care settings. The objective of COPDDotCOM was to design, develop and demonstrate a prototype system for supporting disease management of COPD. This involves the increase of self-management of the patient by 1) self-treatment of exacerbations and 2) coaching in daily life to improve activity behaviour. In order to improve communication in COPD disease management, this and other relevant medical data is shared between the involved care professionals and the patient.

All end-users have been involved from the onset of the design process, as well as during the evaluation of design choices. Following the functional requirements, the disease management system was developed consisting of:

- Body Area Network (BAN) for the patient, for monitoring activity levels and feedback to the patient for changing activity behaviour
- Communication infrastructure that enables data gathering and secure transport: the RRD database (R2D2)
- Web portal for the patient, which is able to organize and present the activity data to the patient, and in addition, is used for a triage diary for self-management of exacerbations
- Web portal for the healthcare professional, which allows monitoring of the health status and adequate coaching of the patient by the professional.

Following several evaluations and iterations, the final prototype disease management system was evaluated in a randomised controlled trial (31 COPD patients). Our results indicate that by using the COPDDotCOM system you can increase activity levels and balance activity patterns over the day.

Purpose and application areas

Empowerment

Chronic diseases

Quantitative monitoring of the daily activity patterns and physical condition of the patient is an essential part of COPDDotCOM. The patient wears a sensor and a PDA, that measures his daily activity levels and compares it to the optimal activity level. Additionally, through a web based portal, the patient answers questions about his current condition, allowing for remotely supervised training and monitoring of the disease status. Quantitative monitoring of the daily activity patterns and physical condition of the patient is an essential part of COPDDotCOM. The patient wears a sensor and a PDA, that measures his daily activity levels and compares it to the optimal activity level. Additionally, through a web based portal, the patient answers questions about his current condition, allowing for remotely supervised training and monitoring of the disease status.

Business model
In Twente hospital COPDdotCOM is developed by a research institute (RRD).

Health insurance companies play a vital role in the implementation of personal health systems, as they decide whether the systems are reimbursed.

**Scale considerations**

For the COPDdotCOM study, the effects on mortality, physical and mental health, quality of life and behavioural outcomes are studied. The utilization of health services will be studied in detail in the follow-up study. The patients fill out the COPD questionnaire of health related quality of life, and the number of (re)hospitalisations and emergency department, primary clinic and specialist visits are registered. For COPDdotCOM the innovation itself is perceived as very positive: it fits with the context, and is not too complex. Care professionals as well as patients were involved in the design.

However, the innovation is not yet fully embedded in the work routines of the professionals. The adoption process is evaluated quite positively, with strong support for patients and care professionals, but a relatively low awareness of the intended adopters (patients) concerning the innovation’s existence and its advantages for the patients. The innovation is seen as very sustainable and the organization is aware of the innovation. Communication among the actors involved in the adoption of the innovation is considered important, though opinion leaders are not strongly influenced. It should be noted that the system antecedents for innovation are not evaluated very positive: the organizational structure is not facilitating the innovation process and the organization is not very change oriented. ICT is seen as a means to tackle challenges of health systems, but the innovation clashes with the existing values, strategies and goals. For COPDdotCOM, the organizational structure related to decision processes and intraorganizational communication did not play an important role in the implementation of the innovation according to the interviewees. Nevertheless, both top and middle management were involved in the process. Political directives did push the innovation process (7 out of 10). Informal inter-organizational networks were included, but hardly facilitated the implementation (5 out of 10). Funding is seen as very relevant for the implementation.

An important factor in the acceptance is the involvement of care professionals (and patients) in the design process of an eHealth innovation. The care sector was often described as a conservative sector. From a patients’ perspective, user-friendliness is vital for the acceptance. Interoperability is seen as a major challenge. A positive attitude of care professionals is also seen as vital.

Further information: http://www.copddotcom.nl/

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PHS Foresight contact: effie.amanatidou@gmail.com
## 9. DIRAYA. HEALTH CARE INFORMATION AND MANAGEMENT INTEGRATED SYSTEM

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Spain</th>
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### Maturity of the system and timing

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<td>Start year: 2005 or before</td>
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<td>End year: Until further notice</td>
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### Summary

Diraya, meaning "knowledge" in Arabic, is the computing service used by the health system in the Andalusia region of southern Spain. It makes available each user's health information whenever and wherever they need it for treatment, and provides services which improve day-to-day life such as electronic prescriptions or booking appointments via Internet.

Diraya offers user access to the services and provisions of the Andalusian health system. It enables the flow of patients to be monitored in order to assure efficient coordination of all the actions required in the diagnosis and treatment of each process.

Diraya is the computer system that the Andalusian Public Health System uses as an information and care management support. The first aim of Diraya is to integrate all the information on each user, irrespective of the health professional or care area generating it, into a Single Health Record, so that it is available where and when it is needed for his/her care. Accordingly, the medical record model permits reference to and annotation of data on all devices and at all care levels: primary care, specialized care, emergency rooms and hospitalisation. The use of telecommunications permits access to a citizen's health record from anywhere within the Andalusian public health network. It is a case, therefore, of a single health record per citizen. The second aim of Diraya is to facilitate accessibility to all the services and provisions of the health system. It enables the flow of patients to be monitored in order to assure efficient coordination of all the actions required in the diagnosis and treatment of each process.

### Purpose and application areas

*Emergency, Prevention, Treatment, Empowerment*

*Chronic diseases, Life-style*

Diraya integrates all the information of each citizen, regardless of the professional or the healthcare area that generates it, in a single medical history, available wherever and whenever it may be needed for providing care. The medical history model makes it possible to consult and note data in all of the healthcare devices and levels: primary care, specialized care, emergencies and hospitalization. Thanks to this system, healthcare professionals that attend the same patient have access to the medical information from any healthcare center in the Andalusian region, as long as it is authorized by the user. The citizen healthcare card is the "key" that provides access to the single medical history. Diraya integrates all the information of each citizen, regardless of the professional or the healthcare area that generates it, in a single medical history, available wherever and whenever it may be needed for providing care. The medical history model makes it possible to consult and note data in all of the healthcare devices and levels: primary care, specialized care, emergencies and hospitalization. Thanks to this system, healthcare professionals that attend the same patient have access to the medical information from any healthcare center in the Andalusian region, as long as it is authorized by the user. The citizen
healthcare card is the "key" that provides access to the single medical history.

### Business model

**Public sector**

The system is part of the public service offering facilitating the access to the patient information.

### Stakeholders

The system has the coverage for 7,687,399 citizens (95% of the population) of Andalusia.

All 8 million citizens of Andalucia, patients and carers, including family carers, neighbours and friends have a stake in Diraya. They are all either currently patients or potential patients. Diraya has registrations for about 99% of Andaluca’s residents. Tourists are also stakeholders. When their details are entered in Diraya, they have an EHR and may benefit from Diraya’s functionalities. One group of patients reveals an important impact of sharing data through Diraya:

*Andalucians that change their regular residence within the region for various reasons. They may have several permanent places of residence; they may need constant care and move between members of their widespread extended family who look after them on a rota; they may have to change their residence according to their carers’ or partners’ domicile. There is a culture in Andalucia, especially in the summer time, which involves many citizens changing their residents for several weeks or months. This includes patients who need constant care.*

With regard to the increasing number of carers of patients with a high care dependency level, currently accounting for about 20% to 25%, interoperability is of special importance.

Launched in 2000, the system today is used by nearly 1,500 health centres, 29 hospitals and 102,000 healthcare professionals (94%). Over 140 million prescriptions have been produced. Between January and September 2011, 18 million appointments were booked using telecommunication methods (telephone, Internet, SMS) with general practitioners (40.5%).

All healthcare professionals authorised as Diraya users are custodians of its stored information. This stakeholder group includes all doctors and nurses in PHCs, doctors and nurses in hospital specialised and emergency care services, help desk staff and pharmacists.

They have to rely on the information to guarantee the best possible healthcare. They also have to guarantee that the information they add is relevant, comprehensive and correct, will be secure and not misused.

Multi-disciplinary healthcare teams share information that supports integrated working compared to isolated healthcare professionals. These team members are essential in achieving many of the changes needed to realise the benefits from Diraya. Consequently, they have a dual role as stakeholders, one as healthcare professionals, and one as innovators in healthcare delivery. This stakeholder group is not considered as employees of HPOs, but as individuals.

**Key suppliers are Indra and Fujitsu.**

Over 90% of the Andalucian citizens have public health insurance exclusively, only 2% have private health insurance and 7% complement their public health insurance with private policies. For example, private health insurance covers plastic and refractive surgery. Private health insurance companies' involvement in co-financing personal healthcare may reap different types of benefits from...
Diraya, such as avoided costs due to fraud prevention and improved risk management.

**Scale considerations**

- **More than 2 million users**
- **More than 25 million euros budget**

Diraya in figures:
- Implemented in 735 Primary Health centers and 27 Hospital Areas
- Coverage for 7,687,399 citizens (95% of the population).
- More than 200,000 emergency cases recorded in the system every month.
- More than 6 million prescriptions a month and 8 million e-prescriptions.
- More than 300 million appointments; more than 7 million appointments a month between primary and specialized health care via different channels: personal, telephone, internet and SMS.

Activity data confirm that Diraya is a widely used system. At December 2009, over seven and a half million users were covered by the Single Health Record system and almost 200 million prescriptions had been dispensed by the Receta XXI system. Every month the system assigns around 7 million Primary Care and 1 million Specialized Care appointments. As for clinical use, we should mention that every month more than 3 million primary care visit forms, over 200,000 emergency episodes and more than 70,000 specialist consultation episodes are recorded. Activity has gone on increasing continually with the inclusion of new centres in the system, although that is not the only reason: a considerable part of the increase in activity is due to the fact that health professionals make more and more use of the system.

**Impacts and factors of success and failure**

Socio-economic benefits from this system were evaluated in 2008 under the European EHR-IMPACT project.

The study points to the most significant benefits as being a reduction in GP visits of over 15% which generates reductions in costs and transport times for patients, savings of €253.3 million through the prescription of generic medication through e-prescriptions, and a significant reduction in prescription errors.

The success of the Diraya programme in an economically hard-hit region is proof that e-health can help maintain an efficient public health system for less cost. Closely followed by all the European countries, it is a model for developing e-health available to all.

The most relevant direct economic benefit has been the improvement in clinical time achieved by reducing the administrative (writing) time allocated by doctors to paper-based administrative procedures. This improvement can be estimated to be between 20 and 50% of total administrative workload of primary healthcare doctors (5 to 15% of total time allocated to consultation work), or to 200 to 500 full-time equivalent doctors per year. During the period September 2001-December 2002, there were estimated savings of €11.6 million in pharmaceutical prescriptions related to the use of the electronic prescriptions module of EHCR. These savings are based on the incremental use of generic prescriptions.

Net benefit over time is the critical measure of the overall socio-economic impact of eHealth systems. It identifies when and by how much, benefits exceed costs over time. Two important features of the net benefit estimates need emphasising. First, the net economic benefit is a monetary measure of the net value of all positive and negative impacts, not a measure of financial returns. A brief analysis of the financial impact follows in the distribution of costs and benefits into different categories, including financial, in section 3.8 below. Second, the measure of net benefits lies in the overall position and performance,
not in the absolute values presented.

The socio-economic evaluation, based on cost benefit analysis, shows that a significant net benefit is achieved from year eight onwards, the third year after implementation of Diraya with a mixed architecture and one year after the implementation of the centralised version.

Annual net benefits grow rapidly until 2008, and then exhibit a more modest growth curve, displaying the combined benefits of the different modules and their gradual implementation. The comparatively long period until realisation of annual net benefits reflects the implementation’s preceding planning and development time. The positive cumulative net socio-economic benefit occurs in 2007. Similar to the annual net benefits, once the cumulative benefits turn positive, they grow steadily with an increasing margin, confirming Diraya’s long-term economic sustainability. The annual net benefit to cost ratio is the relationship of the net socio-economic impact to the costs. It turns positive to +0.4 in 2006, eight years after the start of the investment. It rises to +9.6 in 2010, year twelve. The cumulative ratio increases steadily from 2004, year six of the evaluation period and turns positive in 2007. By 2010, the cumulative net benefit to cost ratio reaches +1.77, meaning that for every 100 EUR in costs, there are 277 EUR worth of socio-economic benefits. The financial analysis shows an investment of extra finance of some 169 million EUR in the seven-year period from 2004, 61% of all costs. It realises cash of some 135 million EUR, 18% of the overall benefits and around 636 million EUR of non-financial benefits and redeployed sources.

All stakeholder groups receive positive cumulative net benefits: HPOs receive 136 million EUR, citizens, patients and carers reap about 218 million EUR, health professionals as individuals 110 million EUR and third parties 29 million EUR.

In primary care, the system contributed to users’ acceptance of Diraya because they built on the previous experience of a clinical information system. Healthcare professionals appreciated the system as it worked quickly and smoothly. Some healthcare professionals initially regarded Diraya as impeding their daily routine rather than enhancing their clinical and working practices. In contrast to the present system, Diraya was initially slow, with several downtimes, slowing acceptance and utilisation.

Solving the technical problems improved Diraya’s efficiency, and healthcare professionals began to recognise the benefits they could reap and the potential to enhance the quality of clinical outcomes. Now, many healthcare professionals recognise that working without Diraya is unimaginable. Healthcare professionals’ suggestions for improvements to optimise its functionalities proves a sophisticated understanding of health informatics and ICT possibilities, indicating the high level of healthcare professionals’ acceptance of, and response to, working with Diraya. For example, nurses and pharmacists are pressing for extensions to their access and user rights so they can benefit more from Diraya’s full potential as they recognise that the system can improve their overall performance and professionalism.

Other perspectives are that Diraya is too complex, already has too many functions and needs too many clicks for some transactions. In response, the SAS team has a long schedule of constructive developments to respond to some of these requirements, and to continue to enhance.

Further information

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Address: Seville, Spain
10. DREAMING: ELDERLY FRIENDLY ALERT HANDLING AND MONITORING

Geographical focus: Denmark, Estonia, Germany, Italy, Spain, Sweden

Summary:
The main aim of DREAMING project is keeping elderly people in their home environment as long as their physical and mental conditions allow this. However, this goal cannot be achieved with technology only. So, the participating Social and Health Authorities will keep providing and enhance their offering of non-technology based services which are essential for supporting the autonomy of elderly people (e.g. visits by community nurses and social workers, psychological support, delivery of hot meals and shopping, special transportations for people with limited mobility, house cleaning, etc.).

Taking this into account, the core objectives of DREAMING are:

1. Enabling elderly people to continue to live in their home, without compromising with their level of safety, as long as they wish or until their physical and mental conditions make mandatory a transfer to an elderly or nursing home.

2. Providing elderly people with the a simple though effective way of staying in touch with their loved ones even when they are physically away.

3. Increasing the appropriateness and the timeliness of interventions by health and social care professionals including emergency services. This translates not only into a better use of the limited resources available but also into reduced intrusion in elderly people’s private life.

