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Table of Contents

List of figures

List of tables

Executive summary

The “integrated network for Completely Assisted Senior citizen’s Autonomy” (inCASA) project deals with citizen-centric technologies and the private/public service networks to help and protect independent elderly people, prolonging the time they can live well in their home by increasing their autonomy and self-confidence.

This objective was pursued in different contexts, with a pilot approach designed in order to test methodologies and solutions to enhance different services:

- KGHNI pilot (Greece): increasing collaboration between health and social services in order to support patients with Congestive Heart Failure who live in their own home;
- FHC pilot (Spain): promoting and monitoring rehabilitation exercise at home for COPD patients;
- INSERM pilot (France): early detection of drug-related adverse events or disease exacerbations in cancer patients through close monitoring of the health condition;
- CHC pilot (UK): to develop an integrated service delivery model to combine health and social care in responding to the needs of frail elderly people in primary care;
- ATC pilot (Italy): integrating tele-monitoring to enhance the value of services provided by the contact centre in social housing.

To reach this purpose, the consortium developed an integrated solution starting from pre-existing technologies, for human/environment monitoring, integrated in order to collect and analyse data to profile user habits and implement customised intelligent multilevel alerts/communication services.

The story so far….

inCASA project developed a flexible solution, in order to be applicable in different local contexts in line with local, national and European regulations, recommendations and guidelines. The project was committed to develop a network of homecare services for the elderly, with a specific focus on integrating healthcare and welfare and trying to support these people by the use of ICT at their own homes. The inCASA platform and services were focused on supporting the independent living of older socially vulnerable people. These services aimed to prevent cognitive deterioration, social exclusion, and developing or worsening general health status. In addition a further objective was the management of chronic diseases and the presence of comorbidities, with close focus on the disease and their “at home” care and management, with indirect but demonstrable effects on the social implications.

The solution commenced operations in 2012 with 5 separate pilots that shared a common model of supporting frailty: each of the 5 pilot sites have contributed to the understanding of how frail and older people (with or without long-term health conditions) can be supported by innovative service delivery models enabled by ICT. Between March 2012 and May 2013, 204 patients across the 5 pilot sites were enrolled into the study. The average age of participants was 71 years.

Patients/end users who were enrolled into the study had a number of different clinical conditions including, COPD, CHF, Cancer, Hypertension and Dementia. In addition, users from one pilot were deemed to be socially vulnerable. The degree of frailty of those patients / end users that were enrolled onto the service was measured using the Edmonton and G8 Frailty Scales. 44% of those that were enrolled onto the service were scored as average frailty or being very frail.

Organisations involved were different: 3 of them were hospitals, one was focused on primary care and one was a social housing institution. A common data set was defined, in order to monitor the same dimension within a common framework.

Two distinct service models were developed during the pilot phase. One service model was aimed at detecting and preventing clinical or social decline of the end users / patients within the existing care structure and the second re-organised existing models of care by providing the services in the patient’s home in order to support clinical and social outcomes.

Detection and Prevention

- CHC: Frail Elderly with Long Term Conditions
  - Monitor change in clinical and social habits to identify and prevent clinical and social deterioration of frail elderly
- KGHNI: Chronic Heart Failure
  - Prevent re-hospitalisations, acute exacerbations and reduce visits to outpatient clinic
- ATC: Socially Vulnerable
  - Reduce unnecessary and unplanned visits as well as reducing planned visits

Reorganising service delivery – delivery in the home

- FHC: COPD - Physiotherapy program in the home
  - Prevent hospitalisations and reduce bed days
- INSERM: Chemotherapy - Delivery of Chemotherapy treatment in the home
  - Improve monitoring and clinical outcomes and cost reductions

4 of the 5 pilot sites were able to develop a degree of integration between local services and professional groups. Within all 4 of these pilots, new pathways of care were developed, new integrated technologies were deployed and as result, information about patients was gathered, leading to targeted and appropriate interventions and actions for the patient.

At the end, we can state that inCASA pilots, and related stakeholders, have at this point a clearer understanding of the potential benefits of integrated service delivery for service provider organisations, and a concrete starting point for the future development of more closely integrated healthcare and social care systems across Europe.

Some conclusions

Each inCASA Pilot site reported a strong awareness of the importance of joint cooperation between healthcare and social care amongst professionals and involved organisations. inCASA led the Consortium to identify and highlight the benefits of creating strong social and healthcare integration, which might overcome the immaturity of a common interoperability model and long history of division between social care and healthcare worlds.

The pilots have presented outcomes that indicate how integrating services can improve the quality of life of patients who are frail and vulnerable. Moreover the pilots show how reorganising existing pathways and delivering care closer to home may improve clinical outcomes and target care effectively and safely. Each pilot has also reported a strong awareness amongst the professionals and organisations involved of the importance of joint working between healthcare and social care.

However, many challenges remain due to the immaturity of a common interoperability model, and the long history of division between social care and healthcare organisations. In some pilot countries, such as Italy, this is not recognised by legislators, and not only will it be necessary to remove cultural but also any legal barriers that currently restrict the sharing of data and cooperation between the healthcare and social care systems. All pilots have reported the continuation of services after the official end of the funding period.

The common conclusion of all pilot sites was that much remains to be done to achieve integration, in terms of joint services and data sharing. This may only be possible through intervention of the legislators and a strong cultural change; technology will follow.

Patient perception, enhanced care and quality of life

Patient perception was measured using the SUTAQ questionnaire which was adopted by the Whole System demonstrator program in the UK:

- 40% of patients said that the service had increased their access to health or social care professionals. However, 36% remained undecided and 24% felt that it had not.
- 86% felt that the kit had not invaded their privacy.
- 56% felt the service had made them more actively involved in their health care.
- 88% felt that the kits could or should be recommended to others.
- 65% felt that it was not a replacement for usual care, with only 13 % saying that it could be.
- 52% said that it was not as suitable as regular face to face care.

Pilots reported that the majority of their patients/end users who took part felt that the service and technology provided **enhanced care** that was over and above what they consider to be their normal care.

Patients reported that they were more **actively involved** in their own care and that the technology was a good addition to their normal health and social care and would recommend it to other patients with similar conditions.
One of the most important points is that none of the patients felt that the technology had affected their **privacy** or made them concerned about the confidentiality of the information being exchanged through it. Only one patient felt that the technology had interfered with their daily routine.
Regarding the **personnel care concerns,** almost all patients had no concerns about the level of expertise of those looking at their data collected via the technology or worried that their continuity of care was being affected.
Moreover, patients within the pilots felt that the technology provided to them as a part of inCASA, **could not replace** their regular health or social care, although some patients felt that the technology was as suitable as a regular face to face consultation.

Professional perception
Professionals who were involved in the pilots were enthusiastic with the inCASA service.
The majority of professional users (**56%**) who were asked to rate their overall satisfaction with the service, rated it as “Average”. 36% rated it as “Satisfied” (**36%**) and 8% were Very satisfied. 96% of those asked said that they would like to continue using the service. Moreover, the 35% of professional users felt that the technology provided them with the information to manage their patients/end users. This outcome is even more valuable considering that only 27% of professional users had used Telehealth technology before and only 6% had used Telecare before.

All pilots reported that the introduction of the inCASA service had **impacted on time** in some way but the pilots also reported having access to more information about a patient had helped **improve communication** between different organisations and groups.

Organisational impact and effectiveness
An outcome of the project for all pilots has been a series of new and redefined pathways in order to care for and respond to the new information being received. Pilots acknowledge that these pathways are still being developed and in some cases will be expanded to encompass other organisations as the service grows.

The Integrated technology
The process illustrated by the project and tested within inCASA, involves a wide range of functional and technological integrations, starting from the clinical data regarding the patient's health (chronic or acute pathologies, hospitalisations, etc.) at a local (integration between the electronic medical record (EMR), social dossier and the project's platform) and regional/national levels (integration with the EHR), as well as an evolution of the behavioural data and clinical profiling models, to ensure a better classification of frailty and to increase the diagnosis, care and treatment integrated models.

All pilots reported that having access to more information about a patient had helped improve communication between different organisations and groups. This level of accomplishment has been enabled by an Electronic Patient Record (EPR) component of the inCASA solution, introduced from health experience and adapted for social/habit data, and was made available to all the users involved in the inCASA pathways.

Strong emphasis on the use of integration standards was highlighted by the project. This was a key success factor in order to introduce the solution in so different contexts, both in terms of co-operation with pre-existing systems, than in term of use of specific solution components.

Sustainability of the service

Each of the pilots has presented economic data concerning the cost of the equipment and running of the service. Some pilots have presented information about change in resource usage and attempted some simple calculations to provide preliminary evaluation of costs for the service.

All pilots provided an analysis of economic reporting. The cost models presented by each pilot were slightly different as they are based on different funding streams and outcomes:

- FHC deteremined a reduction of at least 1 or 2 days of hospitalisation per year for each group of 8 to 9 elderly patients suffering from COPD, which is sufficient to demonstrate an acceptable efficiency ratio for such a programme.
- KGHNI calculated cost savings based on the number of re-hospitalisations averted. The inCASA services provided a reduction of the hospitalisation.
- INSERM calculated its cost benefit by evaluating the running costs of delivering the integrated service for the duration of the pilot, the costs related to the time used by staff was calculated by estimating the number of hours spent by each stakeholder in each kind of activities (training, meetings, installations and monitoring). According to this comparative study, INSERM calculated that the cost of one chemotherapy course is reduced by 4041 € when delivered at home with inCASA monitoring compared to conventional care, which represent a significant cost saving for the national health insurance.
- CHC calculated the cost of the change in resource usage of patients who were enrolled onto the service. Results indicated a £19.651 reduction as compared to the same time period prior the start of the pilot. However when evaluating the start-up costs and running costs of the pilot the cost saving is eroded
- ATC performed similar cost analysis on its pilot. By hypothesising that it would be able to reduce unnecessary and unplanned visits to the user as well as by reducing the number of planned visits to the user, ATC proposes a saving for each patient of about 60/euro month. On this basis, the average cost suggested for this kind of service is about 2/euro a day.

A further factor was the impact on workloads of the users, which depended on the actors involved within the process. All pilots reported that the introduction of the service had impacted on their use of time in some way that depended on the pilot organisation. Much of the additional workload was undertaken by the nurses and front line staff in managing the day to day running of the service. This was especially the case where nurses were undertaking the recruitment, installation and monitoring.

Impacts

Stakeholder viewpoint

The interventions set as pilot objectives demonstrated that an integrated welfare and healthcare system strengthens its ability to protect the most vulnerable population groups, allowing them to have priority access to benefits and care services.

inCASA allowed organisations to develop new forms of co-operative organisational structures within their region as well as identifying further stakeholders interested in adopting the solution to support emerging care organisation based on the socio-health re-organisation. This was true in particular, in the **practice of primary care** (ex: Italy), where it is necessary that healthcare aspects are well integrated with the social care to enable a multi-dimensional assessment of resources.

The implementation of a multi-disciplinary model shared between Primary Care, Social Services and homecare services provided by Healthcare Agencies will ensure effective total patient care of the individuals whose risk profile is associated with the implementation of measured and personalised actions.

Moreover, as frailty becomes a recognised concept (e.g. the work performed within the framework of the EU initiative "Innovation Partnership on Active and Healthy aging" EIP-AHA), it will be possible to define the level of frailty from an objective point of view, and this will become critical for better organisation of public care services, in a time of spending review. The inCASA project assessed the level of frailty of the enrolled participants, but this measurement was based on self-assessment, elaborated according to the Edmonton Frailty Scale. However, a-priori this only provided a level of risk. A more pertinent score would include “real time” information to further define and update a frailty model. At the same time, as the a-priori model is developed, its use and validation with data as measured from the inCasa platform will assist in improving the accuracy with which there can be prevention and early diagnosis of frailty and functional decline, both physical and cognitive, in older people.

Users viewpoint

From the professional perspective, the project helped develop a different culture that goes beyond the initial diffidence to technology. New pathways developed through the project indicate that it is necessary that the healthcare aspects are well integrated with information on the social aspects, and that there is a multidimensional assessment of the needs of the patients and families resources and consequential need for co-operation between healthcare and social services.

The implementation of a multi-disciplinary model shared between the Primary Care systems, the homecare services provided by Healthcare Agencies and the intervention of the social services will ensure effective total patient care of the individual, whose risk profile is associated with the implementation of measured and personalised actions. inCasa was able to identify that, for some types of selected users/patients, it will be possible to implement a series of training, information and monitoring pathways aimed, for example, at compliance with and appropriateness of pharmacological therapy, that is based on a correlation between cognitive impairment and the development of frailty.

Business organisations viewpoint

The project helped the business organisations involved in the project to develop a flexible business model that offered return on investment from customers.

The national and/or regional healthcare service providers are the potential inCASA service customers. These organisations have the institutional mission to care for the health conditions of its citizens and therefore they would have interest to implement any solution that can provide added value for their “customers” (the citizens) in terms of improved service quality and/or provide savings in cost of providing those healthcare and social care services. Future business models of eCare will be driven by differentiated access to services, and the level of frailty could be assessed and used to determine the services that are provided.

One of the main targets of inCasa is demonstrate reduction of cost to the healthcare care service through avoided and reduced hospitalisation and cost-reduction of processes.

Data collected in the project has been used by the industrial partners to develop their business models. Flexibility was introduced by setting prices per service/day/person, in order to consider the effects of cash flow derived from operational savings, and determine break-even point due to the start-up costs through purchase of the equipment. The industrial partners prefer a financial model based on a cost saving/sharing model.

The inCASA platform has the unique features that it can integrate health and social care services as well home automation services. This offers the market advantage of offering a complete solution for health and social care monitoring that can avoid system and data duplication, and therefore reduce costs.

1 Introduction

The “Integrated Network for Completely Assisted Senior citizen’s Autonomy (inCASA)” is a project co-funded by the European Commission under the CIP - ICT PSP program (Competitiveness Innovation Programme - ICT Policy Support Programme) which aims to encourage and accelerate the use of innovative technologies and digital content by citizens, public administrations and companies. More specifically, inCASA project involves 13 partners from 8 different European countries:

- Project coordinator **(Santer Reply S.p.a)**
- Healthcare providers **(Fundación Hospital de Calahorra, Konstantopouleio General Hospital of Nea Ionia, Chorleywood Health Centre, Institut National de la Santé et de la Recherche Medicale)**
- Social service provider **(ATC - Agenzia Territoriale per la Casa della Provincia di Torino)**
- Research organisations **(Steinbeis Innovation Centre Embedded Design and Networking)**
- Educational establishments **(Department of Information Systems and Computing, Brunel University, Intelligent Communications and Broadband Networks Laboratory - National Technical University of Athens)**
- Hi-Tech Industry **(Telefonica I+D, CNet Sweden AB)**
- SME **(In-JeT ApS, Invent)**

The inCASA platform will apply the latest technologies to improve the quality of life of self-sufficient frail or elderly people by increasing independence, self-management and reducing the periods of hospitalisation.

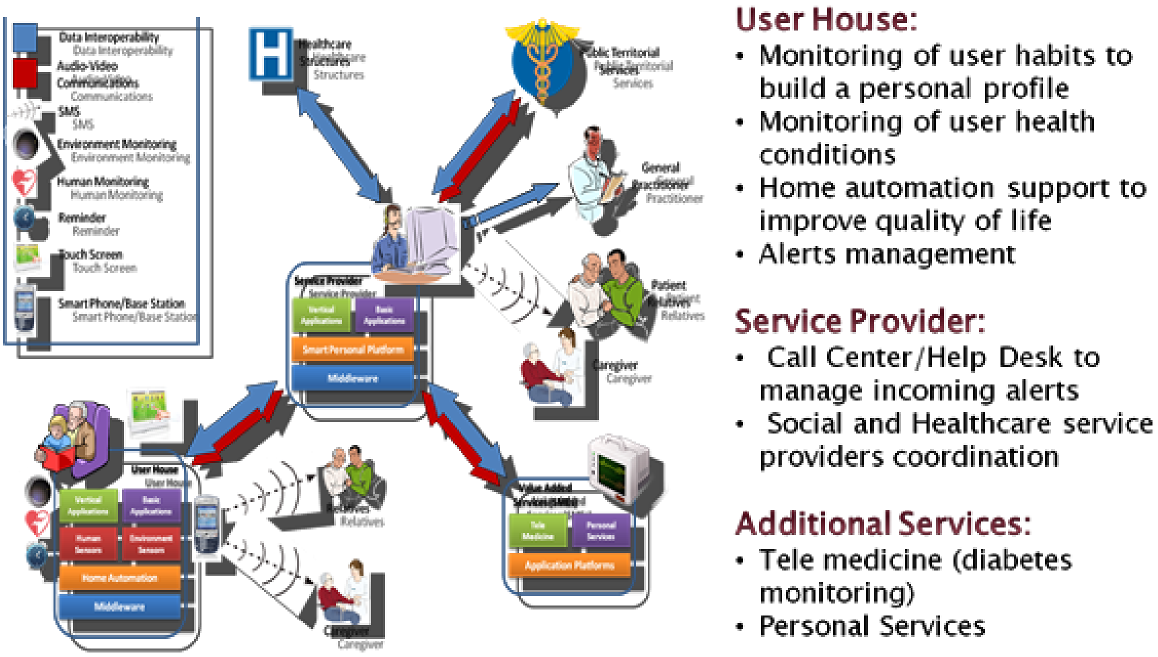


Figure 1 - Overview of the inCASA system

In particular, the inCASA services involved users among European citizens, who were over 65 years old, living alone and had a sufficient level of autonomy and ability for self-care.
The pilot sites (200 Users), where the trial has taken place, are distributed in 5 European countries:

- Institut National de la Sante et de la Recherche Medicale (Paris, France),
- Fundacion Hospital Calahorra (Calahorra, Spain),
- Chorleywood Health Centre (London, UK),
- Konstantopouleio General Hospital of Nea Ionia (Athens, Greece),
- Agenzia Territoriale per la Casa della Provincia di Torino (Turin, Italy).

The deployment of the InCASA project included two steps:

- 5-10 users pilot the service in five countries over 2-3 months
- 30-40 users pilot the service in each country (from end of step 1 to the project end) in addition to step 1 users.

A transferability pilot was implemented in the last phase of the project to determine the market proposition and the related deployment strategy in premises of the Skive Municipality, Denmark.
The project started in April 2010 and ended in June 2013.

WEBSITE:

http://www.incasa-project.eu/news.php

1.1 Purpose and content of this deliverable

This deliverable provides an overview on the inCASA project and highlights the most relevant topics, such as: services deployed; the whole system; how it is intended to be used; and the architecture behind the services proposed.

1.2 Outline of this deliverable

This deliverable is organised as follows:

Chapter 2 "Description of the InCASA Services": The chapter starts by presenting an overview of inCASA services and defining, for every pilot, the service model and the results obtained through the questionnaire submitted to the patients.

