E-health experiences in Spain: mapping and analysis

Engineering (Management)

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1. Executive Summary

E-health is form of health created to improve the health status of patients through Internet and other related technologies. It is an expanding concept being applied in lots of countries because of its benefits. With it, telemedicine is evolving. Telemedicine uses IT's to improve patient's outcomes with services such as diagnosis, treatments, prevention disease and so on.

The objective of this document is to compare different projects being realised in Spain, and in particular, in the Catalonia Region. To do so, it introduces e-health, telemedicine and other related terms. It also describes the actual situation in Spain regarding these subjects.

It provides a description of different telemedicine projects dealt in Catalonia and Spain, as well as a detailed and structured description of the project PALANTE and its pilots, specially the Spanish ones.

It defines a taxonomy model to classify all the projects and the Spanish pilots so that they can be compared to view the differences between them, and the tendency that the telemedicine sector is heading to.

The different resulting ideas that have been extracted are:

- There are projects that full monitor the patients with oximeters, sensors, spirometers…. This full monitoring is closed related to a service that tries to prevent a relapse from patients, which causes a reduction on the readmission of them.

- Several projects offer patients a virtual platform or portal to manage their health. This one should include (some ones already do) a drug intake schedule and an educational service.

- The latest projects developed are trying to give access to electronic health records (EHR) to their patients.

- The projects are trying to use ICT's to get a synchronous link between patients and health professionals.

2. Introduction

2.1. The information Society

The information society is a society where the distribution, creation, uses and manipulation of information are important activities. The main aim of the information society is to gain a competitive advantage using Information and Communication Technology (ICT) in a creative and productive way. It is advance to lead with the always problematic social stagnation, with an important change of mind from the "antique mind", to a "modern mind".

The information society is seen as the successor to the industrial society, a concept created by the great influence of Yonei Masuda, a Japanese sociologist, who in 1980 published his most famous book, "The Information Society as Post-Industrial Society".

During the 1970s, the way in which societies work changed. This was produced by the change of the generation of wealth. Little by little the industrial sectors changed to industrial services, in which the problem was to deal with the management of the information. By the way, this information society is not limited to Internet: the internet has been a great advance in terms of exchanging information and data, but not the only one.[1]

2.2. The Internet

The internet is a system architecture that has revolutionized communications and methods of commerce by allowing various computer networks around the world to interconnect. It has had a deep impact on work, leisure and knowledge worldwide. Thanks to the web, millions of people have an easy and immediate access to a vast and diverse amount of information online. Compared to encyclopaedias and traditional libraries, the web has enabled a sudden and extreme decentralisation of information and data.

The Internet entered and spread in many homes and businesses in rich countries. In this matter, it has opened a digital divide with the poor countries, where the penetration of the Internet and new technologies is still very limited for people.

The internet has become a tool of globalization, ending the isolation of cultures. Due to rapid overcrowding and incorporation into human life, the virtual space of information is constantly updated, with all kind of data.[2]

The Internet was one of the greatest technological advances of the last century. The total number of users of this invention rose from 360 million to 2,279 million between the year 2000 and nowadays. China, with 513 million users is the first listed user country, followed by the United States and India, with 245 and 121 million users respectively.

[1] Beniger, James R. (1986)
[2] John A. Bargh and Katelyn Y.A. McKenna (2003)

However, the United Kingdom is the country with the highest penetration rate (between the highest internet user countries) with an 84.1%. Italy is ranked 16, with 35 million users, and Spain is in place 19 with 30 million users.[3]

During the last years all the searches in the internet have been multiplied. One of the most demanded searches is the one related with health issues. It has been noticed that this kind of information concerns the patients, and this is why each time all the information is more complete and better explained.[4]

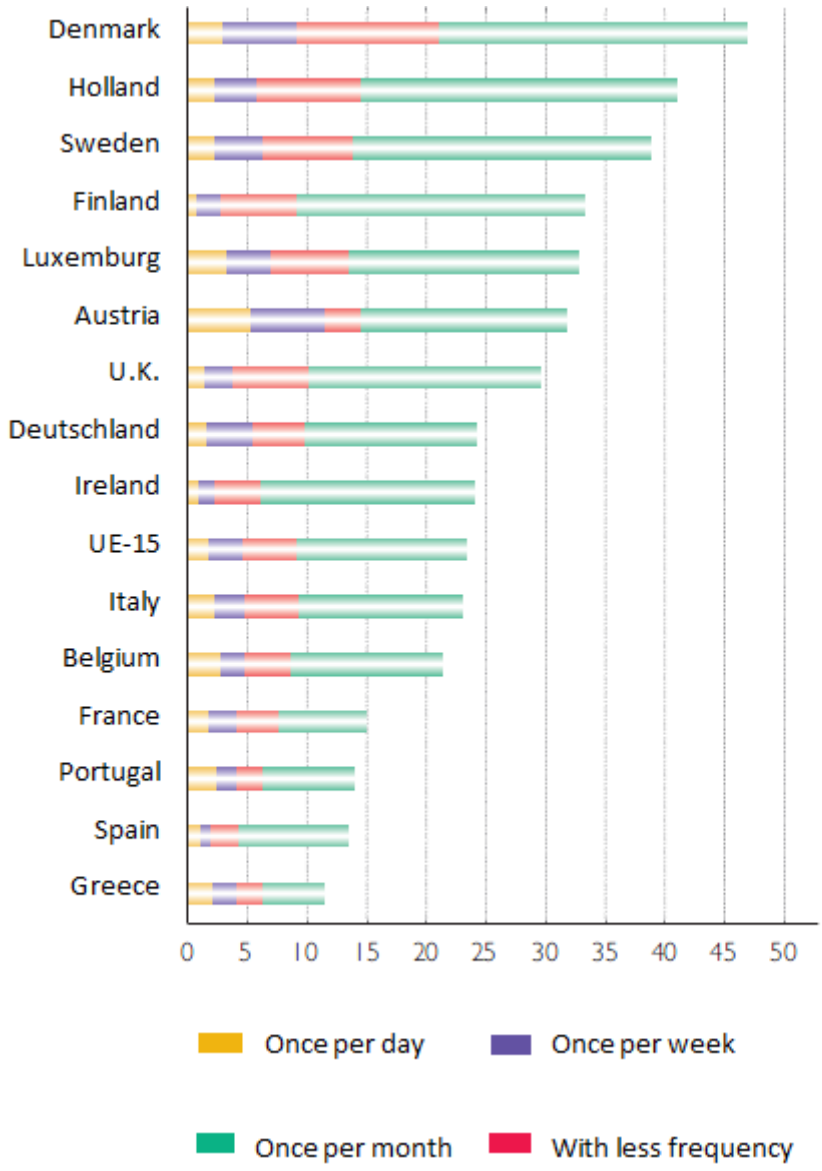

Figure 1: Internet search related with health. UE 2003, in % of the population

[3] http://www.internetworldstats.com (2012)
[4] Fundación OPTI y FENIN (2006)

Health has started to be like a service for the modern society. Hence, the "client-patient" requests an attention similar as if it was another service, and demands new channels of relationship with health professionals. In this context, e-health and the telemedicine appear.

2.3. E-health

E-health can have several definitions, but it can be explained and understood as the application of Internet and other related technology in the healthcare industry to improve the access, efficiency, effectiveness, and quality of clinical and business processes utilized by healthcare organizations, practitioners, patients, and consumers in an effort to improve the health status of patients.

E-health includes many dimensions:

Delivery of key information to healthcare partners

- Provision of health information delivery services
- Facilitation of interaction between providers and patients
- Facilitation of the integration of healthcare industry-related business processes
- Both local and remote access to healthcare information
- Support for employers and employees, payers and providers

Within this framework, the overarching goal is to improve the health status of patients. The infrastructure that supports e-health includes several aspects;

- Internet: universal access to information and sites with or without predefined security authorizations;

- Extranet: secure remote connections between predefined participants. This might have included the e-commerce arena;

- Intranet: support for a communications infrastructure within the enterprise, which may deliver access to internal and core data systems to all participants in the healthcare delivery process;

- Core Data Systems: function-based systems that support the key processes of the enterprise. These may be financial, clinical or administrative systems at any of the partners in the e-health arena. Systems such as the computerized patient record (CPR), PACS, admission and appointment systems, financial patient accounting systems as well as the internal infrastructure systems are included in this group.

- E-Mail: exchange of information between two or more partners using some combinations of the internet/extranet/intranet. Within the architecture this may be considered an application. However, it has become an essential reason for the adoption of the e-health framework by caregivers and patients.

- Telecommunications: the physical and technical layer that enables the connection and interchange of information through various media: wireless, fibre, cable, satellite, and other new and emerging means. Voice and email are interchangeable on some of the new devices. Recording, storing and transmitting this information falls within the boundaries of E-Health.

- Hardware: computers, pagers, personal digital assistants (PDA's), PC tablets telephones, servers and other hardware provide the physical support for this infrastructure.

The term e-health can encompass a range of services or systems that are at the edge of medicine/healthcare and information technology, including: electronic health records, telemedicine, m-health, virtual healthcare teams or knowledge management.

2.4. Telemedicine

Telemedicine, a term given in the 1970s, - the prefix 'tele' derives from the Greek for 'at a distance' – refers to medicine provided at a distance. More simply, it means the use of IT to improve patient's outcomes by increasing access to care and medical information. As such, it encompasses the whole range of medical activities including diagnosis, treatment and prevention of disease, continuing education of health-care providers and consumers, and research and evaluation.

Recognizing that there is no one definitive definition of telemedicine – a 2007 study found 104 peer-reviewed definitions of the word – the World Health Organization has adopted the following broad description:

> *"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities"*[5]

The many definitions highlight that telemedicine is an open and constantly evolving science, as it incorporates new advancements in technology and responds and adapts to the changing health needs and context of societies.

Historically, telemedicine had its first appearance back in the 19th century. Its first uses were with the National postal service; later, electrocardiograph data transmitted through

[5] WHO (2010)

the telephone wires were seen. The new telemedicine in a modern form appeared in the 1960s, introduced by the military and space technology sectors. It spread out to all the people and started to catch the attention by the television. Because of the constant evolution of science and technology, new forms of communication with digital methods, combined with a rapid drop in the cost of ITs, have sparked wide interest in the application of telemedicine among health-care providers, and have enabled health care organizations to implement new and more efficient ways of providing care.

The principal area in which telemedicine is applied are:

- Tele-consulting: Telemedicine resources are used to obtain a second opinion from a distanced healthcare professional, exchanging clinical information about the patient

- Tele-radiology: Telemedicine resources are used to transmit and exchange diagnostically radiology images and similar.

- Tele-pathology: Telemedicine resources related with clinical laboratory and electronically management of records and clinic history.

- Tele-dermatology: Telemedicine resources that involve dermatology. It is used with the help of videoconferencing or image transmission.

- Tele-psychiatry: Telemedicine resources are used to help patients with videoconferences and chats.

- Tele-surgery: Telemedicine resources are combined with virtual reality, robotics and artificial intelligence to realise support, supervise surgery procedures or even surgery at distance, like in the project LINDBERGH where the group of Professor Jacques Marescaux, the European Institute of tele-surgery, realized a surgery to extract the gallbladder from a patient in France, operating the ZEUS robot from the United States.[6]

From the telemedicine Spanish plan of INSALUD (2000), it can be defined that the term "telemedicine" includes the following services:

- Remote assistance: Consists in the uses of telecommunication systems to provide a medical assistance at the distance. We can distinguish between:

    - Consulting/Diagnosis: The capacity to realize remote consults between different professionals for the elaboration of a common diagnose.

    - Monitoring/Vigilance: Possibility to have a distance track of parameters related with an assistive process or a distance follow of the evolution of chronic patients.

[6] Velez J. (2003)

- Management of patients and administration: Covers the management of the administrative processes carried out in the health sector from a double point of view;
    - The patients get an easier relationship with the health system (consulting request, analytical tests, radiological…), where they see it like an altogether process.
    - The professional has a greater speed in the access and information exchange and improves the answer timing (access to clinical information of the patient, results from the tests…).
- Sanitary information to the population: Consists in introducing all the information regarding the health of the population in an easier way. It can be in an informative aspect to maintain a healthy living level (nutrition, lifestyle…), or to inform about specific diseases (HIV, Alzheimer…) like a measure to avoid these diseases or to support the personal care.
- Distance formation and information for professionals: it has the objective of supplying fonts of evidence and knowledge that permit the continuous evolution of the healthcare professionals in general.[7]

2.5. Telemedicine Benefits

Telemedicine provides us with multiple benefits in several aspects. Nevertheless, the benefits realized from the growing use of telemedicine can be separated into three perspectives:

1. Economic development and quality of life
    - Advancements in delivery of services: Some health services can be enhanced via telemedicine. For example, home health services are receiving a great attention and investment in some countries. Telemedicine technologies enable home health providers to redefine patient treatment plans, as they are able to increase patient visits due to elimination of a significant percentage of travel to patients' homes. Rural patients can now have access to professionals.
    - Keeps money in the local economy: Telemedicine helps provide service locally so people don't have to travel out of the community for care. Spending on health care is an especially significant portion of any economy. The money that can be kept locally will improve the local economy. Standard economic effects are also applied here: any money spent locally stays in the local economy.

[7] INSALUD (2000)

- Aids business recruitment and retention: Telemedicine provides the capability to deliver clinical services in the community. Locally available quality health care and quality schools are two important factors in the recruitment of new businesses, especially for businesses in rural communities. So there is a potential business recruitment and retention factor to consider.

- Workforce development / jobs: Nowadays, there is a high poverty and unemployment in our communities. One way to address that problem is to equip local healthcare facilities with advanced telecommunications services for telemedicine purposes. For instance, use the videoconferencing tool with an educational matter to train more local people for the jobs in healthcare that are available locally. Local jobs for local people could have a significant economic impact particularly for people who could not afford to travel outside the community for training.

- Quality of life and longevity gain: The use of telemedicine can have a significant impact on individual health and can therefore favourably impact longevity. The value to the economy through improvements in life expectancy is incredible.

2. Patients

    - Access to healthcare: Access to quality, access to healthcare to people who live in distanced areas, such as rural communities.

    - Saves time, travel, and other expenses: Telemedicine implies moving patients (and often parent or guardian) from an area where they reside to a place to consult with a medical professional. An obvious opportunity is the potential for transportation cost savings.

    - Healthcare at home: Homecare services are becoming an increasingly important part of the healthcare service. There are many reasons for this:

        - Patients are leaving hospital sooner and need some additional care at home while they recover.

        - Treating patients at home is less expensive than treating them in the hospital.

        - Patients prefer to stay in their homes as long as possible before moving onto a higher level of healthcare service.

        - Nurses can "see" more patients in a day, decreased the visit time and ended up costing 33-50% less than the traditional home care visit being less expensive.

- Health professional integration: The improved collaboration between professionals and patients enhances the confidence that all that can be done is being done.

- Acceptance of the technology: Television and computer applications are more common and not a foreign concept. Patients are accepting the use of these applications of technology.

3. Providers

    - Front line support: Instant access to information, whether it is about a certain patient or a certain topic, can be essential or even lifesaving.

    - Accuracy of diagnosis: Reduction of medical errors is a huge concern for the medical community. Getting the right answer on the first try is the best thing. With tele-assistance, it will be easier for a professional to get a second opinion on their diagnosis of a patient. With greater access to help, more patients will be treated correctly the first time. This leads to even more benefits, such as quicker average recovery time, less use of unneeded medicines, and reduced costs to patients and hospitals.

    - Increase in efficiency: Travel times for patients and doctors could be significantly reduced as well as research time and "paper handling" of medical records.

    - Continuous Medical Education: Telemedicine can deal with educational opportunities for healthcare professionals, patients, and families, improving clinical results and reducing hospitalizations. It gives the opportunity to participate in continuous education on medical advances without having to travel long distances.

2.6. Barriers to Telemedicine

Telemedicine is constantly evolving. It is being introduced in different countries and has been made a priority to incorporate telemedicine into their healthcare systems. It is a promising sector with high growth rate expected in the next years. Nowadays, the market is still fragmented with providers that operate at local or regional level. The IT solutions seem to not be a barrier by this time, but there are still many challenges that have to be dealt with:

- Evidence of the benefits associated with telemedicine services is still not enough for all the main chronic diseases: further studies and randomized clinical trials will be necessary.

- There is a market uncertainty due to the legal frameworks in this area.

- The lack of reimbursement by the refusal of the government to pay for the remote monitoring of patients still has to be clarified and fixed in many countries The completion of this step will probably enable the diffusion of large-scale services[8]

- The fast changing technology. With each passing year, technologies become obsolete. Systems need to be developed in such a way that any upgradation/innovation in technology could be easily uploaded.

- Privacy and confidential issues. Healthcare entities must adopt written privacy policies and procedures that define how they intend to abide by the highly complex regulation and protect individually identifiable health information.

- Resistance of aged population to the new technologies.[9]

- The financial cost is also a real problem and perceived barrier to the application of telemedicine. Equipment, transport, maintenance and training costs are costs that lots of countries cannot assume or are not disposed to assume.[10]

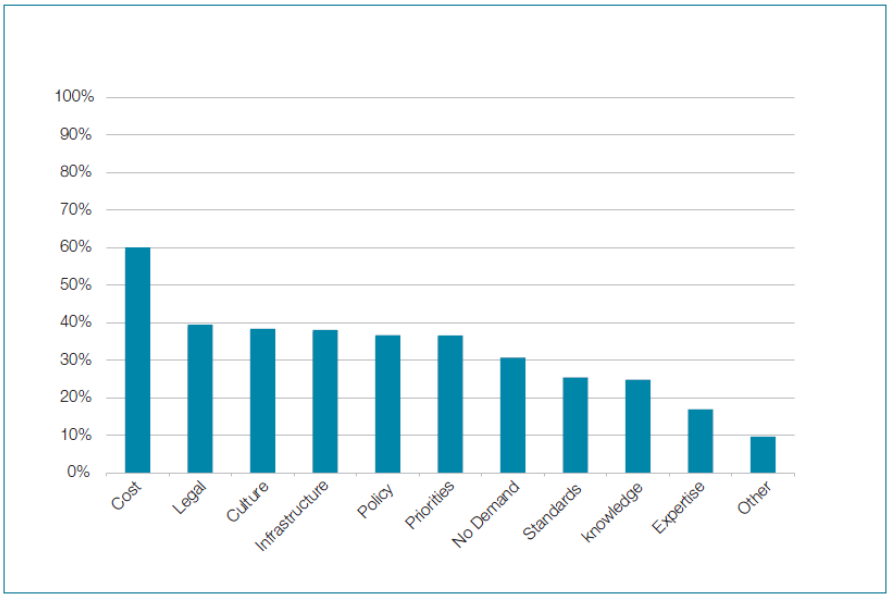

Figure 2: Barriers to telemedicine globally

[8] Chronious Project (2012)
[9] Frost&Sullivan (2008)
[10] WHO (2010)

2.7. M-health

Because of the health priorities and the spread of mobile technologies, a new field of e-health emerged; the m-health. M-health is the use of mobile computing and communication technologies in a healthcare system. M-health programs use mobile electronic devices such as PDAs and mobile phones, from clinical decision support systems and data collection tools for healthcare professionals, to support health behaviour changes and chronic diseases management.