4. Containment of health and social care expenditure. Ongoing experiences have demonstrated that monitoring technology, even when much more basic than that deployed by DREAMING, can delay by up to 18 months in average the moment an elderly person has to be moved to a specialises institution. This translates into substantial savings for the Social Authorities. There is also a reach literature supporting the claim that chronic patients’ management in home settings can reduce the costs of healthcare but experiences in this field. CommonWell services for integrated eCare were developed and piloted at four sites in Europe: in England, Germany, Holland and Spain. At each site, an integrated service with a distinct profile was implemented, showing how flexible integration can serve different needs an

<table>
<thead>
<tr>
<th>Purpose and application areas</th>
<th>Emergency, Prevention, Treatment, Empowerment, Chronic diseases, Assisted living</th>
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<tbody>
<tr>
<td>Business model</td>
<td>Public sector</td>
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<tr>
<td>Stakeholders</td>
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<tr>
<td>Scale</td>
<td>Less than 5000 users</td>
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<td>considerations</td>
<td>budget</td>
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<tr>
<td>Impacts and factors of success and failure</td>
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<td>Further information</td>
<td></td>
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</tbody>
</table>
| Contacts | Case contact: Barbara Dodi, barbara.dodi@tesantelevita.it  
PHS Foresight contact: doris.schartinger@ait.ac.at |
### 11. E-NEFRO: ARQUITECTURA MODULAR ADAPTABLE PARA LA TELEASISTENCIA INTEGRAL DE PACIENTE RENALES" (MODULAR CUSTOMISABLE ARCHITECTURE FOR COMPLETE KIDNEY)

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Spain</th>
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| Maturity of the system and timing | On-going Pilot project  
Start year: 2012  
End year: 2015 and beyond |
| Summary | The research project is named 'e-Nefro - Arquitectura modular adaptable para la teleasistencia integral de paciente renales' (Modular customisable architecture for complete kidney patient telecare', in English). The research partners will study the implementation of a telemedicine system for the monitoring of pre-dialysis patients or patients under substitutive treatment (peritoneal dialysis), with the aim of improving their quality of life and healthcare. The partners consist of the University Hospital Virgen Macarena of Seville (Spain) and the Superior Engineering School of Seville University jointly (The researchers will also receive support from three other hospitals, namely: Hospital del Sureste (Madrid), the University Hospital Nuestra Señora de Candelaria in Tenerife and the Hospital of Gran Canaria (Canary Islands). The project is funded by the Health Institute Carlos III, a public research institute attached to the Spanish Ministry of Economy and Competitiveness, and it will run for three years. |
| Purpose and application areas | Treatment, Prevention  
Chronic diseases, Assisted living, Life-style  
Nephrologists believe that in the current scientific and technological context, home telemonitoring of chronic kidney disease patients in the pre-dialysis phase or under substitutive treatment (peritoneal dialysis) will improve both their health follow-up and quality of life. They expect that patients will thereby gain a better sense of security and support, and that the cost-efficiency of care will be enhanced. For their part, engineers consider that the current state of development of ICT as well as that of sensing devices make it possible to study new devices for patients with special needs, in particular pre-dialysis or peritoneal dialysis patients. At the present stage, the project is in a phase where all management and coordination activities for the project tasks are being developed; during the next phase the partners will analyse the various system needs and develop the methodology. The modular architecture will then be implemented, and the effectiveness of the system assessed. |
<table>
<thead>
<tr>
<th>Business model</th>
<th>Public sector</th>
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<tbody>
<tr>
<td>Stakeholders</td>
<td>Nepfrology affected Patients are the targeted patient group of this service. Doctors and people from observatory prospective. The University Hospital Virgen Macarena of Seville (Spain) and the Superior Engineering School of Seville University jointly (The researchers will also receive support from three other hospitals, namely: Hospital del Sureste (Madrid), the University Hospital Nuestra Señora de Candelaria in Tenerife and the Hospital of Gran Canaria (Canary Islands).</td>
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<td>Scale considerations</td>
<td>More than 2 million users From 500 000 to 2 million euros budget</td>
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<td>Contacts</td>
<td>Case contact: José Antonio Milán Martín, <a href="mailto:webmaster@hospitalmacarena.org">webmaster@hospitalmacarena.org</a> PHS Foresight contact: <a href="mailto:laura.pombo@impetusolutions.com">laura.pombo@impetusolutions.com</a></td>
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### 12. ECARE NETWORK IN BOLOGNA

<table>
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| **Maturity of the system and timing** | Finalised Mature established system  
Start year: 2005 or before  
End year: 2007 |
| **Summary** | eCare is a network for tele-assistance, company and support for elderly people with chronic conditions. The project is aimed at enabling citizen empowerment, prevention, social and health service integration, de-hospitalization and home care, as well as personalization of care. The project eCare covers the territory of 50 councils within Bologna district (without the 10 councils of Imola districts that have not adhered). The service is delivered through a specialized call centre. The call centre is provided by CUP 2000: an in-house company owned by the regional government, the municipality of Bologna, the province (district) of Bologna, and by most of Emilia Romagna’s ASLs and AOs.  
The integration of different domains such as healthcare and social service is the real added value of the service, each user report is truly multidisciplinary and it is created by physicians, nurses and social workers. eCare is a "community health service" in the truer sense of the word. Both clinical and social indicators are taken into consideration. |
| **Purpose and application areas** | Prevention, Empowerment  
Chronic diseases, Assisted living  
eCare network Bologna offers a different set of health services  
- Call center 24/7 (inbound and outbound calls): 128,000 calls in 2010  
- The health-social record  
- Connection to the first aid  
- Connection to GPs  
- Monitoring of fragile conditions  
- eBooking for healthcare services  
Besides healthcare specifics services, through a partnership with local NGOs and the collaboration of municipalities, the eCare network offers services like transportation, shopping home delivery, recreation, access to a network of professionals offering services at agreed prices or advisory services for accessing welfare initiatives.  
The service is available 24/7, users are free to call the call centre whenever they need however when activating the service it is made clear that this is not an emergency service.eCare network Bologna offers a different set of health services  
- Call center 24/7 (inbound and outbound calls): 128,000 calls in 2010  
- The health-social record  
- Connection to the first aid  
- Connection to GPs  
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The service is available 24/7, users are free to call the call centre whenever they need however when activating the service it is made clear that this is not an emergency service. |
emergency service.

**Business model**

*Public sector*

The total budget for 2011 is €800,000. CUP 2000 has calculated that the cost per user, after having passed the 3,000 users threshold, is around €1 per patient per day. These estimates include all costs (capital allowances, volunteers’ reimbursements, wages etc, phone costs etc).

**Stakeholders**

Citizens (patients) enrolled are over 75 years old, present at least a fragility factor (such as chronic diseases), they have been hospitalized in the last 6 months and are not in a position to rely on strong social and family relationship networks.

- the AUSL Bologna (that provides epidemiological service with the list of patients by disease), its GPs (even if so far they have not been really active contributors) and nurses,
- Social services workers and councils/municipalities
- Non-profit organizations.

CUP 2000 is a captive company owned by local authorities and hence not obliged to comply with all the complex public authorities regulations has given the eCare project the flexibility needed to evolve rapidly.

CUP 2000 has two dedicated people in charge of the relationship with non-profit organizations. Altogether CUP 2000 has allocated a staff of 14 people to the project:

- 14 call centre operators trained for this specific service
- 1 reference manager
- 2 people responsible for the relationship with non-profit associations
- 1 person in charge of the relationship with municipalities and social services.

The regional government, the municipality of Bologna, the province (district) of Bologna, and by most of Emilia Romagna’s ASLs and AOs.

**Scale considerations**

*Less than 5000 users*

*budget*

The total budget for 2011 is €800,000. CUP 2000 has calculated that the cost per user, after having passed the 3,000 users threshold, is around €1 per patient per day.

**Impacts and factors of success and failure**

Between 2007 and 2010 the number of citizens included grew from 800 to 3,327. In 2010 the percentage of users with higher fragility condition grew from 8% to 44%. The overall penetration of the service in the addressable population is 19%. This increased appropriateness is the result of the continuous redefinition of the service. CUP 2000 has commissioned a survey to understand customer and stakeholders satisfaction.

It has emerged that:

- 90% of users are satisfied by the service, 90% have seen improvement to their health status following call center advice, and 70% feel safer.
- Social service workers have judged the service quite positively as it increases awareness on social service offering, the sense of loneliness is relieved and the service has increased the compliance to medical prescriptions.
- GPs were also positive about the service but to a lesser extent since only 21% perceived that the service has reduced misuse of their service.

An epidemiological research from AUSL Bologna indicates that the service has reduced hospitalization rates. Analyzing a sample of users and comparing it with a control sample results shows that in 2 years there were fewer hospitalizations (-100). Considering that average costs for inpatient care are...
€600 per day and that the average length of stay is 10 days, the service has helped save €600,000 in two years. From the study it has also emerged that 50% of users have reduced their access to the emergency service. Moreover, AUSL Bologna has confirmed that in several cases, the service has allowed an early intervention in cases that would have resulted in a serious exacerbation. This was possible given that through the monitoring it is possible to evaluate parameters that patients normally ignore.

Major project barriers were experienced especially during the first year of the service. This service was strongly supported by the regional government and Bologna district, while other stakeholders were initially prejudiced about the project. Municipalities/councils that are now experiencing cuts in social care are still quite suspicious or have difficulties in understanding the money spent on the project. Moreover the project includes different professionals, normally used to work in silos, and therefore the cooperation is often difficult. It is more than just an organization issue; it is a cultural process that had to be triggered. For this reason a key contribution was given by Walther Orsi of AUSL di Bologna (walther.orsi@ausl.bologna.it) who is an expert in sociology applied to healthcare service. His contribution made it possible to design processes and decision making flows and to better target awareness campaigns and trainings.

**Further information**

SIMPHS2 report on Italy

**Contacts**

Case contact: ,

PHS Foresight contact: doris.schartinger@ait.ac.at
### 13. FOSIBLE - FOSTERING SOCIAL INTERACTION FOR A BETTER LIFE OF THE ELDERLY.

<table>
<thead>
<tr>
<th>Geographical focus</th>
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<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>On-going Pilot project</th>
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<tbody>
<tr>
<td>Start year: 2010</td>
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<td>End year: 2013</td>
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<table>
<thead>
<tr>
<th>Summary</th>
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<tbody>
<tr>
<td>The project FoSIBLE aims at creating an easy and usable way for communication and interaction of elderly people over distances. It was established to support and relieve social interaction in the daily life of the elderly with regard to their individual living circumstances, needs and interests. This includes the promotion of existing local communities, as well as personal networks to allocate information about the neighborhood or facilitate participation of group meetings without being physically present. Furthermore, it sets out to offer channels for communication and social experiences with friends and relatives - or even strangers with similar interests or problems - through a console-based community platform.</td>
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<table>
<thead>
<tr>
<th>Purpose and application areas</th>
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</thead>
<tbody>
<tr>
<td>Empowerment</td>
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<tr>
<td>Assisted living</td>
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<tr>
<td>Communication and interaction of the elderly</td>
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<table>
<thead>
<tr>
<th>Business model</th>
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<tbody>
<tr>
<td>no information available</td>
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<table>
<thead>
<tr>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria - Austrian Institute of Technology</td>
</tr>
<tr>
<td>Germany - University of Siegen</td>
</tr>
<tr>
<td>Germany - Fraunhofer IMS</td>
</tr>
<tr>
<td>France - Université de Technologie de Troyes</td>
</tr>
<tr>
<td>France - Les Arcades – Centre de Prevention AGIRC-ARCCO</td>
</tr>
<tr>
<td>Germany - Mauser Einrichtungssysteme GmbH &amp; Co. KG</td>
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<tr>
<td>Germany - Kaasa solution GmbH</td>
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<tr>
<td>Austria - CURE – Center for Usability Research and Engineering</td>
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<tr>
<th>Scale considerations</th>
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<td>budget</td>
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<tr>
<th>Impacts and factors of success and failure</th>
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<tr>
<td>currently in status of research</td>
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<table>
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<tr>
<th>Further information</th>
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<tbody>
<tr>
<td><a href="http://fosible.eu/downloads/publications/">http://fosible.eu/downloads/publications/</a></td>
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<table>
<thead>
<tr>
<th>Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case contact: Mario Drobics, <a href="mailto:coordination@fosible.eu">coordination@fosible.eu</a></td>
</tr>
<tr>
<td>PHS Foresight contact: <a href="mailto:peter.kastner@ait.ac.at">peter.kastner@ait.ac.at</a></td>
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### 14. HEALTH BUDDY

**Geographical focus**

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<tr>
<th>Maturity of the system and timing</th>
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<td>End year:</td>
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**Summary**

A simple patient interface backed by powerful content-driven health coaching. The Health Buddy is a telemedicine device that provides the patients with a set of questions on a daily basis. The responses to the dialogues are sent through a protected server to the caretakers.

Patients' responses to the dialogues are transferred into risk profiles (low, medium or high) and ordered according to risk level. Consequently, care providers are able to quickly select high-risk patients and anticipate to their problem. The involved care providers consist of specialized heart failure nurse specialists, a nurse assistant and a supervising cardiologist.

How the Health Buddy System works

Every day, the Health Buddy System sends a new "session" to the Health Buddy device in the patient's home. Each session is composed of vital sign gathering, symptom review, standard assessment surveys (e.g., SF12, PHQ9), education and reinforcement of positive behavior. Through the use of branching logic, the patient is able to obtain feedback to a variety of questions and the healthcare provider is able to obtain additional context to help understand impending and existing changes in the patient's condition.

Once completed, the data from the daily session is sent to the Health Buddy System which then:
- Sends these data to the Desktop Application for review by the health provider with color coding based on pre-defined levels of risk to aid in early identification of patients that may require more urgent assessment and intervention
- Sends a new session to the patient for the next day

The Health Buddy device is able to gather vital sign data from a variety of peripheral devices, either through self-reporting or through wired or Bluetooth connectivity.

**Purpose and application areas**

- *Empowerment, disease management*
  - Chronic diseases
    - Cardiovascular
      - Chronic Heart Failure
      - Coronary Artery Disease
      - Hypertension (HTN)
    - Cerebrovascular/Neurological
      - Spinal Cord Injury
      - Traumatic Brain Injury (TBI)
  - Emotional/Mental Health
    - Bipolar Disorder
<table>
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<tr>
<th>Major Depressive Disorder</th>
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<td>Mental Health Co-morbid Programs Available</td>
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<td>Post-Traumatic Stress Disorder (PTSD)</td>
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<td>Schizophrenia</td>
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<tr>
<td>Endocrine/Metabolic</td>
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<td>Diabetes Mellitus</td>
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<td>Chronic Kidney Disease (CKD)</td>
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<td>Oncology</td>
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<td>Cancer</td>
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<td>Pulmonary</td>
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<td>Asthma - Adult</td>
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<td>Chronic Asthma - Pediatric</td>
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<td>Chronic Obstructive Pulmonary Disease (COPD)</td>
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<td>Other Programs</td>
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<td>Advanced Illness/Palliative Care</td>
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<td>Caregiver Dementia Program</td>
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<td>Chronic Pain</td>
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<td>Substance Abuse</td>
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<td>Co-Morbid</td>
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<td>CHF/COPD</td>
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<tr>
<td>Spinal Cord Injury</td>
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<tr>
<td>Traumatic Brain Injury (TBI)</td>
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</table>

**Business model**

Stakeholders

Sananet, a commercial party is the supplier of the HealthBuddy originally developed by Bosch gmbh.

Health insurance companies play a vital role in the implementation of personal health systems, as they decide whether the systems are reimbursed.

**Scale considerations**

**Impacts and factors of success and failure**

In Health Buddy, the focus is mainly on patient and societal aspects, and the system is not yet an organic part of the health care process in the NL. Testing the HealthBuddy similar aspects as for In Touch were taken into account (economic effects, investment in equipment, use of staff). Additionally, equipment and maintenance cost and time investment of patients and care professionals are included. For TEHAF (the clinical study that studied Health Buddy), the innovation is perceived as positive, holding great relative advantages and fitting quite well with the motivation and intellectual abilities of patients and health professionals. However, in terms of values, goals and specific skills, patients and health
professionals are not fully ready to use the innovation. Health professionals did participate in the design of the innovation, patients did not.

Concerning the adoption process, health professionals and patients were part of the adoption decision process, but did not play a large role. Similarly, the health professionals and patients were quite aware of the innovation and had sufficient information about the innovation and its effect. Support and training were offered to health professionals as well as patients. The innovation is seen as very sustainable, the organization is aware of it and evaluation is taking place. Extensive and planned communication to the heterogeneous stakeholders is taking place. Within the organization, innovation is facilitated, although the score for change orientation is just above average. ICT is seen as a major means to tackle challenges of health systems, and the innovation fits with existing organizational values. The organizational structure in terms of decision processes was a stimulating factor for the innovation. Both top and middle management are involved in the implementation and routinization. Funding and political directives are considered to be extremely important for the innovation process. Intra- and interorganizational networks facilitated the implementation process.

An important factor in the acceptance is the involvement of care professionals (and patients) in the design process of an eHealth innovation. The care sector was often described as a conservative sector. From a patients’ perspective, user-friendliness is vital for the acceptance. Interoperability is seen as a major challenge. A positive attitude of care professionals is also seen as vital.