Chapter 3 "The architecture of the inCASA solution": The architecture for the whole inCASA system will be presented with an overview on the "building blocks" composing the entire system, and on their integration. Furthermore the pilot deployment will be specified.

*Chapter 4 "*Evaluation Results*"*: This chapter starts with an introduction on the results obtained by the whole inCASA services. It continues with the Skive Case presentation as example of the transferability of the inCASA services and it ends with an overview on the adopted Business Model.

Chapter 5 "Lesson Learned": The lessons learned are analysed from the different dimensions of inCASA. The chapter starts with an explanation about the Socio-Technical Innovation provided by inCASA and defines how the user-centric approach needs to be encouraged. From this point the chapter moves on by illustrating the shared frailty model identified and the flexible business model developed. The results provide evidence for the contribution given by inCASA to the enhance care.

*Chapter 6 "*Next Step*":* This chapter, starting from the lessons learned and the evidence gained, describes the next steps to undertake in order to enhance inCASA services and for their exploitation.

2 Description of the InCASA Services

The "Integrated Network for Completely Assisted Senior citizen's Autonomy (inCASA)" project deals with citizen-centric technologies and public/private service networks, to help and protect independent elderly people, prolonging the time they can live well in their own home by increasing their autonomy and self-confidence. Therefore, the inCASA technical platform is designed to support a flexible combination of components and services that will meet the needs ofend-user (independent living sensors, home automation, emergency alert systems, tele and remote monitoring as well as home security), with a "check/act" approach (approach by different iterations).

This goal is achieved through the integration of already existing technical solutions and services (hardware and software) which allow the normal behaviour of patients to be profiled through the collection and analysis of data related to environmental monitoring (Telecare) and vital signs (Telehealth). The innovation brought by the inCASA project is the integration of the two different domains of measurement, Telecare and Telehealth, at technical level and at service level through collaborative working of health and Social Services through the design of specific integrated scenarios.

The platform developed in the inCASA project aims, through the use of technology and provision of a specific set of services, to extend the time for which elderly people can "live well" at home, surrounded by their own comforts and their loved ones.

Figure 2 - Factors enabling the Socio-Medical Integration

One of the main functional requirements implemented by the inCASA platform is the integration at service level of data collected through the monitoring of clinical parameters (Telehealth) and habits (Telecare) of the senior. The combined analysis of the two different kinds of data is used to assess more accurately the impact that the deviations from habits, together with the change of some clinical parameters, may have on the user; this may help to

prevent possible problems by planning actions targeted by the Social Services, general practitioners (GPs) and or other community providers.
Specifically, the inCASA project aims to:

- Provide patients with special needs with a non-intrusive solution of habits profiling that monitors their health conditions outside traditional healthcare facilities;
- Provide physicians, health professionals and Social Services with more comprehensive tele-monitoring measures in order to remotely analyse the physical/behavioural conditions of the user;
- Ensure continuity of care through greater interaction between elderly patients and health workers;
- Foster collaborative working between different agencies responsible for the care and well-being of the user in the community;
- Ensure the integration of the home automation in a system which allows the remote control of electronic devices.

The Telecare service is able to provide physicians, health professionals and Social Services with an indication on the social/physical state of the remotely monitored patient.
Specifically, using environmental sensors, the following parameters are monitored: movement inside the home, chair and bed occupancy, opening/closing of the front door, turning on/off of the television set, wrist movement during the night (actigraphy).
The inCASA Telehealth services cover aspects of prevention, treatment and care and, by using appropriate sensors, support remote monitoring of the following physiological parameters: heart rate, pulse oximetry, blood pressure, body weight, and blood glucose.
The inCASA platform, by collecting measurements for a certain time period, is able to create the clinical profile of the elderly and then to evaluate any deviation of the parameters, not only from the clinical reference thresholds, but with respect to patient specific values.

Every pilot, based on different background and needs, implemented different levels of the overall inCASA solution as reported below:

	Users	Social	Clinical (Disease)				Organisational Setting		
		Telecare	Hyper tension	COPD	CHF	Cancer	Hospital	Primary Care	Social Care
INSERM	40	X				X	X		X
KGHNI	40	X			X		X		X
ATC	40	X						X	X
FHC	44	X		X			X		X
CHC	43	X	X	X	X			X	X
SKIVE	20			X	X		X	X	X

Figure 3 - inCASA Realisation Level

Project evaluation is based on the results coming from the 5 pilots plus a “transferability desk” in Skive (Denmark) in the last phase of the project.

2.1 Services Profile

KGHNI background

Konstantopouleio General Hospital of Nea Ionia (KGHNI) is a public Hospital with more than 500 employees (doctors, nurses, physicians, psychologists, social workers and administrative personnel). It offers almost all medical specialties. The surgery department is fully equipped, and has participated in national and European medical research projects.
During recent years Konstantopouleio General Hospital of Nea Ionia hospital has been carrying out extensive research in elderly people by exploiting technological advances. Using novel methods and gaining experience, KGHNI's personnel will contribute to the testing of the inCASA use cases.

KGHNI demand addressed

The inCASA infrastructure provided the doctors of the Department of Cardiology of KGHNI with the opportunity to have a close follow-up of the patients suffering from Congestive Heart Failure (CHF); estimate the efficiency and safety of the medical treatment; achieve the appropriate management of the medication dose; and detect acute changes of patient situation and early treatment of acute problems.

The aim of the KGHNI pilot was to integrate social and health services in order to support patients with Congestive Heart Failure and co-morbidities who live in their own home. The integrated KGHNI services are designed to complement the established medical services and aim to provide doctors with early signs of the deterioration of a patient (clinical); and to enhance the patients’ quality of life (psychologically, functional-wise in home and in everyday activities). Both components contribute to better prognosis of CHF patients while effectively reducing the risk of re-hospitalisation and averting non-required visits to the hospital out-patient clinic.

The project also aimed to demonstrate substantial prolongation of the time elderly people can continue to be at home, as well as the resulting increased efficiency of the social and health care systems. Through continuous monitoring, KGHNI ensures best medical compliance for patients after discharge while staying at home. A further step is to improve medical therapy, and so decrease re-hospitalisation, improve quality of life for the patients and improve quality and cost effectiveness of health care services. Finally, there was close follow-up of the social and psychological status of the patients, conducted by the social workers and psychologists of KGHNI, to allow behaviour monitoring and early detection of problematic situations, including depression; as it is widely known that depression and Congestive Heart Failure are strongly correlated.

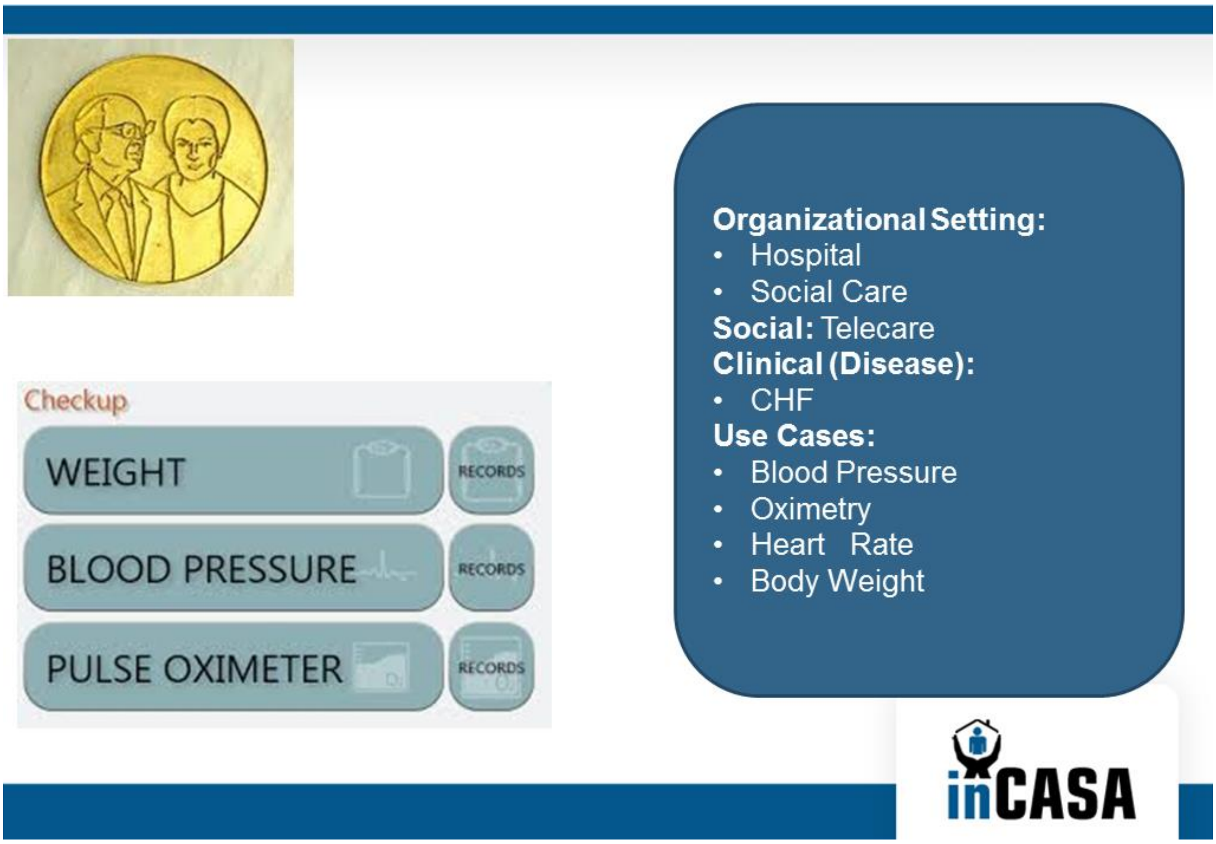


Figure 4 - KGHNI

Therefore, the main objectives of the KGHNI pilot, coordinated by the Cardiology Clinic of KGHNI, in the inCASA project were the following:

- Improving the speed of delivery and the quality of the healthcare services while at the same time reducing costs;
- Reducing the medical risks for the patients due to their continuous monitoring;
- Reducing patients' anxiety about their medical condition;

- Understanding the health condition of CHF patients in their real life at home by analysing the pilot results;
- Discovering correlations between the patients' medical condition and everyday habits;
- Enabling the consolidation of the latter as early indicators of worsening clinical status;
- Demonstrating that the active involvement of relatives and the assistance provided by social workers contribute to the patients' overall quality of life;
- Prolonging elderly patients independence by supporting them in their own home;
- Enabling early discharge of patients;
- Improving medical therapy in order to decrease the risk of hospital readmission.

KGHNI e-Care inclusion strategy

The Greek Pilot addressed its services to elderly people who suffer from Congestive Heart Failure (CHF) and were in most cases already being followed by the KGHNI Cardiology Clinic. The reason of selecting a specific target group is to have a well formed strategy and to better monitor and analyse the pilot results. The KGHNI Cardiology Department has an extended experience in heart failure cases.

Elderly people often feel insecure because they have health problems related to their age such as hypertension, arrhythmias (palpitations), chronic obstructive pulmonary disease, heart failure and often diabetes. For the majority of them it is not easy to communicate with the doctor every time they feel that their situation is worsened. For example, many elderly people get very anxious with slight fluctuations of blood pressure of trivial medical importance. The inCASA infrastructure will alleviate the anxiety and provide more closely follow-up by healthcare professionals.

Patients in the KGHNI target group often have concomitant problems, such as hypertension, diabetes mellitus, atrial fibrillation and other arrhythmias, need for anticoagulant therapy, that influence on their disease and should be monitored as well. By monitoring simple parameters, such as weight trends, blood pressure, heart rate, and/or blood oxygen saturation level (O_2 saturation), the inCASA services can make them feel safer and their disease better managed without forcing them to physically come to the hospital. It can also prevent the deterioration of severe health problems by increasing the dosage of some medications at the appropriate time.

The patients, who participated in the pilot, were selected from a special outpatient clinic of KGHNI created with the specific goal to support the inCASA project. KGHNI chose the patients that would gain the most from participating in the pilot by considering the social and family profile of the elderly people.

End-user inclusion criteria:

- Elderly people with Congestive Heart Failure (CHF)
- Suffering from concomitant problems paying special attention to psychological issues like depression

End-user exclusion criteria:

- Patients who are already managing their condition well.

FHC Background

Fundación Hospital Calahorra (FHC) is a non-profit-making organisation. It operates within the national healthcare system, in particular providing assistance to frail people. FHC is an independent hospital which has an annual contract with the regional authorities. It is also involved in disease prevention and rehabilitation. FHC participates in programs of promotion and protection of healthcare, training, as well as research projects.

It is a small hospital which officially has 100 beds available for in-patients. It meets the needs of patients who live across a large geographical area, formed by small to medium size villages of no more that 3.000 to 20.000 inhabitants, thus some patients live quite far away from the hospital and have serious difficulties when travelling on their own due to the lack of complete cover of transport needs for elderly, disabled or alone people within the region by an affordable public transportation system.

FHC Demand Addressed

Patients with COPD often decrease their physical activity because exercise can aggravate dyspnoea. The progressive physical deterioration associated with inactivity initiates a vicious cycle, with dyspnoea becoming problematic at increasingly lower physical demands. This pilot program aimed to break this cycle by promoting and monitoring rehabilitation exercise at home as this will improve patients' quality of life. The patient's clinical condition is also strongly influenced by their lifestyle and environment. Their life style (degree of daily activity, autonomy, healthiness of the environment, diet guidelines, social life, etc.) is a crucial factor in both the appearance and the evolution of COPD.

By integrating social and health services the FHC pilot aimed to delay deterioration by promoting and monitoring rehabilitation exercise at home as well as providing additional support for social needs.

This has a particular value for patients connected to FHC due to the distance between many patients' homes and the hospital. Moreover, a general shortage of staff means that by offering the service at home and having patient self-monitoring, the needs can be met more efficiently.

A specific training programme was built for every patient. Portable pedal machines, weight scales, pulse oximeters and a touch screen device were provided. Parameters monitored included, fatigue, blood oxygen saturation and heart rate. Breathing exercises were also included to improve the muscles involved in the process of breathing. The patients also received education about their disease and its symptoms and the different ways to deal with them.

FHC social workers acted as the coordinator between the health professionals of FHC and the social workers at primary care level.

Figure 5 - FHC

The overall aims and objectives of FHC pilot were:

- To test the efficiency of FHC's Rehabilitation programme
    - Design of a prospective, legatorial and controlled study.
    - Statistical treatment of media comparison at the beginning and at the end of the programme.
    - In-home group (exercises at hospital for 4 to 5 weeks + 4 to 5 weeks at home) vs. 1 control-group (8 to 10 weeks of exercises at hospital gym).
- To design a programme based on tele-rehabilitation / in home exercises to push forward adherence to treatment through use of new technologies:
- To improve the protocol used for the selection of the best candidates for participation in the programme for tele-rehabilitation for COPD patients via use of Actigraphy (efficiency)
- To detect possible risk factors for social exclusion that complicate the COPD rehabilitation programme through social assessment of patients (effectiveness).

FHC e-Care inclusion strategy

The Spanish pilot involved self-sufficient patients aged 65+ who have COPD and they live far away from the hospital.

Patients were selected on the basis of their health problems as defined above and their age (+ 65 years). Selected patients were then approached by their doctor who fully explained the extent of the pilot and what patients may expect from their participation in it. If necessary, or if the patient wished so, the patient's relatives as well would be fully informed.

Patients were sent from the respiratory medicine department of the hospital and must meet these criteria:

- Age
  - 65 years old or older
- COPD level and related health indicators for each patient (i.e. health issues)
  - COPD levels II or III
  - Clinically stable
  - With or without oxygen at home
  - No cognitive impairment
  - No motor deficit
  - No known coronary diseases
  - No other severe associated disease (e.g. neoplasm)
- Relevant social issues
  - With caregiver at home
  - With telephone network (landline or mobile)
  - Non-smoker or about to start a smoking cessation program
- Patient's commitment to the program
  - High motivation to participate in the pilot

INSERM Background

INSERM (Institut National pour la Santè et la Recherche Medical) has long standing experience in the regulation of tolerability and efficacy of cancer treatments based on circadian rhythm, with research ranging from rodents to patients. It has conceived and implemented chrono-modulated treatment delivery to take advantage of the control mechanisms through which the circadian body clock modulates normal tissue physiology and tumour growth.

Cancer chronotherapy is delivered at home using programmable pumps and helps avoid familial and social disruptions. Since cancer is a complex disease associated with co-morbidities, many healthcare and social care providers are involved. This leads to a large burden on the healthcare system as well as a complex situation for patients and their families. By integrating social and medical care and using Telehealth monitoring, patients can be supported on more than one level in efficient ways.

INSERM Demand Addressed

In the French pilot, the improvements to the existing services were related to:

- Support for a holistic approach to care for cancer patients; care is currently handled by several social and medical care providers who usually interact separately with the patient.

- Early detection of drug-related adverse events or disease exacerbations through close monitoring of the health condition in order to prompt relevant intervention thus reducing hospitalisation.
    - This approach includes the daily self-rating of the symptoms that reflects impaired behavioural or biological functions, as well as body weight and circadian rest-activity pattern through a non-invasive rest-activity monitoring.

This result has improved quality of life and patient prognosis through facilitating healthcare coordination, controlling patient symptoms and enhancing circadian robustness.

Figure 6 - INSERM

Patients were recruited from the outpatient Chronotherapy Unit of the Department of Medical Oncology (Dr Francis Lévi) at Paul Brousse Hospital (Villejuif) and were followed as outpatients.

INSERM e-Care inclusion strategy

Within the inCASA project, the pilot involved 42 patients as end-users who have been diagnosed with cancer, but who are at a stage in the course of their disease where they are not too ill (defined as being ambulatory at least 50% of the daily time). Patients were 65+ years old, self-sufficient and living at home (either alone or with their spouse).

Inclusion criteria:

- Cancer patients at the age of 65+
- Cancer patients living at home and receiving chrono-modulated chemotherapy treatment at home
- Cancer patients who are self-sufficient

Exclusion criteria:

- Cancer patients whose disease has progressed to the extent that they spend more than 50% of their time in ambulatory care.

Patients were selected based on the criteria above. 5-6 patients per month were selected to participate in the pilot. Selected patients were approached by their doctor who fully explained the extent of the pilot and what patients may expect from their participation in it.
Patients were able to freely choose whether they want to participate or not (may withdraw at any time), and it was made clear that should they refuse to participate then this will have no impact on their existent care plan. Patients signed the informed consent form provided by the project before they actively participate in the pilot.
Patients were given repeated opportunities to ask questions and raise any concerns with the health care staff involved in the pilot.

CHC Background

Chorleywood Health Centre is a medium sized general practice based in an affluent area North West of London. The majority of its 6000 patients are elderly and patient care is well managed.

The practice achieves high QOF scores, taking 96.4% of the total points available – 0.7% above national average.

The health centre is staffed by a multi-disciplinary team, including GPs, nurses and on site physiotherapist and counselling services. In addition, a Diabetic Retinopathy clinic is held at the centre.