M-health involves the use of a mobile phone's core utility of voice and short messaging service (SMS) as well as more complex functionalities and applications, including general packet radio service (GPRS), third and fourth generation mobile telecommunications (3G and 4G systems), global positioning system (GPS), and Bluetooth technology.

Nowadays the mobile phone is an extended device, with about 5.383 million subscribers all around the world. It has a penetration rate of the 77% and with view to a 98% by 2014.[11]

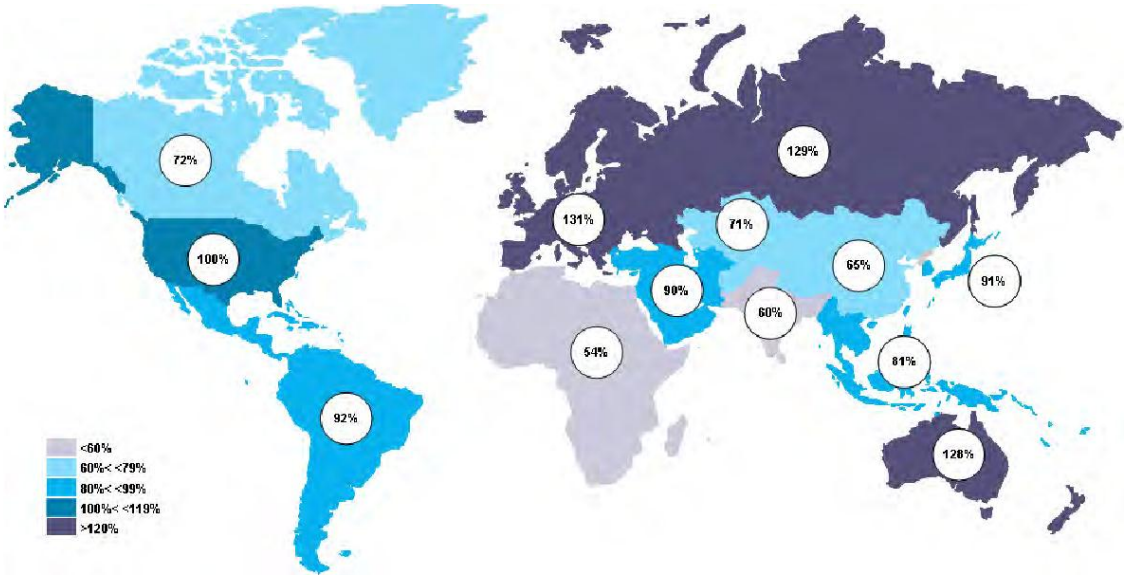

Figure 3: Mobile phone global penetration

M-health is being used because of its benefits. It provides a huge range of benefits for the healthcare system, and specially solves the main barrier in the telemedicine, that is: the cost.

- Reduces initial cost: Mobile technology is cheaper than the computing one, more people can afford one and be introduced to this kind of health.

[11] WHO (2011)

- Provides cost efficiency: It increases the care in low-cost settings, such as preventive care at home, to avoid higher costs later with a possible use of the emergency room, ICU...

- Increase access to care: M-health breaks down the barrier of physical location and time in the delivery of healthcare. It can increase the availability of care in rural areas where access is limited. Because mobiles have a higher penetration rate than internet, more users can have access to the healthcare system through them.

- Improves patients outcomes: It improves available information for care decision making. Recording information with home monitoring programs generates a more detailed and accurate perspective of a chronic condition.

- Facilitates health care models: Enables patients to take an increased responsibility of their health. The use of Smartphones increases the chance to consumers to review and track health information.[12]

2.8. M-health Barriers

M-health has a strong lack of base to verify whether it has a great impact on health outcomes and the health system or not. That is why the main barrier for all countries are the competing priorities. Conflicting priorities indicate that research is done to other programmes ahead of m-health.

The lack of knowledge concerning the possible applications of m-health and its outcomes is the next highest rated barrier. This shows the need for evaluation studies of this kind of healthcare system.

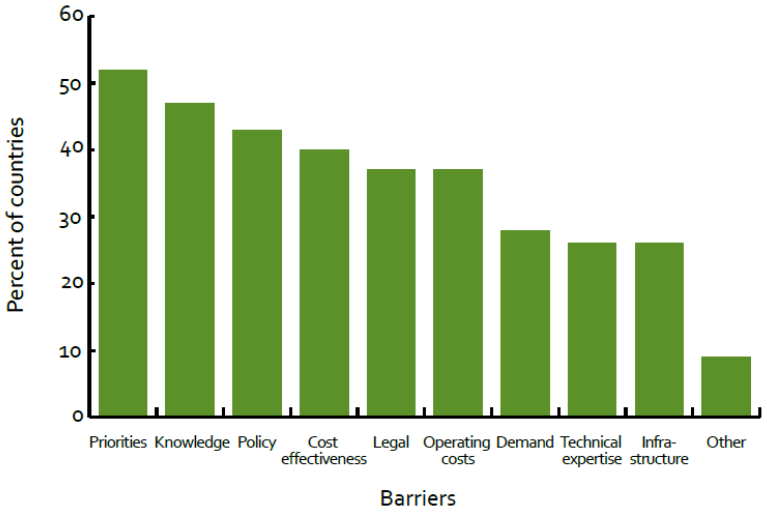

Figure 4: Barriers to telemedicine globally

[12] Accenture (2011)

3. Description of the work

During the last years health has emerged as an important matter to focus on. Since it has been facing various problems like scarce resources, poor quality and so on, new solutions had to be provided. Trying to improve the experiences with health forms, e-health appeared. It was done because of its multiple benefits such as the better quality of life that can be offered, the travel time saving, the possible health care at home etc.

The objective of this document is to compare different projects being realised in Spain, and in particular, in the Catalonia Region.

The methodology used followed this flow: a literature review on the e-health and telemedicine topic. The choice of different Spanish pilots. The review of the Palante project and the application of a taxonomy to categorize all the pilots.

Firstly, the document explains what is the actual situation in Spain in reference to e-health and telemedicine. It focuses on the methods in which Catalonia faces the development of these new technologies.

It explains the different European projects that are being or have been realised in Spain, describing the objectives of the projects, the users they address and how the services are implemented with their functionalities.

This document is framed in the context of the PALANTE project, which started at the beginnings of 2012. The project is described and exposes its different pilots, focusing on the two Spanish ones.

All the Spanish projects will be described to see their functionalities, and will be classified by a chosen taxonomy so that they can be compared between them in order to obtain some conclusions about the evolution of telemedicine in Spain and what are the tendencies that different projects are adopting to improve the healthcare system in the country.

4. Spain

4.1. Country introduction

Spain is a parliamentary monarchy, where the executive power is exercised by the President of the Government and the Council of Ministers. Spain has decentralised its administration and, nowadays, is divided into 17 autonomous communities, plus two autonomous cities (Ceuta and Melilla), which have competences in many areas. In this process, responsibility for most administrative services has been transferred to the regional level.

The Spanish health system is based on the principle that all citizens have the right to health, regardless of their economic and employment situation. The State is responsible for guaranteeing this right, by providing resources from the central budget. Apart from that, the Spanish health system has two levels of organisation: the central and the regional health services. The main body of the central administration is the Ministry of Health. The Ministry is in charge of the proposals and implementation of the government's general guidelines about health policies. The regional organisation of health services is the responsibility of the autonomous regions. The health planning must be based on the central administration policies, and each region is required to have its own health centre. Local health services are the fundamental structures of the Spanish health system. They are responsible for the unitary management of the health centres and institutions within each autonomous region.

The central government is responsible for coordinating the health sector. The Spanish Ministry of Health plays the role of the primary decision maker by establishing valid standards and requirements for healthcare provision.

4.2. E-health in Spain

Regarding e-health, Spain is in an initial phase, where different projects that involve telemedicine are realized. Telemedicine is not yet fully introduced, and diverse pilots in this area are being developed. They are being developed because the government launched two plans to boost the development of e-Government services, containing specific provisions concerning e-health in 2006.

The first plan is the Quality Plan for the National Health System, developed and presented by the Ministry of Health. The main objective of this plan is to respond to the challenges faced by the national health system. By targeting six different points:

- Protection, health promotion and prevention
- Promoting equity
- Supporting healthcare human resources planning
- Promoting clinical excellence
- Using information technologies to improve GP appointments for citizens
- Increasing transparency

The second plan is the Plan Avanza, which is included in the national strategy to boost research, development and innovation. Through the Plan Avanza the Spanish government hopes to further develop the "Knowledge Society" by modernising public services and promoting the expansion infrastructure. With regards to healthcare the plan contains a section called "Sanidad en Linea". It enhances the implementation of PCs and other devices for both administrative and medical purposes. [13]

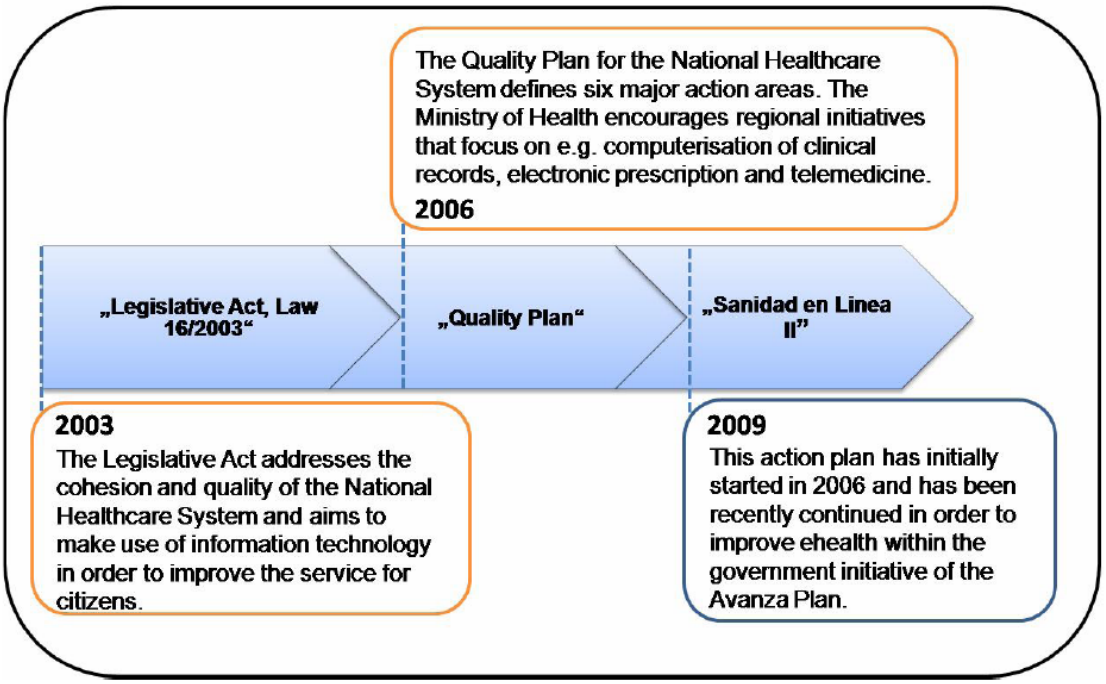

Figure 5: Plan evolution

4.3. Legal Framework

Legal and regulatory issues are concerning aspects of e-health. Privacy and confidentiality, liability and data-protection need to be dealt in order to make e-health applications possible. Countries still don't have a set of laws specifically designed to deal with e-health. That is why, e-health system and applications, have to be addressed within the existing laws on data protection.

In Spain the legal and regulatory field is characterised by three main laws:

- Law 15/1999 of 13 December on the Protection of Personal Data.
- Law 41/2002 of 14 November regulating the patient's autonomy and rights and obligations concerning information and clinical documentation.
- Law 16/2003 of 28 May on the Cohesion and Quality of the National Health System.

[13] http://www.planavanza.es

In the Data Protection Legislation there is the obligation to store health data and electronic clinical records in a decentralized way. This is repeated in the Law on Patient Autonomy. In the second law, a distinction is made between three types of health data:

- Medical or clinical documentation: related to a patient's specific care episode.
- Patient's medical record: contains information on the status and the medical evolution of a patient through the entire care process.
- Medical or clinical information: refers to the acquisition of knowledge on the physical and health status of a patient in order to provide him/her a better health observation, attendance and recovery. This keeps being maintained and updated by the healthcare professionals.

The decentralized stored data among the patients will be shared through the National Health System, where a National Plan created, guarantees the citizens that all healthcare professionals will only have access to the medical information that they require for their attendance.

The medical records will be maintained by health professionals, who will be responsible for the health insurance cards, including the data of every person in the region and for processing the data. The use of theses medical records will enable the consistency of data, avoiding simultaneous assignment to different health services.

These processes will become fully operational when various projects, such as e-prescribing or electronic clinical record are implemented.

Using the Spanish regulation, people who may have access to Electronic Patient Records are:

- Professionals from a medical centre as well as administrative staff have access – if the information is necessary to provide healthcare.
- Patients or their representatives – with the exception of access to personal comments by the health professional, where the professional can restrict access rights.
- The right of accessing a patient's medical history is cancelled when there is a conflict with the right of others and when the protection of confidentiality is in danger –for example when information was recorded for therapeutic reasons or when there is a conflict with the rights of a professional involved.
- Health centres can give access to medical records of deceased patients, for related persons or family – except the deceased has explicitly forbidden access to the files.[14]

[14] Fundacion Vodafone España (2011)

4.4. Present Stage

In Spain, primary healthcare centres provide public health services. GPs are meant to be the first point of contact in the health system and they solve more than 80% of the citizen's health problems. IT infrastructure is being introduced in Spain: a brief overview of IT implementation shows that:

- 77% of the Spanish GP practices use a computer. 51% of the Spanish GP practices are connected to the Internet and only 36% of the GP practices use a broadband connection.

- The storage of electronic patient data is only moderately common in Spain. At least one type of individual data is stored in 71% of GP practices.

- A computer is available in the consultation room of 74% of the Spanish GP practices. 95% of Spanish GPs actually use this computer for consultation purposes with the patients. Here it could for instance be used to display a patient's file to the practitioner, to explain medical issues to the patient by means of a photo or animation but also to run a decision support system helping in diagnosis or prescribing. A Decision Support System is used by 2% of the Spanish GP practices.

- In Spain the electronic exchange of patient data is not yet very common, neither for administrative data nor as far as medical data is concerned.

- 6% of the Spanish GPs exchange administrative data with other care providers. This compares to an average rate of 10% reached in the EU. 91% of primary healthcare centres are connected to their respective corporate networks. 30% of the Spanish GP practices receive results from laboratories electronically via Internet of other dedicated networks. 13% of the GP practices exchange medical data with other healthcare providers.

- The electronic exchange of prescriptions, commonly referred to as e-prescribing, is used by 18% of GP practices in Spain. These services are now available in Andalusia, the Balearic Islands and Extremadura. Five other regions, Canary Islands, Catalonia, Galicia, the Valencia Autonomous Region, and the Basque country, are expanding this service.

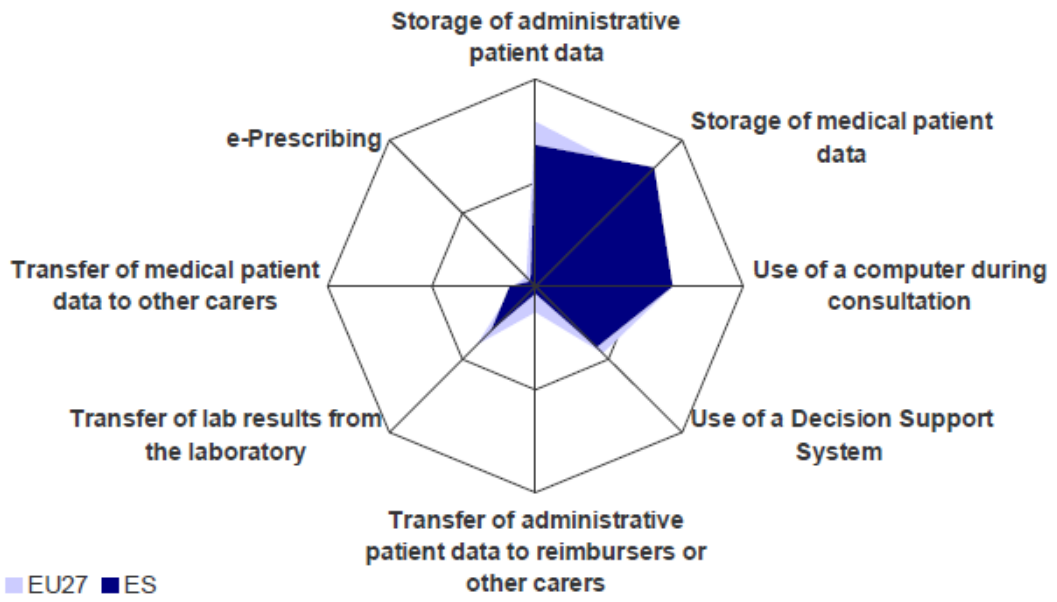

Figure 6: E-health use by GP's in Spain

The nowadays proposal is to increase these numbers, and continue introducing the IT to enhance the public health system: that is why all the different regions in Spain are developing and implementing projects in their healthcare systems. [15]

[15] Deloitte & Ipsos Belgiun (2011)

5. Projects in Catalonia

To achieve the objectives of incorporating and developing the IT in the healthcare system to rise up an e-health service, the Catalan department of health has created a strategic plan for the region. This plan consists of 5 different lines of development:

- **Shared Medical Record (HC3):** collects the set of documents that contain data, information and clinical assessment on status and progress of a patient along a care process. The HC3 allows any doctor to access all relevant information available about their patient, regardless of geographic location or level of care and promotes continuity of care, integrating all information and avoiding errors and duplication of examinations and / or procedures.

- **Personal Health Folder:** digital space that allows citizens to view the availability and use their personal health information in a secure and confidential way. The project, still under design and implementation, will provide a first stage where citizens will have access to relevant data in HC3 (medication and vaccines which have been prescribed and dispensed, medical reports, test results and additional examinations generated in health care). In a second phase, the citizen may have access to other fields of health information and a personalized access to all e-services and procedures that can be made through the network (an appointment with their doctor, modify personal data in the health card, track the status of their complaints or health certificates requests).

- **Image Digitalization:** aims to digitalize radiographic images and establish the basis for the future digitization of other medical images. At present, it is being done the creation of Medical Imaging Central Repository, which stores the images of the health centres in the public network, with a volume of 150 terabytes per year, and it will be a base for distributing the images of the citizen through the HC3.

- **Telemedicine**: aims to accelerate the implementation of pioneering technological applications, using telecommunications to optimize the quality and efficiency of health services in Catalonia. This plan prioritizes real-time communication between the professional and the patient, promotes tele-monitoring in the case of chronic patients with diabetes, respiratory failure and heart disease, and finally, facilitates communication between professionals of different levels of care for making diagnoses.

- **Health Channel:** is a website which brings together in an accurate, clear and scientific portal, health information. It is an information platform addressed, firstly, to citizens to take a better care of your health, and secondly, to health professionals who will find a framework for information and reference resources.

- **Electronic Prescription (Rec@t):** facilitates coordination among professionals, doctors and pharmacists, and incorporates a plan of medication of the patient, promoting the safe use of medicines and improving patient accessibility to pharmaceutical services.