Further information
Telemonitoring in patients with heart failure, the TEHAF study: Study protocol of an ongoing prospective randomised trial
Josiane J.J. Boyne a,*, Hubertus J.M. Vrijhoef b, R.de Wit c, Anton P.M. Gorgels a
a Maastricht University Medical Centre, Maastricht University, The Netherlands
b Maastricht University Medical Centre, Tilburg University, The Netherlands
c Maastricht University, The Netherlands

Contacts
Case contact: ,
PHS Foresight contact: effie.amanatidou@gmail.com

15. HOME SECURITY AND HOME COMFORT - LIMOUSIN (ESOPPE)
**Geographical focus**

France, Limousin region

**Maturity of the system and timing**

Finalised Pilot project
Start year: 2009
End year: 2010

**Summary**

The main purpose of the ESOPPE prospective study was to evaluate the efficacy of a simple home automation pack coupled to a teleassistance service for preventing falls at home among the frail elderly population losing autonomy. The second priority was to evaluate the service efficiency both in terms of reduced number of falls at home and associated admission to hospital emergency.

**Purpose and application areas**

Prevention, Empowerment
Assisted living, fall prevention

The project fits within a territorial strategy to help the elderly live safely and comfortably at home; it is also part of Legrand’s long term strategy and local service organizations’ strategy to deliver home automation coupled with patient care services.

The context for the service is loss of autonomy which is related at least partially to ageing, but also more generally to diseases (regardless of age).

The ESOPPE project is about providing a home automation system which helps to prevent elderly people falling especially when they get up during night, through automatic lighting devices adapted to home layout; and to control and monitor possible falls through fall captors with added-value telealarm environment (i.e. active captors).

It is important to note that the ESOPPE project is one element of the Limousin regional strategy, which has defined coherent strategies to validate and generalise service offering as follows:
- Home care automation targeting 3,200 installations in the Creuse Department by 2014
- Training and support for 30 electrician shops to install and maintain home care automation device
- Social care offering distributed by Intervox, a SME recently acquired by Legrand.

Home security devices include lighting devices, smoke detection, gas leak detection, water leak detection, home intrusion, temperature control failure. Historically, since the 1950s Legrand has been focusing on the home from a building perspective, while it is now moving its focus to the person, i.e. the inhabitant himself (herself) providing added value telealarm button control, and fall monitoring – the central device of the ESOPPE program.
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Business model

*Combined models, Private market, Public sector*

not available

Stakeholders

Elderly >65

Geriatrics expertise center,

Legrand (Industrial company),

Corrèze territorial administration,

Scale considerations

*Less than 5000 users*

budget

The project is taking place as part of a long term strategy originated at the Limousin regional level (territorial administration, University and R&D centres for geriatrics, LEGRAND, a major French industry player)

Impacts and factors of success and failure

Positiv:

Significant reduction of falls at home (comparison between intervention and control goup) p=0.0012

Industrial cooperation

long term strategy

Prospective cohort study with focus on fall

4.1 Social factors

Good cooperation of existing infrastructure

⇒ telealarm centre is monitored in a R&D environment (University hospital, Elropsys pole, Autonom’Lab geriatric expertise centre).

⇒ The medical community is involved through the Limoges University Hospital (Geriatrics department, Pr. Thierry DANTOINE)

4.2 Technological factors

high acceptance rate for home automation pack exisiting of

- fall control bracelets
- home automation lighting control
- cognitive behaviour analysis in case of calls from elderly people.
- WLAN home “box”

4.3 Economic factors
no information on costs

4.4 Environmental factors
not mentioned

4.5 Political factors
The ESOPPE project is part of a long term strategy sponsored by the Limousin regional authorities. For example, the 2006-2011 healthcare plan is handling a decision by which every person aged 75 and over is entitled to get telealarm and teleassistance at home.

4.6 Value-based factors
not mentioned

Further information
http://www.stopauxaccidentsquotidiens.fr/Domicile-des-seniors/Actualites/Esoppe-une-experience-correziennereussie-l-2104
pm.nih.gov/pubmed/22743136

Contacts
Case contact: Achille Edem Tchalla, achille.tchalla@unilim.fr
PHS Foresight contact: peter.kastner@ait.ac.at
### Geographical focus
- France

### Maturity of the system and timing
- **On-going Pilot project**
  - **Start year:** 2008
  - **End year:** Until further notice

### Summary
The Y-DOM offering aims to commercialize mobility devices based upon smartphones, to help monitor, manage and coordinate service staff coming to the home of elderly patient.

### Purpose and application areas
- **Service staff management**
- **Health care service staff management**
  - Exhaustive manuals and product environment documentation are provided, including CNIL registration file (Commission Nationale Informatique et Liberté - IT and freedom national committee).
  - Association staff: one-day training (5 people per session, maximum) on overall platform architecture and service procedures; on process to install NFC or 2D badge at the home of elderly people
  - Employees training: half-a-day training (10 people per session, maximum) on how to use the mobile phone and dedicated application for home registration; on mobile phone delivery;
  - Overall project engineering / project management: liaison and support to set up contracts with mobile telecommunication operator; training on how to access DORO/PRYLOS platform indicators and IT records;
  - Hot-line and support, accessible to employees, and maintenance.
  - Exhaustive manuals and product environment documentation are provided, including CNIL registration file (Commission Nationale Informatique et Liberté - IT and freedom national committee).
  - Association staff: one-day training (5 people per session, maximum) on overall platform architecture and service procedures; on process to install NFC or 2D badge at the home of elderly people
  - Employees training: half-a-day training (10 people per session, maximum) on how to use the mobile phone and dedicated application for home registration; on mobile phone delivery;
  - Overall project engineering / project management: liaison and support to set up contracts with mobile telecommunication operator; training on how to access DORO/PRYLOS platform indicators and IT records;
  - Hot-line and support, accessible to employees, and maintenance.

### Business model
- **Private market**
  - Monthly rental cost per mobile phone (i.e. per employee of the service association) is set between €15 to €20 (phone rental + DORO/PRYLOS platform service access + phone line).
  - A service employee works 80 hours per month for the association, on an...
average basis. Thus, Y-DOM service costs represents around €0.25 per hour. Some studies performed by PRYLOS show that productivity increase should lead to a better efficiency, larger than €0.25 per hour.

<table>
<thead>
<tr>
<th>Stakeholders</th>
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<tbody>
<tr>
<td>Home Care Service Organisations with mobile stuff</td>
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<tr>
<td>DORO/PRYLOS, a French start-up company created in 2003, dedicated to social resources coordination and management based upon android smartphone usage and ICT platform service. 2010 turnover: 1,2 M€ on the French market. In July 2011, PRYLOS has been acquired by DORO, a Swedish company created in 1973, specialised on phone systems adapted for elderly or handicapped people. 2010 turnover: 71 M€ - 75 employees by 3rd quarter 2011</td>
</tr>
<tr>
<td>Ministry of industry</td>
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<table>
<thead>
<tr>
<th>Scale considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5000 users</td>
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<tr>
<td>budget</td>
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<tr>
<td>Y-DOM is currently being commercialised. From a decentralisation point of view, the French government is helping to coordinate mutualisation projects between the Départements.</td>
</tr>
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<table>
<thead>
<tr>
<th>Impacts and factors of success and failure</th>
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<tbody>
<tr>
<td>not much found on the Internet</td>
</tr>
<tr>
<td>4.1 Social factors</td>
</tr>
<tr>
<td>approach focus more on stuff management / documentation support for home nurses, etc. patients are not addressed</td>
</tr>
<tr>
<td>4.2 Technological factors smartphone with NFC interface --&gt; very innovative</td>
</tr>
<tr>
<td>4.3 Economic factors</td>
</tr>
<tr>
<td>€15 to €20 (phone rental + DORO/PRYLOS platform service access + phone line) sounds resonable to be used compared to the time that ist needed for manual documentation, etc.</td>
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<tr>
<td>4.4 Environmental factors</td>
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<tr>
<td>not mentioned</td>
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<tr>
<td>4.5 Political factors</td>
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<tr>
<td>unclear because of missing recent information on the web</td>
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<td>4.6 Value-based factors</td>
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<tr>
<th>Further information</th>
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<tr>
<th>Contacts</th>
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<tbody>
<tr>
<td>Case contact: , PHS Foresight contact: <a href="mailto:peter.kastner@ait.ac.at">peter.kastner@ait.ac.at</a></td>
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</tbody>
</table>
17. HSH- HOME SWEET HOME

Geographical focus
Belgium, Spain, Ireland, Italy

Maturity of the system and timing
On-going Pilot project
Start year: 2010
End year: 2013

Summary
HOME SWEET HOME (HSH) will trial a new, economically sustainable home assistance service which extends elders independent living. HSH intends to achieve this by providing a comprehensive set of services which support elders in their daily activities and allows carers to remotely assess their ability to stay independent.

While systems of this kind inevitably represent an intrusion in the elders private life, HSH privileges features which can be used by the elders themselves and limits to a bare minimum the need for other people to interfere with their private life unless a clear need is detected by the system.

It comprises the following services:
- monitoring and alarm handling
- e-Inclusion
- domotic
- daily scheduler
- navigation
- mental faculty maintaining

The monitoring and alarm handling is based on a DSS which analysis in real time data collected from medical and environmental sensors, fall detectors and geopositioning systems. Standard behavioural patterns are established for individuals and sudden major changes triggers alarms.

e-Inclusion is achieved through intuitive videoconferencing based on the familiar TV paradigm and adapted to use by people unfamiliar with IT technology. Domotics and daily scheduler help elders to organise their daily activities and to manage the house in spite of growing physical and mental impairments.

The navigation system takes people who got lost to the closest safe place.

Cognitive training is implemented through interactive games based on cognitive adaptive technology. Complexity of exercises is adjusted to the performance and current mental level of the user.

The consortium brings together best of breed partners from Belgium, Ireland, Italy and Spain with a very strong presence of public authorities with budgetary responsibility for health and elderly care, supported by SMEs.

HSH will be run according to the clinical trial methodology (randomises study) to give credibility to the outcome.

Purpose and application areas
Emergency, Prevention, Treatment, Empowerment

Assisted living

Business model

Stakeholders
<table>
<thead>
<tr>
<th>Scale considerations</th>
<th>Less than 5000 users budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts and factors of success and failure</td>
<td></td>
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<tr>
<td>Further information</td>
<td></td>
</tr>
</tbody>
</table>
| Contacts | Case contact: peter.crombecq@digipolis.be  
PHS Foresight contact: doris.schartinger@ait.ac.at |
18. INCASA- INTEGRATED NETWORK FOR COMPLETELY ASSISTED SENIOR CITIZEN'S AUTONOMY

**Geographical focus**
- Italy, Greece, Spain, France, UK

**Maturity of the system and timing**
- Finalised Pilot project
- Start year: 2009
- End year: 2012

**Summary**
inCASA will create citizen-centric technologies and a services network to help and protect frail elderly people, prolonging the time they can live well in their own home. This goal will be achieved by integrating solutions/services for health/environment monitoring to collect and analyze data in order to profile user behaviour, implement customized intelligent multilevel alerts/communication services. Data will be made available to care services through a Smart Personal Platform with an embedded Behaviour Analysis Application which will include: access policies to preserve privacy; planning for day-by-day activities and therapies with multiple alerts; co-ordination of local public Social and Health Care Services; and help to deploy specialist community based services. inCASA further investigates the issues of designing ideal specialist services to support activities that are community based – one type will not fit all. By considering the European and different health sector dimensions, it will identify common service delivery paradigms (business models), but can explore how these are delivered in the scenarios to determine optimum clinical models.

**Purpose and application areas**
- Prevention, Treatment, Empowerment
- Chronic deseases, Assisted living

**Business model**
- Combined models

**Stakeholders**

**Scale considerations**
- Less than 5000 users

**Budget**

**Impacts and factors of success and failure**

**Further information**

**Contacts**
- Case contact: m.caprino@reply.it, Massimo Caprino
- PHS Foresight contact: doris.schartinger@ait.ac.at
19. INDEPENDENT- ICT ENABLED SERVICE INTEGRATION FOR INDEPENDENT LIVING

Geographical focus | Ireland, UK, Spain, Greece, Netherlands

Maturity of the system and timing
- On-going Pilot project
- Start year: 2010
- End year: 2012 Not defined

Summary
When it comes to supporting older people living in the community, today’s reality is characterised by fragmentation of service provision resulting in disjointed and patchy care and support. The quest for more integrated care is anything but new. Only recently, however, policy and practice are beginning to fully recognise that fragmentation of care can threaten its quality and cost effectiveness. In particular, the potential of ICT-enabled support such as telecare and telehealth could be exploited in a more effective way if they were not, as today, embedded in healthcare and social care services delivered in “silos”.

Against this background, INDEPENDENT develops and pilots an integrated set of ICT-enabled services dealing with a range of threats to independent living common to older people. Through innovative usage of ICT, current “silos” in service delivery are broken up to allow for cooperation across relevant care sectors and participation of family members.

Overall, the pilot brings together twenty partner organisations across six European Member States.

Purpose and application areas
- Assisted living

Business model
- Combined models

Stakeholders

Scale considerations
- Less than 5000 users

Impacts and factors of success and failure

Further information

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- PHS Foresight contact: doris.schartinger@ait.ac.at
## 20. ISIMED - INTELLIGENT SYSTEM FOR INDEPENDENT LIVING AND SELF-CARE OF SENIORS WITH COGNITIVE PROBLEMS OR MILD DEMENTIA

**Geographical focus**
- Ireland, Denmark, Greece, Finland

**Maturity of the system and timing**
- Finalised Pilot project
  - Start year: 2009
  - End year: 2012
  - Not defined

**Summary**
ISISEMD is an ambitious initiative of a number of organizations across Europe that aim to address ageing well, independent living and health issues for elder citizens by exploiting the advances of edge converging technologies of Telecommunications and IT. The project will deliver, test and validate a pilot service with the following key characteristics:

- Intelligent scalable supporting services targeting elderly people in general or people with pre- and mild dementia within their home environment in the context of ambient assisted living – with the aim to help them to perform independently their every day activities at home and improve their social life.

- Intelligent additional services for their closest family members aiming to keep them informed at any time for the activities of their loved ones, improving their own quality of life and reducing their anxiety and stress.

- Intelligent additional services for the care-givers, keep them informed at any time for the activities of their clients and to reduce time and personnel costs, leading indirectly to reduced cost for the whole society.

- Extensively tested and validated pilot service in four EU Member State regions, based on an innovative and integrated prototype, built on various ICT technologies that advance the state-of-the-art and involve the most updated standards.

- A business model framework and business plan with a detailed analysis for the whole value chain of the pilot service.

**Purpose and application areas**
- Treatment, Empowerment
- Chronic diseases, Assisted living

**Business model**
- Combined models

**Stakeholders**
- [Blank]

**Scale considerations**
- Less than 5000 users
  - budget

**Impacts and factors of success and failure**
- [Blank]
| Contacts         | Case contact: Kjeld B. Olesen, kbo@aalborg.be  
|                 | PHS Foresight contact: doris.schartinger@ait.ac.at |
### 21. ISTOPPFALLS - ICT-BASED SYSTEM TO PREDICT AND PREVENT FALLS

**Geographical focus**
Austria, Netherlands, Spain

| Maturity of the system and timing | On-going Pilot project  
Start year: 2011  
End year: 2014 |
|---|---|

**Summary**
The aim of iStoppFalls is to develop and implement ICT-based technologies which can be easily integrated in daily life practices of older people living at home, and which allow for continuous exercise training, reliable fall risk assessment, and appropriate feedback mechanisms, based on discreet measuring technologies and adaptive assistance functions. Beyond continuous fall risk monitoring, this enables tailoring individualized exercise programs coached by iStoppFalls.

Main objectives of iStoppFalls are to increase the quality of life of our elder citizens and to reduce fall-related costs for our societies.

iStoppFalls will involve representatives of world-leading technology and research experts from both university and industry partners in Europe and Australia. The program will strengthen collaboration between research and technology which will provide tailored solutions for the ageing society, and thus contributes to European competitiveness and excellence.