The practice is housed in a purpose built building which replaced its predecessor after a flood in 1997. The building was developed specifically to exploit technology and telecommunications to deliver health care and the team has been using technology as tools to help them with their work since 1984 when the EPR was introduced. In addition to providing sufficient power points, network outlets, ISDN and telephone lines are provided in each of its rooms. The practice also has a purpose built telehealth room which houses video conferencing and digital imaging equipment. The practice runs a regular vascular teleclinic and uses the video conferencing equipment to link with the John Radcliffe Hospital in Oxford. It has a similar program for heart disease linked with Watford General Hospital.

CHC Demand Addressed

The CHC pilot helped to develop an integrated service delivery model to combine health and social care in responding to the needs of frail elderly people with long term conditions. This service integration was driven by both health and social care. Information about the patient and data from the remote monitoring were shared and exchanged between the general practice and social services.

The demand addressed was to:

- Build an integrated health and social service to deal with the data from both remote patient monitoring and environmental monitoring.
- Evaluate the value of the integrated service to both the frail elderly person and the social and clinical services that care for that person.
- Understand and measure the impact of such a service to a patient's quality of life
- Prevent or delay the eligibility of frail patients for social services
- Prevent or reduce the numbers of unnecessary interventions and hospital admission
- Reduce length of stay and enable early discharge of the frail patient into their own home.

Figure 7 – CHC

The CHC service model supported the identification and monitoring of those frail patients with chronic disease who are at risk of sudden deterioration so that they can be treated and supported in their own home. The integrated health and social team can monitor, review and respond to the patients' needs as they change by providing comprehensive support covering a range of services.

Costly hospital admissions can be avoided and the number of bed days can be reduced and early discharge can be enabled. Appropriate social support can be identified earlier in order to enable the frail elderly patients to remain safe and independent in their own home.

CHC e-Care inclusion strategy

The project helped to monitor frail elderly patients who are currently on the chronic disease register at Chorleywood Health Centre. Patients were identified based on a number of inclusion criteria. Registers from Acute, Adult Social Services and Primary Care were used.

Patients were included who met 5 or more of the following criteria:

- Registered at CHC
- Over the age of 65
- Living alone
- Have more than 2 comorbidities
- Number of clinical contacts
- Social Service Contacts
- More than 5 Medications
- History of Falls
- Referral
- More than 1 hospital admission in 6 months and 2 in 12 months

ATC Background

ATC Torino (Agenzia Territoriale per la Casa della Provincia di Torino) is the public body in charge of social and public housing in the area of Torino, Italy, and its surroundings.

ATC's mission is to supply low-cost housing to underprivileged citizens, and to manage its own real estate. Furthermore, ATC undertakes the refurbishing and conservation of the patrimony of public housing and the related services.

More than 14,000 people over the age of 70 are currently living in the flats that ATC is responsible for. Approximately, 5,000 people live alone. As the number of elderly people is increasing the demand for social housing is subsequently growing. In the next 10 years, it is estimated that the demand for assistance of the elderly people in social housing will rise to around 36%. ATC plans to increase its focus on linking housing assistance programs to support tenants over 70 in order to give them the opportunity to maintain independence in the flats where they are living.

ATC manages 18,000 flats in Turin. Approximately 39,300 people live in flats, 11,233 of them being over the age of 65 (of which 3069 are over the age of 80).

Figures from December 2009 show that 910,504 elderly people live in Turin of which 79,609 live in District 1 (Centro – Crocetta). As a percentage, this means that 24.5% of elderly people (over 65) live in Turin, with 30% living in District 1. Of these, the percentages of elderly people who are living alone are:

- Age 65-74: 33.5%
- Age 75-84: 44.8%

- Age 85+ : 61.7%

By working in partnership with public authorities, private and voluntary sectors, public housing authorities and housing agencies, ATC can improve the quality of life for tenants by offering housing and services adapted to their needs.
The main tools that ATC has available include:

- Social master plans and governance white papers;
- Policies for elderly people;
- Policies for social inclusion of foreigners;
- Promotion of urban regeneration;
- Moderation of neighbourhood disputes;
- Mixing social housing, affordable and private tenancy;
- Policies to improve social security in our district (with police cooperation).

ATC Demand Addressed

ATC sought to incorporate the concepts, values and standards of the inCASA solution into the organisational structure and culture of the local environment by: improving the quality of life of Italian frail elderly people; improving the quality of work of socio-medical professionals; supporting healthy environments; and actively cooperating with the social and healthcare community. It provided local authorities with an opportunity to contribute to the public health agenda, incorporating health promotion as a daily work activity.

Figure 8 - ATC Torino

The service implemented profiled user habits in order to identify automatically anomalous situations and send alerts to the user, carers and service providers. Any significant deviation from the Habits Model generated an alert that required a defined action by a designated person (e.g. case manager, clinician or social worker).

Social services involvement contributed to the maintenance and the improvement of the social contacts and the social relations between elderly people who had many opportunities to meet with other persons of their age, and to develop various activities and interests, and the outcomes were easily monitored through inCASA integration.

This services improved thanks to the inCASA project were:

- Improve quality of life (loneliness/safety)
- Promote remote health monitoring of people living alone
- Improve relations with neighbours (social neighbourhood)
- Integrate a free ATC number (24 hour call service) with social services network
- Develop a local community among users.

ATC e-Care inclusion strategy

The inclusion criteria for ACT residents who participated in the inCASA pilot were:

- Self-sufficient senior citizens over 65 that require light support by professional to improve their autonomy in addition to or in replacement of the family network (where absent);
- Senior citizens over 65 partially self-sufficient or non-self-sufficient who require support by professional to improve their autonomy in addition to or in replacement of the family network (where absent);
- Different situations where a coexistence of the matters above is present;
- An already well-established and good relationship with his/her social worker.

Exclusion criteria:

- Residents who do not require social support;
- Residents who do not have chronic health conditions.

The tenants/users were able to freely choose whether they want to participate or not, and could withdraw at any time. They were clearly informed that they would participate exclusively on a voluntary basis.

2.2 Service Model

KGHNI

The main objective of the KGHNI pilot in the inCASA project is to develop an integrated healthcare service for patients suffering from Congestive Heart Failure (CHF). Thus, the overall coordination of the Pilot activities belongs to the KGHNI Cardiology Clinic.

In this project, KGHNI is devoted to take care of people suffering from CHF. By monitoring medical parameters (such as blood pressure, heart rate, body weight, blood oxygen saturation level) KGHNI has developed new practices to guarantee a close follow-up of patients, ensure an early intervention in case of critical situation and re-hospitalisation cost reduction.

The Pilot activities in Greece were primarily motivated by the existing problematic situation whose outline is the following:

- Nearly two thirds of all deaths in women and men aged ≥ 65 years in Greece are associated with cardiovascular diseases.
- The increasing rate of cardiovascular diseases poses a substantial economic burden on society and on the health care system.
- Remote Healthcare Monitoring is not deployed and re-hospitalisation is practically the only way to resolve a heart related issue.
- Healthcare system is based on treatment and not on prevention.

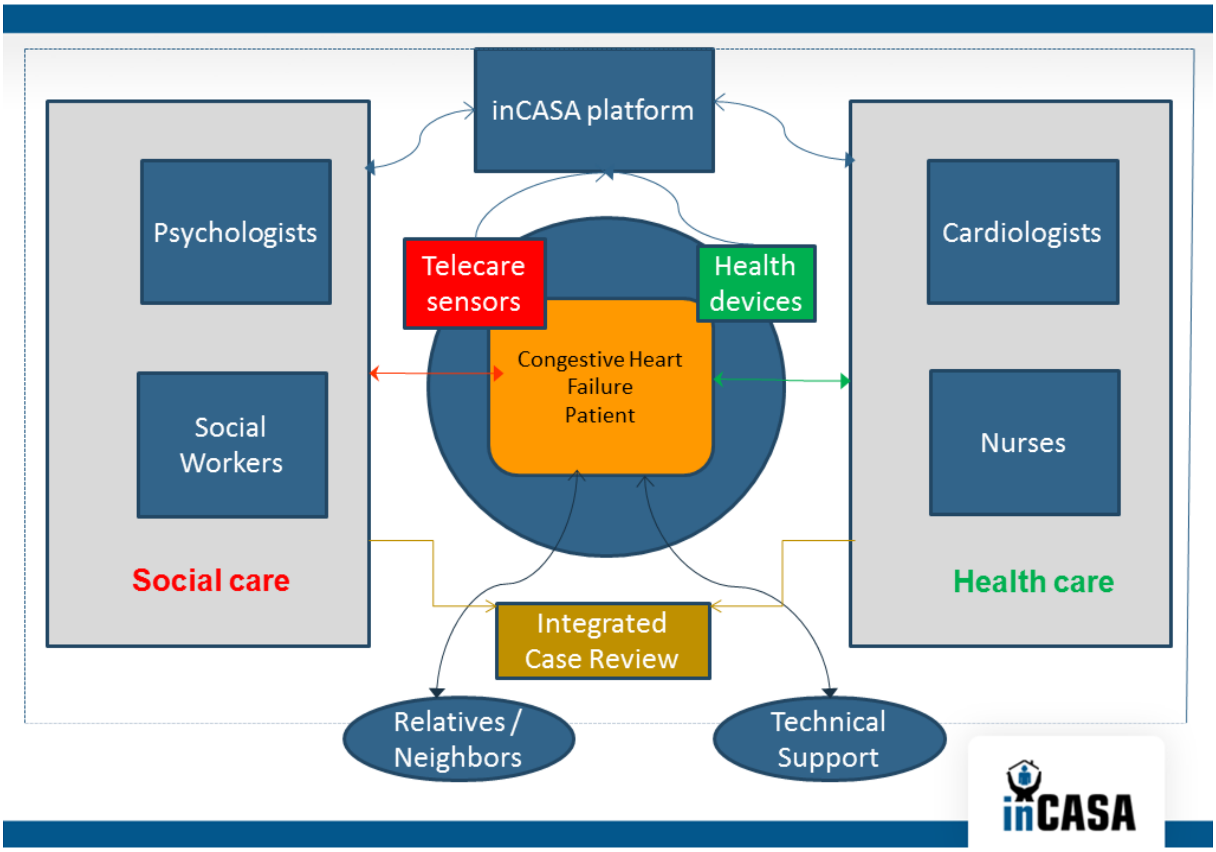


Figure 9 - The KGHNI Service Model

The KGHNI pilot was coordinated by the Cardiology Clinic of the hospital. The appointed cardiologists and nurses participating in the project had the overall case management for every CHF patient monitored via the inCASA solution. Some of their tasks were: monitoring measurements, trend analysis, alerts management, interventions, and change in medication.

Specifically, the KGHNI cardiologists coordinated the activities of the pilot. They were responsible for patient recruitment, data monitoring, alerts processing, interventions and pilot evaluation. As they coordinated all activities, they also reported any ethical issues to the hospital ethical committee as well as to the inCASA Ethical Board.

The parameters monitored during the pilot phase were:

Parameter
Body Weight
Blood Pressure
Pulse Oxymetry
Heart Rate
Chair Permanence
TV Usage
Indoor Movement
Indoor Temperature

Figure 10 - KGHNI Parameters

The threshold values for the clinical parameters were personalised in order to adapt more precisely to the status of each patient. For all clinical parameters an alert was raised in case of measurements outside thresholds.

In additional to the clinical measurements, further behavioural, psychological and environmental parameters were monitored in the inCASA Pilot. The list below summarises the extra parameters and their purpose.

- Depression monitoring via specific questionnaires, recommended by the scientific community, administered to the patients either by the social workers or directly by the expert psychologists especially to patients who have already shown early signs of depression.
- Chair occupancy, TV usage and motion monitoring in order to create a habitual profile and, according to the core inCASA protocol, generate an alert in case of significant divergence from the stored profile. These alarms required an integrated case review from the Professional stakeholders involved who were seeking to discover correlations with the changes in the respective health status. Even if no health deterioration was proven, this kind of alarm was analysed as they could indicate an early sign of worsening mental or psychological status that could lead to a deteriorating health situation.
- An indoor temperature sensor was also placed in the patients' homes targeting mainly to notify any high temperature values during the Greek summer. Such high values are considered a prohibitive factor for the well-being of CHF patients.

KGHNI integrated social and health services are targeted towards:

a) Mitigating health-related risks by employing combined Tele-Health/Tele-Care views to assist doctors in early identification of the deterioration of individual patients

b) Supporting the patients' everyday life, particularly in cases where their physical/social/in-home activities are also impaired by their psychological condition and/or other societal circumstances.

KGHNI social workers had an active role in the framework of the inCASA project. They were responsible for communication with patients and for making them feel that the inCASA solution is as user-friendly as possible. The social workers may call the patient asking them to come to the hospital if the doctors make such a decision. Moreover, they were asked to perform phone conferences with the patients to determine their psychological status and alert the doctors/psychologists if necessary. This was achieved using specific questionnaires, indicated by experts from the Psychiatric Clinic, which make it possible to elicit useful information about the patient's mental and social well-being. Furthermore, the social workers offered services at home to people who required social support and/or to help them register with nation-wide social care services such as “Help at Home”.

KGHNI psychiatrists/psychologists defined the questions posed to the patients by the social workers during their meeting. These questions were formed with respect to the scientific standards of this domain. They were responsible for the psychological status assessment and for the habits change alerts assessment based on the analysis of the inCASA platform data. Last but not least, they performed face-to-face interviews with patients having non-negligible social and psychological difficulties.

Nurses were responsible for continuous remote monitoring of the patient through the Web Interface of the Consumer Applications. They reported to the assigned cardiologist any alert produced by the system. Nurses also participated in the patient’s initial and final evaluation through health questionnaires (dementia, frailty, SF36).

The true potential of the inCASA solution is realised when effectively combining healthcare and social care services. For the Greek pilot case it made sense to deliver a solution that also addresses the psychological condition of elderly CHF patients. Several studies have already suggested that the prevalence of depression increases sharply with the severity of heart failure symptoms while major depressive incidents are also a stronger predictor of mortality than minor incidents. Moreover, depression has been found to have a negative impact on every dimension of health-related quality of life, including physical-social functioning and mental health.

FHC

The FHC pilot goal is to integrate health and social services for patients with chronic obstructive pulmonary disease (COPD) and who live a significant distance from the hospital.

Patients with COPD often decrease their physical activity because exercise can aggravate dyspnoea. The progressive physical deterioration associated with inactivity initiates a vicious cycle, with dyspnoea becoming problematic at increasingly lower physical demands. This pilot program aims to break this cycle by promoting and monitoring rehabilitation exercise at home as this will improve the quality of life for the patient. The patient’s clinical condition is also strongly influenced by their lifestyle and environment. Their life style (daily activity degree, autonomy, healthiness of the environment, diet guidelines, social life, etc.) is a determining factor both in the appearance and in the progress of COPD.

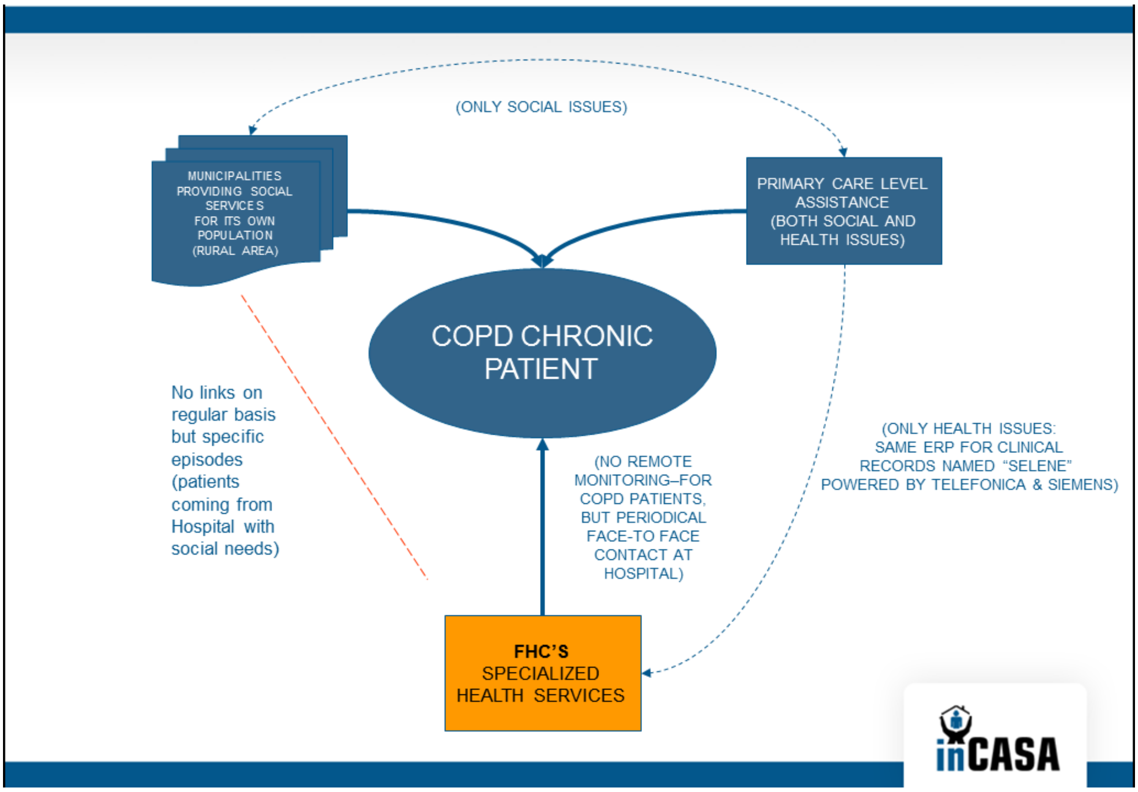


Figure 11 - The FHC Service Model

By integrating social and health services the FHC pilot aims to delay deterioration by promoting and monitoring rehabilitation exercise at home as well as providing additional support for social needs. This has a particular value for patients connected to FHC due to the distance for many patients between home and the hospital. Moreover, a general shortage of staff means that by offering services at home and self-monitoring, the patients' needs can be met more efficiently.

A specific training programme has been built for every patient. Portable pedal machines, weight scales, pulse oximeters and a touch screen device will be provided. Parameters that are monitored include, fatigue, blood oxygen saturation and heart rate. Breathing exercises are also included to improve the muscles involved in the process of breathing. The patient also receives education about their disease and its symptoms and the different ways to deal with them.

The management board at FHC decided to establish cooperation guidelines with the units in charge of providing social services within the regional public organisation. FHC has decided to redefine the roles for some of their staff whose tasks presently includes attending to patients and users (by managing complaints and claims) and who only occasionally carry out social tasks. They were part of the project and played an active role.

FHC's social workers were the interlocutor between the health professionals of FHC and the social workers at a primary care level. This also created a better connection to social services and municipalities.