To deal with these lines of development, different projects have been developed in Catalonia.[16]

5.1. Projects Developed in Catalonia

5.1.1. RENEWING HEALTH

One European project that has a pilot going on in a public Catalan hospital is a project named: RENEWING HEALTH (RegioNs of Europe WorkINg toGether for HEALTH).This project includes 9 regions from all Europe: being one of them, Catalonia.

The hospitals involved in the pilot are from two different areas in the region of Catalonia. Hospital Clínic covers a large area in Barcelona and Hospital de Mataró covers an area with a small city and small villages near Barcelona.

This project had it start at February 2010. The project will function as a multi-centre clinical trial measuring the efficiency and cost effectiveness of telemedicine solutions implemented. This will confirm the results of scientific tests, and thus may promote the adoption of systems for monitoring and treating patients at a distance scale. The project is supported by national health authorities of the participating regions that are responsible for defining the health budget, and are committed to implementing telemedicine services in its territory, once they have been validated on a large scale. It is realized, to be finished at end 2012.

The pilot deals with chronic obstructive pulmonary disease (COPD) patients with frail conditions. A total of 800 patients will be included in the intervention group of the pilot, which is nowadays in clinical trials by the hospitals.

The main objectives of the pilot are:

- Clinical objectives: the project improves the quality of life of patients suffering from chronic obstructive pulmonary disease. This objective will be achieved by means of removing anxiety about health conditions and reducing the need to use emergency services and hospital stays.

- Patient objectives: the project will provide coherent clinical services through ICT that take into proper consideration patients' and professional users' needs,

[16] Catalan Ministry of Health. http://www.gencat.cat/salut

capabilities, risks and benefits. The actions are planned to implement solutions that support the empowerment of patients and increase their satisfaction.

- Economic objectives: the project implements a new healthcare model that is expected to reduce the cost of chronic patients care to the society by progressively reducing the stays of these patients on expensive facilities, geared to tackle only the acute episodes of the chronic disease they suffer from and to replace them with more affordable homecare.

- Organisational objectives: the project intends to create an organisational model for telemedicine services that ensures a safe, clear and efficient pathway for patients in their journey through the healthcare system by creating standard patients programs for each telemedicine service that take into account the active participation of the patients.

Patients admitted at respiratory or internal medicine unit at the hospitals are candidates for the pilot. The service provided is adjusted to the patients, starting from a call centre support to a complete monitoring with biosensors, videoconference, personal health folder access and remote professional support.

A clinical management platform is the core of the IT infrastructure used. The platform manages the different intervention levels that patients receive, with pre-scheduled interventions, with fully customizable treatment by healthcare professionals. The platform manages the individualised programmes defined, and has scheduled activities in an agenda, to ensure the performance of the treatment. The results from the interventions are also collected by the platform, and showed to the professionals and the patients by accessing to the Personal Health Folder.

Figure 7: Renewing Health Platform

A mobile telephone is used for managing data collection from sensors and agenda.

Figure 8: Renewing Health Devices

The aim of the study is to evaluate the effects of a complex telemedicine intervention as a part of an integrated care program for patients with chronic obstructive pulmonary disease (COPD) on health services use and mortality, compared to conventional care in the two participating hospitals.

The pilot will be evaluated with:

- Clinical outcomes like readmissions, mortality, quality of life and user satisfaction.
- Economical outcomes like cost-utility and cost-effectiveness.
- Organisational impact to implement the service.

5.1.2. NEXES

Nexes is another European project that is being leaded by the Hospital Clinic de Barcelona. It involves other two regions from Europe: Trondheim, in Norway and Athens.

Nexes searches the use of ICT-enabled integrated care programs targeting chronic patients with respiratory disorders, mainly chronic obstructive pulmonary disease (CODP); chronic heart failure (CHF) and coronary artery disease (CAD) and diabetes type II.

The service started in 2008, and it is supposed to be ended by 2012. The total number of users is 2.040, which 1.670 are in Barcelona, 100 in Greece and 270 in Norway.

The services to be deployed are grouped in four programs that represent a spectrum of health problems, from those affecting citizens at risk or early disease to those characterising patients with advanced chronic disorders. The four integrated care services (ICS) explored are:

- Wellness and training (W&T) - The underlying hypothesis was that enhanced self-management of clinically stable patients using mobile Information and Communication Technologies (ICT) as part of a remotely controlled home-based training program has a positive impact on life style, disease progression and use of healthcare resources.

- Enhanced care for frail patients (EC) - It addressed prevention of emergency room consultations and hospital admissions in high risk patients. EC also explored frail patients that can benefit from ICS entirely managed by primary care professionals. EC includes transitional care post-discharge and palliative care.

- Home hospitalization and early discharge (HH) – This study investigated factors modulating extensive deployment of HH and, in particular, the role that ICT plays as one of the components of a comprehensive chronic care program.

- Remote support to primary care for diagnosis and therapy (Support) – Transfer of diagnostic and therapeutic tools to Primary Care and accessibility of tertiary care to home programs addressing complex issues will improve the efficiency of delivery of care and it generates cross-fertilization between levels of care.

The project plan foresees three main areas of work:

- Area 1 - Evolving from pilots to product/services: this area concerns the process modelling activities with the IT solution available. It includes:
    - Re-assessment of functionalities of current platforms equalizing different deployment stages to meet the programme requirements
    - Planning necessary technical adaptations to achieve platform modularity and integration via the use of open standards.
- Area 2 - Deployment, Integration and validation: this area represents the core of the project and encompasses:
    - The necessary logistics related to the running of the field studies (from preparation to execution)
    - The definition and application of a validation strategy covering the different dimensions of the project (Organizational and educational issues for professionals, caregivers and elder individuals; standardization of the interventions and service consolidation, and; identification of the technological requirements and limitations).
- Area 3 - Strategies for extensive commercialization of integrated care services: this area will summarise the project findings and present them from a practical perspective towards a real application.

This project is getting finished. It started in May 2008, and lasted 49 months, until June 2012. It is very recent to see all the results, but the first conclusions are:

- Recognition that we face very similar challenges despite the heterogeneities observed among European regions.
- Validation and deployment of novel integrated care services (ICS) for chronic patients should be our core activity. Successful adoption of those ICS will result in more efficient healthcare.
- Information and Communication Technologies (ICT) plays a pivotal role as enabling tool for the change but it was not identified as the main driving force. Implementation of simple and robust technological solutions is a must to ensure extensive adoption.
- Collaboration among regions was considered a key element to efficiently build-up the future landscape scenario for efficient healthcare in Europe.

5.1.3. BETTER BREATHING

Better Breathing is a European project with a cluster in Barcelona, more precisely, in the Hospital Clínic de Barcelona. It is a finished project, started in June 2007 and ended by February 2009. It was formed by ten partners in five European countries, in which there had been trials in four regions, Denmark, Norway, Catalonia and Wales.

Nowadays, the service is being further developed between the Hospital Clínic de Barcelona and TB-Solutions.

This project dealt with COPD patients. In the first year, the prevision was to deal with 1562 patients and with 3124 patients for the second year.

The project had four central objectives:

- To optimise the care of chronic patients both in hospitals and at home and to foster professional collaboration and capacity building across borders by utilising user-friendly ICT tools developed in a trans-national network;
- To have the developed Better Breathing model adopted by healthcare systems in the participating regions;
- To have the Better Breathing model integrated in national health strategies and implemented into daily practice in local healthcare organisations;

- To secure the sustainability of the model by ensuring that it becomes part of the recommendations for evidence-based treatment published by clinical societies

The goal of the project is to provide a model for the continuous care of chronic patients by using IT more effectively. This project wants to achieve the objectives by providing four different services:

- E-care: Non-invasive home monitoring of chronic patients by the use of ICT. The e-care service consists of treatment, care and monitoring in the patients' own homes. These ICT solutions are then installed in the patients' homes and include hardware, communication interface (audio and/or video) and measuring devices (spirometer, pulse oximeter etc.).

- E-rehabilitation: Training the patient in his/her own home by use of ICT. The e-rehabilitation service consists of training the patient, as well as providing education about the chronic disease from the comfort of the patient's own home. Pulmonary rehabilitation programmes (training and education) for COPD patients improve endurance and quality of life significantly. The programmes conducted by therapists. Due to the patient's poor health condition, the visit to the hospital is often difficult, so the provision of the e-Rehabilitation service eases these difficulties.

- E-community (Patient or Professional): Severely sick COPD patients have difficulties getting out of their own home and meeting other patients with the same disease. The Patient e-community is a sophisticated way of allowing chronic patients to virtually meet with other chronic patients from the convenience of their own home, and exchange experiences and advice on how to live with the disease.

- E-learning: Self-management of chronic disease. Training and learning is an important aspect when COPD patients are to manage their own disease. The Better Breathing eLearning service provides an effective and pedagogical tool that the patients can use, thus achieving greater understanding of the disease and their ability to manage it. The eLearning device is not a web-based service, but can be described as giving patients the right technical equipment and regular support by qualified healthcare professionals (i.e. specialised nurse); the patient learns faster how to administer the right dosage of medicine or to manage exacerbations, and thereby run into fewer complications in the future.

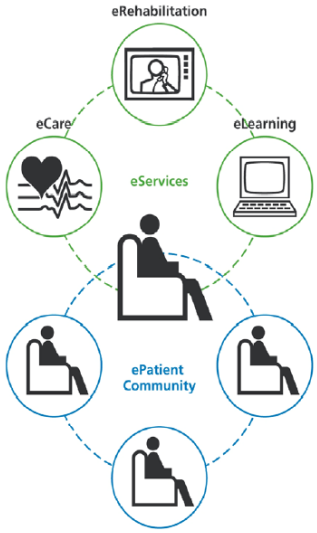

Figure 9: Better Breathing services

Two distinct services were piloted in the Better Breathing studies carried out in Spain:

- Spirometry service: Programme of quality control of spirometries carried out at primary care. Spirometry is a medical test used in the early detection, diagnosis and treatment of respiratory conditions, notably in the case of COPD. Even if the equipment's costs are usually affordable, the specifics of the usage have traditionally prevented its widespread application in primary care. This difficults the possibility of GPs to diagnose early this condition, or to be more precise, in the required treatment and follow-up.

- E-rehabilitation Service: Remote monitoring of rehabilitation sessions, as well as providing education about the chronic disease from the comfort of the patient's own home. The ICT solutions are installed in the patients' homes and include communication interface (audio and/or video) and measuring devices (spirometer, pulse oximeter etc.).

Once finished the project (using all the services, not only the ones in the Spanish poilot), it was able to respond some initial questions about the possibilities of the project:

- That it was possible to obtain "more health for the same or less money". It was demonstrated that the model can provide more health for the same or less costs.

- That a better care pathway was possible. Continuous care and improved collaboration was achieved.

- That a continual monitoring of patient's parameters enables prevention or early intervention. Readmissions were prevented.

- That patients impaired by the condition or living remotely could be offered the same services as in a normal set-up. It was possible to reach people over distance and provide high quality services.
- That needed support (between professional-professional or patient-professional) could be provided at the appropriate time. Both patients and health professionals gained access to needed information and support at the time they needed it.
- To encourage empowerment and self-care by supplying tools that facilitates patient involvement. Patients had access to more information on their disease and the ICT enabled care facilitated strong patient involvement.

5.1.4. HOME SWEET HOME

This is a European project conducted by different countries. There regions in which the pilot is developed are; Antwerp (Belgium), the North Eastern Region of Ireland, Latina (Italy), and Badalona (Catalonia, Spain).

This project will provide an integrated care environment addressing social and health services that combines, in a simple to use solution, monitoring, inclusive and domotic tools covering the essential needs, and trying to extend the independent living of elderly people.

The project started on March 2010 and will last 36 months, 27 of which will be used to validate the solution defined in different trials.

The trials are being done in the regions mentioned above, with patients distributed as following:

- 60 patients in Belgium
- 60 patients in Ireland
- 60 patients in Latina
- 30 patients in Catalonia

This project comprehends a large number of users; it is addressed to:

- Elderly people: they will see the time span in which they can live independently extended because the services compensate for their growing physical and mental impairments.
- Relatives and caregivers: they will be warned of situations of risk according to the

notification of protocols agreed for each type of risk, even when they are away.

- Contact Centre operators: they will be supported in their work through the automatic detection of risky and emergency situations and will have immediate access to essential information for adequate response (e.g. GPS coordinates of the location from which an alarm has been generated).

- Social Workers: they will keep in touch with elderly people they look after, even if they cannot be physically next to them, and will be therefore able to optimise the use of the limited time they have by better targeting their home visits.

- Healthcare professionals: they will be able to monitor frail individuals who are at permanent risk even when they are not within the premises of a healthcare outlet and prevent as much as possible the insurgence of acute episodes.

- Social and Health Authorities will receive reliable information on demand for services that they have to satisfy and will be therefore able to better plan resources and interventions.

The main objectives of the pilot are:

- To improve the quality of life of elderly people by extending their independent life, even if they live alone, while providing a level of safety equivalent or better than that enjoyed in elderly homes.

- To improve the quality of life of caregivers and relatives by offering both freedom from the care routine because part of their workload can be provided by the technology that the project offers.

- To improve the social connection of elderly people confined inside the four walls of house by allowing them to stay in touch visually through an intuitive videoconferencing system.

- To compensate for growing physical impairments by easy-to-use domotic devices which make it possible to manage a house if elderly people are no more able to move around.

- To demonstrate a more efficient business model for care provision, which will reduce the cost of healthcare to elderly people, through a better targeting of interventions, an early detection of situation of risk and a deterioration of mental conditions.

In order to achieve all the objectives mentioned, different services must be implemented:

- Monitoring and alarm handling services

- E-inclusion services

- Domotic services
- Daily scheduler
- Navigation services
- Cognitive training services
- Behavioural analysis

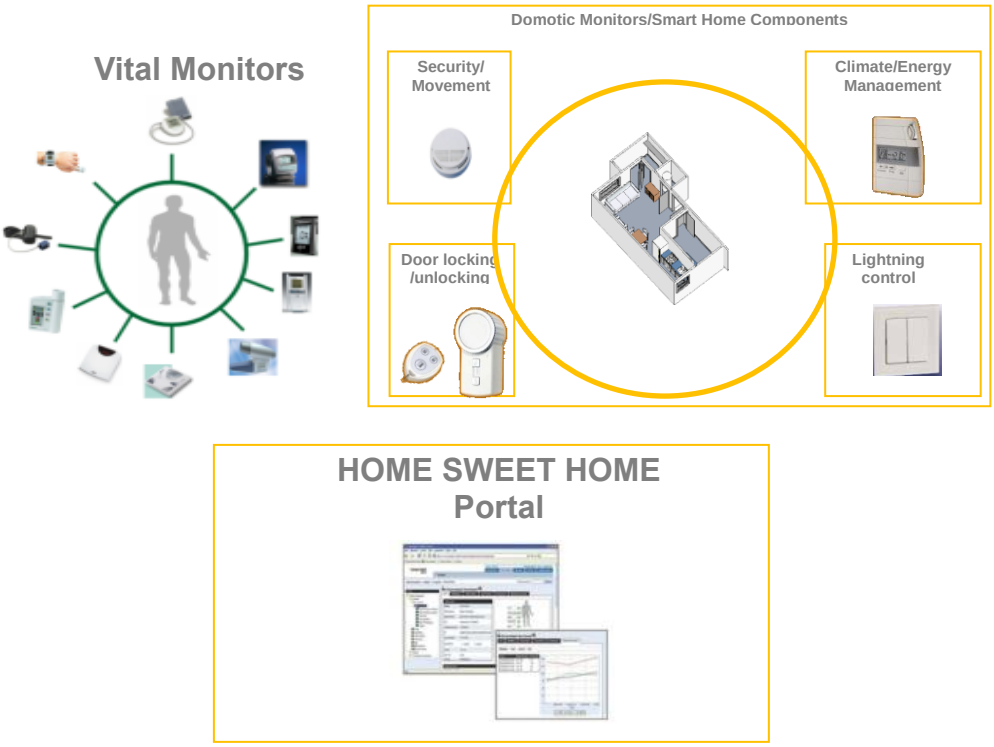

Figure 10: Home Sweet Home devices, domotic house and portal

5.1.5. ICARDEA

The acronym icardea comes from the project An Intelligent Platform for Personalized Remote Monitoring of the Cardiac Patients with Electronic Implant Devices.

According to consensus statement prepared jointly by the Heart Rhythm Society and the European Heart Rhythm Association, more than 800,000 patients in Europe have Cardiovascular Implantable Electronic Devices (CIEDs) for the treatment or secondary prevention of cardiac arrhythmias. This project wants to deal with those patients, it was set out to establish an interoperability framework to semi-automate the follow-up of

cardiac arrhythmia patients with care plans based on computer interpretable clinical guideline models by seamlessly accessing the CIED data and the EHRs of the patients.

The project involves several countries form Europe such as Turkey, Germany, Austria, Greece and Spain. In Spain, it has a cluster in Barcelona. It is being developed by the "Hospital Clínic de Barcelona".

The project had its start in February 2010, and it is supposed to be finished by January 2013 if things go as scheduled. The first trials have been made. The early trial was done by physicians and 5-10 CIED patients. The evaluation and validation of the final prototype, are supposed to be done by the Months 28-36. That's means, from June 2012 to February 2013. This evaluation will address 2 groups of 25 patients each.

The objectives the project wants to reach are:

- Reduce visits: CIED patients are usually scheduled to visit healthcare centres twice a year, which is a routine procedure even though the situation of the patient does not require it.

- Better care quality: The intermittent monitoring of cardiac rhythm is not enough to detect most of the remediable adverse events either because they are asymptomatic, or become apparent only after persisting long enough. With remote monitoring, CIED patients will be monitored continuously and no significant developments will be overlooked.

- Improved disease management: The data coming from the CIEDs are collected, analysed and stored at the data centres operated by the vendors, and only in case of emergencies, alerts are sent to responsible parties. This process pretends to be enhanced by icardea.

- Reducing Cost Without Compromising Quality of Care: By shifting the healthcare monitoring to the preferred environments of the patients, and by integrating healthcare processes and information, the project wants to improve the quality of healthcare and reduce its cost.

To achieve the objectives, the project wants to implement diverse services:

- Remote monitoring for implantable cardiac devices - develop an intelligent platform to automate the follow-up of the CIED patients with adaptable computer interpretable clinical guideline models which access data seamlessly in EHR data resources, CIED data and PHRs using standard interfaces.

- Integrating remote cardiac monitoring with EHR Systems - data coming from the CIEDs are collected, analyzed and stored at the data centers operated by the vendors, and only in case of emergencies, alerts are sent to responsible parties.

- Leveraging the potential of CIEDs as intelligent devices – using the information received to semi-automate the care and follow-up processes based on computer interpretable clinical guidelines.
- Enhanced use of EHR Systems – the platform will provide EHR interoperability so that information about patients' medical history can be viewed and used in the clinical workflow.
- Integration of indicators for the quality of service - introduce "Outcome Indicators" to measure the success of the care process so that it can be automatically combined with expert feedback to achieve a closed-loop system.
- Patient specific adaptive care - enhance underlying warning and alerting mechanisms for early diagnosis of further complications without altering CIED programs. It will be done, by providing additional data analysis and correlation mechanism generating patient specific alerts or warnings based on data accumulated in already established knowledge bases.
- Validation for effectiveness, privacy, trust and security - medical records and patient's context information cannot be disclosed indiscriminately and different healthcare providers must have different access rights.