**Purpose and application areas**
Assisted living

**Business model**

**Stakeholders**
- Germany - University Siegen
- Germany - German Sports University Cologne
- Germany - Kaasa Solution GmbH
- Austria - Austrian Institute of Technology
- Spain - Instituto de Biomecanica de Valencia
- Netherlands - Philips Research Europe
- Australia - Neuroscience Research Australia

**Scale considerations**
*From 2 million to 5 million euros budget*

The Economic Policy Committee estimated that in 2004 one in six Europeans was older than 65 years and in 2050 it will be one in three Europeans.

More than 30% of the people older than 65 years and more than 50% in the age group above 80 fall at least once a year.

**Impacts and factors of success and failure**
Research oriented

The main evaluation study will analyze several falls related aspects and shall provide evidences for a successful dissemination and exploitation.

appropriate business model
| Contacts           | Case contact: Rainer Wieching, rainer.wieching@uni-siegen.de]  
|                    | PHS Foresight contact: peter.kastner@ait.ac.at |
# 22. MEDTRONIC CARELINK FOR CARDIAC RHYTHM MANAGEMENT

## Geographical focus

<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>On-going</th>
<th>Mature established system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start year:</td>
<td>2005 or before</td>
<td></td>
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<tr>
<td>End year:</td>
<td>Not defined</td>
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</table>

## Summary

Medtronic CareLink is a remote monitoring system for implantable cardiac rhythm management devices (pacemakers, implantable cardioverter defibrillators, loop recorders).

## Purpose and application areas

- **Emergency, Prevention, Treatment**
- **Chronic diseases**

During standard care of implants for cardiac rhythm management, follow-ups for checking the implant's status are necessary in regular intervals. Remote Monitoring is intended to reduce the number of in-clinic follow-ups by automatically sending information concerning the status of the implant to a backend system, where they are analysed and presented to the physician in a concise way.

## Business model

- **Stakeholders**
  - Patients themselves are involved only.
  - Medical professionals (cardiologists, cardiac surgeons)

## Scale considerations

**Budget**

Remote monitoring proved to be beneficial for several indications, especially in case of implantable cardioverter defibrillators.

## Further information


## Contacts

- Case contact: ,
- PHS Foresight contact: dieter.hayn@ait.ac.at
# 23. MEDTRONIC CARELINK FOR DIABETES PATIENTS WITH IMPLANTEO INSULIN PUMPS

**Geographical focus**

<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>On-going Mature established system</th>
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<tbody>
<tr>
<td></td>
<td>Start year: Not defined</td>
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<td>End year: Not defined</td>
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</table>

**Summary**

Medtronic CareLink for diabetes patients with implanted insulin pumps and continuous glucose monitoring sensors is a service which gives patients and physicians additional information about blood glucose values and insulin dispensing, nutrition etc.

**Purpose and application areas**

*Treatment*

*Chronic diseases*

By the use of a diabetes diary therapy should be enhanced. Data that is available within the implant is intended to be presented to patients and physicians.

**Business model Stakeholders**

- patients themselves
- physicians / diabetes team

**Scale considerations**

**Impacts and factors of success and failure**

**Further information**

**Contacts**

Case contact: ,

PHS Foresight contact: dieter.hayn@ait.ac.at
24. MYDOCTOR@HOME

Geographical focus  Italy

| Maturity of the system and timing | On-going Roll-over implementation  
| Start year: 2008  
| End year: Not defined |

Summary

Through the geriatrics and bone metabolic diseases' unit of the hospital rehabilitation department, the hospital has launched a telemonitoring project called "Mydoctor@home" for elderly patients treated in the home based hospitalization (OAD) setting or just discharged.

AOU San Giovanni Battista Molinette hospital and, in particular the geriatrics unit, are since long involved in projects to improve the home based hospitalization and after discharge activities. In 2008, based also on the findings of the "DREAM-Adamo" project, the regional health department and the AOU San Giovanni Battista Molinette, with the scientific collaboration of Istituto Superiore Mario Boella and in partnership with Telecom Italia (through the totally owned company TILab), launched the MyDoctor@home project. The initial objectives of the project were to innovate in the home based hospitalization activity and to reduce the workload of health staff (especially for nurses that are the most active resources in the OAD).

The OAD regime has been in place at AOU San Giovanni Battista Molinette since 1985. The OAD service is active every day, normally, involving 13 professional nurses, 1 nurse coordinator, 1 social worker, 3 physiotherapists and 1 counselor. The aim of OAD is to transpose hospital service at the patients' home. For emergency outside service hours patients rely on emergency services (118 or 112), with which the hospital has special agreement for these patients. Besides routine visits, during working hours the health staff of OAD is also able to answer patient calls and be at his/her home within 20 or 30 minutes.

There are different and complex services that can be delivered at the patient's home such as ECG, small surgeries treating bedsores, central intravenous catheters management, positioning naso-gastric tubes, ultrasounds, blood drawing etc. Normally the service is activated by the family GP (instead of sending patient to A&E), by hospital physicians (protected early discharge) or directly by the emergency department. The hospital estimated an average daily cost of €160 for patients in OAD53 (including health and administrative staff, ambulance service, drugs and treatments).

Purpose and application areas

Treatment

Chronic diseases

- Improving patients' quality of life (moving information instead of these fragile elderly patients)
- Making relevant patient data easily accessible for physicians
- Supporting integrated home care and the caregiver-patient relationship
- Reducing costs: anticipating patient discharge and proactively changing therapy and treatment thanks to real time monitoring (so decreasing the number of rehospitalization)
- Improving patients’ quality of life (moving information instead of these fragile elderly patients)
- Making relevant patient data easily accessible for physicians
- Supporting integrated home care and the caregiver-patient relationship
- Reducing costs: anticipating patient discharge and proactively changing therapy and treatment thanks to real time monitoring (so decreasing the
Business model

Combined models

The total value of the contract between Telecom Italia and the region for the implementation is €10 million per 5,000 patients for 3 years. The cost of the project is about €2 per patient per day (as in the contract with Telecom Italia); the first envelope of funding for €364,416 for the first next 416 patients has been already allocated by Aress (Aress is the regional agency for health services) on behalf of the region. According to the contract the hospital will also need to fund expenditure for consumable such as batteries.

The contract does not specify who has the responsibility for the technology delivered to the patient. For instance it is not clear whether it is the hospital or the patient who has to refund or not Telecom Italia if the patient mobile phone has been stolen or lost. According to the head physician of the geriatric unit, this is the only cost for the region since the medical staff involved in this project is not exclusively dedicated to this service. It is difficult for the hospital to understand how many man/hour are allocated to the project so the €2 per patient per day estimate is not totally reliable in considering the whole expenditure.

Stakeholders

Elderly patients treated in the home based hospitalization (OAD) setting or just discharged from hospital.

AO San Giovanni Battista Molinette is a university teaching hospital (integrated with the University of Turin) that offers diagnostic and care services to inpatients and out-patients. It employs 5,957 people (of which 2,856 are nurses and physicians). The hospital includes four facilities: le Molinette, San Lazzaro, San Giovanni Antica Sede and, outside Turin, San Vito hospital. It is the third largest hospital in Italy and it is the leading center for the oncologic network in Piedmont and Valle d’Aosta regions.

The OAD (=home based hospitalisation) regime has been in place at AOU San Giovanni Battista Molinette since 1985. The OAD service is active every day, normally, involving 13 professional nurses, 1 nurse coordinator, 1 social worker, 3 physiotherapists and 1 counselor. The aim of OAD is to transpose hospital service at the patients’ home.

Normally the service is activated by the family GP (instead of sending patient to A&E), by hospital physicians (protected early discharge) or directly by the emergency department.

The service "manager" is the physician with the credentials (each hospital department that is involved in the project has to ensure there is at least one responsible physician and a nurse).

MyDoctor@Home represents a solution of the Telecom Italia eHealth offering portfolio. The company is still investing in the solution development and offers it to other healthcare organizations in Italy.

Aress is the regional agency for health services.

Scale considerations

From 5001 to 25 000 users

From 5 to 10 million euros budget

The total value of the contract between Telecom Italia and the region for the implementation is €10 million per 5,000 patients for 3 years.

Impacts and

demonstrated that for patients that have been discharged, especially for
Factors of success and failure

Geriatrics patients that very frequently have chronic diseases, telemonitoring can be very useful in reducing rehospitalization. According to the geriatrics' unit head this type of project can have a significant impact as long as it does not remain an exception limited to the San Giovanni Battista Molinette hospital and becomes part of a more complex network. Besides OAD telemonitoring can be a useful element in a system of protected discharges.

From an organizational perspective key to the success of the pilot was the experience of the hospital department personnel with the OAD regime. The preexisting organizational conditions make OAD well suited for remote patient monitoring in general, and for the project in particular. Organizational (resources such as staff, cars and procedures) and administrative (including reimbursement models) arrangements were already in place before the use of the telemonitoring technology. In a sense the technology was perceived as a kind of natural extension of the OAD. For this first phase, the solution has proved to be very flexible and has allowed a good integration with the department workflow and according to all stakeholders interviewed; this characteristic will continue to be important as the solution will be implemented in different settings.

From a management point of view key to the success of the pilot phase was the high interest and support from the direction of the geriatrics unit and from the Aress commissioner. Again this will continue to be essential as, apart from the support from Aress, the position of other healthcare decision makers on the topic is not clear. In October 2010, Aress took the decision to formalize the project and the related allocation of funds with an official document. Besides the administrative aspects (that in highly regulated environment as healthcare are however important) this document has helped in raising the awareness and the interest of other hospitals that are now adhering to the initiative.

Since 1st October 2010 the region has preliminarily approved a specific DRG including telemedicine but, at operational level, the regulation is not clear. These problems are already emerging in the first steps of the extension of the project to other departments. The protocol is still in definition and has slowed down the roll out kick off. The before mentioned document of Aress has encouraged other organizations that were interested explaining the framework agreement with Telecom Italia.

The slowdown experienced between the end of the pilot and the roll out is also due to the fact that the project is involving three big organizations such as the hospital (the biggest in the region), the region (through Aress) and Telecom Italia.

Further information

SIMPHS2 report

Contacts

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## 25. NEXES-SUPPORTING HEALTHIER AND INDEPENDENT LIVING FOR CHRONIC PATIENTS AND ELDERLY

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Spain, Greece, Norway</th>
</tr>
</thead>
</table>
| **Maturity of the system and timing** | Finalised Pilot project  
Start year: 2008  
End year: 2012 Not defined |
| **Summary** | The main objective of the project was to identify strategies for extensive deployment and adoption of ICS supported by Information and Communication Technologies (ICS-ICT). The core hypothesis was that implementation of ICS-ICT for chronic patients generates efficiencies at system level ensuring sustainability of the services and these results foster reshaping of European Health Care Systems to face the challenge of chronic conditions.  

The four ICS considered in NEXES cover a wide spectrum of care coordination with a strong focus on prevention and disease modulation. NEXES identified the need for bridging with social support acknowledging that fragmentation between healthcare and community services represents a major problem leading to exclusion.  

NEXES studies were conducted in three different sites: Barcelona (Spain), Athens (Greece) and Trondheim (Norway). Although the specificities of each site represented a challenge during the take-up of the project, the design has provided the opportunity to generate outcomes with validity at European level. |
| **Purpose and application areas** | Treatment  
Chronic diseases |
| **Business model** | Combined models, Public sector |
| **Stakeholders** | |
| **Scale considerations** | From 5001 to 25 000 users  
budget |
| **Impacts and factors of success and failure** | |
| **Further information** | |
| **Contacts** | Case contact: Miriam Hillenius, mhillen@clinic.ub.es  
PHS Foresight contact: doris.schartinger@ait.ac.at |

## 26. ODUM HEALTH SYSTEM
<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Finland</th>
</tr>
</thead>
</table>
| Maturity of the system and timing | On-going Mature established system  
Start year: 2005 or before  
End year: Until further notice |
| Summary | ODUM Health System allows the comprehensive development and maintenance of the personnel's fitness for work in companies. The system provides company management, HR departments and occupational health services with support and practical tools to identify risks and improve your staff's fitness for work.  
ODUM Oy was founded in 1988 to monitor the effectiveness of work fitness rehabilitation programs. The company served both Finnish and European customers. In the late 1990s, the indicators of work well-being and fitness were transported into a web-based system which enabled the cost-effective collection, analysis and reporting of the high-quality research data. |
| Purpose and application areas | Prevention, Empowerment  
Life-style  
ODUM Health System allows the comprehensive development and maintenance of the personnel's fitness for work in companies. The system provides company management, HR departments and occupational health services with support and practical tools to identify risks and improve your staff's fitness for work. |
| Business model | Private insurance, Private market  
The system is offered to companies to improve occupational health. The client and related insurance companies finance the system. ODUM Health System is produced and maintained by an active network of partners who benefit from it different ways. |
| Stakeholders | ODUM Health System allows the comprehensive development and maintenance of the personnel's fitness for work in companies.  
Occupational well-being experts and medical specialists in Diacor, Kisakallio Sports Institute, The Kuortane Sports Resort, Mehilaïinen and Avire-Rehabilitation Ltd benefit from the Odum health system in their work and offer its services to their clients.  
Diacor offers the services of some 600 physicians and other health sector experts. In addition to providing comprehensive occupational healthcare services, Diacor's healthcare professionals offer their services also to private customers not associated with a particular company.  
Kisakallio Sports Institute is a non-profit foundation which offers a wide variety of sports, activities, educational possibilities and excellent facilities for professional and amateur sports enthusiasts. |
| The Kuortane Sports Resort is a centre for training, wellbeing, education and leisure, which in addition to quality services, offers excellent surroundings and... |
Mehiläinen’s nationwide service network of privately funded health services consists of a total of 26 medical centres, occupational health centres which augment the service network, and 9 hospitals. On the publicly funded markets the Mehiläinen group consists of 10 elderly care centres, 14 child welfare units and a psychiatric hospital for children, 26 mental health rehabilitation units.

Avire-Rehabilitation Ltd is a professional rehabilitation and well-being oriented service company. It was founded in the autumn of 2010 to continue the business of the Foundation for Rehabilitation rehabilitation.

ODUM Oy was founded in 1988 to monitor the effectiveness of work fitness rehabilitation programs. The company served both Finnish and European customers. In the late 1990s, the indicators of work well-being and fitness were transported into a web-based system which enabled the cost-effective collection, analysis and reporting of the high-quality research data.

The company is owned by the Finnish Innovation Fund Sitra, BPM Group and a group of ODUM employees. ODUM Health System is used to assess the work fitness of over 50,000 employees annually.

ODUM Health System is produced and maintained by an active network of partners. Health companies, system providers, occupational well-being experts and insurance companies are included in the network. Measuring and developing the work fitness of our clients’ personnel requires professional expertise in various fields.

Scale considerations

| Less than 5000 users |
| Less than 500 000 euros budget |

The system is applicable in different sizes of organisations.

Impacts and factors of success and failure

Odum health system can be applied to increase the overall well-being, increase the working ability, labor productivity and thereby increase profitability. When the calculations are made based on improved ability work the ROI tends to be between 1:2 - 1:3.

The success in the development of working capacity requires adequate information about the working conditions, work-related risks, as well as the expertise to assist business leaders to realize the potentials of development needs.

Odum offers support to the management to draw up an effective and timely program and implement the system for its management and monitoring.