The parameters monitored, as previously expressed, were:

Parameter
SpO2 (blood oxygen saturation level)
Weight
Heart rate
Mobility of lower limbs (pedalling rate)
Fatigue (pedalling curve)
Rest-activity rhythm (Actigraph)

Figure 12 - The FHC Parameters

Finally, the implementation of the actigraphy in Pilot Escalation Phase has allowed FHC to meet two new objectives:

- To improve the protocol used for the selection of the best candidates for participation in the tele-rehabilitation programme for COPD via actigraphy (efficiency).
- To detect possible risk factors for social exclusion that complicate the COPD rehabilitation programme through social assessment of patients (effectiveness).

INSERM

In conventional care, healthcare services and social services are separated and there is no cooperation between the hospital nurses, the homecare nurse, the general practitioner and other healthcare or social care professionals. When the patient requires healthcare or social services, he/she contacts the relevant professional him/herself.

With the inCASA solution, the nurses are the primary access point and directly interact with the patient and if necessary communicate any health problem at an early stage to the oncologist, the GP, the local nurse or other relevant healthcare professionals. Early detection of worsening of cancer or early detection of adverse events on chrono-therapy followed by immediate appropriate action could prevent health deterioration, hospitalisation and/or death.

Depending upon the type of deterioration (e.g. symptom, body weight, rest-activity), as indicated with reference to a pre-set threshold eventually completed with a patient interview, the nurse refers the patient to the relevant healthcare or social care professional (oncologist, geriatrist, general practitioner, psychologist, dietician, physical therapist or social worker).

The patient can then check the appointments with the healthcare or social care professional directly in the diary displayed on the electronic platform at his or her home. When a patient has medical questions or requires social services, the nurses can be contacted by phone during office hours.

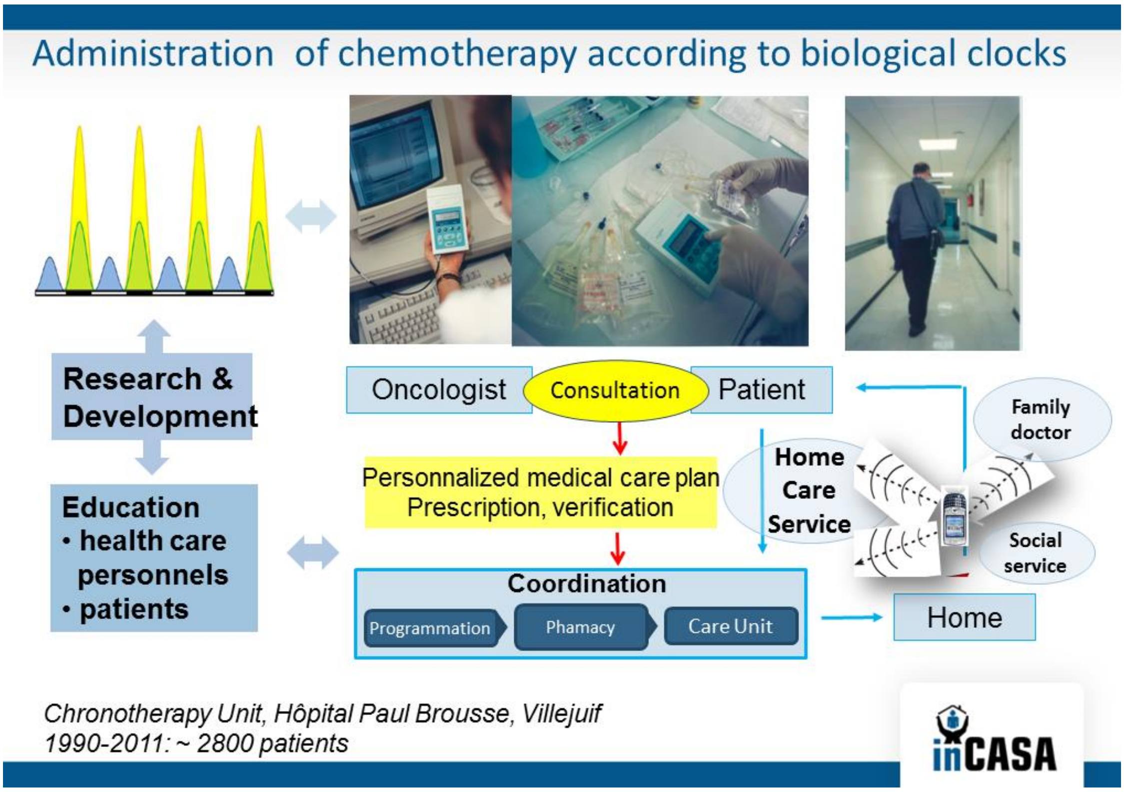


Figure 13 - The INSERM Service Model

To facilitate cooperation between professionals, it was agreed that during the initial evaluation the nurses are entitled to collect information about the patients' environment, including the details of the carers. This information will then be reported on the web portal. The intervention of professionals will be coordinated by the LVL Medical homecare company. They will organise a consultation with a dietician at home at the beginning of the study in order to have an initial check-up and prevent under-nutrition.

The parameters monitored were:

Parameter
Body weight
Symptoms self-assessment
Rest-activity (Actigraph)

Figure 14 - The INSERM Parameters

CHC

Currently health and social services are delivered separately. Adult services are organised by Hertfordshire County Council and Chorleywood Health Centre provides primary care health services to over 6000 residents within the area. While work elsewhere in the county is looking at integrating health and social care, it has not yet been accepted as a model by West Hertfordshire where Chorleywood Health Centre is located. Referral between health and social care is currently carried out by referral letter and by phone. Social workers are then assigned to the patient directly and no further communication between health and social care takes place.

Information about the patient is kept in separate health and social silos. Coordinating responses to patients' needs is complex. There are many competing interests between the two organisations in order to reduce costs. This separate working is recognised as possibly leading to inappropriate or missed interventions which ultimately can impact on the patient, their carers and the organisations charged with delivering the care whether it is health or social.

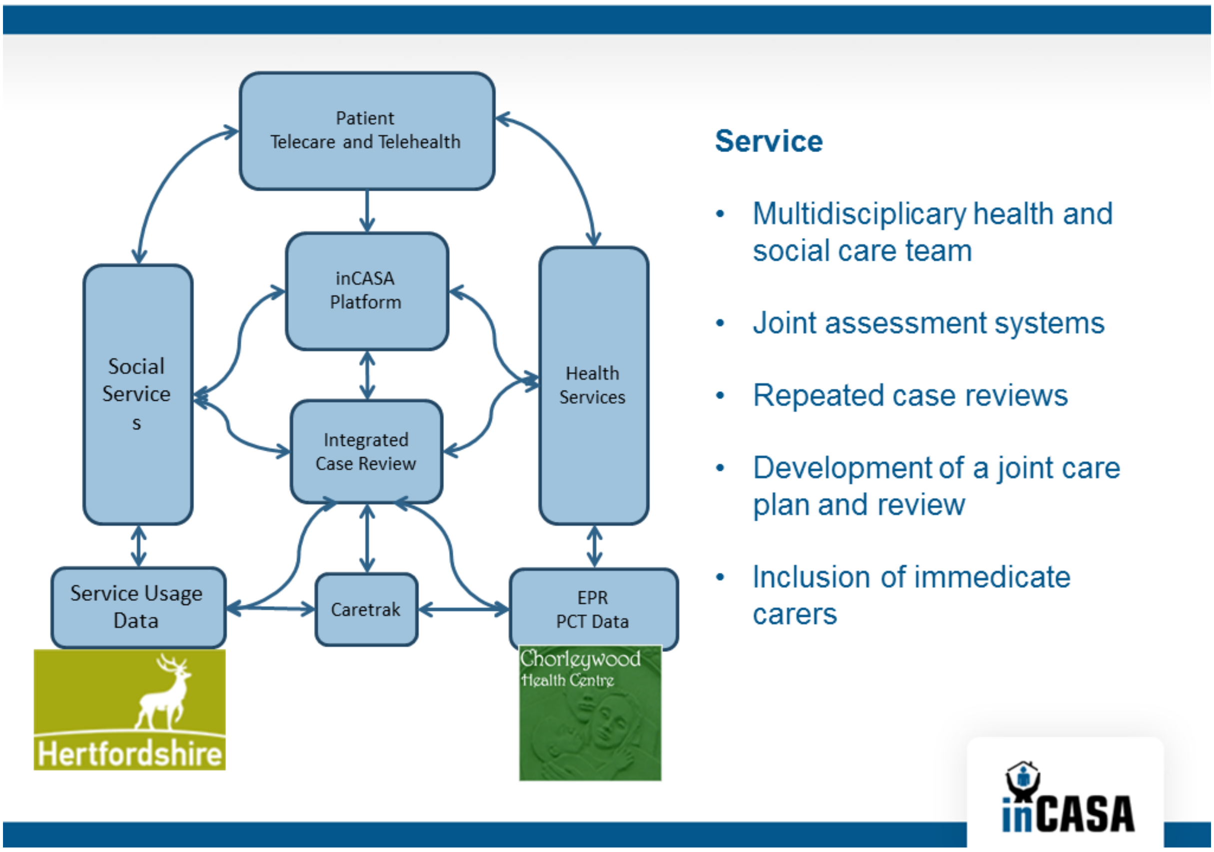


Figure 15 - The CHC Service Model

The CHC pilot implemented an integrated process by implementing Telecare and Telehealth services. A frail elderly patient was monitored by a combination of health and habits sensors in his own home (blood pressure, weight, SpO2, blood glucose, bed/chair sensor, PIR motion sensor, and medication dispenser). Sensor data were transferred from the home to the health care team in the general practice and to a key social worker in social services. Data can be viewed on a combined health and social care interface. Changes in usual clinical measurements and levels of activity were identified.

Incoming data were monitored by the healthcare team at Chorleywood Health Centre. Patterns of behaviour and physiological data, including in-bed restlessness, habits and deviations from habits, toilet visits, eating patterns, rapid weight loss or gain, medication adherence, blood pressure, weight, SpO2, etc., were assessed to provide decision support for the health and social care professionals for cases such as loss of autonomy or early detection of clinical deterioration. Responses to the information were managed by joint case conference between health professionals at Chorleywood Health Centre and social workers from Hertfordshire Adult Social Services. These was held weekly or sooner if deemed necessary and facilitated by means of video conferencing or teleconferences. Appropriate social and/or medical interventions ware determined by the joint team.

Each patient was provided with a monitor in their home to capture and transmit a number of different physiological measurements based on their condition(s). Patients were asked to take these measurements once per day.

The patients were also provided with environmental sensors to monitor and capture trend information about the patient's movements while in the home in order to develop an activity template. This monitoring was unobtrusive and did not require the patient to actively do anything.

Management of the "push" of information from the patient to the clinician was critical to the success of the inCASA pilot. It required systems to enable the data to be collected, processed, sorted, prioritised and displayed to the clinician in a way that supports the patient's management plan, the clinician's need and delivery of the service. In addition, the introduction of habits monitoring was a new level of monitoring that the clinicians never experienced with. The management system needed to analyse the data being sent via the habits monitoring devices, analyse and display this data in a meaningful way to the clinician. The advantage is that the behaviour data could be correlated with physiological data and the clinical information to find patterns or relationships.

One of the main challenges of the introduction of Telehealth programs is the increased workload that "alert" management can create. Many systems use simple high/low parameters to create alerts based on the patient's data. These have been found to be highly susceptible to "false alerts" and often lead to clinicians having to call patients unnecessarily. CHC proposed that responses to deviation from pre-determined parameters will be analysed using automated algorithms that will take into consideration factors such as change in medication. This helped to keep "false alerts" to a minimum.

The parameters monitored were:

Parameter
Blood pressure
Weight
SpO2 (blood oxygen saturation level)
Bed permanence
Indoor movement
Chair permanence
Medical compliance

Figure 16 - The CHC parameters

The CHC pilot also collected clinical event data including hospitalisation, GP and nurse contacts, and visits to A&E, in order to assess the financial and resource impact of the inCASA service and provide cost-effectiveness and cost-benefit analysis.

ATC

The purpose of ATC pilot was to develop an integrated service delivery model to combine health and social care in response to the needs of frail elderly people with long term conditions. This service integration should be driven by both health and social care. Information about the user and data from the remote monitoring should be shared and exchanged between the General Practitioner (GP) and social services.

The main part of this task should be developed in cooperation with the Social Services Department offices of the Municipality of Torino, the main authority responsible for the Social Services District.

Secondly, ATC was aiming to integrate Telecare and Telehealth services in the 3rd phase of the pilot in cooperation with an association of General Practitioners of Turin.

The planned Telehealth services will focus on monitoring blood pressure, weight and blood oxygen saturation level (SpO2).

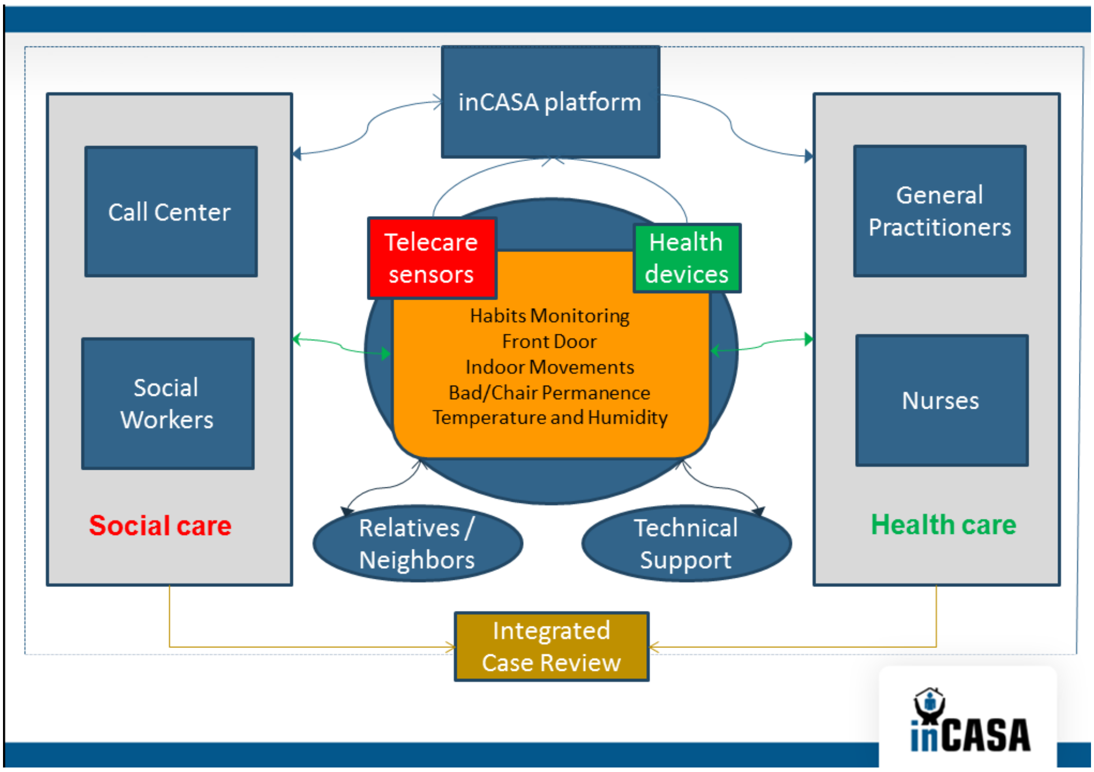


Figure 17 - The ATC Service Model

Unfortunately, despite the several meetings held with the local authorities the ATC pilot was not able to start the integration process between the Telecare part and the Telehealth part.

Therefore only the Telecare part was developed for this pilot, as described below.

For the Social Services and specifically the Call Centre which was designed to filter the incoming alarms, the project developed predefined protocols to triage events, which supported timely detection of all features specific to each user, as well as its reference points to provide an alert in case of alarm.

The design of the protocols was extended to the definition of flows relating to each sensor in the event of an alarm. Each operator in the project was given a period of education and training on the system and the procedures to be used and then employed in the local Call Centre (screen alarm monitoring).

The computer application, after the initial period of development, did not present any particular problems and the ease of use of the application and the completeness of the information relating to each individual user allowed operators to carry out duties in a straightforward manner.

The parameters monitored were:

Parameter
Front door
Indoor movement
Temperature and humidity
Water leaks
Bed permanence
Chair permanence
TV

Figure 18 - ATC Parameters

During the pilot phase, and the Telecare application of the inCASA solution, the Italian pilot continued meetings with the local health authorities and the MMGs to find a way to implement the integration between both services, Tele-Care and Tele-Health. Currently, due to a reorganisation of the local health system, the Piemonte region is interested in a chance to build an integrated system to support the growing demand of frail elderly living in this region. In Piemonte, the introduction of CAP (Centre of Primary Assistance), a multifunctional centre with doctors having different specialisations, allows the duties of primary assistance to continue without the need to relocate the increasing number of people asking for hospitalisation. In this kind of context the inCASA integration will help the de-hospitalisation process with the remote monitoring of both vital signs and habits.

2.3 Pilot Evidence

The evaluation method of the inCASA services is based on the MAST methodology; a series of questionnaires were used in order to reveal the outcomes on the various aspects of the inCASA solution. A multi-perspective evaluation has been conducted, based on the following supporting tools:

- Demographic analysis;

- Level of frailty of a patient as categorised using the Edmonton Frail Scale;
- Patients Perception analysis using the SUTAQ (Service User Technology Acceptability Questionnaire) questionnaire;
- Analysis of the changes in the quality of life, measured using SF-36 v2 questionnaire;
- Professional perception evaluation, measured using the relevant inCASA common questionnaire administered to the Professional stakeholders with core participation in the Pilot activities;
- Where intended, Clinical effectiveness evaluation, conducted both from a quantitative point of view based on the Pilot Action Log analysis and from a qualitative point of view based on the deep and correlated incidents analysis from the involved Professionals;
- Human resources consumption evaluation based on the inCASA service usage and statistics log;
- Economic reporting analysing the costs of the equipment, the additional professional workload introduced due to the inCASA service and the cost saving factors;
- Safety issues analysis based on the pilot action log and on the equipment specification;
- Ethical issues analysis based on the pilot action log and on the continuous monitoring of the feedback both from the patients and the Professionals.

In the present report, we provide evidence of the project perception, taking into account other evaluations in terms of overall conclusions and remarks. Specific reporting on other items is listed in the specific deliverables.

KGHNI Methodology

For every questionnaire that required a response from the patients, this was done in person at the patient's home. KGHNI professionals interviewed the patients and recorded all responses that were later analysed statistically.