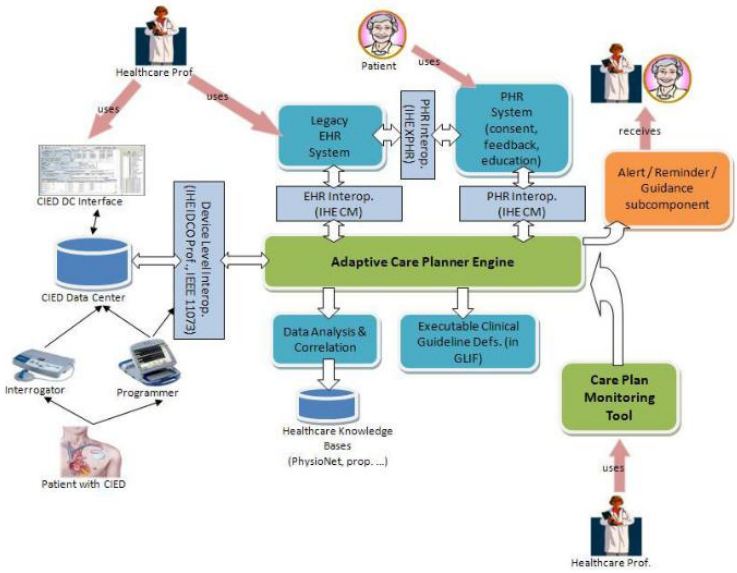

Figure 11: Icardea Flowchart

5.1.6. CHRONIOUS

CHRONIOUS proposes an adaptive and ubiquitous chronic disease management system that offers continuous monitoring to patients by using several sensors either in a form of a wearable solution or scattered in the patient´s living environment and a series of intelligent services to healthcare providers and organizations that aid them in the monitoring of their patients.

It is a European project that had a preliminary pilot in Italy and a second one in Spain. There are other partners from Germany, Portugal, Cyprus, UK, Austria, Switzerland, Greece and Czech Republic.

The project was started in February 2008, and it was finished by May 2012.

The consortium has identified potential target groups for the exploitation of the system, which include:

- Citizens and other end users: People suffering from Chronic Obstructive Pulmonary Disease (COPD) and Chronic Kidney Disease (CKD), who are sensitive as far as their health is concerned because of their need for continuous medical treatment with a specific health condition monitoring plan.
- Health Professionals: Chronic Disease specialists, who perform all medical procedures and monitor chronically ill people in order to provide high-quality and personalized medical care services. Furthermore, they will be able to use their time in the most efficient way without their physical presence which in most cases is extremely costly.
- Organizations: Hospitals, Nursing Homes, Clinics and Rehabilitation centers, which need to provide high quality and personalized health services. Health Care Organizations/Institutes, who wish to provide the abovementioned services to their chronically ill patients.

Targeted patients were grouped with respect to their pathology (COPD and CKD) and its level of severity, thus identifying five groups. For each group of patients, the project has specific objectives:

Patients	Objectives
- Severe and very severe COPD	- Reduction of hospitalizations due to exacerbations
- Mild and moderate COPD especially if with comorbidities	- Reduction of the accesses to the secondary care - Increasing in the quality and appropriateness of care
Moderate and severe CKD patients	- Better adjustment of therapies and prescriptions - Increasing in the compliance of patients

	to the treatment - Retarding of CKD progression
People with risk factors for CKD or initial-stage patients	- Better lifestyle management - Early referral of CKD and slowing progression of CKD
End stage renal disease patients that undergo peritoneal dialysis at home	- Better regulation of therapies and identification of critical situation - Reduction of the utilization of healthcare resources (especially drugs)

Table 1: Chronious objectives

The main elements of the project that have to be implemented are:

- Use of integrated wearable sensors.
- Development of very simple and friendly interfaces.
- Implementation of new algorithms and methodologies for assessing information coming from the different sensors.
- New decision mechanisms and instruments aiming at enhancing both patients and physicians possibilities in deciding in real time how to react.
- Decision support system.
- Collection and management of appropriate and validated medical knowledge.
- Interoperability with existing systems based on common standards to exchange useful information.

The Chronious system has to be validated, in two phases (A and B), by the healthcare professionals according to pre-defined validation protocol.

The Phase A is a pilot done in Italy; 50 real subjects (30 in the Careggi Hospital in Firenze and 20 in the Feltre Hospital) were recruited in order to test and validate the system's components and services. The main expected results were the determination of accuracy, reliability and usability of the platform and the creation of a database of experimental tracings from healthy subjects and patients.

In the Phase B, the prototypes have been enriched from the previous phase. Trials have taken place in Spain, to validate the system and its services on 60 patients, in home settings. Phase B finished at the end of May 2012. A complete data analysis of all collected information is being done.

6. Projects Developed in Spain

6.1.1. PERFORM

The PERFORM project aims to tackle problems associated with the efficient remote health status monitoring, the qualitative and quantitative assessment and the treatment personalisation for people suffering from neurodegenerative diseases and movement disorders, such as Parkinson's disease (PD).

This project is being developed by Siemens Spain, helped by the University of Madrid, and with other partners from the rest of Europe – Greece, Poland, Italy, UK, Cyprus and Czech Republic. It has its beginnings in February 2008, and it is foreseen to last about 42 months. It will have four differenced phases and the patients of the trials realized will be from Greece, and from the region of Navarra in Spain.

The main objectives of the project are:

- A system for the individualized monitoring of the motor and behavioural status of patients suffering from neurodegenerative diseases such as Parkinson's.
- Early detections of the frequent therapy-related complications and monitoring of the effectiveness of the undertaken measures for their management.
- Increase efficacy of treatment by neurologists, by offering a set of objective patient's data, adequately combined and correlated.
- Advance medical research through the provision of innovative decision support tools and the exploitation of the vast pool of monitored parameters and the generated statistical data for the production of new diagnostic models and protocols.
- Reduce the cost and improve quality of life for these patients and their families, through reduced number of hospital visits, and better and timely interventions.
- Reinforce European strengths in mobile and wireless communications systems for health.

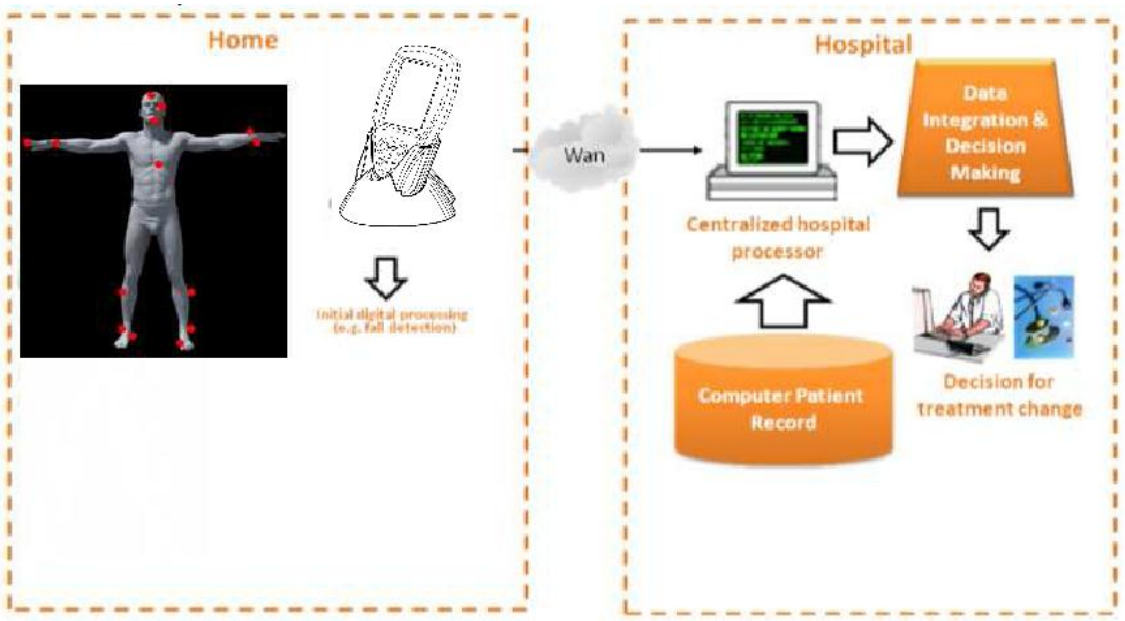

Figure 12: Preform flowchart

To achieve those objectives, this project will be achieved through the implementation of a multi-sensorial, wearable system that will constantly monitor the motor status of the patients in addition to other physiological signals. This data will be processed and integrated by the system to obtain a quantitative overall evaluation of the status of the patient.

The system will also keep track of the times and doses of the patients, along with the times and compositions of their meals. Symptoms and medicine and meal intake will be correlated and evaluated by the system and result in recommendation aimed at maximizing the quality of life of the patients. The recommendations provided by perform will not only be valuable to the patient, but to the general practitioner who has little or no experience with neurodegenerative diseases.

The pilot will try to develop and implement:

- A Multi-parametric wearable monitoring system to recognise health status and detect pattern of symptoms of motor disorders in patients with Parkinson's disease.
- Designing an intelligent close-loop mechanism that will be used to inform the patient about the appropriate actions to reduce disease signs and progression.
- Implementing a Remote Monitoring and Health Care support system with intelligent decision tools that assists general and specialized physicians to identify better patient-specific treatment standards when and where needed.

As mentioned before, the project has four phases to be accomplished:

Phase I: Collection of data from healthy persons - The objective of this phase is to test the experimental set up of the designed patient monitoring solution and the collection of data that will serve for the initial stage of development of the algorithms for PD symptom detection and quantification.

The patients involved in this phase are 20, - 10 in Greece and 10 in Navarra. The inclusion criteria are healthy people that can stimulate patient symptoms.

Phase II: Hospitalized outpatients - The objective of this phase is to test the first daily monitoring prototype on real patients and the collection of data that will serve for the adaptation of the developed algorithms from simulated symptoms to real patient symptoms.

The patients involved in this phase are 10, - 5 from Greece and 5 from Navarra. The inclusion criteria are; diagnosis of PD, ages 18-85, experiencing motor fluctuations and the presence of a caregiver who can cooperate with the patient and doctor.

Phase III: Outpatients at home – The objective of this phase is to evaluate the system with real patients at home. The aim is to identify the success of the system in identifying correctly the status of the patient. The data collected by the device in conjunction with those collected by the patient and the caregiver will assist the physician to quantify the patient's symptoms and estimate the real functional disability during the day, the duration of "on" and "off" states, the existence of "sudden offs" so as to successfully regulate the patient's medication dosage.

The patients involved in this phase are 24, - 12 from Greece and 12 from Navarra. The inclusion criteria are; diagnosis of PD, ages 40-60, experiencing motor fluctuations, the presence of a caregiver who can cooperate with the patient and doctor and the capability of operating the device.

Phase IV: System evaluation – Evaluating the project prototype.

The patients involved in this phase are 25, located in Italy. The inclusion criteria are; diagnosis of PD, ages 18-85, experiencing motor fluctuations and the presence of a caregiver who can cooperate with the patient and doctor.

6.1.2. METABO

The project Metabo is being realized by some European partners. The Spanish cluster is in Madrid, more precisely, it is being held by the "Hospital

Clínico San Carlos" in Madrid. The other partners are from Czech Republic, Finland, Greece, Italy, Malta and Luxemburg.

This project started on January 2008 and arrived to an end on June 2010, after 42 months.

The mission of METABO is to contribute to the improvement of diabetes management by providing patients and medical doctors with a technological platform to help them share and gather information that will allow them to enhance patients' self-management and improve medical therapies and diagnose.

To provide an extensive user-oriented validation of the METABO platform six different scenarios will be used as a conceptual framework. The six major application scenarios, called SEGMENTS are:

- Sudden Hypoglycaemic prediction: Problems related to hypoglycaemia in diabetics, is that patients tend to lose awareness of early symptoms. This can lead to dangerous situations. The study of early hypoglycaemia sings makes them prevent hazardous conditions.

- Changes in the Environment: Segment dedicated to study the conditions in which diabetic patients are exposed to changes, which can cause a disruption in their treatment routine or a need to adjust the routine to new conditions.

- Physical Activity: It focuses on the effect of physical activity on glucose metabolism and diabetes control. Physical activity is a known risk for hypoglycaemia, but it can also be turned into a tool to reduce insulin intake.

- Lack of Motivation: Diabetes is a chronic disease highly demanding in both, the physical and psychological dimensions. The patients must be motivated and controlling the situation so that they do not need to deal with an unstable metabolic state with health consequences.

- Unstable Diabetes Control: Addresses the cases of patients who cannot reach metabolic stability despite the treatment strategy. The project tries to isolate the different factors that should be monitored in these cases, such as; food intake, physical activity, lifestyle, insulin intake etc.

- Comorbidity Disease Management: Patients with comorbidities (presence of one or more major diseases related or not to diabetes) represent a significant challenge for clinical medicine as one disease may affect progression and response to treatment of the other

All in all, the project addresses the need of health care practitioners to:

- Develop and implement more effective and adaptive monitoring and modelling processes of metabolic diseases for clinical research purposes, as well as improving care provision.

- Design, develop, implement and validate an integrated system and technology interoperable platform for the effective monitoring of metabolic parameters of diabetic patients

- Generate predictive personalized models and their application in care processes of diabetes.

To do so, the services to be implemented within the project are:

- Use and integration of available sensors and medical devices to collect body and health parameters, environmental and contextual data, behavioural responses to stress life situations to identify and detect the effects on personal metabolic process.

- Personalisation and adaptation of sensors and other equipment (cameras, electronic components of cars, etc.) and of the software to detect and record the necessary data.

- Design and implementation of a technical platform arranged for interoperability and data transfer among different monitoring devices, based on shared semantics.

- Design of algorithms for detection and analysis of facial expression, eye movements, body posture for early prediction of hypoglycaemic episodes.

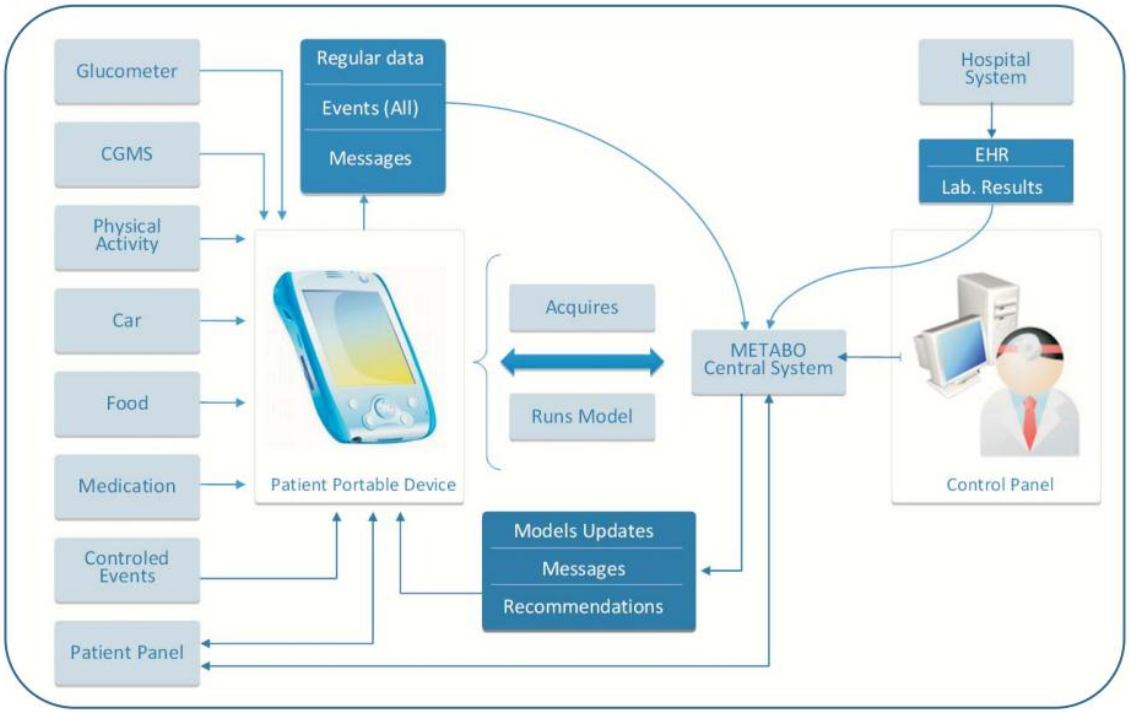

Figure 13: Metabo flowchart

The project has been realized in five different centres. In each centre, a pilot has been realized. The pilots are divided in diverse phases, which are common. The five, centres

are – Parma (Italy), Madrid (Spain), Modena (Italy), Paris (France) and Prague (Czech Republic).

Phase 1 is the system training, where the implementation of a multi-centric observational study collecting real-life data of diabetic patients will take place. This phase involved from 5 to 10 patients in each pilot.

Phase 1.5 is the system validation. This phase has been used to test the system inside the clinical context.

Phase 2 is the clinical validation. It is the final step in the scientific activities. It will test the use of the system against the non-use (current clinical practice) to assess the effectiveness of the procedure.

6.1.3. PSYCHE

The acronym PSYCHE stands for (**P**ersonalised monitoring **SY**stems for **C**are in mental **HE**alth).

This is a European collaborative project realized by diverse partners. The Spanish partner is in Madrid, the "Universidad Politécnica de Madrid". The other ones are from Czech Republic, Germany, France, Ireland and Italy.

The project started in January 2010, and it is supposed to be finished 40 months later, by May 2013.

The project is focused on mental diseases management; in particular it is targeting bipolar patients. It wants to provide a system that aims at empowering bipolar patients to take control of their own health status, providing educational content and providing a continuous assessment of the patient's mood both for patients and health professionals, and promoting the communication between patients, their peers and health professionals.

The project will try to approach indexes and trends after a 24 hours monitoring of patients in a natural setting, so that that it can be used to assess mood status, to support patients, to predict and anticipate treatment response at its earlier phases, to prevent relapse and to alert physicians in case of critical events.

The main objectives are:

- Scientific objectives are:
    - Improve disease management for bipolar patients
    - Develop a mood status assessment for patients in a natural environment

    - Predict treatment response and prevent relapse
    - Develop a closed-loop interaction for patients and medical professionals
- Technological objectives are:
    - Enable naturalistic physiological and behavioral parameters sensing
    - Develop of bipolar patients personalized monitoring platform
    - Data management for the assessment of psycho-physiological patient status
    - Decision support system for patient management
    - Improve patient and physician interaction

To achieve those objectives, the project will implement some services:

- Integration of sensors for physiological and behavioural data into a monitoring system for patients affected by bipolar disorders.
- Development of novel portable devices for the monitoring of biochemical markers, voice analysis and a behavioural index correlated to mental illness. Special emphasis will be placed on the reliability of these systems and user acceptability.
- Implementation of an integrated system to collect data from bipolar patients. The collected data along with the subjective annotations will be recorded in a reference database, where information from the EHR such as medication, patient history and exams, will be integrated.
- Data managing: the large amount of data will be analysed to correlate patient status assessment (from health professional annotations and other clinical findings) with the measured parameters. The ultimate goal is to identify signal trends indicating detection and prediction of critical events.
- User interface: once the group of patients has been selected, the most adequate input and feedback methods will be defined. Adequate devices will be chosen depending on user needs and expectations, and therefore different dialogue strategies will be defined depending on the selected devices and interaction techniques.
- Professional interface: mental health professionals involved in the project will perform patient monitoring tasks. A user friendly environment will be developed where, through easily formulated queries, medical professionals will be able to view current patient data as well as information extracted from electronically stored medical files.