Further information

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27. ONLINE PREDICTIVE TOOLS FOR INTERVENTION IN MENTAL ILLNESS (OPTIMI)

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Spain, Switzerland, United Kingdom</th>
</tr>
</thead>
</table>
| Maturity of the system and timing | Finalised Pilot project  
Start year: 2010  
End year: 2012 |
| Summary | Mental health care represents over a third of the cost of health care to all EU nations. However little is being done to develop effective systems for Prevention of the onset of the illnesses or to provide easier Diagnosis with a view to better determine the effects of treatment. OPTIMI will change this by developing tools to perform Prediction through early identification of the onset of an illness by monitoring poor coping behavior. It is based on the hypothesis that the central issue and starting point of longer term mental illness depends on the individual s capacity and ability to cope with stress. OPTIMI will first identify the occurrence of high stress in the individual on a daily basis. Then it will determine the ongoing effect of stress on the individual by studying the behavior pattern over a longer period. Finally it will also make estimates of the base line changes in the person s state of mind using symptomatic measurements that closely link depression with cognitive, motor and verbal behavior. |
| Purpose and application areas | Prevention, Treatment  
Chronic deseases |
| Depression and Anxiety disorders are believed to be more common in those people who suffer high levels of stress in their daily lives exhibit poor coping behaviours that deal with the stress. By detecting poor coping behaviours associated with long term stress, we hope to be able to predict the consequent/probabilistic onset of depression in this group of people.  
By monitoring their stress levels and behaviour/depression signs, we aim to provide treatments that steer them away from illness and at the same time heighten their coping and resilience. OPTIMI is based on a PROACTIVE approach to mental health care that will lead to lower costs and higher levels of life quality. OPTIMI objectives: |
| - Develop behavioral and physiological monitoring technologies (EEG, ECG, Activity monitoring, Voice Analysis, Cortisol sampling, Electronic Diaries) with the potential to detect early signs of stress, poor coping and depression. |
| - Develop a database and a datamining system making it possible to correlate these measurements with assessments by experienced therapists using gold standard diagnostics and cortisol sampling. |
| - Conduct “calibration trials” in three countries, comparing data from sensors with results from regular assessments by trained therapists using gold standard diagnostics. |
| - Analyze the results of the calibration trials with the data-mining system. |
| - Identify a set of measurements providing effective prediction of stress, poor coping and depression. |
| - Design and implement a wearable sensor system, providing these measurements on a 24/7 basis and acceptable to users. |
| - Develop a rule based engine providing automated diagnosis based on measurements from the sensor system. |
| - Integrate this engine and the sensor system with two existing online CBT therapy systems, making it possible to measure the effectiveness of... |
treatment and to optimize the treatment cycle.
- Test the integrated system in “treatment trials” in three countries
- Measure the viability, user acceptability and accuracy of the system as a tool to diagnose and prevent the onset of depression

OPTIMI will initially target persons at High Risk of depression, such as carers of elderly and disabled, long term unemployed, emergency services and university students in their final year.

The final aim is to develop a system that will encourage resilience to depression, to enhance QOL.

As Stress is the starting point it will be necessary to measure stress using physiological indicators: Body sensors must detect stress events on a fine time resolution over long periods.

Besides stress alone, some early indicators of the onset of Depression can also be indirectly assessed using physiological indicators such as EEG, Speech and Sleep patterns.

OPTIMI senses:
- Stress
- Cortisol (this is the physiological Gold Standard)
- ECG (this allows us to see stress induced physiology)
- EEG (this allows us to examine a more general mood)
- Activity (this allows us to model).

Depression and Anxiety disorders are believed to be more common in those people who suffer high levels of stress in their daily lives exhibit poor coping behaviours that deal with the stress. By detecting poor coping behaviours associated with long term stress, we hope to be able to predict the consequent/probabilistic onset of depression in this group of people. By monitoring their stress levels and behaviour/depression signs, we aim to provide treatments that steer them away from illness and at the same time heighten their coping and resilience. OPTIMI is based on a PROACTIVE approach to mental health care that will lead to lower costs and higher levels of life quality.

### Business model

**Stakeholders**

OPTIMI will initially target persons at High Risk of depression, such as carers of elderly and disabled, long term unemployed, emergency services and university students in their final year.

The final aim is to develop a system that will encourage resilience to depression.

### Scale considerations

*From 5 to 10 million euros budget*

Mental health care represents over a third of the cost of health care to all EU nations and, in USA, it is estimated to be around the 2.5% of the gross national product. Depression and Stress related disorders are the most common mental illnesses.

### Impacts and factors of success and failure

The European project “Optimi” aims to develop a set of tools to prevent an individual from falling into depression. For this reason a friendly application that can detect the stress level of a user in his daily life has been developed. This application collects and combines different types of measures: ECG, physical activity, voice analysis, self-registration and EEG to obtain the individual’s stress level.

An initial usability study of the application has been conducted and has been presented in this work. The results of this study show that the application has a friendly, easy to use interface and that users feel comfortable using the application. (Human-Computer Interaction. Design and Development Approaches Lecture Notes in Computer Science Volume 6761, 2011, pp 423-
431, A User-Friendly Tool for Detecting the Stress Level in a Person’s Daily Life, by Irene Zaragozá, Beatriz Rey, Cristina Botella, Rosa Baños, Inés Moragrega, Diana Castilla, Mariano Alcañiz)

|                     | http://www.optimiproject.eu  
|                     | ec.europa.eu/information_society/activities/einclusion/.../optimi.pps |
| Contacts            | Case contact: Catalina Jimenez (Everis), catalina.jimenez@everis.com  
|                     | PHS Foresight contact: effie.amanatidou@gmail.com |
# 28. REMOTE

<table>
<thead>
<tr>
<th><strong>Geographical focus</strong></th>
<th>Greece, Italy, Romania, Spain</th>
</tr>
</thead>
</table>
| **Maturity of the system and timing** | Finalised Pilot project  
Start year: 2009  
End year: 2012 |
| **Summary** | REMOTE is a pan-European research project concerned with the needs of elderly and individuals with chronic conditions. The focus is especially on those living in geographical or social isolation whose independent life is at risk with chronic conditions or lifestyle risk factors. The project will provide support for an independent life at home with the aid of AmI (Ambient intelligence) and tele-healthcare. The elderly's personal environment will be enhanced with various kinds of monitoring and automation abilities for tracing activity and health condition, as well as detecting risks or critical situations. For this purpose the project will use and scale-up existing research prototypes and new systems for collecting human- and context-related data (including sensors attached to a person's body, or sensors and actuators installed in houses or cars). As a growing number of elderly in urban as well as in rural areas live on their own, monitoring activity and medical data at anytime and from anywhere can ensure autonomy and a better quality of care and thus close the growing gap between urban and rural areas. |
| **Purpose and application areas** | Emergency, Prevention, Treatment, Empowerment  
Chronic diseases |
| **REMOTE** | REMOTE enhances the elderly's personal space with various kinds of monitoring and automation intelligence for tracing activity and health, and for detecting risks and critical situations. The patient is equipped with a customised kit of medical devices that are managed by a smartphone and record vital sign measurements. The recorded data is transmitted to remote authorized care professionals and appropriate alerts are triggered if health status deterioration is detected. Overall, patients can receive on their device numerous integrated services related to tele-care and independent living support, such as personalized guidance on nutrition, physical or mental exercise, etc.  
A key priority for REMOTE is to contribute to interoperability in the field as a means for unblocking the potential of currently available technology and for leveraging chronic care services across Europe. This is achieved by introducing an innovative, ontology-driven, open reference architecture and platform that now enables interoperability, seamless connectivity and sharing of content among different applications, sensors and services.  
3 main versions of the REMOTE monitoring and support battery.  
The three configurations of Aerotel's system (smartphone-based, workstation, public kiosk) could be studied as related work to the envisioned light, core and extended versions of REMOTE. |
|  | • Light-weight version, based mainly on portable devices (PDA, smart phones and wearables). A wrist cuff blood pressure meter could be considered for the light system version, but it should be verified that the measurements are reliable. |
Core version, based mainly on fixed / home installations and including all major applications and services. A paper print facility may be useful in various scenarios (e.g., print-out a paper based test or a cook recipe).

Extended version, which consists of any of the other two versions plus extra features and “peripheral” services for ageing well at home (activity coach; nutrition management; social interaction facilities; advanced home automation; mobility enhancements).

REMOTE Deliverable D1.1 includes the list of 41 use cases identified with actors involved, possible scenarios and system outputs, resources required and necessary conditions for realisation. REMOTE enhances the elderly’s personal space with various kinds of monitoring and automation intelligence for tracing activity and health, and for detecting risks and critical situations. The patient is equipped with a customised kit of medical devices that are managed by a smartphone and record vital sign measurements. The recorded data is transmitted to remote authorized care professionals and appropriate alerts are triggered if health status deterioration is detected. Overall, patients can receive on their device numerous integrated services related to tele-care and independent living support, such as personalized guidance on nutrition, physical or mental exercise, etc. A key priority for REMOTE is to contribute to interoperability in the field as a means for unblocking the potential of currently available technology and for leveraging chronic care services across Europe. This is achieved by introducing an innovative, ontology-driven, open reference architecture and platform that now enables interoperability, seamless connectivity and sharing of content among different applications, sensors and services.

Primary end-users of REMOTE are elderly with specific chronic conditions, especially those living in rural and isolated areas. For them the project will design multi-user controlled home environments. The elderly-oriented applications and services will enhance their self-care, social interaction, and skills maintenance ability, in order to offer the comfort, security and safety required: to maintain links with their family and friends, to go out for shopping or vacation etc.

Health professionals are the secondary users of REMOTE. They will be provided with tools for continuous monitoring of a person’s situation (e.g. real time data and records of the patient's condition, activity, and life environment changes) and history patient data. The modules include decision support tools that enable health professionals to review patient-data and to generate personalised, disease care plans and every-day feedback to the patients. All of these modules will be web-based to access them at anytime and from anywhere.

The REMOTE partners:
SIEMENS S.A. www.siemens.com
Universidad Politecnica de Madrid www.lst.tfo.upm.es
Fundación para la Investigación Médica Aplicada www.cima.es
Saliwell (renamed to Peh-Med Ltd.) www.saliwell.com
Centre for Research and Technology Hellas www.certh.gr
Foundation for Research and Technology – Hellas www.ics.forth.gr
Netscouts gemeinnuetzige GmbHwww.netscouts-gmbh.de
Abama Technologies S.L. www.abama.es
University Hospital of North-Norway (UNN) - Norwegian Centre for Telemedicine

The tertiary end-users of REMOTE are health and care insurance providers.
They will profit from the applications and services that will facilitate the development and integration of new services and new delivery platforms. This will meet their requirements concerning cost reduction, interoperability, and standardisation of services.

<table>
<thead>
<tr>
<th>Scale considerations</th>
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<tbody>
<tr>
<td><strong>More than 2 million users</strong></td>
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<tr>
<td><strong>From 2 million to 5 million euros budget</strong></td>
</tr>
<tr>
<td>Today, over 140 millions of people around the world live with a chronic condition (Hypertension, Arthritis, Stroke, Parkinson’s Disease (PD), Alzheimer’s Disease (AD), Asthma, etc.) placing new challenging demands on health care systems worldwide. REMOTE is a pan-European project aimed to support elderly with chronic conditions in enjoying an independent life at home with the aid of AAL technology.</td>
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</table>

<table>
<thead>
<tr>
<th>Impacts and factors of success and failure</th>
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<tbody>
<tr>
<td>Expected benefits for chronic patients: enhancement of self-care, self-management, social interaction, and skills; enjoying comfort, security and safety in a self-determined life. Expected benefits for chronic care providers: the shifting from hospital-based acute care towards long-term condition management in home settings; more effective and holistic care coordination and care management around the needs of the patient.</td>
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<table>
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<tr>
<th>Overall Expected results and impact:</th>
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<tr>
<td>• Open reference architectures and ontologies;</td>
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<tr>
<td>• Intelligent agents and AmI framework;</td>
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<tr>
<td>• Wearables, sensors and health/activity monitoring</td>
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<tr>
<td>• Independent living applications;</td>
</tr>
<tr>
<td>• Social support applications;</td>
</tr>
<tr>
<td>• In-home and domotic sensors and localisation systems;</td>
</tr>
<tr>
<td>• User interfaces and adaptive systems;</td>
</tr>
<tr>
<td>• Tele-healthcare products and services;</td>
</tr>
<tr>
<td>• Information extraction and use;</td>
</tr>
<tr>
<td>• Understanding of (chronic) and age-related conditions;</td>
</tr>
<tr>
<td>• Patient modelling (the medical perspective);</td>
</tr>
<tr>
<td>• User modelling (the human-machine interaction perspective);</td>
</tr>
<tr>
<td>• Elderly-friendly user interface design &amp; development;</td>
</tr>
<tr>
<td>• Evaluation methods and tools;</td>
</tr>
<tr>
<td>• Guidelines, standards and policy.</td>
</tr>
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</table>

The high informational requirement concerning telemedicine and remote monitoring suggests that the specific applications are viewed as individual therapies, but that more detailed information on costs or the experience of third parties with such technologies is generally lacking. The classification of each individual element of a medical monitoring device or system, e.g. blood glucose monitoring device in its overall context, including costs of the device, its acquisition and maintenance as well as the experience of others with the device, are an essential component in the assessment of the device, its’ benefits and thus its acceptance by the concerned individuals, whether Elderly/Disabled Individuals, Formal Carers or Informal Carers within the Tele-Healthcare Spectrum. Elderly/Disabled Individuals are confronted with new technology and personal health issues on a daily basis. As a general rule it plays no role if a disability such as Parkinson's Disease or Multiple Sclerosis exists. Social factors are the core determinants, such as integration into a stable social structure and the related personal health assessment for the acceptance or not of telemedicine. A basic scepticism could however be determined for the individuals surveyed as concerns technical devices. There is a general fear of operating errors or hard to control alarms. Elderly individuals also show uncertainties as to new
technologies, e.g. they frequently commented that they are unable to use Touchscreens. Information and understanding of the technology is obviously lacking. There is lack trust in technical devices, as such can fail, either due to an operating error or due to a technical defect. The general scepticism towards new technology is governed by a lack of information about the possibilities and usage of medical monitoring devices. Treating and prescribing physicians generally take insufficient time to provide information on the new Tele-Healthcare methods, over their benefits, their risks and their areas of usage. Care personnel have, as a rule, such time limitations that they cannot provide proper clarification and utilization instructions for such technology. Family and friends seem to be the foremost advisors, as they have time and understand the fears of the individual concerned and are best able to provide adequate information as to the benefits of Tele-Healthcare. Family and friends are also the individuals best suited to assuage the fears concerning loss of personal contact through increased use of technology. They are not only facilitators which can positively present the utilization of new technology, but they can also be a crucial factor in helping the concerned individual make realistic assessments of their personal health status. Substantial backlog exists as concerns informational sourcing as well as in regards to further education on the technological possibilities available also on the side of stakeholders. Existing informational sources are not accessible to many individuals.

A regular and comprehensive informational exchange between physicians, therapists, health care personnel, health insurance organisations and elderly or disabled individuals and their family and friends plays an important role in the development and acceptance of Tele-Healthcare possibilities. The networking of medical specialists, stakeholders, formal and informal carers as well as elderly or disabled individuals becomes an important function in research activities in the field of Tele-Healthcare and Tele-Medicine. These individuals are in many instances confronted with unreasonably excessive information on assistive.