Regarding the questionnaires that required a response from the Professional stakeholders, they were administered to the professionals via the mediation of INCASA inCASA personnel who conducted the procedure. The professional perception has been measured at the end of the Pilot period through face to face survey with one indicative representative from each one of the main Professional Stakeholders' categories. In other words, the set of the sample was formed by the following members:

- 1 Representative Cardiologist
- 1 Representative Psychologist
- 1 Representative Nurse
- 1 Representative Social Worker

The following list summarises the demographics of the patients having participated in the Greek pilot:

- 40 patients each having Congestive Heart Failure (CHF)
- Average age is 63 years old

- 30 men and 10 women
- 34 are married
- 20 have retired
- 35 live with their spouse. 5 live alone

KGHNI Patient Perception

Following a summary of the most important conclusions regarding the SUTAQ questionnaire:

- Patients agree that the inCASA services helped them save time in terms of required visits to the outpatient clinic. Their strong alignment to this view may be further explained by the reported enhanced sense of security due to the usage of the inCASA services in their own house.
- Patients agree strongly that the use of the inCASA platform to conduct medical measurements did not interfere with their daily routines. Furthermore, the user-friendly design of the inCASA patient computer interface turned the whole process of conducting measurements into a pleasant action.
- Patients felt that using the inCASA platform contributed to their well-being medical-wise. Many of them noted that: "*The inCASA daily schedule is a pleasant routine that helps me to keep my health status under control* "
- The vast majority of the patients did not think that the inCASA equipment intruded in their private life in any way. None of them considered the Telehealth equipment as intrusive.

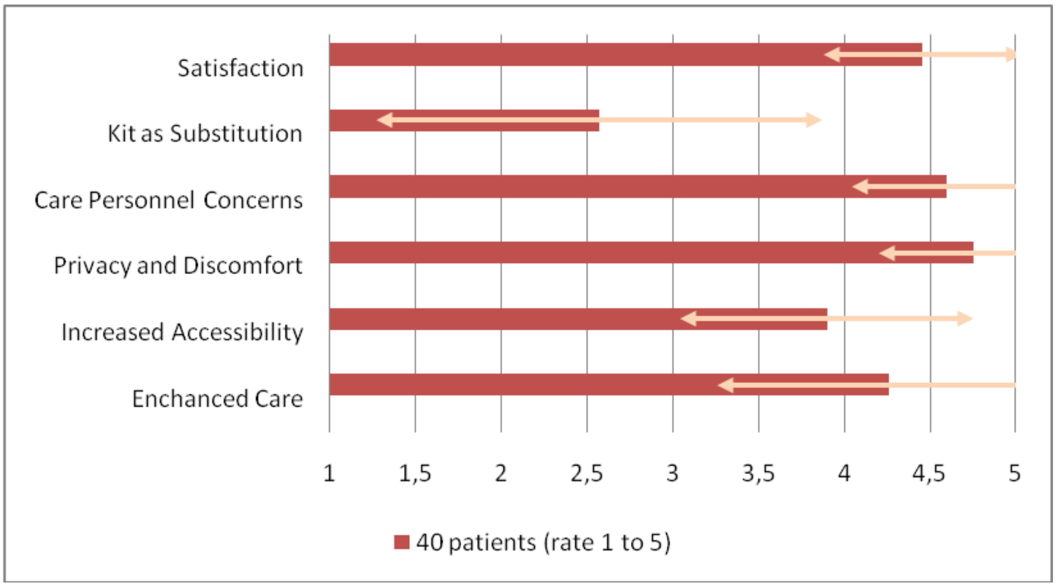


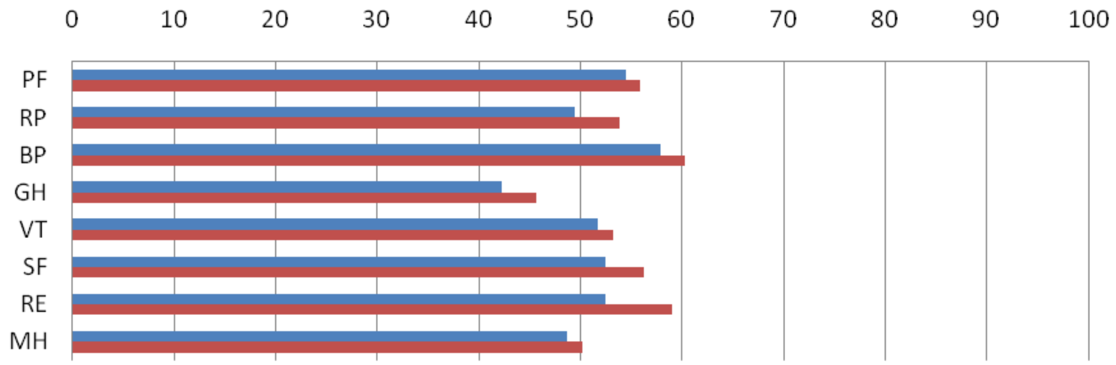
Figure 19 - KGHNI Patient Perception

- Generally, the user interface of the specialised software for conducting measurements is intuitive to most elderly patients since it is touch-based. Also the patients were already familiar with the usage of the medical measurement devices (i.e. blood pressure monitor).

- Patients agree strongly that no physical or psychological inconvenience was incurred by the deployed equipment. Patients were already familiar with the devices provided and are used by them (blood pressure monitor, weight scale, Oximeter), as expected for CHF patients.
- The majority of patients thought that the use of inCASA services contributed to making them more actively involved in their personal health. They all noted that the daily monitoring raises their active role.
- No objections were raised concerning the handling of personal data. Patients did not feel that the inCASA monitored data are part of their sensitive private data. In contrast, they trusted the personnel conducting the monitoring and, mainly, they expected that they would use these data in order to help them with their health problem.
- The majority of patients thought that the use of the platform services allowed professional carers to monitor their condition more closely on a daily basis as well as more efficiently.
- Patients felt strongly that the use of the inCASA platform and services should be expanded to include and/or recommended to more people suffering from similar health problems.
- Patients saw inCASA as a very important added value to the current model of care provision but not yet as a complete substitution of it and strongly agree that the inCASA services could constitute a useful addition to the already provided care services.
- The daily use of the platform made the patients feel less concerned, but only at a medium level, about their health condition.

KGHNI Quality of Life

Changes in the patient’s quality of life were measured through completion of the SF36-v2 questionnaire at the beginning and at the end of the monitoring period.



	MH	RE	SF	VT	GH	BP	RP	PF
Start	48,64	52,47	52,40	51,74	42,26	57,89	49,45	54,50
End	50,20	59,06	56,25	53,25	45,71	60,21	53,82	55,90

Figure 20 - KGHNI SF36

We note that there was slight improvement in quality of life in all aspects after the inCASA monitoring.

The SF-36 v2 questionnaire scoring was compared from a user starting the pilot to concluding the pilot and we compared over the principal components.

Significant variation can be seen in the following parameters:

- Role-Physical (RP) = +8.85% (primarily correlates to PCS)
- General Health (GH) = +8.16% (mixed correlation to both PCS/MCS)
- Social Functioning (SF) = +7.33%(mixed correlation to both PCS/MCS)
- Role-Emotional (RE) = +12.57% (primarily correlates to MCS)

Use of inCASA contributed to an improvement in both the Physical Component Summary (PCS) and the Mental Component Summary (MCS).

The direct translation of the above results is (according to definitions of the SF-36 v2 scores):

- Most patients experienced fewer problems with work or other daily activities as a result of physical health.
- The majority of patients evaluated that their personal health has improved after using the inCASA services.
- Most patients experienced less interference due to physical or emotional problems while performing their normal social activities.
- The majority of patients experienced significantly fewer problems with work or other daily activities as a result of emotional problems.

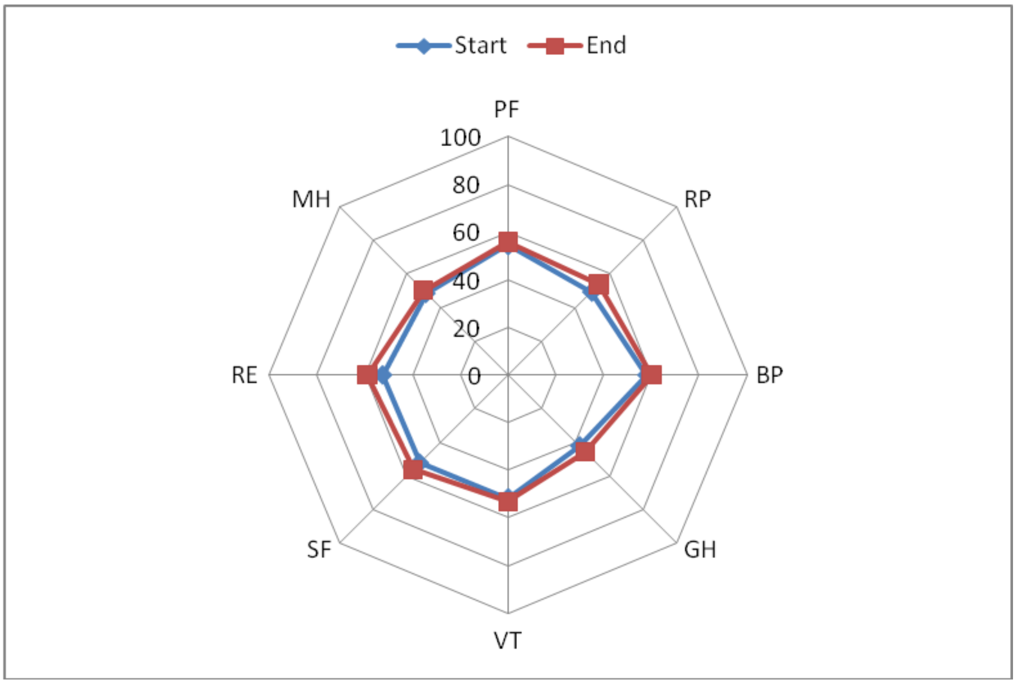


Figure 21 - KGHNI SF36 Radar Graph

From the above findings, we can infer that the inCASA services used by KGHNI patients had a positive effect on their emotional stability due to their increased sense of security and because they progressively developed a more proactive stance regarding their self-treatment of heart failure. This effectively led them to experience fewer difficulties in their daily activities and also, to a lesser extent, to self-evaluate their health in better terms. These findings also closely correlate with the fact that patients reported an improved social functionality.

All the above factors contributed to an increased quality of life for our patients especially regarding their emotional handling of their chronic condition.

Professional Perception

As a general conclusion, all Professionals were enthusiastic about the inCASA service as it was something new and interesting for them to work on a health and care integrated solution and to closely cooperate with the other involved Units of the hospital. The wide-range of available data allowed them to make correlations between different domains and to gain knowledge on sectors that are not limited to their expertise. Of course, they all appreciated the speed and efficiency with which the service is offered thanks to the inCASA technology; it is more than obvious that interventions on CHF patients cannot suffer from delays.

Professionals reported that the technology reinforces the service in the following key points:

- Makes it possible to correlate multi-parametric data;
- Offers immediate notification in case of alarming situation through SMS or on-screen alert;
- Supports historical data analysis. It's always useful to have the history of the patient when examining the current status.

Some technical problems were reported. Professionals agreed that these mainly affected the environmental sensors; temperature, motion detection, TV usage and chair occupancy which did not always send accurate values. Further research on Telecare sensors is advised for the future evolution of the platform. Technical problems with the Telehealth devices were rarely present, and caused no issue in the normal operation of the Pilot service.

KGHNI Conclusions

In conclusion, the inCASA Pilot had a significant impact on the Health and Care Professionals of KGHNI, the recruited patients and their relatives and the management of the hospital. The project brought new ideas compared to the current healthcare system practices in Greece, emphasising use of technology, cooperation between different units of the hospitals and placing priority on prevention based on continuous monitoring of patients rather than treatment.

With regards to the specific goals set by KGHNI pilot, a summary analysis can be presented providing evidence whether each of the goals was achieved or not and to what extent.

Goal	Evaluation
Improve the speed of delivery and the quality of the provided healthcare services while at the same time reducing costs	The speed of the provided service was improved thanks to the usage of new technology (inCASA platform). The quality of the service is mainly thought to be improved due to the continuous monitoring, assisted by the technology, of CHF patients by a multi-disciplinary group of health and care professionals who are all aware of their role in the overall organisational schema. The reduction of the costs requires a larger study with more time to be proven, but it is estimated that the reduction in the hospitalisations is a major point, taking into account that the costs of hospitalisations for CHF patients is a significant burden to the national health system, as explained in the Economic section of the KGHNI report.
Test and evaluate the organisational cooperation between the hospital units in the new inCASA pathway (Cardiology, Psychiatric Clinic and Social Services)	Cooperation was eventually quite fruitful as they all had the same goal: To provide care to the patient using the inCASA service. More specifically, KGHNI developed a patient monitoring flow targeted to CHF patients. The monitoring combines health, behavioural and depression monitoring. In this new pathway. The organisational cooperation between the hospital units was compelled in order to run a

	successful pilot.
Reduce patient anxiety about their medical condition	This goal was achieved as it is depicted in the analysis of Patient Perception questionnaires together with improvement in quality of life as depicted in the SF-36 v2 questionnaires.
Understand the health condition of CHF patients in their home	The inCASA service offers to the professionals a wide variety of data, helping them with statistical tools and graphical representations. Medical, psychological, habitual data and answers from specific questionnaires are made available to the professionals and offers them great support for a better understanding of the condition of CHF patients.
Discover correlations between the patients' medical condition and their everyday habits and enable the consolidation of the latter as early indicators of worsening clinical status	Towards this goal, the inCASA monitored parameters including medical data, habitual data and frequent psychological monitoring. In this report, examples of medical and psychological status correlations are stated but it is considered that more research is needed in order to discover more correlated patterns.
Demonstrate that the active involvement of relatives and the assistance provided by social workers contribute to the overall quality of life of the patient	The patient's relatives and social workers both have their role in the inCASA pathway, primarily helping with everyday activities and contributing to the overall emotional status improvement of the patient. As reported in the document, the emotional status of the patients was improved as per the Quality of Life analysis. The inCASA social workers and the relatives were successful in supporting the patient.
Prolong independence of elderly patients by supporting them in their own home	In this domain, the inCASA service gave a significant improvement in the status of the patient. Specifically, the role of the social workers is crucial in helping the patients with their everyday activities. However the Social Service provided by KGHNI cannot be as specialised as social housing companies; therefore there is room for improvement in this specific target.
Enable early discharge of patients	Early discharge is supported by the fact that the patient can be monitored remotely and the medical team can maintain the status of the patient and be notified immediately in case of

	an alert. It was found that face to face consultations with the Doctors during the first period after the discharge cannot be omitted.
Improve medical therapy in order to decrease the risk of hospital readmission	The majority of health interventions that occurred during the Pilot were mainly changes to medication triggered by the Telehealth alerts produced by the inCASA system. The medical team observed constantly the progress of the patient after the change to medication and proceeded with any other needed action following the medical protocol.

Table 1 - KGHNI goals evaluation

KGHNI is strongly convinced that the inCASA service should be further developed and can transform the healthcare system from a treatment oriented system to a patient-centred system based on prevention, ubiquitous monitoring and continuous multi-level support.

FHC Methodology

The methodology followed four phases:

In the first phase, agreement was reached between the Internal Medicine Unit, the Pulmonology Unit and the Rehabilitation Unit, regarding the patients to be included in the pilot, the first medical consultation with the physicians, the information to be provided to the healthcare professional and the patient and how to gain informed consent.

Social Workers were also consulted to gain further inputs related to social determinants affecting each patient.

In the second phase, training was given on the exercises to be performed and the devices that the patient would use at home.

In the third phase, the monitoring devices were transported and installed in the home of the patient and remote monitoring of exercise commenced. Physiotherapists visited the patients every week to resolve problems related to the exercises or the use of the devices and to check the status of the patient.

The last phase included final evaluation by the Rehabilitation physician through standardised and ad hoc questionnaires.

All the patients that have been included in the GR RHB Control live in Calahorra and each patient belongs to one of the following groups:

- 65 years old or less.
- From 66 to 70 years old.
- From 71 to 75 years old.
- From 76 to 80 years old.
- More than 80 years old.

The average age is 75.6 years old.

FHC Patient Perception

The in-home tele-rehabilitation programme has been designed according to available relevant scientific evidence, and shows that maintenance of COPD patients at home is a positive alternative to rehabilitation at hospital for the initial stages of the disease.

Results obtained at the end of the pilot demonstrate the benefits of in-home treatment targeted to elderly COPD patients as it improves the status of their clinical parameters and, thus, their quality of life. However, the number of patients involved is not statistically significant for its general extrapolation for general practice. The main achievement for FHC is that the inCASA solution provides a reliable tele-rehabilitation program which allows analysis of the long term evolution of chronic elderly patients and that treatment based on e-health solutions can be successfully implemented at a larger scale.

	Average (1-5)
Enhanced Care	3,26
Increased Accessibility	2,32
Privacy and Discomfort	1,38
Care Personal Concerns	2,50
Kit as Substitution	1,04
Satisfaction	4,36

Table 2 - FHC Patient Perception

Relevant conclusions related to the analysis of patient perception are:

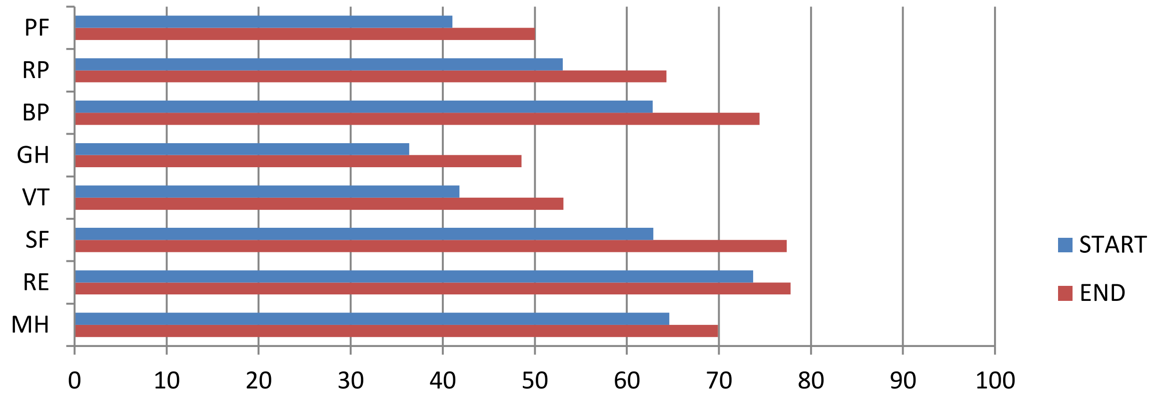
- A majority of patients agreed that the inCASA services helped them save time in terms of required visits to the outpatient clinic.
- Most of the patients reported that the use of the inCASA platform equipment to conduct medical measurements did not interfere with their daily routines. A majority of them felt that using the inCASA platform contributed to a decrease in their concern about their health status.
- An interim conclusion is that the majority of patients were satisfied with the training provided on equipment use, due to previous training at the hospital gym plus continuous support by physiotherapist.
- Most patients trusted the inCASA equipment to be reliable and did not report any physical or psychological inconvenience incurred by the deployed equipment.
- There were no significant concerns expressed regarding the personnel assigned to monitoring the patients' condition. There were no emergency events due to the nature of clinical status of the patients (stabilised COPD patients with focus on upper & lower limb training).