One part of the project is a Wearable Wellness System involving a multivariable electronic monitoring device allowing the recording of heart rate, respiratory rate and movements, connected to a t-shirt or bra with electrodes in its textile structure.

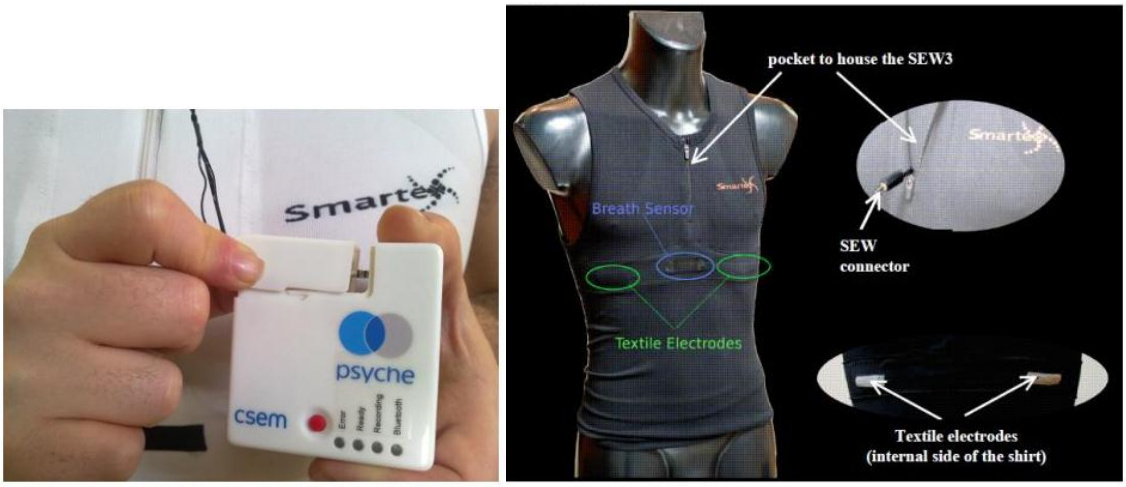

Figure 14: Psyche devices

A preliminary study about the feasibility and acceptability of the WWS system in bipolar patients has been done in a first trial.

A pilot study has been performed with these first generation prototypes within 8 bipolar patients (6 men and 2 women) during moderate hypomanic or depressive phases at different times.

Every subject was monitored during 2-3 day (in laboratory) + night (at home) sessions and 5 night only (at home) sessions.

6.2. Summary Table

Pilot	Where in Spain	When	Actual State	Type of Patients	Number of Patients	Services implemented
Renewing Health	Hospital Clínic de Barcelona Hospital de Mataró (Catalonia)	February 2010 – January 2013	Clinical trials by the hospitals are being done	COPD patients with frail conditions	800 patients	- Call centre support - Complete monitoring with biosensors - Videoconference with health professionals - Personal health folder access - Remote professional support - Clinical management platform
Nexes	Hospital Clínic de Barcelona	May 2008 – June 2012	Evaluating the project after trials have been made	COPD, CHF, CAD and diabetic type II patients	1.670 in Barcelona, 100 in Greece and 270 in Norway	- Self-management of stable patients by usage of mobile ICT - Enhanced care of frail patients - Home hospitalisation and early discharge - Remote support to primary care for diagnosis and therapy
Better Breathing	Hospital Clínic de Barcelona	June 2007 – February 2009	The service is being further developed	COPD patients	- First year: 1562 - Second year: 3124	- Non-invasive home monitoring - E-rehabilitation (training patients through ICT) - Possible videoconference with health professional
Home Sweet Home	Badalona (Catalonia)	March 2010 – March 2013	Clinical trials are being done	Elderly people	60 in Belgium, 60 in Ireland, 60 in Latina and 30 in Catalonia	- Monitoring and alarm handling services - E-inclusion services - Domotic services - Daily scheduler

						- Navigation services - Cognitive training services - Behavioural analysis - Virtual platform
Icardea	Hospital Clínic de Barcelona	February 2010 – January 2013	First clinical trials have been done. Evaluating the final prototypes.	Patients with CIED	First trials: 5-10 patients Final evaluation: 50 patients	- Remote monitoring of cardiac devices - Integrating monitoring with EHR systems - Enhance CIED operations - Indicator of quality of service - Patient specific adaptive care
Chronious	Universitat de Barcelona	February 2008 – May 2012	Analysing the collected data from phase B	COPD, CKD patients	Phase A: 50 patients in Italy Phase B: 60 patients in Spain	- Remote monitoring through wearable sensors - Integrated platform - Decision mechanism to real time react - Decision support system - Medical knowledge -Interoperability with existing systems
Perform	Navarra (Spain)	February 2008 – September 2011	Ended	Neurodegenerative disease and movement disorders patients	First 3 phases in Greece & Navarra Phase I: 10 & 10 Phase II: 5 & 5 Phase III: 12 & 12 Phase IV: 25 Italy	- Multi-parametric wearable monitoring system - Inform the patient about the appropriate actions to follow - Health care support systems for physicians
Metabo	Hospital Clínico San Carlos	January 2008 – June 2010	Ended	Diabetic patients	Pilots done in: Parma, Madrid, Modena, Paris and	- Sensors and medical devices to collect body health parameters

	(Madrid)				France with 5-10 patients each	- Personalisation of equipment - Technical platform -Algorithm design for episode detection
Psyche	Universidad Politécnica de Madrid	January 2010 – May 2013	First clinical trials have been done	Bipolar patients	8 patients	- Integration of sensors - Portable devices - Integrated data collection system in EHR - User interface creation - Professional interface creation

Table 2: Summary of Spanish projects

7. Palante Project

"PALANTE - **PA**tients **L**eading and m**AN**aging their heal**T**hcare through **E**Health project" focuses on the idea of "patient empowerment" that has become an element of high priority in the EU health strategy, supported by national and regional health authorities. Patient empowerment is the situation where an individual is an active member of his/her own disease management team. Patient empowerment integrates multiple concepts that allow a patient to effectively self-manage his/her disease. In a context of aging population and increasing number of chronic patients, it is considered a key tool to reduce healthcare costs and to improve quality and efficiency of the health delivery process.

The Project considers the implementation of seven new pilots – Andalusia, Lombardy, Turkey, Norway, Austria, Czech Republic, Basque Country - and the evaluation of two additional ongoing ones – France and Denmark - involving twenty-one partners in ten different countries. All the pilots address the issue of patient's secure access to their own health information. Additionally, five of these pilots deal with integrated chronic disease management support, including comprehensive self-learning, education and monitoring system, with a focus on diabetes, chronic heart failure, severe arthritis and respiratory diseases.[17]

[17] POLIMI, FPM and all Pilots (2012)

7.1. Palante Projects

7.1.1. Lombardy Pilot

The Italian health care system is a regionally based national health service (Servizio Sanitario Nazionale (SSN)) that provides universal coverage free of charge at the point of service.

The Lombardy Health System has been focusing on the development of IT tools to improve and rationalise health care processes for some years: the central project of the entire Regional Administration is the consolidation and development of the Social Services and Health Care Information System (SISS). SISS involves all healthcare-related organisations in the region. Currently the SISS involves almost all public healthcare organisations in the region, about 94% of the GPs and pediatricians, and with more than 9,9 million CRS cards released, the coverage encompasses almost the entire population. The main objectives of the SISS Program are to unify and to protect, within a co-ordinated system, all the information related to the citizens' state of health.

Currently, the SISS enables the following services:

- General services
    - Identification and authentication (for both operators and citizens).
    - Digital signature (embedded in the card using PKI, RSA).
    - Encrypted mail.
- Health care services
    - Prescription and Provision of Healthcare Services.
    - Electronic Health Record.
    - Support for GP's patient dossier.
    - Test result consultation.
    - Booking Process.
    - Emergency data management.
    - Accounting information flow management.
    - Clinical information exchange among HC Professionals.

The Pilot, is addressed to patients affected by chronic heart failure, and has been designed keeping in mind the following general goals.

- Clinical objectives

    - To improve clinical compliance.
    - To improve the quality of care.
    - To improve the quality of life and patients' functional status.
- Economical objectives
    - To reduce re-hospitalizations and related costs.
- Organizational objectives
    - To introduce a tool for Integrated Care Pathways – ICP (Percorso Diagnostico Terapeutico PDT) to support the connection between hospital specialists and GPs.
    - To extend the number of services as well as the number of included operators.
    - To extend the structured data available for semantic interoperability (e.g. Patient summary and structurization, Structurization of laboratory data etc…).

The services to be implemented in the Lombardy Region to achieve the goals mentioned are:

- Providing both specialists and GPs with access to the Integrated Care Pathways information
    - Through a specific ICP folder all the Electronic Clinic Documents (ECD) related to a disease will be available in the EHR, facilitating also the collaboration among specialists and GPs
    - Specific ECD: Electronic Clinic and Scheduling Document and Electronic Life Style Document
- Provision of notifications, reminders and alerts
    - Integrating them in the public service platform or using third party providers, such as trusted service centers, the solution will offer different kind of notifications according to the specific activity of the ICP.

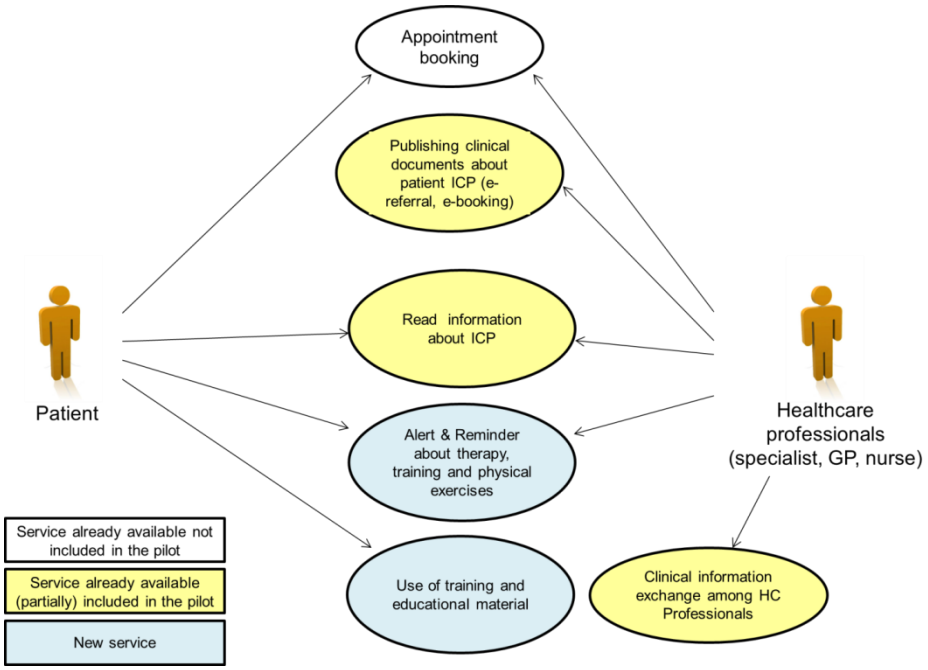

Figure 15: Lombardy pilot services

7.1.2. Turkey Pilot

In Turkey the Ministry of Health is primarily responsible for setting health policies, implementing national health strategies and directly delivering health care services. The Ministry of Health is the main provider of primary and secondary care, maternal and child care, and family planning services. It is also the single provider of preventive services through family health centres and population health centres. All public hospitals, dispensaries and health care facilities belonging to other bodies were transferred to the Ministry of Health in 2005; at this point the Ministry had 848 hospitals, 4.371 health centres and 7.224 health posts.

The Turkish Ministry of Health has integrated some health information systems in the e-health policy, such as:

- The National Health Information System (NHIS-T) that has already EHR records of more than 60 million citizens out of the 74 million population of Turkey.
- The Family Medicine Information System (FMIS-T) is another national system, this time for primary care only, covering all the population.
- The Centralized Hospital Appointment System (CHAS).

In addition to these major eHealth systems,the Ministry of Health is in an effort to realize the to-be Turkish Personal Health Record System (PHR-T), based on the

eSaglikKaydim PHR platform of Software Research Development and Consultancy - SRDC Ltd.

ESaglikKaydim is already integrated with NHIS-T and FMIS-T in a pilot environment, but not yet open to public, with the mission of empowering patients in the management of their own health care.

Thanks to PALANTE project, eSaglikKaydim will be enriched with new services and functionalities. The main service that will be developed and integrated into eSaglikKaydim within the scope of PALANTE Project is the Virtual Arthritis Clinic Service (VACS), based on well-accepted clinical guidelines and care plans. This service will provide treatment support and lifestyle guidance to the patients who have severe arthritis. The pilot will start off with 100 patients in an initial phase, which afterwards will be increased to 2000 patients to evaluate the processes.

VACS will have three modules which are stated below:

- Care Plan Engine
- Care Plan Execution Monitoring Tool
- Patient Networking Module

Care Plan Engine will evaluate the predefined care plans, collect necessary information from several data sources such as EHR and PHR of patient and will behave as a decision support system.

Care Plan Execution Monitoring Tool will provide interfaces for following up the care plan execution process. Patients will be able to see what stage at their disease are, what are the possible results under which conditions. Shortly, they will be able to access the information about their treatment process in detail.

Patient Networking Module will provide interfaces for patients to share their information with other patients having same disease. This will provide collaboration between patients, supporting each other and sharing experiences. Moreover, with the consent of patients, statistical results will be provided to doctors. With these results, doctors will be able to make more accurate decision on the treatment of patients and this will improve the quality of the care given.

With the pilot implemented, the initial treatment system will develop like this:

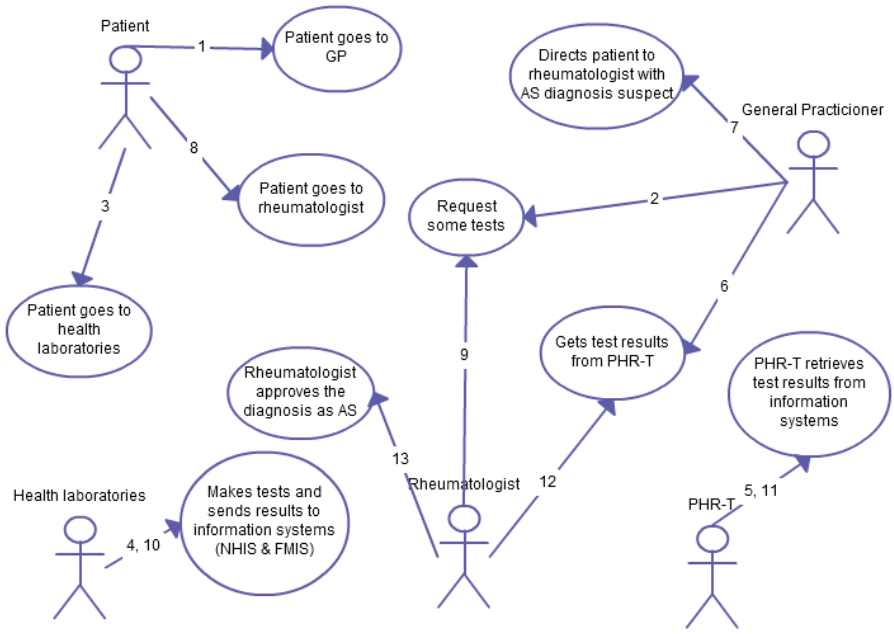

Figure 16: Initial treatment system in the Turkey pilot

The main goals the pilot tries to achieve are the following::

- Clinical objectives
    - To motivate the patient for compliance to treatment
    - To actively involve patients in the follow-up and treatment decision process
    - To enable a wide range of patient follow-up through tele-assistance
    - To improve arthritis healthcare services in quality and quantity in the long run
    - To support patients in their struggle against the chronic arthritis disease which generally longs for lifetime in most cases
- Economical objectives
    - To reduce the number of unnecessary hospitalization episodes
    - To use the resources more effectively and efficiently
    - To reduce the number of sick leave days and their negative impact on productivity

- Organizational objectives
    - To increase tele-assistance in order to improve the concentration on the treatment and enlarge the geographical area to reach
    - To improve the patient's participation in care processes and health management in order to:
        - Help the patient to understand his/her current condition and care plan: how he/she should comply and perform according to the care plan, how well the treatment succeeds and the risks, limitations, benefits and uncertainties in certain actions in the next phase of care plan
        - Guide and motivate the patient to behave in sound and preventive fashion, to refrain from certain specific harmful behaviors and to adhere to prescriptions and lifestyle guidelines

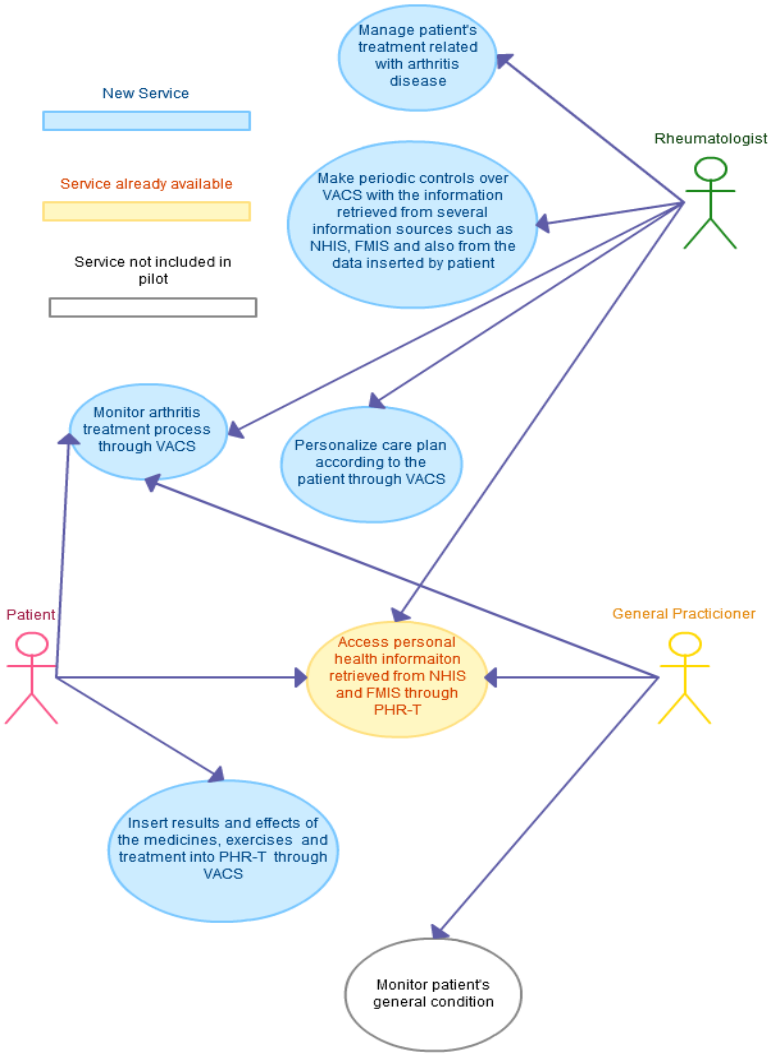

Figure 17: Turkey pilot services

7.1.3. Norway Pilot

The Norwegian health system is predominantly tax based and is built on the principle of providing all inhabitants with equality of access to services, regardless of their social status, location and income. The entire resident population of Norway is covered with regard to needs and the financial burden of using health care services, and there is only a small connection (limited to out-of-pocket payments) between individual health risks and costs.