**Further information**

http://www.aal-europe.eu/projects/remote/
http://www.remote-project.eu/

**Contacts**

Case contact: Prof. Nikolaos Maglaveras, nicmag@cert.gr
PHS Foresight contact: effie.amanatidou@gmail.com
<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Austria, Denmark, Finland, Greece, Italy, Spain, Sweden, Norway, Germany</th>
</tr>
</thead>
</table>
| Maturity of the system and timing | On-going Roll-over implementation  
Start year: 2009  
End year: Not defined |
| Summary                  | RENEWING HEALTH aims at implementing large-scale real-life test beds for the validation and subsequent evaluation of innovative telemedicine services using a patient-centred approach and a common rigorous assessment methodology. 
It involves a Consortium of 9 of the most advanced European regions in the implementation of health-related ICT services. In those regions the service solutions are already operational at local level for the tele-monitoring and the treatment of chronic patients suffering from diabetes, chronic obstructive pulmonary or cardiovascular diseases. The services are designed to give patients a central role in the management of their own diseases, fine-tuning the choice and dosage of medications, promoting compliance to treatment, and helping healthcare professionals to detect early signs of worsening in the monitored pathologies. 
These services will be scaled up, integrated with mainstream Health Information Systems, grouped into a limited number of clusters bringing together services with similar features, trialled and assessed with a rigorous and common assessment methodology, and using a common set of primary indicators. 
Although integration of the service solutions at regional level is the highest priority for the Project partners, the use of international standards and the progressive convergence towards common interoperable architectures will be equally sought to prepare and facilitate their scaling up at national and European levels. Each cluster of pilots will operate as a multi-centre clinical trial measuring the efficiency and the cost effectiveness of the implemented solutions. 
The Project is supported by the Health Authorities of the partners and they are fully committed to deploy the telemedicine services in their territory, cooperating in a network that let them an overview not only among partners, but even on other European initiatives with similar objectives. |
| Purpose and application areas | Prevention, Treatment  
Chronic deseases  
Telemonitoring Support for patieintes with Diabetes, COPD, Heart Failure  
Telemonitoring Support for patieintes with Diabetes, COPD, Heart Failure |
<p>| Business model            | Public sector |
| Stakeholders              | | |
| Scale considerations      | From 2 million to 5 million euros budget |
| Impacts and               | Assessment method: Model for Assessment of Telemedicine (MAST) |</p>
<table>
<thead>
<tr>
<th>factors of success and failure</th>
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<tbody>
<tr>
<td>Further information</td>
<td></td>
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</tbody>
</table>

**Contacts**

Case contact: info@renewinghealth.eu  
PHS Foresight contact: peter.kastner@ait.ac.at
### 30. RENEWING HEALTH - REGIONS OF EUROPE WORKING TOGETHER FOR HEALTH

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Austria, Denmark, Finland, Greece, Italy, Spain, Sweden, Norway, Germany</th>
</tr>
</thead>
</table>
| Maturity of the system and timing | On-going Roll-over implementation  
Start year: 2009  
End year: Not defined |
| Summary | RENEWING HEALTH aims at implementing large-scale real-life test beds for the validation and subsequent evaluation of innovative telemedicine services using a patient-centred approach and a common rigorous assessment methodology. It involves a Consortium of 9 of the most advanced European regions in the implementation of health-related ICT services. In those regions the service solutions are already operational at local level for the tele-monitoring and the treatment of chronic patients suffering from diabetes, chronic obstructive pulmonary or cardiovascular diseases. The services are designed to give patients a central role in the management of their own diseases, fine-tuning the choice and dosage of medications, promoting compliance to treatment, and helping healthcare professionals to detect early signs of worsening in the monitored pathologies. These services will be scaled up, integrated with mainstream Health Information Systems, grouped into a limited number of clusters bringing together services with similar features, trialled and assessed with a rigorous and common assessment methodology, and using a common set of primary indicators. Although integration of the service solutions at regional level is the highest priority for the Project partners, the use of international standards and the progressive convergence towards common interoperable architectures will be equally sought to prepare and facilitate their scaling up at national and European levels. Each cluster of pilots will operate as a multi-centre clinical trial measuring the efficiency and the cost effectiveness of the implemented solutions. The Project is supported by the Health Authorities of the partners and they are fully committed to deploy the telemedicine services in their territory, cooperating in a network that let them an overview not only among partners, but even on other European initiatives with similar objectives. |
| Purpose and application areas | Prevention, Treatment  
Chronic diseases  
Telemonitoring Support for paateintes with Diabetes, COPD, Heart Failure |
<p>| Business model | Public sector |
| Stakeholders | |</p>
<table>
<thead>
<tr>
<th>Scale considerations</th>
<th>From 2 million to 5 million euros budget</th>
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<tbody>
<tr>
<td>Impacts and factors of success and failure</td>
<td>Assessment method: Model for Assessment of Telemedicine (MAST)</td>
</tr>
</tbody>
</table>

**Further information**

**Contacts**

Case contact: info@renewinghealth.eu

PHS Foresight contact: peter.kastner@ait.ac.at
### 31. SOCIABLE-MOTIVATIONG PLATFORM FOR ELDERLY NETWORKING, MENTAL REINFORCEMENT AND SOCIAL INTERACTION

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>Greece, Italy, Norway, Spain</th>
</tr>
</thead>
</table>
| **Maturity of the system and timing** | Finalised Pilot project  
Start year: 2009  
End year: 2012  
Not defined |
| **Summary** | SOCIABLE will pilot a radically new ICT based approach for integrated support of mental activity, as well as boosting of social interaction for individuals that have been diagnosed to suffer from mild dementia. SOCIABLE will integrate human support and care services offered by care centres and specialized /expert operators (e.g., geriatric internist, geriatric psychiatrist, neurologist, neuropsychologist or geropsychologist), with state-of-the-art ICT infrastructures (notably surface computing infrastructures) and independent living technologies. This new approach will build upon three tested (in the scope of past EU projects) technological pillars, which have proven therapeutical value, namely: (a) Novel perceptive mixed reality interfaces based on multi-touch surfaces, (b) A modular platform for cognitive training games development, which allows the flexible creation and customization of cognitive training games and (c) ―Profiling‖ and social ―matching‖ capabilities boosting social networking and interaction between aged individuals. SOCIABLE will be piloted with the participation of a minimum of 350 senior citizens in 7 different pilot sites (TRONDHEIM Kommune, Hygeia, Morgagni Pierantoni Hospital, Municipality of Forlì, Social Policy Centre of the Municipality of Kifissia, Santa Lucia Foundation and PREVI S.L) from 4 European countries (Greece, Italy, Norway, Spain). Overall, SOCIABLE will integrate, deploy and operate an innovative ICT-enabled on-line service for assessing and accordingly reinforcing the mental state of the elderly through pleasant gaming activities for cognitive training, while at the same time boosting their social networking and activating their day-to-day interpersonal interactions. SOCIABLE is envisaged as a service with high potential for societal impact that could add significant value to current service offerings of care services providers. Furthermore, it is associated with a clear business potential for sustainability and wider use by care service providers within (but also outside of) the SOCIABLE consortium. |
| **Purpose and application areas** | Treatment, Empowerment  
Chronic diseases |
| **Business model** | Combined models  
The consortium has developed a preliminary business plan for exploitation. |
<p>| <strong>Stakeholders</strong> |  |
| <strong>Scale considerations</strong> |  |
| <strong>Impacts and factors of success and failure</strong> |  |
| <strong>budget</strong> |  |</p>
<table>
<thead>
<tr>
<th>Further information</th>
<th></th>
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</thead>
</table>
| Contacts            | Case contact: Stelios Pantelopoulos, spantelopoulos@singularlogic.eu  
|                     | PHS Foresight contact: doris.schartinger@ait.ac.at |
# 32. ST. JUDES MEDIAL MERLIN

**Geographical focus**

<table>
<thead>
<tr>
<th>Maturity of the system and timing</th>
<th>On-going Mature established system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start year: 2007</td>
<td>End year: Not defined</td>
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</table>

**Summary**

St. Jude’s Medial Merlin.net Patient Care Network (PCN) allows efficient remote management—including scheduled transmissions and daily alert monitoring—of patients with implanted cardiac devices, including pacemakers, implantable cardioverter defibrillators and cardiac resynchronization therapy devices.

**Purpose and application areas**

*Emergency, Prevention, Treatment*

*Chronic deseases*

During standard care of implants for cardiac rhythm management, follow-ups for checking the implant’s status are necessary in regular intervals. Remote Monitoring is intended to reduce the number of in-clinic follow-ups by automatically sending information concerning the status of the implant to a backend system, where they are analysed and presented to the physician in a concise way.

**Business model**

**Stakeholders**

Patients themselves are involved only.

Medial professionals (cardiologists, cardiac surgeons)

**Scale considerations**

**Impacts and factors of success and failure**

*Budget*

Remote monitoring proved to be beneficial for several indications, especially in case of implantable cardioverter defibrillators.

**Further information**

**Contacts**

Case contact:

PHS Foresight contact: dieter.hayn@ait.ac.at
### Geographical focus
- France, Champagne-Ardenne region

### Maturity of the system and timing
- **On-going Pilot project**
  - Start year: 2010
  - End year: Until further notice

### Summary
The DOMOCARE Project corresponds to a long-term partnership strategy led by industrial groups providing a product and services integrated on an ICT platform, proposed in a phased approach through an industrial offer strategy planned in liaison with the territorial administration.

To sum-up and simplify the go-to-market scheme linked to the territorial deployment, three main phases have been identified:

- **Phase 1** – offered today: local deployment focussing on telealarm devices, to be monitored at local level by a service company (SENIORALERTE input)
- **Phase 2** – offered today: territorial or regional deployment currently proposing various added-value services, called DOMOCARE, from classical telealarm buttons to home controls and personal behaviour control at home.
- **Phase 3** – on-going development and pilot deployment called PICADO: e-health devices as captors added on top of telealarm functions, based upon overall regional service platform; major 3-year project, €4.1 funding, partially covered through administration budget, led by ALTRAN, a large industry stakeholder.

The on-going phase 1 has been established after first contacts between AXON and SENIORALERTE in 2010. The SENIORALERTE service was initially focussed on the Lyon region. The DOMOCARE project is currently commercialised nationwide, with a specific focus on the Champagne Ardenne region. Phase 3 (i.e. the PICADO project) corresponds to a bi-regional approach supported by the French administration, aiming at pilot deployment in the Isle of France and Champagne Ardenne regions (representing around 22% of the French population – Champagne Ardenne having an ageing population).

### Purpose and application areas
- **Prevention, Empowerment**
- **Assisted living**

It is a systemic approach with a strong territorial to work today technologies, services and applications that will adapt living spaces to the plight of people in loss of autonomy or chronic diseases, while providing comfort, security and facilities to the disabled, frail or dependent. It is a systemic approach with a strong territorial to work today technologies, services and applications that will adapt living spaces to the plight of people in loss of autonomy or chronic diseases, while providing comfort, security and facilities to the disabled, frail or dependent.

### Business model
- **Private market**

Phase 1 and 2: product and service development has been funded on both AXON and Senioralerte shareholders’ equity. The service itself is paid directly by the customer on a monthly fee basis, following a fixed price list:

- "classical pack" : €24.90 per month
- "Active offer" : €44.90 per month
- “Prevention offer”: €54.90 per month.
  Note: the pricing of €10.00 per month for simple “telealarm button” service based upon a local phone call centre organization should be borne in mind.

Stakeholders

Domocare is a subsidiary of AXON (Headquartered in Montmirail)
Senioralerte is a start-up company created in 2008, Phase 3: led by ALTRAN, a large industry stakeholder.

Reims University Hospital CHU Reims (undernutrition, diabetics)
CARINNA – Regional agency for research and industrial innovation in Champagne

Ardenne – promoted by the Conseil Régional de Champagne Ardenne

Scale considerations

Less than 5000 users
From 2 million to 5 million euros budget

Phase 1 – offered today: local deployment focussing on telealarm devices, to be monitored at local level by a service company (SENIORALERTE input)

Phase 2 – offered today: territorial or regional deployment currently proposing various added-value services, called DOMOCARE, from classical telealarm buttons to home controls and personal behaviour control at home.

Phase 3 – on-going development and pilot deployment called PICADO: e-health devices as captors added on top of telealarm functions, based upon overall regional service platform;

For phase 3, various administrations provide funding (at national, regional and local levels) allowing to increase the financial budget by €1.7 million to a total of €4.1 million for project development.

Impacts and factors of success and failure

Positiv:
Plans to generalise the experimentation at regional and national levels are currently under way, through the PICADO DOMOMEDECINE bi-regional projects which foresees to serve 10,000 homes and via the “Investissement d’avenir” to speed-up the “go to market” strategy with industrial partnership service focus on digital usage

4.1 Social factors
integration of family members and relatives in the notification chain

4.2 Technological factors
Internet VPN has been identified as the key backbone technology, leveraging the concept of “Telemedecine operator” checking and controlling service availability and platform liability.

4.3 Economic factors
- "classical pack": €24.90 per month
- "Active offer": €44.90 per month
- "Prevention offer": €54.90 per month.

The pricing of €10.00 per month for simple “telealarm button” service based upon a local phone call centre organization should be borne in mind.

The economic model will be studied through a research program conducted by
Regarding the DOMOCARE commercialization, simple advertising on the Internet appears to be sufficient to capture a market segment representing some 2,000 homes.

<table>
<thead>
<tr>
<th>4.4 Environmental factors</th>
<th>not mentioned</th>
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<tbody>
<tr>
<td>4.5 Political factors</td>
<td></td>
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<tr>
<td>Conseil Général de la Marne (dealing with social funding)</td>
<td></td>
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<tr>
<td>Communauté de Communes de le Brie Champenoise</td>
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<tr>
<td>4.6 Value-based factors</td>
<td>not mentioned</td>
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</table>

**Further information**

Strategic Intelligence Monitor on Personal Health Systems phase 2 (SIMPHS 2)
Country Study France
Authors: Fabienne Abadie (IPTS), Emmanuel Pavageau (2IM)

**Contacts**

Case contact: n.a., contact@domocare.fr
PHS Foresight contact: peter.kastner@ait.ac.at
Geographical focus | Netherlands

| Maturity of the system and timing | On-going Mature established system  
Start year: 2005 or before  
End year: Not defined

| Summary | Developed by Tactive, Tactus delivers online care and treatment to Dutch citizens affected by alcoholism. Overall, it performs more than 5,500 units of care per year with an operational budget of EUR 1,605,000. Its activities are targeted at alcohol addicts residing in the eastern part of the Netherlands. Tactive developed an online tool, which allowed structured asynchronous interaction between counsellor and patient. The goal was to replicate cognitive behavioural therapy centred on one-to-one counselling by a professional assistant in an online environment.

| Purpose and application areas | Treatment  
Life-style

Alcoholism is a prominent problem in the Netherlands leading to direct financial damage to Dutch society of about EUR2.58 billion. According to official statistics, only 10% of Dutch alcohol-addicted citizens receive appropriate support. Therefore, the main driver for this system has been the need to increase this low percentage by providing an anonymous professional support system, since Tactus-sponsored research concluded that preventative action in treatment can improve behavioural changes in individuals affected by alcoholism.69

Tactive developed an online tool in conjunction with the IT supplier TheFactor.e, which allowed structured asynchronous interaction between counsellor and patient. The goal was to replicate cognitive behavioural therapy centred on one-to-one counselling by a professional assistant in an online environment.

| Business model | Combined models

As previously anticipated, the core changes in the business models are the possibility of providing online treatment in complete anonymity (Relation), potentially addressing other forms of addictions (Value Proposition). Moreover, by providing asynchronous online support, it has led to a reduction in the number of professional staff required.

Due to the ability to scale the IT platform, its potential revenue streams have evolved. Prior to introduction of the online platform, revenues were obtained only from the fees paid by individual alcohol addicts. However, the organisation...
is to develop a reseller fee that allows for treatment organisations in other countries to consider use of the available online platform to offer similar treatments locally. Currently, the organisation is considering the possibility of consolidating a 'franchise' model so that other organisations can license its services for a fee.

**Stakeholders**

Developed by Tactive, Tactus delivers online care and treatment to Dutch citizens affected by alcoholism. Overall, it performs more than 5,500 units of care per year with an operational budget of EUR 1,605,000. Its activities are targeted at alcohol addicts residing in the eastern part of the Netherlands.

Tactive developed an online tool, which allowed structured asynchronous interaction between counsellor and patient. The goal was to replicate cognitive behavioural therapy centred on one-to-one counselling by a professional assistant in an online environment.

This electronic service involves four organisations:
- Tactus (franchiser);
- Tactive (franchisee);
- Mondriaan (franchisee); and
- the Symphora Group (franchisee).

These franchiser and franchisees provide teleconsultations and see the internet as a way to consolidate their offering beyond the current geographical presence in the eastern part of the Netherlands.

Tactive developed an online tool in conjunction with the IT supplier TheFactor.e, which allowed structured asynchronous interaction between counsellor and patient. Tactus is the franchiser of the service.

Alcohol addicts can access their nominated assistants anonymously via the online platform, while Tactus can manage interactions with individual healthcare insurers and the relevant national, regional and national public health authorities more efficiently. Interactions with the latter actors are extremely important, since it simplifies the overall reimbursement process, even if the service per se is provided anonymously.

**Scale considerations**

*From 5001 to 25 000 users*

*From 2 million to 5 million euros budget*

Currently, the organisation is considering the possibility of consolidating a 'franchise' model so that other organisations can license its services for a fee. Tactus invested EUR3–3.5 million of private equity funding in Tactive to develop this solution. Moreover, Tactive has gained additional funding (EUR650,000) for their online treatment from M&ICT (an action programme of the Dutch Government to contribute to societal problems) because of the innovative nature of their solution in terms of value for patients. This additional funding was reinvested to improve the scale of its online activities. Presently, the service generates revenues for EUR2,000 per patient, with an estimated profit of EUR200 per patient. The profit is used to take this service internationally and to counter other addictions.