No major objections were raised concerning the remote handling of personal data, nor its transmission via the internet.

FHC Quality of Life

The main clinical outcomes of the in-home tele- rehabilitation programme developed at the FHC pilot site are related to the observed health status of patients at the end of the training period compared health status at the start and also with patients in the control group (i.e., those that came to the hospital gym instead of staying at home).

As a general conclusion the statistical analysis demonstrates that there is a relevant increase of each item measured in the 8 dimensions of the SF-36 - General Perception of Health Status- between the measurement taken at the beginning and at the end of the training programme and is consistent with the clinical outcomes related to the variation of health status of the patients.



	MH	RE	SF	VT	GH	BP	RP	PF
START	64,61	73,74	62,88	41,82	36,36	62,79	53,03	41,06
END	69,90	77,78	77,38	53,10	48,57	74,40	64,29	50,00

Figure 22 - FHC SF36

Moreover, the analysis of results offered by BODE index calculation – which embraces a set of clinical inputs such as MRC, FEV1 and 6MW - shows the benefit to respiratory rehabilitation for COPD patients. Data gathered at the FHC pilot site (BODE index) suggests that doing respiratory exercises at home is more efficient than coming to hospital to do the same type of exercises (see figure below):

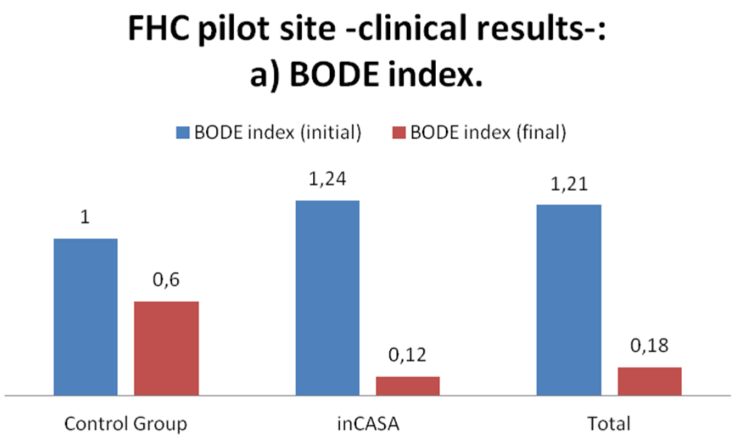


Figure 23 - FHC BODE Index

In contrast, outcomes measured by the St. George questionnaire – specifically designed for COPD patients - shows better final health status observed in patients in the control group compared to the COPD patients who were treated in their own homes (see figure below):

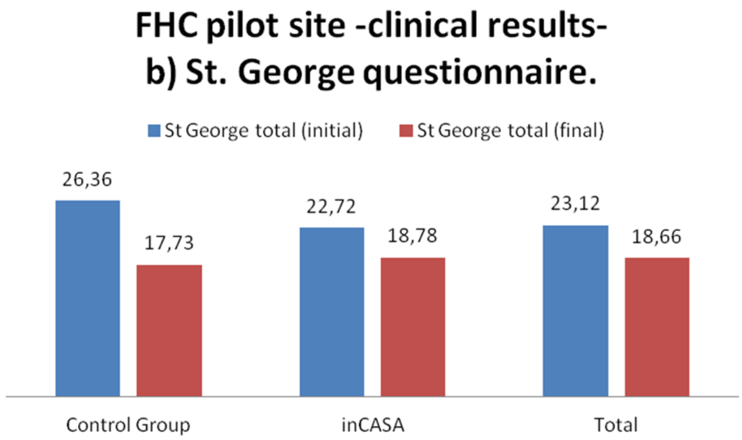


Figure 24 - St. George Questionnaire

An explanation may be related to the level of COPD and age (average) of patients for each group, although further analysis is still pending.

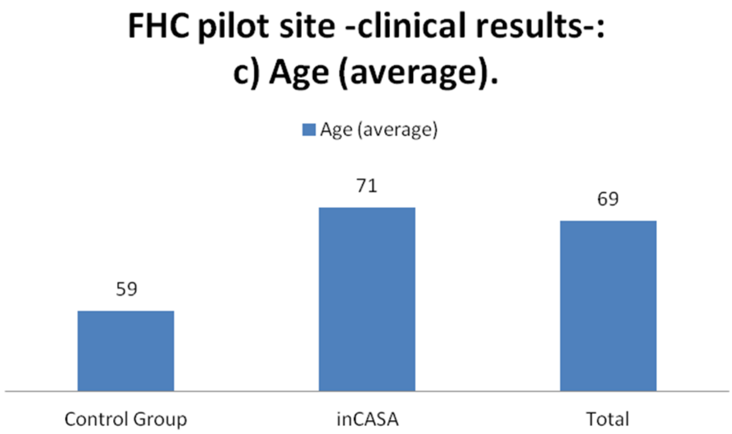


Figure 25 - FHC Age

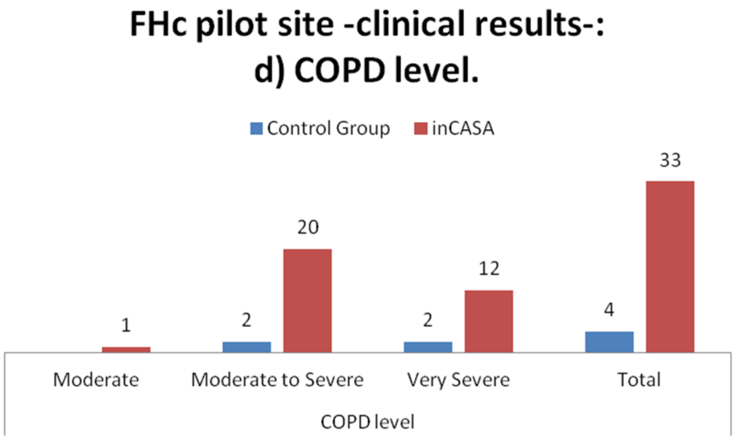


Figure 26 - FHC COPD Level

FHC Professional Perception

The FHC professionals involved in the project were asked to complete a questionnaire to evaluate their perceptions. Five professionals participated. 40% think that the experience was good, and the other 60% consider it very good. Most of them consider that the relationship between professionals at FHC has improved, and they also think that thanks to this experience their knowledge of tele-rehabilitation has increased. Finally, 80% of them describe their personal satisfaction with the project as 'excellent'.

Regarding the integrated technology, 60% of the professionals consider that their experience in this part of the project was satisfactory. They value the real time monitoring of patients but they also think that the technology should be easier in order to facilitate the patient using it.

FHC Conclusions

The inCASA solution has provided the FHC pilot site with a fully developed tele-rehabilitation programme ready to be offered to chronic patients suffering from COPD so that they can improve or maintain their health status without any need to visit hospital facilities on a regular basis, except for their pre-defined consultations at the end of the training period. The outcomes include not only health but also social, with social evaluation of each patient being included. Both social and health issues are included into the programme, and a closer relationship between hospital and social professionals has become a major outcome of the pilot. The tele-rehabilitation programme provides a proven tool to provide for the needs of chronic patients suffering from COPD and living in rural areas. Patient satisfaction and self-perception of their health status and quality of life agree with previous scientific evidence offered by studies focused on rehabilitation exercises for COPD patients, giving the advantage of: less resource is required to support these patients; patients can remain at home and continue doing their exercises under remote monitoring when needed. Reduction in hospitalisation is expected to be a further outcome of this type of tele-rehabilitation programme.

INSERM Methodology

Patients meeting the inCASA inclusion criteria after a medical consultation with their oncologist at Paul Brousse hospital in Villejuif, France, were offered the opportunity to participate in the inCASA study. Patients were asked to provide oral consent to participate, and then given a demonstration of the system and all the information about the terms of the study, and an appointment was made to install the equipment at their own home. Patients were asked to sign a written informed consent on the day of the installation. The patients were then interviewed in order to complete a demographic questionnaire and frailty scale. They were also asked to fill in one SF36 questionnaire at the beginning of the study (on the day of the installation or the day after). A second SF36 questionnaire, one perception and satisfaction questionnaire were given at the end of the study (6 weeks after the day the equipment was installed).

Each patient was enrolled in the study for a minimum monitoring period of 6 weeks. 30 patients completed the study at the time of writing. Although more patients were enrolled, some patients didn't complete the SF36 and SUTAQ questionnaires as they commenced after the beginning of the pilot phase and did not complete the six weeks and some did not return the questionnaires after the end of the study.

The average age of the INSERM patients is 61 with a 58% male and 42% female. Regarding the level of education, most of patients (84.3%) completed secondary school or high school. Most of patients were married (36.3%) and retired (50%). Almost all patients were non-smokers. 80% were familiar with a PC and 90% with a mobile phone.

INSERM Patient Perception

Patient perception and satisfaction of the system were assessed at the end of the study. They were asked to fill out the Service User Technology Acceptability Questionnaire translated into French. Fourteen patients completed this questionnaire. The items were assessed using the Likert Scale which was then converted on a score from 0 to 5 (with responses of negatively biased questions converted to their positive equivalent). The 22 items have been divided into 6 clusters. Results from the patient perception questionnaire are presented in the following table:

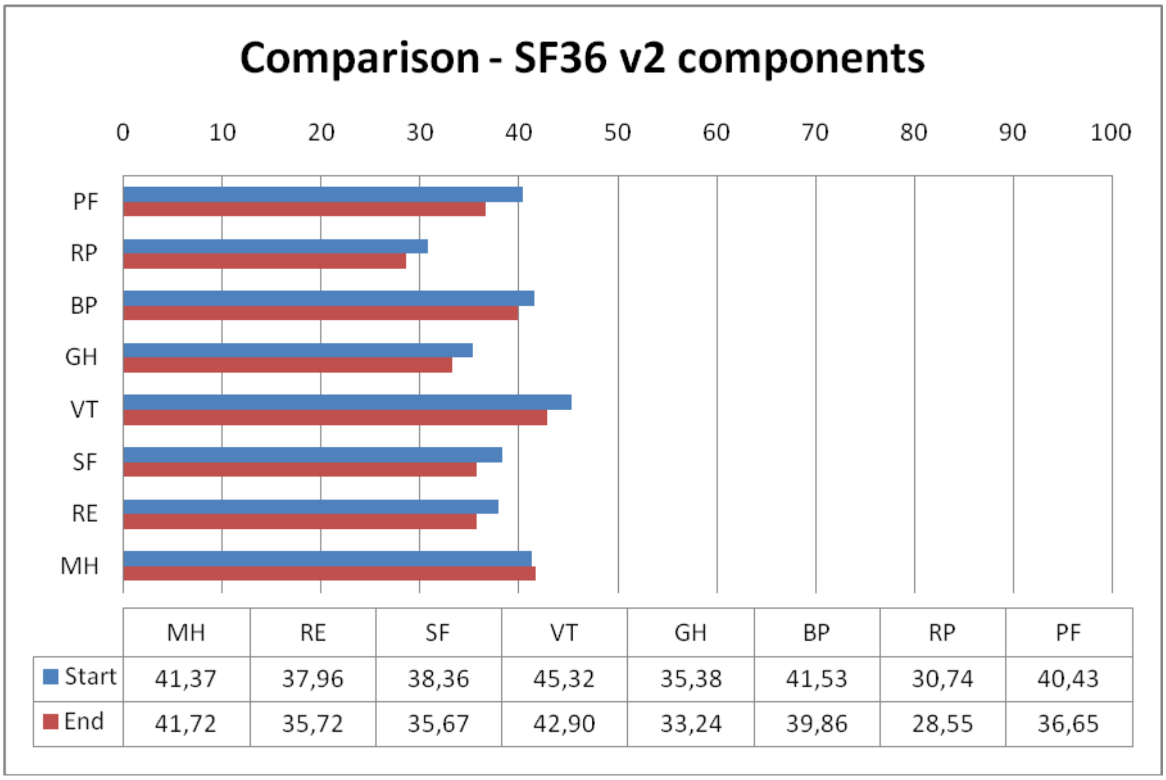
Subscale	**End of Monitoring Period: Mean (SD)**
Enhanced care	3.99 (1.10)
Increased accessibility	3.22 (1.23)
Privacy and discomfort	4.05 (1.15)
Care personal concerns	3.95 (0.93)
Kit as substitution	3.23 (1.13)
Satisfaction	4.20 (0.82)

Table 3 - INSERM Patient Perception

These figures show that on average patients think that the kit they received can enhance care. However they are undecided about the ability of the system to increase accessibility to care and with the fact that the system could be used as substitute for conventional care. The mean score for privacy and discomfort shows that the kit has generally not interfered with their life. Most are concerned about their personal care and the use of their data. Finally, patients are satisfied with the kit they received.

INSERM Quality of Life

Patients were provided with the SF-36 paper questionnaire for quality of life assessment at the beginning of the study and they were asked to complete the questionnaire at the end. Results are presented on several components.



	MH	RE	SF	VT	GH	BP	RP	PF
Start	41,37	37,96	38,36	45,32	35,38	41,53	30,74	40,43
End	41,72	35,72	35,67	42,90	33,24	39,86	28,55	36,65

Figure 27 - INSERM SF36

The two main parameters are the Physical Component Summary (PCS) and the Mental Component Summary (MCS). PCS provides an overall assessment of physical health which includes both functioning and evaluation of the ability to perform physical activity. MCS provides an overall measurement of mental health as comprised of an assessment of psychological distress and well-being, social and role functioning, and overall vitality.

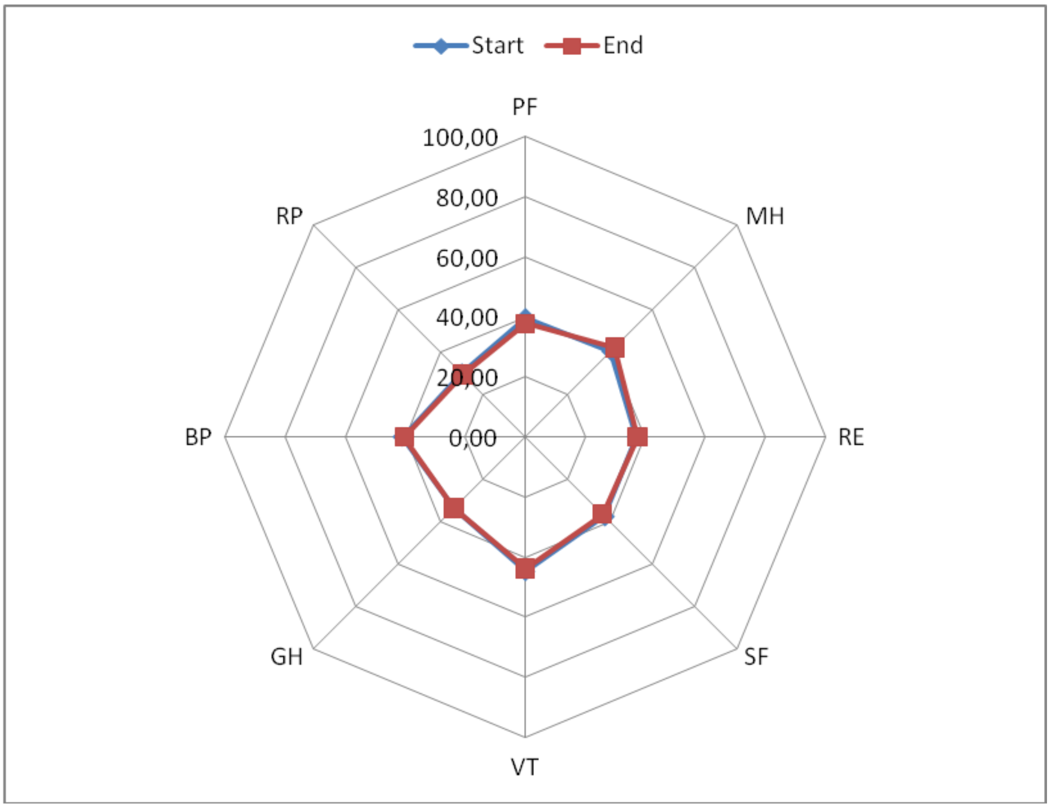


Figure 28 - INSERM SF36 Radar Graph

Professional Perception

The perception of the professional users was evaluated by asking them to fill out the professional perception questionnaire at the end of the pilot phase. Three nurses and one technician completed the questionnaire. This questionnaire includes one part related to the integrated service and one related to the integrated technology.

The satisfaction questions were scored on a Likert scale from 1 (very unsatisfied) to 5 (very satisfied), the mean score for the integrated service part was 3.25 (SD=0.71) whereas the mean score for the integrated technology was 3.46 (SD=0.92).

In summary, all the professional users acknowledge the value of the service and the system to improve the follow up of health condition of patients and to be able to intervene and avoid unplanned hospitalisations. However their perception of the service was altered by technical issues. The nurses, especially, had trouble with the web portal to visualise the monitoring data. As some patients had data transmission problems, the nurses had difficulties in performing close monitoring of the health condition of the patients.

The results of the professional perception questionnaire showed that even if the professional users appreciated the use of the system for the benefits of the patients and for the integration of healthcare and social care professional, the technical issues and the limitations of the technology affected their overall satisfaction.

INSERM Conclusions

The inCASA solution has allowed the French pilot to efficiently monitor body weight, symptoms and rest-activity patterns of frail cancer patients. These data were not accessible before and provided much useful information to healthcare and social care professionals for the follow up of patients, while improving the safety of chemotherapy delivery at home and avoiding hospitalisations. In general the patients were very compliant and satisfied with the use of the system and the service delivery. However, the service seemed more beneficial for the patients who scored higher on the frailty scale as they were more likely to suffer from severe adverse events and they may need medical or social interventions.

CHC Methodology

From September 2012, patients who were registered at Chorleywood Health Centre were enrolled into the study.

A total of 44 patients were enrolled into the service, at the end of the project 36 patients were still being monitored.

Those patients meeting the inclusion criteria were sent a letter of invitation and a participant information sheet which described the project. The letters were followed up by phone calls in order to further explain the service and to answer any questions the patients had. Patients interested in the service were visited at home where they were given a demonstration of the devices and given further explanation.

If the patient agreed to take part they were asked to complete a consent form.

Patients were then contacted by the clinical team to arrange for the installation and training. Installation was carried out by both clinicians and non-clinical staff.

Patients were evaluated on clinical health outcomes, frailty, quality of life and patient perception with the inCASA common questionnaire set. Data were collected at baseline and at the end of the pilot.

Habits data were collected via the habits monitoring devices within the home. Data were examined for normality and then deviations from the normal pattern were identified and recorded.

The baseline demographics for the CHC are as follows:

- 39% of patients are male,
- 61% are female,
- The mean age is 82.

CHC Patient Perception

Patient perception was measured for 31 patients. Patients were asked to complete the questionnaire at the end of the pilot. The questionnaire was self-administered.