The Norwegian organizational structure has three levels that mirror political tiers: the national/state level, the four health regions and the municipalities; the Ministry of Health and Care Services is responsible for administering the following services: primary health care, specialized health care, public health, mental health, medical rehabilitation, dental services, pharmacies and pharmaceuticals, emergency planning and coordination, policies on molecular biology and biotechnology and nutrition and food safety.

The statutory reimbursement of pharmaceuticals is based on an approved positive list called “blue prescription list” of drugs drawn up by the National Medicines Agency.

Overall responsibility for the health care sector rests at the national level, with the Ministry of Health and Care Services. The Ministry of Health and Care Services outlines national health policy, prepares major reforms and proposals for legislation, monitors their implementation and assists the government in decision-making

There are approximately 4000 regular GPs in Norway. The GP acts as gatekeeper and agent for the patient with regard to the provision of health services. At present 99% of the population is registered on the regular GP scheme, a list system, which aims to strengthen the patient–physician relationship by giving the patient the right to choose a regular general practitioner.

At this point, the Norwegian health system has implemented a MinJournal; a MinJournal is a patient’s portal that includes a security solution / secure authentication and several services such as:

- Appointment booking and ordering of self-tests, etc.
- Secure messaging
- Deputy solution (parents/children)
- Forms to be filled in by patients and used by clinicians
- Ordering solutions (net shop) for treatment accessories
- My medicines, my health accounts
- RareICT: wikipedia network for patients, next-of-kins and health personnel

- Some specialized services – for instance for patients with Hemophilia
- Discharge notes – in a small scale pilot

Within the PALANTE project, the MinJournal will be extended and diverse services will be added:

- For all patients:
    - Access to their discharge notes using existing public PKI or Netbank solution for authentication reaching their discharge note from the Electronic Medical Record (EMR) system at the hospitals. This solution will be scaled up to provide the service for more patients, including integration with more than one EMR provider.
- For chronic patients:
    - Develop and implement a module for diabetes patients; the pilot will focus on both Diabetes Type I and Type II.

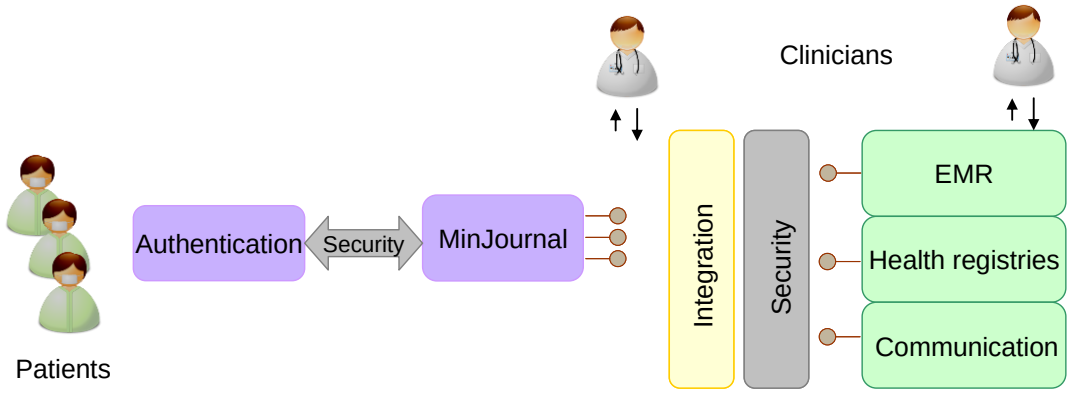

Figure 18: Norway pilot flowchart

There are two main objectives to achieve with the implementation of this pilot:

- To develop the necessary integrations and related functionality to be able to provide access to discharge notes for all patients that visits Oslo University Hospital.

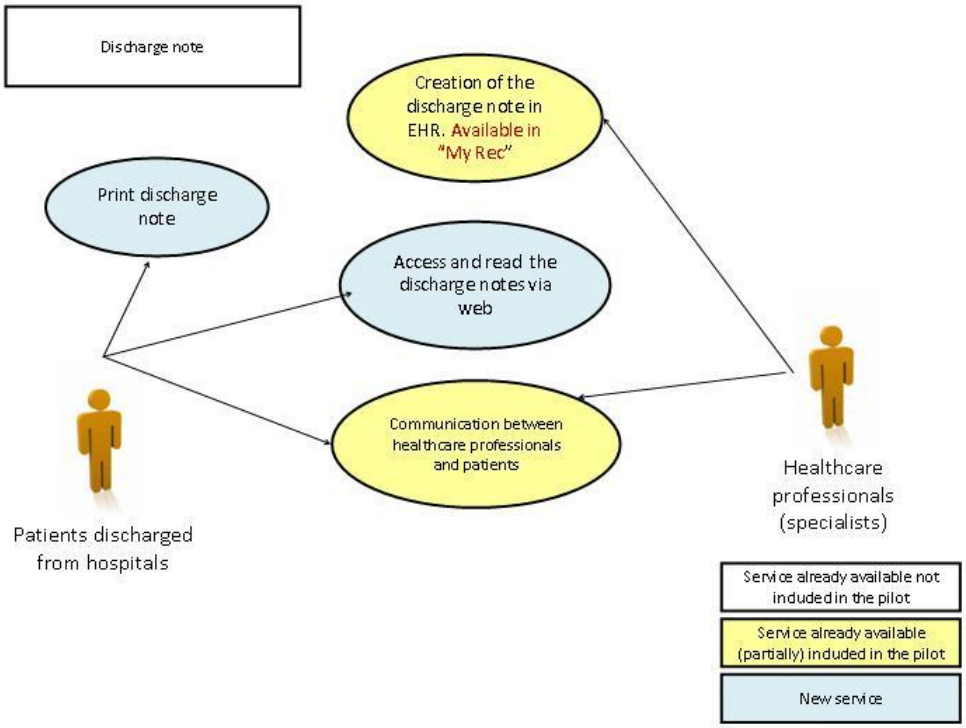

Figure 19: Norway pilot general services

- To develop and implement a module within the existing patient portal MinJournal for patients with Diabetes.

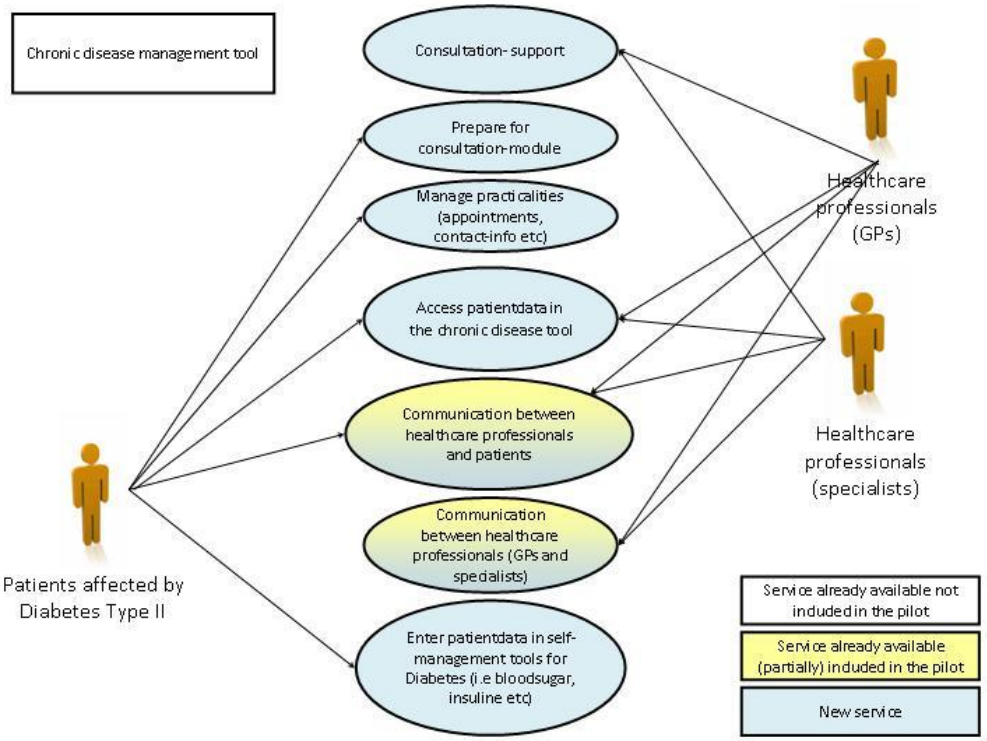

Figure 20: Norway pilot chronic services

7.1.4. Austria Pilot

According to the Federal Constitution, almost all areas of the health care system are primarily the regulatory responsibility of the federal government. The most important exception is the hospital sector. In this area, the federal government is only responsible for enacting basic law; legislation on implementation and enforcement is the responsibility of the nine Länder. In the outpatient sector, but also in the rehabilitation sector and in the field of medicines, health care is organized by negotiations between the 21 health insurance funds and the Federation of Austrian Social Insurance Institutions on the one hand and the chambers of physicians and pharmacists (which are organized as public-law bodies) and the statutory professional associations of midwives or other health professions on the other.

Austria has 8,43 million inhabitants (2011). It counts with about a million hospital admissions per year, with 267 hospitals that have about 64,300 beds for in-patient care (2008).

21.000 physicians and more than 80.000 other health care professionals are employed in Austrian hospitals (2008).

Styria is a state located at the southeast of Austria; Styrian health care system counts with KAGes, a Hospital Holding. It is a non-profit organization and the public welfare promoter. Its core task is the construction and operation as well as the management of regional hospitals in the Federal State of Styria. In this state, is where the pilot of the PALANTE project will be started, aiming to involve at least 1.000 patients; the ones that visit one of the 20 hospitals of the Styrian Hospital Holding (KAGes) and have a radiological examination.

Nowadays, in Austria there is an Electronic Health Record (EHR) known there as ELGA, which includes:

- electronic prescription;
- electronic referrals;
- electronic medication history

ELGA's vision is to make patients' data accessible to the patients themselves and to the doctors of private practice. It provides a central register that contains every document related to their health pointing to decentralized data sources. ELGA's features:

- All authorized persons can access to patients' data independently of place and time;
- ELGA contains relevant multimedia based and health related data and information about a specific person;

KAGes offers the following services for health professionals in Styria through a web-portal:

- Receiving medical reports and radiological images (documents are sent by the employees of the hospitals and can be retrieved by the physicians via the web-portal).
- Searching and fixing appointments in outpatient clinics (this is done by the physicians for the patients).
- Additional Services only for hospitals and therapeutic centres.
- Active query and retrieval of medical reports and radiological images directly from the KAGes-HIS and PACS through the web-portal.

With the pilot, the ELGA planned services are:

- Electronic Discharge Letter, e-Report Laboratory and e-Report Radiology.
- E-Prescription (Pilot started in 2011 for operating tests in three regions in Austria).
- E-Vaccination-Pass.

With this pilot, the eXray-Record will be developed. In a first step, the eXray-Record will be offered to the patients of KAGes via a web portal (and not via ELGA).

The pilot should comply with relevant international technical standards and ELGA-specifications so its results can be used to implement a further module of the Austrian health record ELGA.

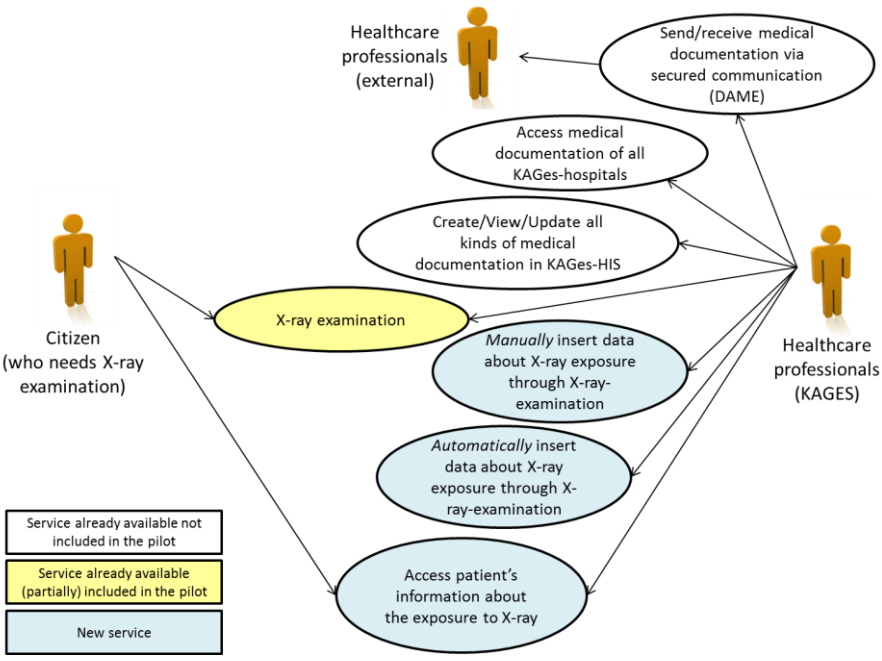

Figure 21: Austria pilot services

7.1.5. Czech Republic Pilot

The Czech Republic has a system of social health insurance (SHI) based on compulsory membership in a health insurance fund, of which there were 8 as of 2011. The funds are quasi-public, self-governing bodies that act as payers and purchasers of care.

The regional authorities and the health insurance funds play an important role in ensuring the accessibility of health care, the former by registering health care providers, the latter by contracting them. Eligible residents may freely choose their health insurance fund and health care providers. The health insurance funds must accept all applicants who have a legal basis for entitlement regardless of age or health status; risk selection is not permitted.

Regulatory authority for primary care, which includes GPs, pediatricians, gynecologists, dentists and pharmacists, is divided among the State, the regions, and the health insurance funds.

Secondary care services in the Czech Republic are offered mainly by private practice specialists, health centres, polyclinics, hospitals and specialized inpatient facilities.

The SÚKL is responsible for pricing and reimbursement decisions related to registered pharmaceuticals. Pharmaceuticals are assessed based on their efficacy, safety, quality and cost–effectiveness

The PALANTE project, tries to develop and improve the actual IZIP system with the project LIFELINE; involving at least 1.000 users, getting 20 physicians to involve 50 of their patients.

Nowadays in the Czech Republic, IZIP receives and matches data from 3 sources:

- Health care professionals (clinical data)
- VZP (reimbursement data)
- Patients (own records and notes)

The data contains medical history, diagnosis, results of lab and medical examinations, scans, conclusions, recommendations, therapy, medications, expense reports, notes etc.

The system offers the following services:

- EHR (also known as Electronic Health Notepad): health care professionals (HCP) engaged can enter the patients' health data but only those authorized by the patient can view these data (however most of the patients authorize all HCPs).
- Emergency data set: the extract of all health data relevant during rescue and ambulance.

- Citizen´s Health care costs control: the complete overview of the healthcare provided, claimed by and reimbursed to health care professionals by VZP; the overview also includes the information on balance of premiums/contribution.

Personal Health care manager: enables citizens to organize their own health care and monitor the physical condition; such as vaccination calendars, BMI monitor, glucose monitor, child´s grow index.

The pilot tries to develop the LIFELINE project, with the aim of achieving these functionalities:

- Scheduling appointments of preventive check-outs
- Vaccination calendar
- Health indicators monitoring (glucose, blood pressure, child's growth, BMI)
- PEHR data visualization on time line
- Entering the data into PEHR

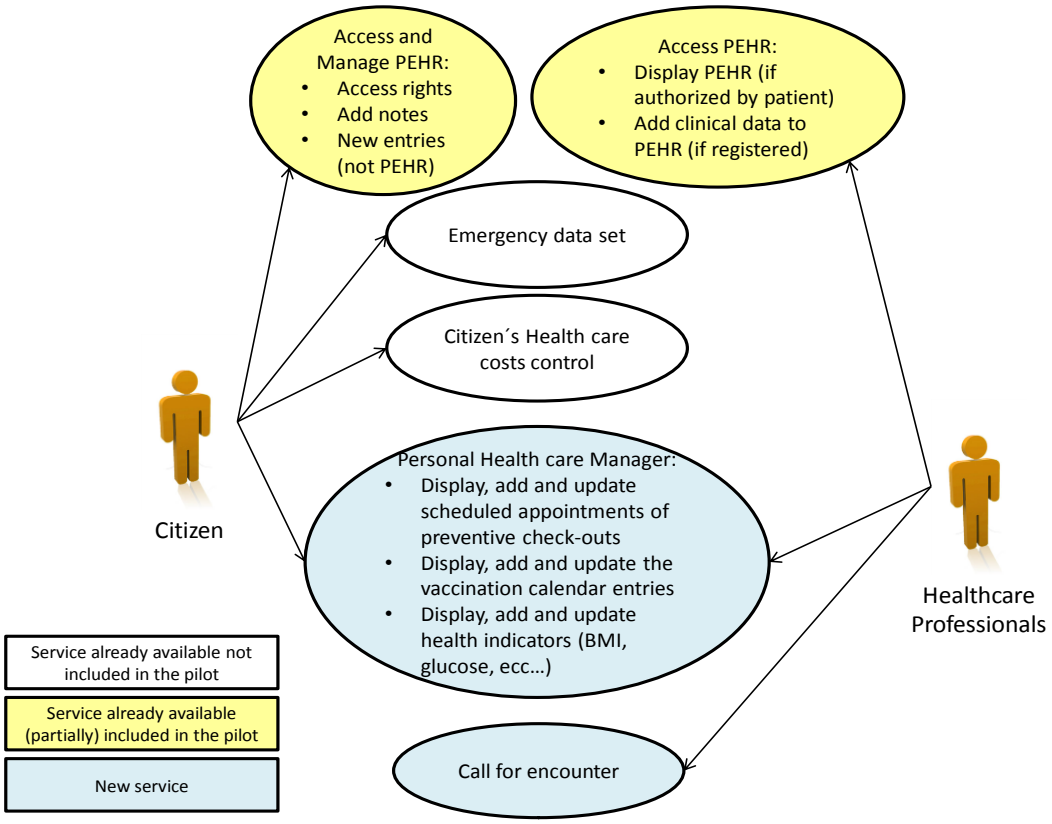

Figure 22: Czech Republic pilot services

7.1.6. Andalusia Pilot

The Spanish health system is based on a Beveridge model, with universal coverage, funded by taxes and free of charge at the point of care. Provision is free of charge at the point of delivery with the exception of the drugs prescribed to people aged under 65, which entail a co-payment with some exceptions. Health competences were totally devolved to the regional level (Autonomous Communities –ACs-) from the end of 2002; this devolution resulted in 17 regional health ministries with primary jurisdiction over the organization and delivery of health services within their territory.