Tactive dominates on access, as it enables easy interaction between professional staff and addicts. In particular, the anonymity herein is the key to its success: Tactive has found that 96% of its users prefer this feature in the service. Moreover, it registered 5,000 unique visitors per month and 700 regular forum members between January and June 2009.

**Impacts and factors of**

The online platform has allowed Tactive to differentiate its offering by moving beyond face-to-face treatments. More importantly, company statistics confirm
success and failure

that online treatments are perceived better by patients. Of all patients who start treatment online, 61.2% move to the second part of the treatment, while 36% complete it. This data does not indicate that 64% of them fail to continue treatments: some of them indicate that they have had enough support to stop the treatment after the first phase. It is important to indicate that this online treatment is to be considered as an additional option for traditional face-to-face treatment. Addicts can always return to face-to-face treatment provided by the organisation if required.

Another benefit is the empowerment of alcohol addicts in their treatment. Since the treatment is usually conducted in two different phases (diagnostics and behaviour) to be delivered online, power is vested in the hands of the client. They are the captain of their own destiny. This element is expected to increase the effectiveness of the method and the final results.

The analysis of this case study allows for identification of the following best practice.

• Senior management had a clear vision on how to operate an online treatment service and infuse strong commitment in making the transformation a success. The strategic objective was to implement an online platform that provided a valuable tool for personal counselling to alcohol addicts.

• This strong commitment was underpinned by a detailed prior identification of the functionalities that the new online platform was expected to deliver. Even after delivery of the online platform, senior management monitored the situation regularly and carried out regular feedback sessions and enhancement cycles.

• It is important to emphasise that the design and delivery of the online system saw the continuous engagement of professional assistants who received the required training and support.

Further information


Contacts

Case contact: Helen Westendorp, h.westendorp@tactive.nl
PHS Foresight contact: totti.konnola@impetusolutions.com
# 35. TELEMACO - NUOVE RETI SANITARIE (NRS)

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<th>Geographical focus</th>
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<td>Start year: 2006</td>
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## Summary

The project was started in April 2006, the first phase ended in September 2010, the second phase is still running. The project was aimed at supporting the accessibility to specialized healthcare for small municipalities in mountain valleys through the provision of telemedicine services. Only part of the project is directly related to the topic of PHS, which is telemonitoring for patients with chronic heart failure (CHF) or chronic obstructive pulmonary disease (COPD) after hospital discharge.

Other parts of the project relate to tele-consultation among specialists (GP - specialist or rural - central).

The objectives of the care model enabled by PTP are to improve COPD patient management, in particular the efficacy of oxygen therapy delivered at patient home, and avoid recurring acute episodes as well as to:
- Improve clinical effectiveness and patient quality of life;
- Reduce unnecessary / inappropriate hospital admissions and recourses to A&E
- Improve accessibility to secondary care in rural and mountain areas;
- Improve patient’s satisfaction and disease self management
- Promote telemedicine networks involving governments, ASLs, AOs, small hospitals, GPs and external Service Centers.

## Purpose and application areas

**Prevention, Treatment**

**Chronic diseases**

Telemaco was initially implemented by 5 AOs and one ASL (AO Chiari, AO Pavia, AO Seriate, ASL of Vallecmonica Sebino, AO of Valtellina and Valchiavenna, AO Varese). At the end of the experimentation in September 2010, Telemaco involved patients in the catchment area of 8 ASLs (organized in 19 health districts with 400,000 inhabitants). Telemaco project was funded by the Ministry of Health (€1.6 million), the Ministry of Innovation and Technology (€0.45 million) and by the Lombardy regional health department (€1.4 million). After this independent phase, the project has been included (without major organizational changes) within Nuove Reti Sanitarie 74 (New Health Networks).

NRS is a regional common framework for new experimental initiatives aimed at developing chronic disease management tools for chronic and post acute patients.

The PTP path integrates the activities that the GPs are usual asked to perform when dealing with COPD patients. The service is also meant to provide consulting support to GPs for an integrated management of chronic patients.

The service involves:

- Promote telemedicine networks involving governments, ASLs, AOs, small hospitals, GPs and external Service Centers.
A specialized nurse (tutor) which will follow the patient during the service and that will play a major role for counseling and patient education activities. Regular phone contacts between patients and tutor. A call centre available to patients 24/7 for ad hoc requests. Management of a shared database which can be accessed by GPs, Nurses and Specialists.

Key players in PTP implementation are:
- The respiratory medicine (pneumology) department within the hospital. Normally departments organize a dedicated team/unit for the telemonitoring service composed of:
  - One or two specialists who are the clinical referent for the service, the referent and coordinator for GPs and the service centre eventually involved; and
  - Patients’ tutors (specialized nurses) who are the patient’s main contact point, responsible for the patient’s education as concern adherence to prescriptions, rehabilitation activity and self-management.
- GPs give their assent for patients to participate in the telemonitoring. The GP is regularly informed on a particular patient condition by the specialists and the tutor.
- The service centre provides technological and organizational support for telemonitoring (devices, information systems, such as electronic patient record, and complementary services such as the management of the shared database where information is stored) and call centre functionalities for weekends, holidays and all other moments when the tutor is not working. The service centre is at the same time an application service provider, a web contact centre and a call centre. The service centre is also responsible for collecting all patient data and sending them to Cefriel on a regular basis. Telemaco was initially implemented by 5 AOs and one ASL (AO Chiari, AO Pavia, AO Seriate, ASL of Vallecamonica Sebino, AO of Valtellina and Valchiavenna, AO Varese). At the end of the experimentation in September 2010, Telemaco involved patients in the catchment area of 8 ASLs (organized in 19 health districts with 400,000 inhabitants). Telemaco project was funded by the Ministry of Health (€1.6 million), the Ministry of Innovation and Technology (€0.45 million) and by the Lombardy regional health department (€1.4 million). After this independent phase, the project has been included (without major organizational changes) within Nuove Reti Sanitarie 74 (New Health Networks). NRS is a regional common framework for new experimental initiatives aimed at developing chronic disease management tools for chronic and post acute patients.

The PTP path integrates the activities that the GPs are usual asked to perform when dealing with COPD patients. The service is also meant to provide consulting support to GPs for an integrated management of chronic patients. The service has a strong clinical emphasis, which makes the specialty department a key element in the care path. From a reimbursement point of view, the role of specialists has allowed to assimilate the service to an outpatient activity. Generally speaking, GPs remain responsible for care services delivered at the patient’s home but the operational decisions are made within the hospital department.

The service involves:
- A specialized nurse (tutor) which will follow the patient during the service and that will play a major role for counseling and patient education activities.
- Electronic transmission of clinical data.
- Regular phone contacts between patients and tutor.
A call centre available to patients 24/7 for ad hoc requests Management of a shared database which can be accessed by GPs, Nurses and Specialists.

Key players in PTP implementation are:

1. The respiratory medicine (pneumology) department within the hospital. Normally departments organize a dedicated team / unit for the telemonitoring service composed of:

   - One or two specialists who are the clinical referent for the service, the referent and coordinator for GPs and the service centre eventually involved; and
   - Patients' tutors (specialized nurses) who are the patient’s main contact point, responsible for the patient’s education as concern adherence to prescriptions, rehabilitation activity and self management

2. GPs give their assent for patients to participate in the telemonitoring. The GP is regularly informed on a particular patient condition by the specialists and the tutor

3. The service centre provides technological and organizational support for telemonitoring (devices, information systems, such as electronic patient record, and complementary services such as the management of the shared database where information is stored) and call centre functionalities for weekends, holidays and all other moments when the tutor is not working. The service centre is at the same time an application service provider, a web contact centre and a call centre. The service centre is also responsible for collecting all patient data and sending them to Cefriel on a regular basis.

**Business model**

*Public sector*

Hospitals participating in the PTP receive a funding envelope based on tariff for each patient activated of €720 for the first six months (€120 per month), when high intensity services are provided, and €480 for the next eventual 6 months (€80 per month) with low intensity services. This funding is expected to cover all costs related to the service center and hospital internal costs (i.e. the allocation of nurses and specialist time to the telemonitoring unit). The service center offering includes devices, call center services and information systems. Currently hospitals participating to the initiative buy services directly from the Temporary Enterprises Group - RTI Raggruppamento Temporaneo d’Imprese that won the framework contract tender. As PTP, as all NRS care paths, is still considered an experimental initiative, this funding is on top of the annual budget of the hospital. In the summer of 2010, when the regional health department decided to continue the Telemaco experience and migrate it into the NRS, the regional government approved a decree (DGR IX/409 del 05/08/2010) for the prolongation of services included in Telemaco and its transition toward NRS79. This decree confirmed that in 2010, resources allocated for the continuation of the home telemonitoring path for severe and very severe COPD patients (PTP) covering 300 authorized care paths (of which 150 already authorized within Telemaco) were €216,000. This funding covers hospital reimbursement (therefore covering tariffs for 300 "possible" patients) but do not include all activities such as experimentation management, evaluation and reporting. These activities have been so far covered by Cefriel (leveraging on Telemaco agreements). Before the end of the summer 2011, the region will officially identify the provider of these services. In order to have an idea on the relative weight of this type of expenditure, it can be useful to consider that within the 2010 total budget for the NRS (€6,937,500), including PTS ODCP and ODP paths (therefore excluding PTP), the sum allocated to experimentation management, evaluation and reporting was € 237,500.

**Stakeholders**

Patients with chronic heart failure (CHF) or chronic obstructive
pulmonary disease (COPD) after hospital discharge

- The respiratory medicine (pneumology) department

- GPs

In Telemaco, the service centre provider was selected through a European tendering process. The selection procedure was managed by a temporary group of enterprises led by HTN and consisting of:

- Cefriel in charge of all experimentation management including planning support, evaluation activities and reporting
- Telecom Italia in charge of service integration
- Tesan -Ital TBS in charge of providing back up functionalities in service peak and interruption
- Telbios in charge of providing a web based solution for clinical information exchanges, videoconferencing and repository management.

Within the NRS framework, hospitals and ASL can decide to choose the service provider they prefer. They are not anymore obliged to use the temporary group of enterprises led by HTN, but selected providers need to meet technical and organizational requirements.

Telemaco was initially implemented by 5 AOs and one ASL (AO Chiari, AO Pavia, AO Seriate, ASL of Vallecamonica Sebino, AO of Valtellina and Valchiavenna, AO Varese). At the end of the experimentation in September 2010, Telemaco involved patients in the catchment area of 8 ASLs (organized in 19 health districts with 400,000 inhabitants).

Telemaco project was funded by the Ministry of Health (€1.6 million), the Ministry of Innovation and Technology (€0.45 million) and by the Lombardy regional health department (€1.4 million). After this independent phase, the project has been included (without major organizational changes) within Nuove Reti Sanitarie (New Health Networks).

### Scale considerations

| Less than 5000 users | From 2 million to 5 million euros budget |

### Impacts and factors of success and failure

Since the PTP path has only been included in NRS from September 2010 at the time of writing it is too early to have access to new results. During the Telemaco project, however, a continuous, systematic and comprehensive assessment has been conducted, covering effectiveness, costs, access, satisfaction and organizational impact. Between May 2007 and September 2010, the total number of activated Telemaco paths was 393. The number of activation has constantly grown over the 3 years' period. Patients enrolled were mainly males (73%) with an average age of 72 years presenting comorbidity and other risk factors. When asked about their satisfaction with the service, patients judged the service very positively overall, for the support received in difficult moments, for the communication with the tutor and other health staff and for the ease of use of the device. These satisfaction results are remarkable, since users are stage 3 and 4 COPD patients: in this type of patients, even successful therapy programs improve patient conditions very slowly. Through the Telemaco project, it was possible to dedicate more time to patient education. Patients are more aware of their conditions and can have a more active role in their disease management.

Even though results are not statistically significant because of the small size of the sample, they show that the service has led to fewer hospitals re admissions, fewer accesses to emergency service and disease peaks have been largely addressed at patient home.

Hospital readmissions for respiratory disease in Telemaco patients were 11%, while deaths directly caused by COPD were below 1%. These data were also
reported in the regional decree D.R.G. IX / 000489 in August 2010 that established the transition of Telemaco to NRS.

According to the specialist interviewed, specialization is an important factor, as remote interaction with patients requires specific skills. It is important, however, to ensure a certain degree of "turnover" between operators dealing with the patients through the telemonitoring service, because this is a service that needs a constant evolution.

The transition toward NRS and the extension of the project to more than 30 AOs and ASLs will certainly need to be carefully managed. During the Telemaco planning phase, activities like defining protocols, workflows and rules has been relatively easy, as the number of organizations involved was limited. The extended network of healthcare organizations participating in the initiative today is already expressing some difficulties in applying the established protocol. It will be important therefore to continue with the regular review process.

Looking at the economic analysis done on Telemaco, comparing four hospitals, as showed in table 1, one can notice that costs vary significantly from hospital to hospital. This variation confirms that the problem of reaching economies of scale can be determinant over the long run. Smaller hospitals activating a smaller number of patients might find the services difficult to manage risking to allocate resources that will be underexploited, or to assign extra workload to already busy staff that will be not able to deliver the service. It will be important to encourage shared service models also for the clinical / nursing part of the project, with a hospital or a third party (e.g. a scientific society such as AIPO – Associazione Italiana Pneumologi Ospedalieri 96 ) providing the services for a group of hospitals. Incentives fostering this type of shared service models, such as establishing a minimum threshold for patients enrolled, to achieve economies of scale will be therefore an element that can ensure sustainability to the project.

GPs need to be more involved in PTP patient management. Their action is considered key for efficient case management and to support patient self management.

Further information

Contacts

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36. TELEMEDICINE IN ALS VCO

Geographical focus
Italy

Maturity of the system and timing
| On-going Roll-over implementation |
| Start year: 2008 |
| End year: Not defined |

Summary
The telemonitoring project of VCO involves patients with different chronic conditions: diabetic, COPD, cancer and chronic heart failure patients. The majority of patients involved in the project are diabetic patients. In the territory served by ASL VCO there are 9638 diabetic patients (9002 type 2-T2DM). Currently 43% of ASL VCO type2 diabetic patients are under the integrated management of T2DM patient projects, involving the support of 95% of GPs of the territory. These projects have helped in defining protocols for the telemedicine project. The rationales subtending the project are:
- to provide a service whose priority is promotion and continuity of care
- to ensure a follow up for chronic and fragile patients out of traditional care settings
- to focus on clinical and organizational aspects while technology should be perceived as a commodity
- to preserve the role of the physician through the establishment of a rigorous clinical protocol for telemedicine services

Purpose and application areas

Treatment
Chronic deseases
The objectives were to reduce the distance between patient and the healthcare organization, help implementing new diagnostic and therapeutic paths, optimize processes and resources, and reduce A&E access, hospitalization and ambulatory visits.

Once the ASL VCO professionals have identified a suitable patient for the service (normally ASL VCO nurses are the ones that identify suitable patients and refer them to the head physician), the supplier’s staff (a technician and a nurse) go to the patient’s home to verify that the conditions for service functioning (e.g. availability of ADSL) are met and provide the patient with training to start using the device. The objectives were to reduce the distance between patient and the healthcare organization, help implementing new diagnostic and therapeutic paths, optimize processes and resources, and reduce A&E access, hospitalization and ambulatory visits.

Once the ASL VCO professionals have identified a suitable patient for the service (normally ASL VCO nurses are the ones that identify suitable patients and refer
them to the head physician), the supplier’s staff (a technician and a nurse) go to the patient’s home to verify that the conditions for service functioning (e.g. availability of ADSL) are met and provide the patient with training to start using the device.

**Business model**  
*Public sector, Maybe PPP aspects*

The ASL VCO tender was attributed to Tesan in partnership with Medi4All for about €1,817,000. The contract started officially in March 2009 and it will expire in December 2011. Contractually the supplier is expected to provide service for 300 patients. On top of that, CSI Piemonte costs about 2% of total costs. The region is paying the costs related to the supplier and the start up costs, as included in contract specifications, and it is using internal and already available resources. As infrastructures, such as technological platform and contact centre management have been outsourced to the supplier, the ASL VCO, and consequently the region, have been able to minimize capital investments, focusing on operational expenditure of the project.