The main results from the analysis on the questionnaire are:

- The majority of patients felt that the service and technology provided enhanced care that was over and above what they consider to be their normal care. Patients reported that they were more actively involved in their own care and that the technology provided a good method for their clinicians and social workers to have better access to their information.
- Most patients reported that the technology was a good addition to their normal health and social care and would recommend it to other patients with similar conditions.
- None of the patients felt that the technology had affected their privacy or made them concerned about the confidentiality of the information being exchanged through it. Only one patient felt that the technology had interfered with their daily routine.

	Mean	STD
Enhanced Care	3.32	1.09
Increased Accessibility	2.82	1.04
Privacy and Discomfort	3.92	1.27
Care Personnel Concerns	3.54	1.14
Kit as Substitution	2.63	1.13
Satisfaction	3.66	1.09

Table 4 - CHC Patient Perception

- Almost all patients had no concerns over the level of expertise of those looking at their data collected via the technology or that their continuity of care was being affected.
- None of the patients felt the technology could replace their regular health or social care. Although some patients felt that the technology was as suitable as a regular face to face consultation, there was no strong feeling that the technology had enabled the patients to feel less concerned about their health.
- Overall patients reported being satisfied with the technology.

Patients in general felt that the equipment supplied was useful and in some cases helped their overall understanding of their health but did not see it as substitute for usual face to face care. This may in part be due to the fact that the service is very much clinician driven. The patient was not given any self-management tools. Whilst some of the devices gave feedback of clinical measures, some did not. Interestingly, it was observed that those patients that had access to their own measurements e.g. blood pressure, who indicated concern to the clinicians when they saw their own measurements exceed their expected levels. Whereas for those patients that had the SpO_2 device which showed no feedback to the patient, there were no concerns raised.

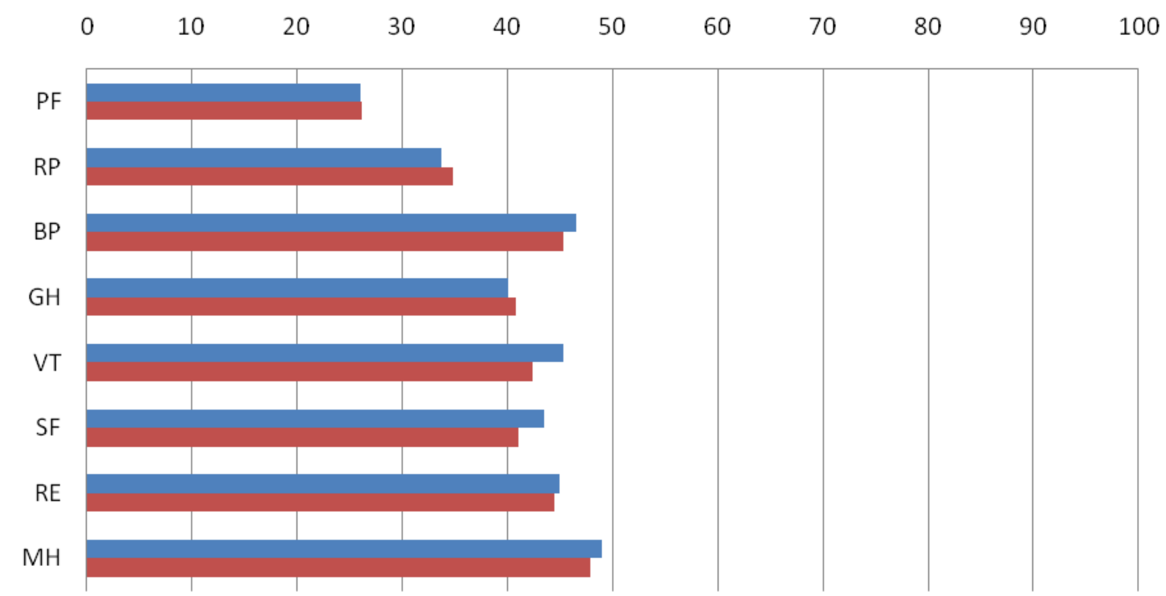
CHC Quality of Life

All patients were asked to complete the SF36 at baseline and at the end of their time monitoring.

When looking at the analysis for all of the patients it is possible to see that the score for physical functioning (PF) and for role limitations due to physical health (RP) in table 18 is very low. A small increase in the score for General Health Perception is present.

The figure below shows the summary scores for those patients that were scored using the Edmonton Frail Scale. For these patients we can see slight increase in all measures other than bodily pain and social functioning.

We also could see changes in scores from baseline to end when we analysed data for those patients that were scored using the Edmonton Frail Scale as very frail. For these patients we can see slight increase in mental health scores, general health and role physical.



	MH	RE	SF	VT	GH	BP	RP	PF
Start	48,97	44,91	43,50	45,26	40,10	46,52	33,75	26,08
End	47,83	44,42	40,99	42,43	40,83	45,37	34,77	26,20

Figure 29 - CHC SF36

Given the nature of the population that was monitored, a decline in health status is expected over time. However, from the analysis of the patients who were enrolled onto the service, it could be summarised that there was no overall decline in quality of life that could be attributed to the service.

Indeed, for those patients that scored as average frailty or who were very frail, a positive impact on quality of life was indicated.

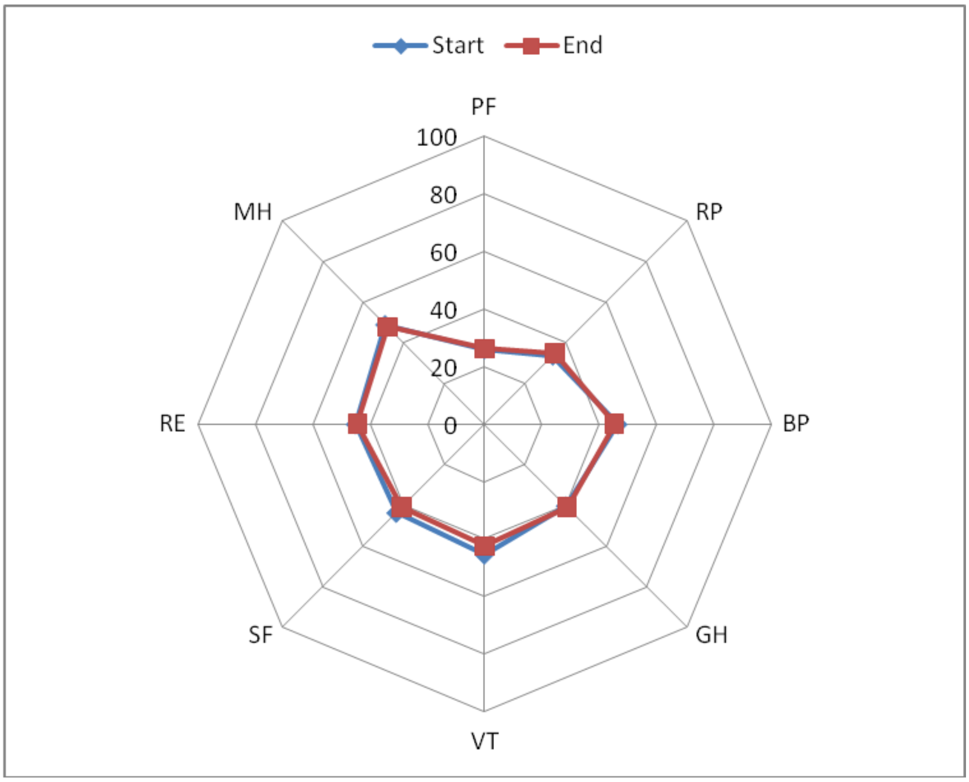


Figure 30 - CHC SF36 Radar Graph

Professional Perception

The service team comprised Nurses, General Practitioners, non-clinical researchers, Social Service worker, administrators and technical support.

All staff involved in the service was asked to complete the professional perception questionnaire which was common to all pilots. This questionnaire measured the opinions of the professional about the service and technology.

All those that responded felt that there had been many challenges in setting up the service and that some of these remained. It had taken staff time to become used to the service, however even at the time of reporting it was generally felt that the service was still in its infancy and that the outcome of the evaluation would be useful to feed learning and improvements back into the service design.

It was felt that the introduction of the service had initiated conversation between the two organisations, and had allowed understanding of the difficulties and what pathways needed to be changed in order to overcome them. For the care of patients, it was reported that the opportunity of providing the possibility to recognise risk and improve care was a real benefit. The service had given new ways of assessing patients for both clinical needs and for social needs which has impacted on usual tasks in a positive way.

The main benefits of the technology was that it was easy to install and unobtrusive for the patients. The overall usability was very good, when working. However, it was felt that the technology needed to be more reliable as this was creating extra workload for the clinical team in having to provide support to the patients.

CHC Conclusions

The aim of the CHC pilot was to investigate and develop an integrated service model for monitoring by a general practice their frail older patients, enabling them to stay safe and well in their home. The following table summarises if and how we achieved the overall pilot objectives.

Objective	Outcome
Develop an integrated service model for monitoring the frail older patient within their home.	We designed a new pathway of care within inCASA. We developed new working relationships between Chorleywood Health Centre and Hertfordshire Adult Social Services.
Evaluate the value of the integrated service to both the frail elderly person and the social and clinical services that care for that person.	We have used a number of tools to manage the value of the service. We have found that for the patient the service has been beneficial in both clinical and in general wellbeing. For the professional the service has provided a greater depth of data to help make more informed decisions about the patients care.
Understand and measure the impact of such a service to a patient's quality of life	We have used a validated tool to measure the change in quality of life for all patients who took part in the project. We have seen that the greatest impact is to those that were deemed to be the most in need or "frail".
Understand the change of resource usage and economic impact on a local health economy	We have measured cost of service and compared it to change in resource usage of both the professional and patient. Data is only indicative at this stage but we are able to inform future expansion of the service
Identify patterns and develop understanding of whether environmental monitoring can aid and even predict clinical events and care	In conjunction with Brunel University we developed ways in which to analyse, visualise and correlate health and habits data in a way that is useful and meaningful for clinicians to better manage a response to

	patient data.

We have demonstrated through inCASA a platform that has been designed to manage integrated information from telecare and telehealth. We have developed new pathways that include both health and social care in order to better support older patients who are in need.

We have used existing knowledge as well as developed new ways in which to identify those patients that are “frail” or in “need” and who may benefit from being monitored in their own home.

We have developed new tools in order to gather information in an unobtrusive and affordable way and to display that information in a meaningful way to clinicians and other professionals who are charged with caring for those people in need.

We have presented and tested a hypothesis that the clinician may gain as much insight into their patient’s level of risk from telecare monitoring as from telehealth.

Through our work we have identified that the important issue has not been which organisation establishes and owns remote monitoring but what data is needed, which route it will take and the nature of the response. The latter may be engendered by an integrated and multi-professional group as well as by a number of agencies working in partnership.

However, we have also seen within inCASA that working together across organisational boundaries is a complex issue. There has to be a lead contractor that can carry the main responsibility and that contractor has to be able to respond to the data and all that it implies.

For remote monitoring to make an impact on healthcare services it must be used where there is an expected clinical gain for the patient. To convince, the case for the widespread remote monitoring of patients must highlight its ability to make a difference to clinical outcome and patient risk in addition to being affordable and deliverable by present healthcare services.

ATC Methodology

A total of 40 end-users have been involved in the project because they have been identified to be at risk of loneliness or who have safety or autonomy issues.

The target group composed of 25 women and 15 men. They all live alone. Their average age is 72 and 87 respectively.

The targeted groups of tenants living in ATC buildings in the district area of Turin are:

- 28 senior citizens over 65 self-sufficient that require light support by professional to improve their autonomy in addition to or in replacement of the family network (where absent);
- 8 senior citizens over 65 partially self-sufficient or non-self-sufficient who require support by professional to improve their autonomy in addition to or in replacement of the family network (where absent);
- 4 different situations where a coexistence of the matters above is present.

The staff involved in the project at ATC include: supervisor, call centre operators; at Municipality of Turin: social workers of Social Services Department.

ATC used the inCASA common evaluation measures for the pilot and used the following questionnaires to gather information.

1. SF36 Quality of Life – asked at baseline and end of data collection period;
2. Edmonton Frail Score – asked at baseline;
3. Patient Perception – asked at end of data collection period;
4. Professional Perception – asked at end of data collection period.

All 40 end users were asked to complete the questionnaires. Social workers contacted the patient and administered the questionnaires in the home of the end user in person at a pre-arranged time. The questionnaire response rate was 95%, with 38 out of the 40 patients completing all of the questionnaires.

ATC Patient Perception

The Service User Technology Acceptability Questionnaire (SUTAQ) was submitted to all the users and the table below provides an overview of the obtained results in term of Mean Value on the pool of users questioned.

Category	Mean (SD)
Enhanced care	3,74 (0,41)
Increased accessibility	3,10 (0,46)
Privacy and discomfort	4,64 (0,45)
Care personal concerns	3,31 (0,58)
Kit as substitution	2,94 (0,54)
Satisfaction	4,00 (0,62)

Table 5 - ATC Patient Perception

As illustrated in the figure above, the results are very interesting. 75% of users think that the services provided really enhance the level of care and there is an 80% of satisfaction of the proposed Kit; these numbers fit with the feedback provided by the users:

- Mrs. D.C. has seen this project thanks to a neighbour (user of the Project inCASA) and has taken steps to benefit from the services provided by the inCASA solution. She founds it interesting to be monitored at a distance and without violation of her private life, h24. This has ensured her psychological security.

- Mrs. C.R., who suffers from delusions of persecution, with the services provided by the inCASA project, has significantly reduced the threshold of her fears related to the possibility that someone might break into her apartment, forcing the door. This increased feeling of safety is as a consequence of the sensors installed.

Moreover, this feedback is also consistent with the very low level of concern regarding the privacy and discomfort scale; and the converse is seen.

The users have been recruited by the social workers because they have known them personally for more than ten years, so they had the chance to involve appropriate people for the project's aims and objectives.

Even from the pre-pilot phase, we noticed that the users were enthusiastic about the fact that, thanks to the sensors, their daily habits were monitored in every moment of the day.

Indeed, when one of the pre-pilot users talked about the project with one of her neighbours, the neighbour was so enthused by the project that she wanted to be involved in the pilot at any cost, and so she was allowed to participate.

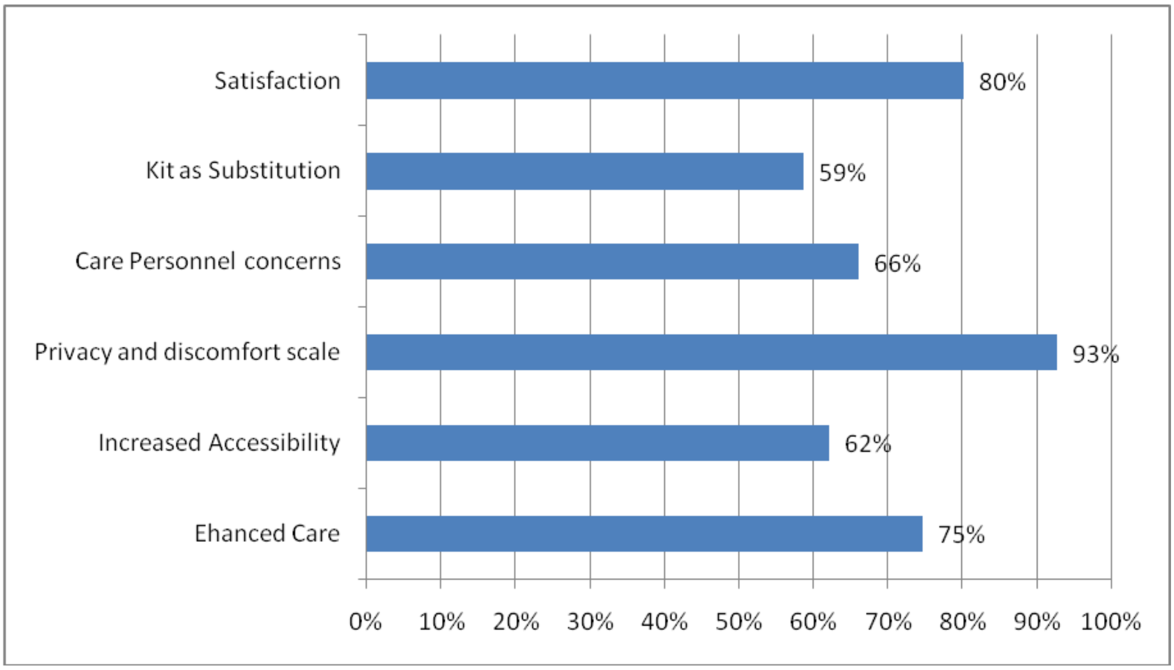


Figure 31 - ATC Patient Perception

The users have highlighted how much the monitoring has increased their feeling of safety and protection. Perhaps for the first time, they saw the local institutions in a very different way: in particular, ATC has been viewed not only as the institution that asks them for the payment of the rent and the other expenses, but can also be an institution that has implemented support to increase their welfare in their own homes.

Satisfaction is now so high that, at the end of the project, their worry is that they will no longer be monitored in their daily life.

In order to address this concern ATC has decided to maintain the system in the 40 users until at least the end of September 2013.

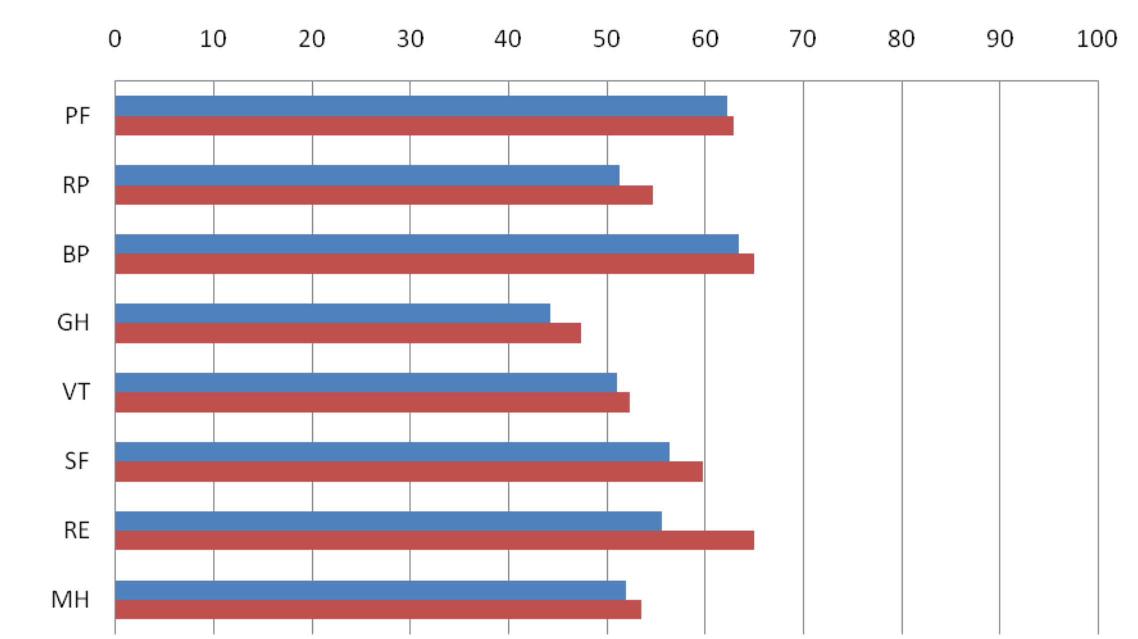
In summary, inCASA has increased the sense of security of the users and, consequently, increased the feeling of trust in public institutions because they feel more secure.