Andalusia, one of the largest regions in Europe, is located in the south of Spain. With a size of 87,597 square km and a population of 8.4 inhabitants, Andalusia is the most populated autonomous community (region) in Spain. The healthcare system in Andalusia is part of the National Health System with universal coverage, free access, publicly funded by taxes, free of charge at the point of care and strongly decentralized.

The Andalusia Public Health System (APHS) is responsible for the provision of healthcare and public health services in Andalusia. The healthcare network includes 47 hospitals (including University hospitals), with outpatient clinics. More than 92% of all beds in the region are publicly managed. One hundred thousand health professionals work in the APHS, as public employees. It is a wide network based on a high-quality, patient-centred, accessible primary healthcare system. Primary healthcare is the gate to the system and, therefore, is a key element within the Public Healthcare System in the Andalusia Region. Family doctors are specialists and have 1.400 persons average assigned. Public hospitals are in a network where patients are referred by levels of complexity and professionals work in multidisciplinary teams following objectives.

As an actual point, in Andalusia there is Diraya; Diraya is the electronic healthcare management and information system of the Andalusian public healthcare service. It is an excellent example of the successful implementation of a region-wide system.

The first aim of Diraya is to integrate all the information on each citizen, irrespective of the health professional or care area generating it, into a single electronic health record. This model permits reference to and annotation of data on all devices and at all care levels: primary care, specialized care, emergency rooms and hospitalization. The second aim of Diraya is to facilitate accessibility to all the services of the health system. Lastly, the third aim is to ensure that all relevant information is structured. Diraya uses common tables, codes and catalogues.

Since the beginning of 2011, the electronic health record covers 100% population at primary healthcare level. In 2011, 98 million appointments were scheduled using Diraya, generating more than 41 million consultation sheets at this level. In the same year, 3.402.501 emergency care episodes with 3.041.574 discharge reports were issued. 1.526.902 outpatient specialised care episodes were registered in the system during 2011, compared to 1.134.883 in 2010. All public hospitals but two are connected to the system (79, 6% of the population).

DIRAYA's main features are:

- Citizen registry (user data base)
- Provider registry
- Structure module (departments and functional units, physical locations of health centres, corporate catalogues management and main master tables)
- Health record (heart of Diraya, integrates clinical information through the unique citizen's identification)
- Electronic prescribing (Prescription XXI, with a central dispensing module accessible by pharmacies in the region)
- A centralized appointment module (managing appointments at primary care, outpatient specialized care visits and diagnostic test agendas)
- Laboratory test module, and
- Radiology management and data.

Second medical opinion is also available and linked to Diraya.

The extension at the beginning of 2012 is focused on Laboratory and Radiology departments, and hospital inpatient units.

Besides, a summary of the electronic health record has been made accessible to the patients through secure access via internet. Currently available in three hospital areas, it will be expanded during the coming months to other areas.

There are several objectives in the PALANTE project. Patients' access to their personal health record will allow them to manage their diseases in a better way. This is of particular interest for people with Diabetes, who will benefit from accessing to their health information, having the chance to include information themselves and communicating with their healthcare team using this common platform. Therefore within this pilot we will validate the proposed solution for a target group of diabetic patients.

This will be done through the use of Tratamiento 2.0, which includes different options to train people in DSME (Diabetes Self-management Education) programs (diet counselling, daily activities, measurements, games, and reminders). Healthcare professionals will take advantage of this new IT service in DSME sessions and training process. Tratamiento 2.0 will help people with diabetes to improve their self-control of their disease.

- Clinical objectives
    - To facilitate and improve knowledge about diabetes and self-

management in people with diabetes

  - To improve parameters related to an appropriate disease control and to healthcare quality in diabetes care by the health services (i.e.: the determination of HbA1c, the diminish of the frequency of some acute complications, the indicators such as body mass index, blood pressure, cholesterol and LDL-cholesterol, microalbuminuria, etc…)

- Economical objectives
  - To reduce costs related to hospital admissions due to acute complications of diabetes
  - To reduce the number of patient visits to the Health Care System, both Primary Care and Hospital Care.
  - To improve control of pharmaceutical expenditure (better use of test strips, better control of treatment, etc)
- Organizational objectives
  - To facilitate access of patients with diabetes to their personal health records.
  - To establish two-way communication circuits in the programs of Diabetological Education that could be used out of the health care system.
  - To learn from experiences developed by other health systems, with different approaches and scenarios.

This pilot has several users; at first, there are 7000 patients with Diabetes (type 1 and type 2) involved. 500 participants with diabetes mellitus type 1 will be selected from hospitals and 6.500 participants with diabetes mellitus type 2 will be selected from Primary Care Health Centres and hospitals.

Caregivers and relatives of people with diabetes will be users of this system.

Health professionals (doctors and nurses), both Primary Care and Hospital Care will also be users. All of them from centres with a certain degree of professionals' involvement, accessibility, and degree of development in diabetes self-management education programmes.

To achieve the objectives mentioned, the pilot wants to implement the following services and functionalities:

- **Tratamiento 2.0:** for chronic disease management is a generic middleware platform of services designed for the intelligent application and management of chronic diseases, which includes useful applications, both for health professionals (doctors and nurses) and for the patients and caregivers, facilitating the monitoring and evolution of patients and their disease.

  Tratamiento 2.0 aims to help people with diabetes to improve the self-control of their disease, and will allow to improve the adherence to the treatment, providing patients with better understanding of the indications and recommendations about their disease.

- **Devices Integration**: monitoring of vital signs is the key for the control of a patient and his/her disease. For PALANTE Project, a Glucometer and Blood pressure self-measurement devices will be provided. The recorded data from the devices will be evaluated to detect values outside the normal range that would bring out warnings of this situation to the patient / caregivers. The recorded data from devices and sensors will be sent to the health professional for assessment.

- **Adherence to Drug Therapy:** the unfulfillment of drug treatment is one of the major causes of treatment's failure and leads to serious problems for patient's health and costs to the health system. Besides providing information on treatment, from this screen the user can access the following features:

- Reminder of drug intakes

- Record of prescribed medication intakes

- Registration of non-prescribed drug intakes

- Record of adverse reactions / allergies to medication

- Obtaining information about drugs

- **Educational Games:** The design of educational games has been made according the following requirements:

- Simple operation.

- Easy to understand.

- Adaptable to different levels of knowledge.

- Progress report generated by the patient.

- Points system and ranking based on knowledge and not randomly.

- Storage of results and relevant data.

While patients are having fun playing the Game data on the results are registered.

This data are used later to generate reports on progress of knowledge about diabetes mellitus. Thanks to these reports, the healthcare professionals can see what level of knowledge of each patient and their evolution in the different areas as progresses the number of sessions played.

Figure 23: Andalusia's educational games

- **The Magic Book of Augmented Reality:** augmented Reality vision system (3D contents) developed in the following areas: What is diabetes mellitus; Areas and rotating injection areas, Chronic complications (Nephropathy, Retinopathy, Diabetic Foot); Diet and nutrition. This book will help patients to learn more about the disease, allowing its timely identification, treat problems and learn to live with it. The use of Augmented Reality makes easy for patients to understand the contents.

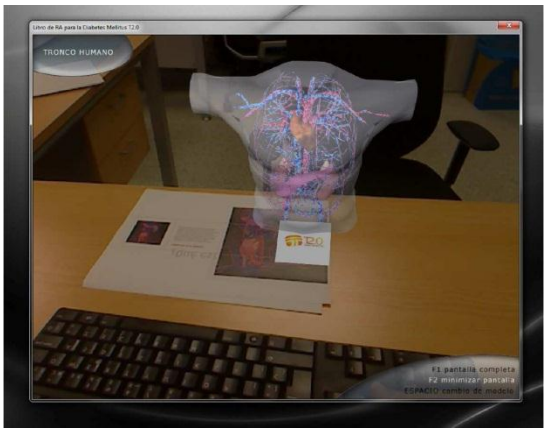

Figure 24: Andalusia's augmented reality service

- Messaging's management for patients and caregivers
- Education Tools for patients with diabetes (Educational Video Games, Augmented Reality Book)
- Integration of biometric devices (Glucometers, blood pressure meters, Scales)

- Pharmacological Monitoring
- Blood Glucose Monitoring
- Meals Schedules Tracking and monitoring of the diet
- Monitoring of BMI
- Monitoring of blood pressure

All in all, the services and functionalities to be implemented are:

- Patient's management of their personal health information
    - Patients will have the chance to include information themselves and to communicate with their healthcare team using the proposed solution.
- Chronic disease management support services
    - The solution for chronic disease management will allow improving the adherence to the treatment facilitating the monitoring and evolution of patients and their disease.
    - The following features will be included in the platform:
        - Reminder of drug intakes
        - Record of prescribed medication intakes
        - Registration of non-prescribed drug intakes
        - Record of adverse reactions / allergies to medication
        - Obtaining information about drugs
- Tailored education and lifestyle guidance
    - Patient will have a better understanding of the indications and recommendations about their disease that health professionals do for the optimal evolution of the disease.

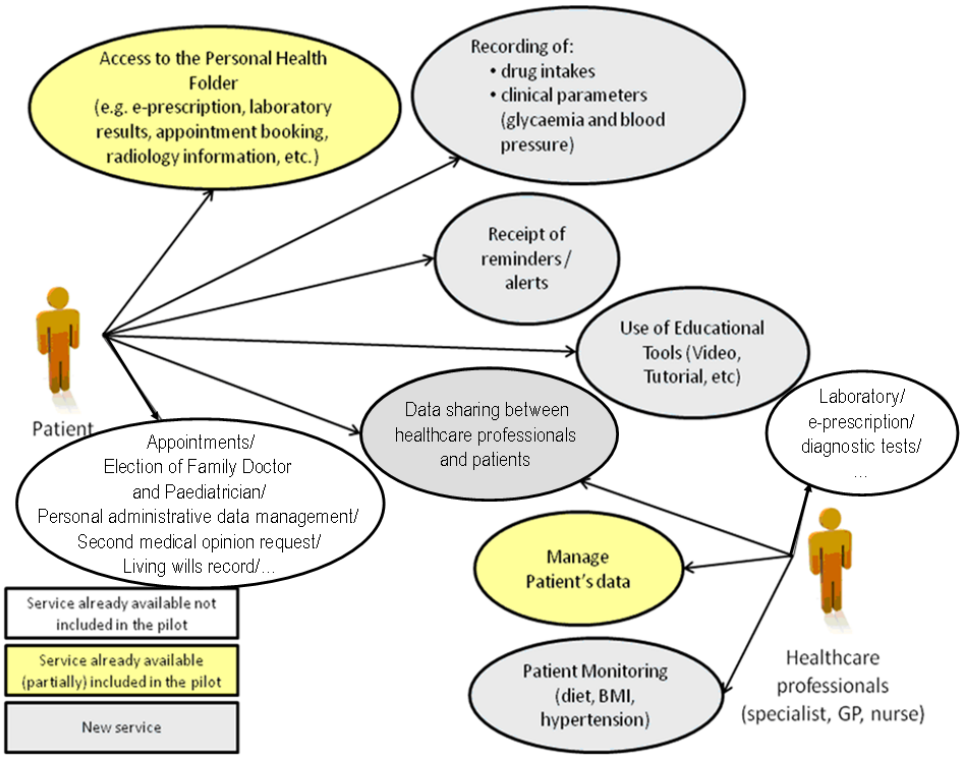

Figure 25: Andalusia pilot services

7.1.7. Basque Country Pilot

Like mentioned before, the Spanish health system is based on a Beveridge model, with universal coverage, funded by taxes and free of charge at the point of care. Health competences are totally devolved to the regional level within the 17 regions.

The Basque Country is a region where the geographical, social, cultural and economic conditions generate highly desirable expectations. The Basque Country has a population of 2.171.243 inhabitants and about 42% live in the Gran Bilbao.

Osakidetza is the public health system of the Basque Country. The system encompasses 18 hospitals, more than 300 Primary Care centres, and more than 25.000 professionals that look after 2,2 million potential patients. All the public Hospitals and Primary Care of the Basque Region are under this organization.

The Basque Country health system has been pioneering the use of ICT technologies since the early 90s when Osakidetza launched the CLINIC project that allowed consulting the clinical information of one patient in the whole network of hospitals and centres independently of the architecture of each system in the network.

The actual aim of Osakidetza is to pilot a tele-assistance service for complex chronic patients to provide them with treatment support, education and guidance so that they become active partners of their health management process. This transformation will

require between 2 to 5 years before having a significant impact in the system.

Now the e-health services available concern with the possibility of the patient to stay at home where they will follow their treatment with the 24 hours for 7 days supervision and virtual support of a medical team that monitors them.

The implementation of the unified electronic health record started in 2010 thanks to the decision of Osakidetza. The unified electronic health record permits to connect the electronic health care record of the Primary Care services and the health record from the specialized care services. With this method, the patient in the Basque Country has a unified health record that contains all his/her healthcare activity (i.e.: admissions, transfers, discharges, appointments, surgery, radiology, pharmacy, e-prescriptions, invoicing and costs).

In the PALANTE project, the pilot focuses on patients affected of chronic respiratory diseases (COPD). In the Basques Country, there are 135.000 estimated persons who suffer from this chronic disease.

In a first stage of the initial phase, the system will be analysed in 30 patients with conditions such as asthma and COPD. The number will be incremented in the next phase.

The main objectives for the pilot are:

- Clinical objectives
    - To increase patient's life quality
    - To increase the quality of the health service by providing more personalized and flexible assistance
    - To involve patients in their own health care, fostering the self-control, self-management and autonomy
    - To increase patients' satisfaction and confidence in the public health service
    - To promote the use of self-care technology among the elderly (chronic patients)
- Economical objectives
    - To reduce the number of hospitalizations
    - To reduce the number of face-to-face visits of chronic patients (both at patients' home and in the healthcare provider premises)
    - To guarantee the economic viability of the technological solution. This means that the level of investment needed per patient (including

equipment, maintenance and human resources) should be equal or lower than the current hospitalization costs per year and patient.

- To contribute to the sustainability of the public health services

- Organizational objectives
  - To provide direct services and resources to the patients when self-care and self-management is not possible
  - To facilitate an immediate response to patient's requirement
  - To define a new organizational structure in the Basque Health services (change of paradigm: from a practitioner-centred model to a patient-centred model)
  - To enable remote treatment (monitorized and personalized) to chronic patients
  - To facilitate the communication and relationship between patients and the public health service thanks to the use of information technologies
  - To rationalize the use of resources (the service provided to a patient is the specific service that this patient needs)

The vision of the pilot is to integrate all the data and information that a patient generates with the information that the health services already have on his/her patient. This integration will be done in an easy-to-use intuitive and bidirectional scenario.

Figure 26: Basque Country platform

The provided functionalities are:

- Tailored education and lifestyle guidance
- Patient's access to their personal health record

- The patient, or the caregiver in charge of the monitoring, receives information from the Monitoring Centre (audio, text or video), that is responsible to manage and receive data by internet
- The patient can be in contact with other people in charge of his/her care (family, care assistants, etc.)

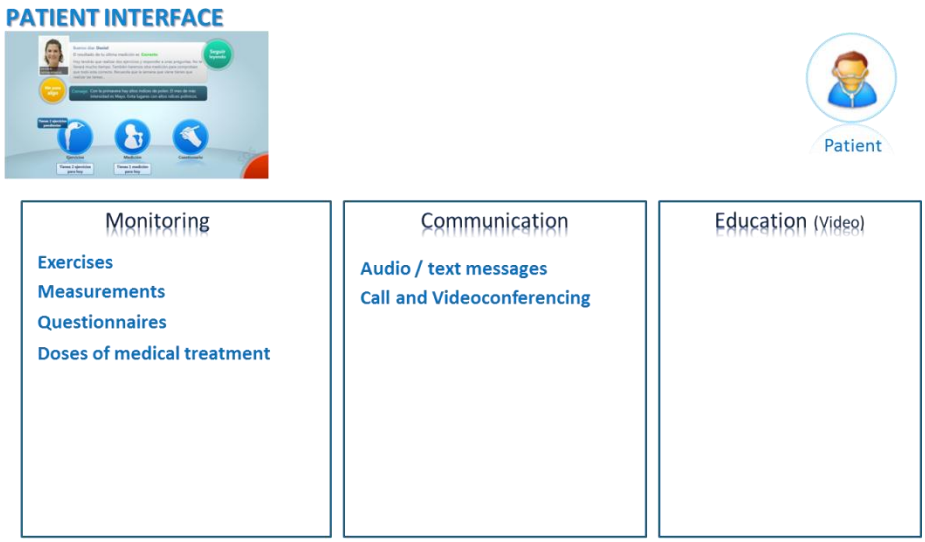

Figure 27: Basque Country patients interface

- Chronic disease management support devices

Monitoring Centre

The patient is monitored while he/she is at home, with his/her equipment (devices and sensors that measure different parameters relevant for the chronic condition). Three main devices will be used to analyse the state and evolution of CODP's patients:

- Spirometry: will allow to measure and control Vital capacity (VC), Forced vital capacity (FVC), Forced expiratory volume (FEV) at timed intervals of 0.5, 1.0 (FEV1), 2.0, and 3.0 seconds, Forced expiratory flow 25–75% (FEF 25–75) and Maximal voluntary ventilation (MVV).
- Pulse oximetry: non-invasive method allowing the monitoring of the oxygenation of a patient's haemoglobin.
- Temperature

The healthcare professionals (physicians, general practitioners, nurses, etc.) are connected with the system that receives the data from patient's equipment and from Osakidetza's health systems. Healthcare professionals will be able to use different criteria according to each patient's needs. Health professionals receive information from the monitored patient, evaluate it and they are able to:

- Send instructions to the patient;
- Evaluate the need to intervene;
- Share / discuss with other professionals about certain symptoms, treatments, etc.;
- Communicate with the patient (audio, e-mail, teleconference);
- Decide whether the information / parameters received from the patient should or should not be included in the patient electronic health record.

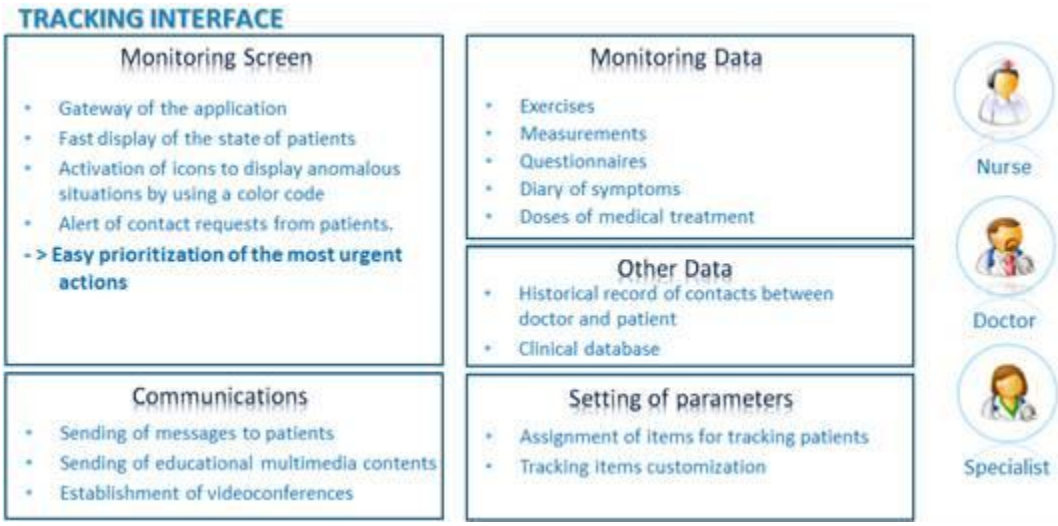

Figure 28: Basque Country health professional interface

The service is characterized by a personalized actuation plan that provides the possibility to:

- Visit to the specialist, etc.
- Remotely contact via the multichannel centre such as online consultations, telephonic calls for surveys, or via the tele-assistance technological platform (the measurement of physical parameters, the execution of educational programs, or the remote bi-directional communication with the professionals at the monitoring centre, etc.).