Looking at the reimbursement model, so far the adoption of a specific DRG was not necessary because the project is officially considered an experiment. Once the services will be extended to other ASLs there will be some marginal costs to be added, however CSI executives interviewed expect those not to be significant because the project was already conceived with the goal to expand (so no further or only limited infrastructure costs needed and most importantly no need for going through another procurement process). The price setting, considering also the current 150 patients, is still for a "prototype". However, before contract expiration, when the project will serve a sufficient number of patients and it will be possible to prove economies of scale, CSI will open tariffs renegotiations.

**Stakeholders**

*Chronic and fragile patients out of traditional care settings*

The role of ASL in the project is focused on the clinical side. ASL clinicians:

- identify and enroll patients that can be treated through the service
- establish the monitoring protocol, that prescribes the number and the frequency of the measurements
- get in contact with supplier and the health personnel to ensure the compliance to the protocol and SLAs.

Supplier is Tesan in partnership with Medic4all.

- Provides patients with the devices and the related training
- Receives, validates, stores patient data in a repository and makes it available to ASL VCO clinicians through a service centre
- Also offers technical and nursing assistance to patients through the same service centre.

ASL Verbano Cusio Ossola (ALS VCO) is a Piedmont local health enterprise born after grouping 3 former ULS (local health unit). USL and USSL were former local health organizations before the health reform of the 90ies. In USL and USSL the municipalities within the health organization catchment area had a significant decision power (especially from an administrative point of view). With the advent of ASL, local health organizations are more independent ( municipalities maintain an orientation function on management designation an on public health policy priorities).

**Scale considerations**

*Less than 5000 users*

*From 500 000 to 2 million euros budget*

Extension of the system was envisaged from the beginning, infrastructure was set up accordingly. Roll-out has started.
### Impacts and factors of success and failure

Initial results available show that
- Considering to have avoided at least one travel per month from the patient home to the closest ASL ambulatory, the project should have saved to patients and their relatives car travel for about 25000 Km.
- Considering patients interactions with the ASL VCO between July 2008 and 30 June 2010 there has been: 124 access to A&E; 92 hospitalizations; 1554 ambulatory visits. Comparing the history of the same patients before being involved in the telemedicine project, CSI recorded a decrease in:
  - Number of A&E accesses (-80%)
  - Number of hospitalizations (-56%)
  - Ambulatory visits (-63%)

From a clinical point of view results for diabetic patients are already available. After one year, large percentages of involved patients have experienced reduction of average values for key clinical parameters:
- Reduction of glycosylated haemoglobin (HbA1) average values in 76% of patients. Most importantly, especially for type A patients, there is a reduction in the number of peaks and hypoglycemia episodes.
- HbA1 average variance from a value of 8.5 went down to 7.2
- Hypoglycemia episode rate per months went from 10 to 5 for type A patients and from 4 to 3 in B type patients
- Reduction of cholesterol count in 54.4% of patients
- Reduction of triglyceride

For all stakeholders interviewed, defining precisely protocols has been fundamental: where they were less precise in defining protocols (for example with cancer patients) results were worse.

From a development point of view, the whole system has been set up to be in a constant process of fine tuning. For instance, at the beginning of the implementation, video conferencing with diabetic patients was perceived as important by ASL and CSI project managers.

An extension of the service to a much broader geography was envisaged since the beginning with the procurement process. As required by the tender specification, the current infrastructure is conceived for managing more patients than the current 128.

The human factor can be a barrier to the adoption - finding motivated and supportive clinicians can be difficult.

A good definition of processes is also important in order to understand roles, workloads, responsibilities and setting expectations correctly.

According to the clinician interviewed it is important to understand that telemedicine does not replace primary care / ambulatory care but integrates them.

### Further information

SIMPACS2-report
37. THE “GESUNDHEITSDIALOG” – ADVANCED THERAPY MANAGEMENT FOR DIABETES PATIENTS BASED ON MHEALTH

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<thead>
<tr>
<th>Geographical focus</th>
<th>Austria</th>
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| Maturity of the system and timing | On-going Pilot project  
Start year: 2010  
End year: Not defined |
| Summary | The Austrian Social Insurance Institution for Railways and Mining Industry (Versicherungsanstalt für Eisenbahnen und Bergbau, VAEB) started with a proof-of-concept telediabetes project, called Health Dialogue (“Gesundheitsdialog”). The project aims at setting a new standard in the management of chronic diseases by integrating different healthcare elements across different healthcare sectors (patients, general practitioners, specialized clinics, hospitals). Overall aims of the “Gesundheitsdialog” are to increase the quality and efficiency of healthcare. |
| Purpose and application areas | Prevention, Treatment, Empowerment  
Chronic diseases  
Specific aims are to support patients and physicians in:  
1. achieving sustainable lifestyle modifications  
2. tailoring therapy to individual needs  
3. increasing therapy adherence  
4. increasing patient safety  
The projects ultimate goals are to optimize the health status, to reduce risk for long term complications and to increase the quality of life of the patients.  
The project addresses primarily Diabetes mellitus but should be extended to other chronic diseases (cardiovascular diseases) and towards prevention programs for patients with known risk factors (obesity, pre-diabetes).Specific aims are to support patients and physicians in:  
1. achieving sustainable lifestyle modifications  
2. tailoring therapy to individual needs  
3. increasing therapy adherence  
4. increasing patient safety  
The projects ultimate goals are to optimize the health status, to reduce risk for long term complications and to increase the quality of life of the patients.  
The project addresses primarily Diabetes mellitus but should be extended to other chronic diseases (cardiovascular diseases) and towards prevention programs for patients with known risk factors (obesity, pre-diabetes). |
| Business model | Public sector  
Up to now the public insurance company covers all costs for service, equipment and general practitioners efforts.  
General practitioners get paid for giving online feedback to the patients once a week. |
| Stakeholders | Patients with chronic disease (diabetes mellitus)  
General practitioners  
Medical device suppliers  
System operator |
Technical Helpdesk  
Health resort  
Mobile network provider

Ministry of Health  
Chamber of physicians  
Public health insurance company

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<td><em>From 500 000 to 2 million euros budget</em></td>
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<td>up to 10,000 diabetes patients - clients of the Austrian Social Insurance Institution for Railways and Mining Industry</td>
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<th>Further information</th>
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| Case contact: Werner Bogendorfer, wernder.bogendorfer@vaeb.at  
PHS Foresight contact: peter.kastner@ait.ac.at |

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| Case contact: Werner Bogendorfer, wernder.bogendorfer@vaeb.at  
PHS Foresight contact: peter.kastner@ait.ac.at |
### 38. THE PATIENT BRIEFCASE

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<th>Denmark</th>
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| **Maturity of the system and timing** | On-going Roll-over implementation  
Start year: 2009  
End year: Until further notice |
| **Summary** | This implementation project has been set up by the medical department at Odense University Hospital (OUH) and Svendborg Hospital, together with the company MediSat A/S as product manufacturer and MedCom as a project advisor. The project aims to bring ICT tools into healthcare and, in a cost-efficient manner, facilitates high-quality care for chronic patients by offering remote patient monitoring in the Chronic Obstructive Pulmonary Disease (COPD) patient's own home. The hospital and provider is currently considering expanding the service delivery into other areas than COPD, such as diabetes and to early discharge of parents with new-born babies to their own home. |
| **Purpose and application areas** | *Emergency, Treatment*  
*Chronic diseases, Assisted living* |
| **Business model** | *Public sector* |
| **Stakeholders** | In total, the patient briefcase has been tested with approximately 800 patients. Up to 90 per cent of the patients who have had the briefcase would like to have it again and would recommend it to others.  
Odense University Hospital, Svendborg Hospital |
| | MediSat A/S. A common access to the two Danish electronic patient records MediCare and Cosmic has been ensured. In relation to the establishment of the telemedicine model of treatment, agreements were made with MediSat A/S on providing the setup of the technical connection as well as the necessary telemedicine equipment. |
The standards organisation MedCom as project advisor.

In earlier stages, the project received 1.2 m DKK (161,000 EUR) EC funding for the EU pilot project Better Breathing.

MediSat A/S and OUH have signed a contract of operation wherein the costs of the briefcase have been settled to be approximately 4-6,000 DKK (530-800 EUR) per month, i.e. a leasing agreement for 40 briefcases (the exact amount is classified). The contract has gone through the National Procurement Ltd. Denmark – an organisation funded and run by the Ministry of Finance and the National Association of Local Authorities in Denmark.

**Scale considerations**

**Less than 5000 users**

**From 500 000 to 2 million euros budget**

In earlier stages, the project received 1.2 m DKK (161,000 EUR) EC funding for the EU pilot project Better Breathing. The estimated remaining cost of approx. 10 m DKK (1.3 m EUR) for the implementation project was funded by OUH and the manufacturer, MediSat A/S.

MediSat A/S and OUH have signed a contract of operation wherein the costs of the briefcase have been settled to be approximately 4-6,000 DKK (530-800 EUR) per month, i.e. a leasing agreement for 40 briefcases (the exact amount is classified). The contract has gone through the National Procurement Ltd. Denmark – an organisation funded and run by the Ministry of Finance and the National Association of Local Authorities in Denmark.

**Impacts and factors of success and failure**

COPD patients account for an increasingly higher share of healthcare resource use compared with a similar population group of same age without COPD. The patient suitcase gives the hospital a possibility to rapidly discharge COPD patients, following an emergency admission to the hospital, with continuation of treatment in their own home.

Thereby, expensive bed days in the hospitals can be given to patients with greater needs or alternatively be closed down so that the use of resources for COPD patients is reduced while patients receive a better follow-up on their illness.

This is a bottom up initiative that received relevant guidance (MedCom), funding (EU) and was driven by creative entrepreneurs. The provider covered 50% of the development costs.

According to the co-owner and operational manager of the company behind the Patient Briefcase, Jørgen Thomsen, a simple service can easily be incorporated into existing workflows and organisational routines.

**Further information**


http://www.asianhhm.com/information_technolog/telemedicine_remote_monitoring.htm
http://www.ouh.dk/wm122110

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<th>Contacts</th>
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<td>PHS Foresight contact: <a href="mailto:totti.konnola@impetussolutions.com">totti.konnola@impetussolutions.com</a></td>
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### Geographical focus
United Kingdom

### Maturity of the system and timing
**On-going Pilot project**
- **Start year:** 2008
- **End year:** Until further notice

### Summary
The Department of Paediatric Endocrinology at UCLH partnered with the NHS, Great Ormond Street Hospital, iMetrikus and Capgemini Consulting to implement an eHealth service supporting young patients and their parents. The solution allows for the electronic upload of blood glucose results from home by plugging into blood sugar meters and automatically uploading the results. These results are available to clinicians and nurses who can intervene proactively when and if needed, or call patients to give advice or guidance.

### Purpose and application areas
- **Emergency, Treatment
- Chronic diseases**

The Department of Paediatric Endocrinology at UCLH serves a population of about 2000 children and young people affected by diabetes. One of the main drivers to implement IT applications is that 85% of the children and young people in the UK with diabetes type-1 do not have it under control. It is vital that these patients understand how much insulin is required to have a normal healthy life.

Therefore, UCLH partnered with the NHS, Great Ormond Street Hospital, iMetrikus and Capgemini Consulting to implement an eHealth service supporting young patients and their parents. The solution allows for the electronic upload of blood glucose results from home by plugging into blood sugar meters and automatically uploading the results. These results are available to clinicians and nurses who can intervene proactively when and if needed, or call patients to give advice or guidance.

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### Business model
**Combined models**
The introduction of this IT system has extended the value proposition of the diabetes monitoring service managed by UCL hospitals. It has allowed for the development of a remote management model through which young patients and their parents can monitor their conditions in cooperation with designated medical staff. The extension of the value proposition has required the use of additional key resources such as centralised monitoring systems and specialised modems for patients; these led to an increase in cost structure. The costs of the service are divided into two parts: capital and revenue. There is some capital expenditure in setting up the service and purchasing hardware; then there is the expense of maintaining the service and the process of dealing with patients proactively. However, the service has become sustainable through
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<th>Stakeholders</th>
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<td>Previously, young patients had to provide regular feedback of their status via physical meetings or other delayed methods. By introducing the IT application, a homecare remote monitoring system came into place by facilitating the overall monitoring of diabetes among young children treated from a distance.</td>
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<td>The whole area of London is participating, which means that all UCL hospitals and Primary Care Trusts cooperate. All system partners have been gathered into the paediatric diabetes ‘federation’, which is a clinical network covering the area encompassing the five boroughs of north and central London. The cooperation between UCLH, Great Ormond Street Hospital, iMetrikus and Capgemini was set up.</td>
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<th>Scale considerations</th>
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<td>Less than 5000 users</td>
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<td>Less than 500 000 euros budget</td>
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<td>The case of UCLH has some interesting benefits for the treatment of young diabetics. In general, it has been possible to witness increased patient proactivity in managing their chronic condition, with less time devoted to consultation with healthcare professionals. This is leading to a decrease of GBP1.75 million per year in cost for Primary Care Trusts. Should this system be scaled to rest of the UK, it is expected that it will generate savings of about GBP20 million in total.</td>
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<th>Impacts and factors of success and failure</th>
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<td>One of the major benefits for UCLH is the increased granularity on data. Usually clinicians have to rely on a measure known as HbA1c (glycated haemoglobin). This is an average measure over four to six weeks; it does not give the highs and the lows that are so important in monitoring this health condition. The data gathered via this eHealth system is more accurate, since it also measures important hypoglycaemic and hyperglycaemic episodes on a regular basis. The system promotes improvement in the quality of patient data received by healthcare professionals. Earlier, they had to rely on paper charts that children or their parents had to maintain. Where results existed, often they were not clear and did not provide an easy way to extract trends or series, to understand the evolution of the condition over a period of time. The introduction of the system has changed this state of affairs by improving data availability and immediacy. The specialised nurse or clinician can see a patient’s results as soon as they are uploaded, often on a weekly basis. This enables the identification of possible interventions.</td>
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<td>This system dominates in terms of service innovation and associated quality of care, especially in terms of immediacy. Normally, interventions in the treatment of diabetes took six to seven weeks (because the nurse or clinician gained insight into the blood glucose levels at these durations), whereas now they can actually monitor the day-to-day health status of the patient. This increased amount of information means better and more focused care, which in turn means fewer hypoglycaemia and hyperglycaemia patients, and lower average blood glucose in patients. The result of this is fewer acute escalations and complications in patients, and less money spent on their care.</td>
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<td>It is possible to identify the following best practice from this case study.</td>
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<td>• The first fundamental element of this system starts with the establishment of a consortium of partners sharing the same commitment to the success of the project, and at the same time, respecting each other's professional and operational role.</td>
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• The project benefited from strong senior management leadership by Professor Peter Hindmarsh throughout the entire development and implementation phase. He had a clear understanding of the specific needs of his patients and was committed to devising an IT application that could assist them in their care. This resulted in clear technical and organisational guidance to the technical members of the consortium: Capgemini and iMetrikus.

• The development of the systems saw the continuous involvement of all clinicians, who were clearly informed on the way that the new tool would change their operational activities.

• This engagement required the implementation of tight feedback sessions and enhancement cycles. Finally, all involved clinicians were provided with comprehensive training on the specific technical functionalities of the system and its data visualisation tools.

• It is important to emphasise that the development and implementation of the system is underpinned by repetitive quantitative and qualitative evaluation cycles. This facilitates regular performance evaluation of the system and identification of potential organisation and technical corrective actions.

• The sustainability was achieved primarily through the large savings achieved in treating individual patients. At this point, the objective is to roll out the system to cover the entire UK, which would lead eventually to even higher savings.

### Further information

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<tr>
<th>Name</th>
<th>Title</th>
<th>Contact Details</th>
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<tr>
<td>Peter Hindmarsh</td>
<td>Professor of paediatric endocrinology</td>
<td><a href="mailto:HindmP@gosh.nhs.uk">HindmP@gosh.nhs.uk</a></td>
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<td>Pre-and post natal growth, hypertension,</td>
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### Contacts

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<tr>
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<tbody>
<tr>
<td>Case contact</td>
<td>Peter Hindmarsh, <a href="mailto:HindmP@gosh.nhs.uk">HindmP@gosh.nhs.uk</a></td>
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<td>PHS Foresight</td>
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