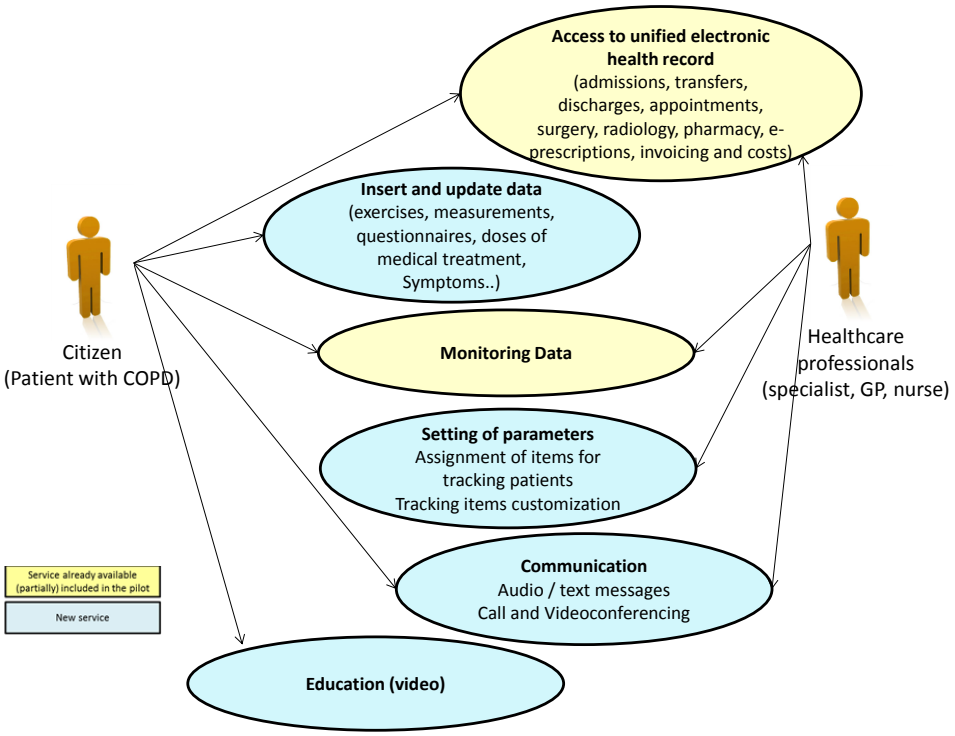

Figure 29: Basque Country pilot services

Equipment for monitoring and sending information will be installed in each patient house by a technical team where healthcare professionals will also participate. After the installation the patient will be trained for the adequate use of the equipment and for the development of the planned activities. Patients will develop exercises and will measure the parameters that will be included in the application and monitored by the specialized nurses. The healthcare professionals, mainly nurses, will use the professional interface to monitor the measures, exercises and questionnaires completed by the patient and could leave audio and written messages to the patient in the Kinect with the aim of monitoring and controlling the progress of the patient.

7.2. Summary of the Spanish pilots

Pilots	Where in Spain	Actual State	Type of Patients	Number of Patients	Services implemented
Andalusia pilot	Hospitals and care centres in Andalusia	Project	Diabetics type I and II patients	7.000 patients – 500 type I and 6.500 type II	- Disease management platform - Monitoring vital signs - Adherence to drug therapy - Educational games - Augmented reality vision system
Basque country pilot	Hospitals and care centres in Basque Country	Project	COPD patients	30 patients in phase I Incremented number in phase II	- Monitoring centre - Education and lifestyle guidance - Access to EHR

Table 3: Summary of Spanish Palante pilots

8. Overall offered services

Monitoring: It is when the project offers the service to control somehow the patient status to view its evolution.

Educational Services: It is when the project offer knowledge or assessment to patients about their diseases.

Alarm for drug intakes: It is when the project offers the service to notify the patients when to take their drugs.

Portal / Platform: It is when an interface with different applications (videoconference, the education, schedule appointments, etc.) that enclose all the management disease. Usually, it is not an interface only to insert the data monitored.

Videoconference patient-health professionals: It is when the project offers the service to patients, in which they can have a videoconference with a health professional.

EHR access: It is when the project offers the service to patients to have access to their electronic health records.

Prevention Services: It means that one of the project objectives is to prevent patients relapses.

E-community: It is when the project offers the service to patients to communicate themselves with other patients with their same disease.

Pilots	Monitoring	Educational Services	Alarm for drug intakes	Portal / Platform*	Videoconference patient-health professionals	EHR access	Prevention services	E-community
Renewing Health	X		X	X	X	X		
Nexes	X	X					X	
Better Breathing	X	X			X			
Home Sweet Home	X		X	X				X
Icardea	X					X	X	
Chronious	X	X	X	X			X	
Perform	X						X	
Metabo	X						X	
Psyche	X	X			X		X	X
Palante Andalusia	X	X	X	X		X		
Palante Basque Country	X	X		X	X	X		

Table 4: Offered services

9. Taxonomy

Taxonomies represent attempts to establish explicit classifications according to presumed relationships among similar elements or between the elements and other phenomena of interest. Their main objective is to categorize information for increased theoretical understanding and predictive accuracy in empirical research.

Taxonomy is important because it brings order to an extant body of information and provides an effective guide to the development, collection, and classification of new information.

There is not a universal taxonomy to use; thus, one has to be selected to establish the categorizations. A telemedicine taxonomy has been chosen. This taxonomy identifies discrete sets of variables representing specific telemedicine configurations. The bundles identify unique sets and subsets of applications, functions, and technologies, requiring a multilayered hierarchical system.

The one selected has a first classification of three different "dimensions" in the taxonomy of telemedicine.[18]

This first level of dissemination is the most inclusive and its "dimensions" are; the functions that are performed, the specific applications and the technological configurations.

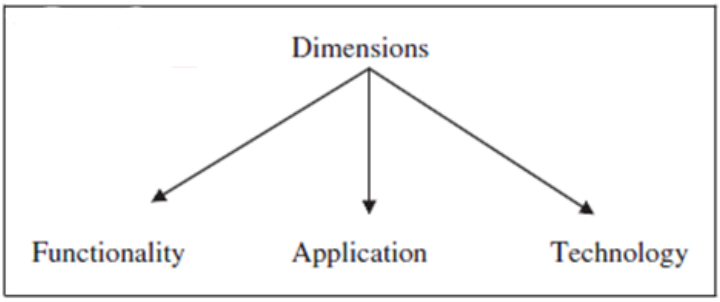

Figure 30: First level dimensions

The first "dimension" is functionality. This dimension incorporates all aspects of the medical care process, including activities involved in prevention, diagnosis, treatment, follow-up, and rehabilitation. These aspects are grouped into four component parts:

- Consultation: occurring between two or more physicians (often between primary-care and specialist physicians) as well as between provider and patient.
- Diagnosis: typically takes place remotely by a radiologist, pathologist, cardiologist, or other specialist relying on transferred images, records, and laboratory results.

[18] Rashid Bashshur, Gary Shannon, Elizabeth Krupinski, and Jim Grigsby (2011)

- Monitoring: includes tele-home care for home-bound chronically ill, recently discharged persons requiring continued skilled care, wound-care patients, as well as those who are not home, but have chronic conditions such as congestive heart failure, chronic obstructive pulmonary disease, asthma, and/or diabetes.

- Mentoring; includes remote guidance typically by surgeons and other specialists to other surgeons performing new or complex procedures. The patient education will be also considered here.

As a second "dimension", it is considered the application. This dimension includes four areas; processes of care across virtually all basic *medical specialties*, as well as subspecialisation based on *disease entities*, *sites of care*, and *treatment modalities*.

The components of the technological dimension can be grouped into three sets of variables: synchronicity, network design, and connectivity.

- Synchronicity; it is used to incorporate both timing and technology. With regard to timing, telemedicine may be either synchronous (in real time), referring to the concurrent presence of interacting participants located at different places; or asynchronous (store-and-forward), in which the participants do not interact in real time.

- Network design/configuration; it includes three modalities: Virtual Private Networks, the open Internet, and social networks, in which information is posted and shared. The three modalities substantially vary in terms of security arrangements and the ability to protect confidential information.

- Connectivity; there are two types of connectivity: Wired and wireless. Both of which now provide different levels of bandwidth and the attendant speed and resolution or quality of service.

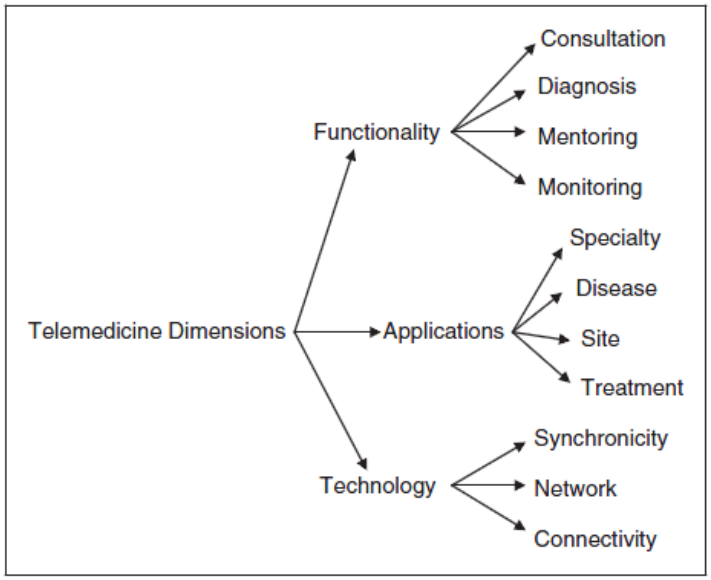

Figure 31: Dimension of telemedicine and components

9.1. Taxonomy Table

Functionality				
Pilot	**Consultation**	**Diagnosis**	**Monitoring**	**Mentoring**
Renewing Health	- Call centre support system - Videoconference with health professionals		- Full monitoring with biosensors	
Nexes		- Remote support to primary care for diagnosis	- Vital signs monitoring post-discharge to prevent emergency room consultation	- Medical knowledge for the disease self-management
Better Breathing	- Videoconference with health professionals		- Full monitoring with spirometer and pulse oximeter	- Medical knowledge for the disease self-management
Home Sweet Home			- Vital signs monitoring	
Icardea		- Comprehends warning and alerting mechanisms for early diagnosis	- Full monitoring for CIED	
Chronious	- Decision support system with other professionals		- Full monitoring with wearable sensors	- Medical knowledge for the disease self-management
Perform	- Healthcare support systems for physicians	- Early detections of the frequent therapy-related complications	- Full monitoring wearable system	
Metabo		- Early prediction of hypoglycaemic episodes	- Full monitoring with sensors	
Psyche	- Videoconference with health professionals - Decision support system with other professionals	- Predict and anticipate treatment response	- Full monitoring with sensors	- Educational content and continuous assessment

Palante Andalusia	- Communication between patient with the healthcare team using the platform		- Vital signs monitoring – Glucometer and blood pressure devise	- Educational games
Palante Basque Country	- Decision support system with other professionals - Videoconference with health professionals		- Full monitoring with spirometer and pulse oximeter	- Medical knowledge for the disease self-management - Lifestyle guidance

Table 5: Taxonomy - Functionalities

Application				
Pilot	**Medical Specialty**	**Disease Entity**	**Site of Care**	**Treatment Modality**
Renewing Health	- Remote monitoring applied to pneumology	- COPD patients with frail conditions	- At respiratory or internal medicine unit patients - Patients at home	- Full monitoring with fully customizable treatment done by healthcare professionals in a functional platform. There is an available a call centre support
Nexes	- Remote monitoring applied to pneumology or cardiology	- COPD patients - CHF patients - CAD patients - Diabetic type II patients	- Patients at home	- Monitoring and enhanced care support to early discharged patients to prevent a readmission through ICT managed by primary care
Better Breathing	- Remote monitoring applied to pneumology	- COPD patients	- Patients at the hospital - Patients at home	- Full monitoring with access to a videoconference call with primary care
Home Sweet Home	- Remote monitoring applied to independent living	- Elderly people	- People at home	- Monitoring of vital signs to be seen by the caregiver
Icardea	- Remote monitoring applied to cardiology	- Patients with CIED	- Patients at home	- Full monitoring where only in case of emergencies, alerts are sent to the responsible parties to decide how to react
Chronious	- Remote monitoring applied to pneumology or nephrology	- COPD patients - CKD patients	- Patients at the hospital - Patients at home	- Full monitoring which its data is analysed by algorithms aiming to enhance patients and physicians in deciding in real time how to react. Decision support system available
Perform	- Remote monitoring applied to moving	- Neurodegenerative disease patients	- Patients at home	- Full monitoring used with an intelligent decision tool to inform the

	disorders	- Movement disorders patients		patient and a Healthcare support system with a general or specialised physicians about the appropriate actions to reduce disease signs and progression
Metabo	- Remote monitoring applied to endocrinology	- Diabetic patients	- Patients at home	- Full monitoring with sensors which send the data to a platform to be analysed by algorithms for early prediction symptoms and alert a professional
Psyche	- Remote monitoring applied to psychiatry	- Bipolar patients	- Patients at home	- Full monitoring with sensors. After a first 24h monitoring, a trend can be extracted to predict and anticipate treatment response at its earlier phases. It alerts the physicians in case of critical events
Palante Andalusia	- Remote monitoring applied to endocrinology	- Diabetics type I and II patients	- Patients at home	- Monitoring of vital signs. If the data evaluated has values outside the normal range, it would bring out warnings to the patient or caregivers and data would be sent to the health professional for assessment
Palante Basque Country	Remote monitoring applied to pneumology	- COPD patients	- Patients at home	- Full monitoring with sensors which send the data to a system that is seen by health professionals so that they can operate in the correct way

Table 6: Taxonomy – Applications

Technology	
Pilot	**Description**
Renewing Health	- Synchronous – A videoconference can be established to act in real time
Nexes	- Asynchronous
Better Breathing	- Synchronous - A videoconference can be established to act in real time
Home Sweet Home	- Asynchronous
Icardea	- Synchronous - Although a videoconference with health professionals is not possible, immediate alerts are sent in case of emergency to decide in real time how to react
Chronious	- Synchronous - Although a videoconference with health professionals is not possible, immediate alerts are sent in case of emergency to decide in real time how to react
Perform	- Synchronous - Although a videoconference with health professionals is not possible, immediate alerts are sent in case of emergency to decide in real time how to react
Metabo	- Synchronous - Although a videoconference with health professionals is not possible, immediate alerts are sent in case of emergency to decide in real time how to react
Psyche	- Synchronous - A videoconference can be established to act in real time
Palante Andalusia	- Synchronous - Although a videoconference with health professionals is not possible, immediate alerts are sent in case of emergency to decide in real time how to react
Palante Basque Country	- Synchronous - A videoconference can be established to act in real time

Table 7: Taxonomy - Technology

10. Conclusions

The taxonomy is an organisational tool. With it, it has been possible to create a classification of the different projects and pilots previously described. In the taxonomy, it has been tried to use the same wording to describe similar functionalities or processes so that a comparison can be done in an easier way, and tendencies about the telemedicine evolution can be found.

Despite the fact that the monitoring is not done the same way ("Table 5") in the different projects, there have been distinguished two main paths. The full monitoring and the vital signs monitoring. This is the main differential feature of all projects.

There are the projects that full monitor the patient. From "Table 5", it can be seen that these projects are; Renewing Health, Better Breathing, Icardea, Chronious, Perform, Metabo, Psyche and the Basque country Palante project. The other ones are the three that only monitor the vital signs; Nexes, Home Sweet Home (HSH) and the Andalusia Palante project.

This full monitoring system is closely related to another variable; the prevention service. The projects Nexes, Icardea, Chronious, Perform, Metabo and Psyche, have prevention services to avoid a patient collapse. They all use the full monitoring system and rely the prevention service in this system, except Nexes. The Nexes project also tries to prevent a medical relapse although it only monitors vital signs. It tries to do so in a different way; it does it by enhancing the care support of the discharged patients.

This prevention service is a very important thing because it is one of the economic objectives of some of the projects; to reduce readmissions. Maybe in a future, all the full monitoring systems should tend to use this method. Once the project Better Breathing had ended, a response to some questions could be done. One of these ones told that readmissions were prevented. It has to be mentioned that all the projects targeted different patients, so initially it would be possible to get the service function, independently of the disease. It can be seen in the "medical specialty" section in "table 4", that remote monitoring is applied to all the medical fields involving the different projects.

Another relation between services can be seen from "Table 3". If the project has already a platform for users created, maybe a good idea would be to insert the alarm drug intakes, and an educational service. Two projects already have both services (HSH and the Andalusia Palante project), but other ones have the platform created but not both services introduced. In early explanations it has been shown the benefits of the educational services, hence, if the platform is already done there could appear a place with them, such as the Basque Country Palante project in figure 27 with the education. The same should happen with the scheduled alarm drug intakes; it seems that it is a simple-to-insert service, if the portal is already exists.

Another aspect to mention is the fact that all the projects tend to last between two and four years. The ones that started later are; Renewing Health, HSH, Icardea and psyche. They started in 2010 and are supposed to have an end in 2013. However, between all the studied ones, the only ones with electronic health record access are Renewing Health, Icardea and the two pilots from the Palante project; the newest projects. All the newest ones tend to have access to EHR. The nowadays projects tend to evolve with the ICT's and are being adapted to the new needs and improvements. In exception there are the HSH project - addressed to elder people and maybe not useful, and Psyche – maybe not appropriate because the kind of patient. These two are the only ones that have an e-community service, to establish a relation between other people in a similar state. Maybe for this kind of people or disease, it is more interesting to give them that kind of service.

There is one important pattern that has to be seen between the "treatment modality in Table 5" is the fact that the projects aim to use the ICT's to evolve in a same direction. Most of the projects try to monitor the patient at home or being yet at the hospital, to get a notification or alarm if something goes wrong. Through ICT's professionals try to encourage and train patients to self-manage their diseases and get notified if there is an unsuspected result monitored.

With this, a synchronous link is created. Like in "table 6" is seen, most project tend to use the ICT's a path to establish contact with patients without having to speak (videoconference) with them. Although some projects give the possibility to have a videoconference with specialists or call centres; it is the use of ICT's that makes this a great synchronous link. Health professionals are only "used" if there is a complication, if not, they can continue working in other patients and improve the healthcare system.

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