ATC Quality of Life

The SF36 questionnaires were administered in person to all participants.

As shown in Figure 32, the level of some of the components was significantly higher at the end of the monitoring period.

The results are consistent with the services provided in the Italian Pilot where only the Tele-Care services were active. The overall Mental Status, identified by MCS (Mental Component Summary) increased from 47.68 to 51.16 at the end of period. This increase is also seen in each of the Sub-Categories that combine to give MCS, as shown below.



	MH	RE	SF	VT	GH	BP	RP	PF
Start	51,92	55,65	56,44	51,09	44,27	63,37	51,32	62,19
End	53,51	64,94	59,76	52,38	47,35	65,00	54,67	62,88

Figure 32 - ATC SF36

The value is not only increased in the MCS status of the users, which corresponds to the Tele-Care services, but also in the PCS (Physical Component Summary) value, representing the Physical health status of the user.

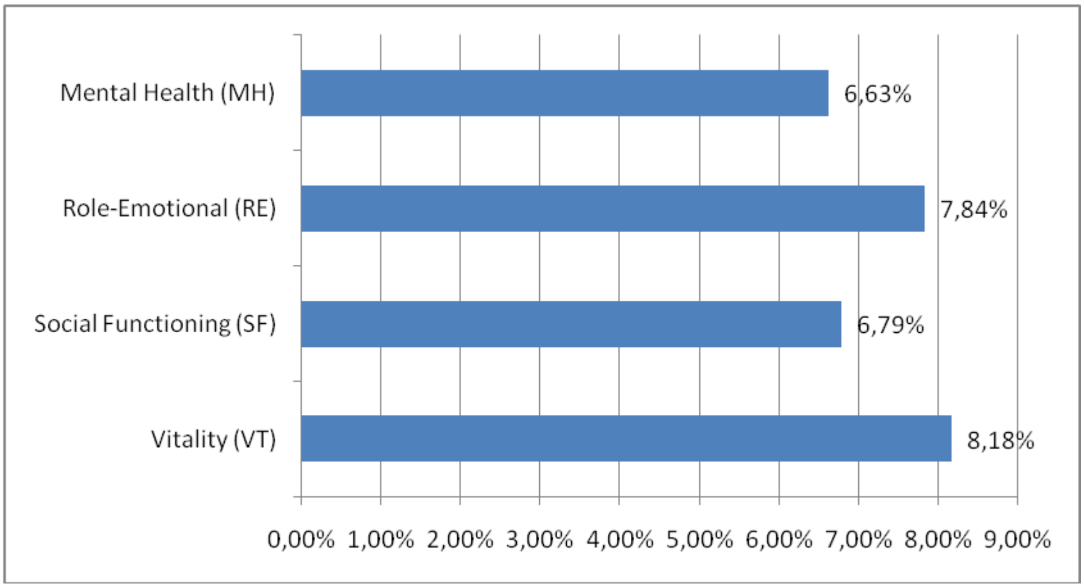


Figure 33 - ATC MCS Direct Sub Category

The mean level of PCS was seen to have a small increase from 45.05 to 46.63 (+3.50%). The Radar Graph (Figure 34), shows how not only the left part of the Radar Graph shows an increase (MCS parameters) due to the benefits of the services of Tele-Care provided by the Italian Pilot, but also the right part of the Radar Graph (PCS parameters) shows a slight increase. The level of “Body Pain” and “Physical Functioning” are substantially unaltered, while the parameters, “General Health” and “Role Physical” show a major increase compared to the other PCS parameters.

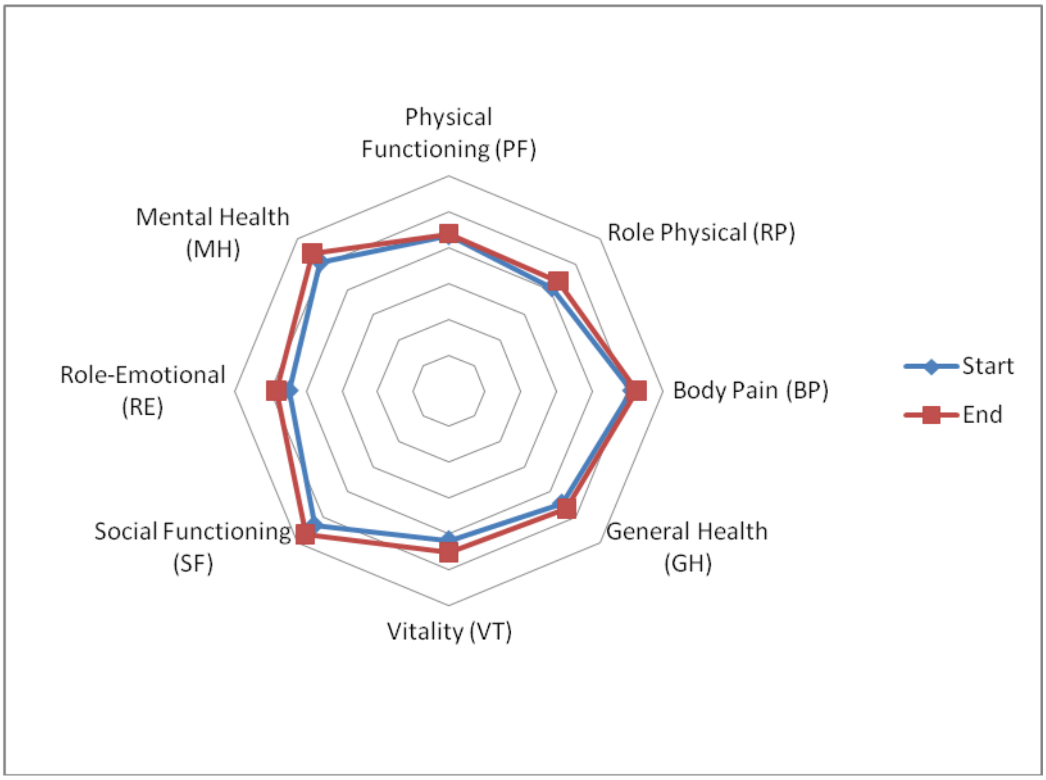


Figure 34 - ATC SF36 Radar Graph

Hypothesis: The services as provided by the inCASA pilot at ATC were aimed at Telecare and there would have been an expected increase in the MCS status of the users. However, the results also show a slight increase in the PCS status, representing the physical status of the users. We might hypothesise that the benefits provided by the Telecare solution, together with the high level of acceptance of the technology, impact on the perceived physical status and as a result patients are reporting an improvement in PCS as well.

Feedback from user about the questionnaire SF36: The questions, sometimes, were not clear so, in such cases, the interviewer rephrased them.

Professional Perception

The two groups of professionals involved in the Italian pilot include social workers of the Social Services Department of the Municipality of Turin and operators of the call centre in ATC Turin.

The social workers participated in all the phases of the project. The answers to the questionnaires shows that involvement in the project has been very positive; they were already aware of sensors for remote control monitoring but had never used them. They are very satisfied with the experience of the pilot, because they had to do home visits only in cases of real problems of the users. They are convinced that the integration of telecare and telehealth services should be the next step in the Italian pilot in order to guarantee a better life at home for the elderly people.

The operators of the call centre of ATC Turin have gained important experience answering requests from the tenants calling the free toll number; this number is dedicated to them for any kind of maintenance problem inside their homes.
They have been involved in the project since its beginning. In particular, they participated in meetings where the alarms have been decided, who should be the person to be contacted, and other details.

The impact of inCASA on their daily routine has been very positive; they have been able to manage the alarms and the calls without any particular difficulty. Before inCASA they never used the model built for the pilot, but they considered it very easy to learn and use.

ATC Conclusions

The inCASA solution has allowed the Italian pilot to monitor efficiently the daily habits of the 40 elderly people living alone that have been recruited for the project. Such data were not accessible before and has provided much useful information to the social care professionals for the follow up of patients. In general the users were very compliant and satisfied with the use of the system and the service delivery. The service has been very useful for this kind of person, because their frailty is very high, so they need to overcome loneliness thanks to 24h monitoring that gives them the safety to be well-protected by the local institutions.

3 The architecture of the inCASA solution

The inCASA platform integrates pre-existing components to create an enhanced socio-medical platform able to monitor both user behaviour and clinical conditions. The platform is essentially service oriented. The inCASA services functionally address the following two main service domains:

- *Telecare (TC):* A combination of equipment, monitoring and response that can help individuals to remain at home independently. It can include basic community alarm services able to respond in an emergency, provide regular contact by telephone and trigger a warning to a response centre. Telecare can work in a preventative or monitoring mode, for example, through monitoring signs, which can provide early warning of deterioration, prompting a response from family or professionals. Telecare can also provide safety and security by protecting against bogus callers and burglary.
- *Telehealth (TH):* The delivery of health related services and information via telecommunication technologies. Telehealth is an expansion of the functionality of Telemedicine and encompasses prevention, treatment, cure and health promotion aspects. Telehealth is generally used as an umbrella term to describe all the possible variations of health care services using telecommunications.

3.1 The inCASA Architecture design: the Building Blocks

The architecture of the inCASA platform includes four levels of communication:

- Primary communication between sensors and gateway, at home level;
- Secondary communication for local monitoring of data and events;

- Tertiary communication between the gateway at home and the central platform accessed by the service centre;
- Quaternary communication between the service centre and external actors.

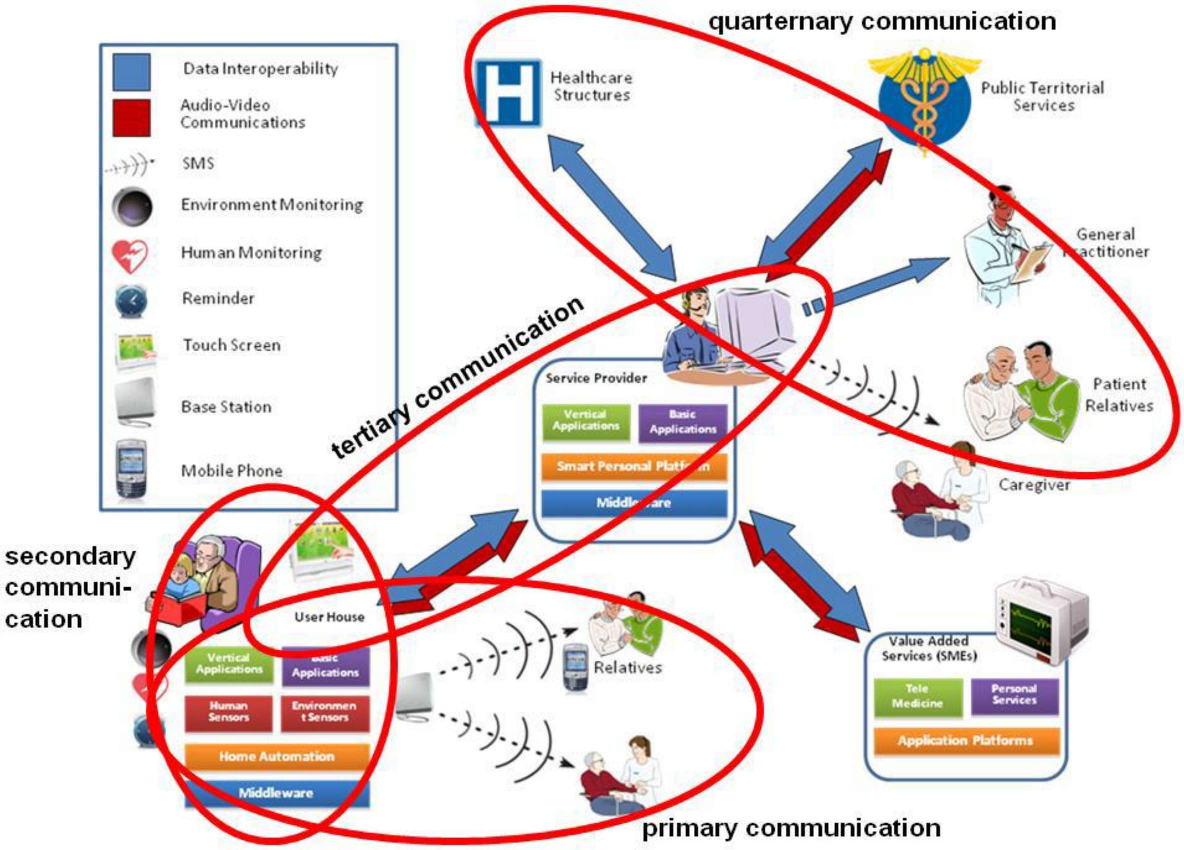


Figure 35 - The inCASA Architecture

The primary communication takes place locally, at the home of the elderly or in appropriate healthcare facilities, between the sensors and the gateway that collects the measures and will then process or transmit them to the service centre.

The secondary communication presents the collected measures to a graphical user interface to monitor clinical parameters.

The tertiary communication takes place between the gateway installed in the home of the elderly and the "smart" platform which processes the measurements and, if needed, generates the alarms to be sent to the service centre.

The quaternary communication provides access to the data to the external actors who take care of the senior patient (Social Services, caregivers, relatives), and can also forward alarms, depending on their nature and severity, to the external actors.

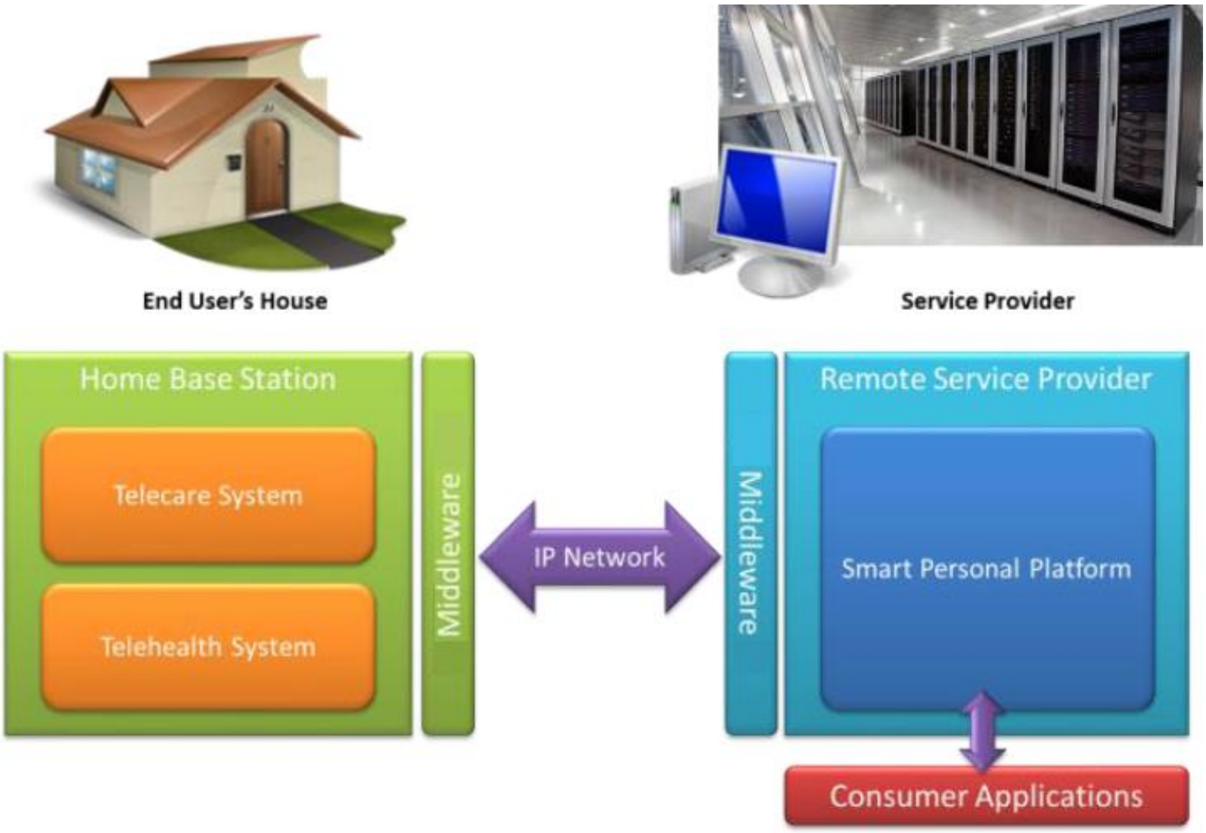


Figure 36 - The inCASA Building Blocks

The inCASA platform architecture comprises components installed in the patient's home (Home Base Station) and a central system dedicated to the collection and processing of data (Remote Service Provided). Data is viewed on graphical user interfaces (Consumer Applications). Data transmission from the Home Base Station to the Remote Service Provider is performed via the GPRS network.

Figure 36 summarises the architecture and shows its constituent modules. These are:

A) *Telecare and Telehealth Gateways*: Within the Home Base Station are the Telecare and Telehealth systems. The Telecare gateway (SIG HUB) receives measurements from the environmental sensors connected via the wireless network (multiple wireless). The elderly patient is monitored in a non-intrusive way. The Telehealth system (SARA), integrated by Telefonica (project's partner) into the inCASA platform, requires the interaction with the patient who, guided by a graphical touch screen interface, performs the clinical measurements using devices connected via Bluetooth.

B) *Integration Middleware*: The communication between the Home Base Station and Remote Service Provider is realised through the LinkSmart integration middleware, which is the outcome of a separate project that was co-funded by the European Commission (Hydra[1]). Inside the Home Base Station the client component of

[1] http://www.hydramiddleware.eu/news.php

LinkSmart acts as a collector of the Telecare and Telehealth data flows and transmits them in a normalised and homogeneous way to the server side of LinkSmart, placed into the Remote Service Provider. The architecture of LinkSmart, which allows the communication between many home networks and the server side of the platform, is based on P2P technology.

C) *Smart Personal Platform:* The Smart Personal Platform (SPP) is placed inside the Remote Service Provider and has the task to collect and process tele-monitoring measurements, to generate alarm events and report them to the Consumer Applications. The core of the SPP is the Reasoner, a context-aware module that uses Semantic Web standards (OWL, SWRL, SPARQL) to create the model of the user habits and clinical profile of the elderly patients and to use this to determine any changes. The life cycle of the alarms is managed by the Reasoner, automatically or by interacting with a service centre operator, depending on the nature and evolution of the alerts. The Reasoner is based on the Alarm Communication Management (ACM) integration profile, defined by IHE. Measurements and data and alarms generated by the Reasoner, are stored in a patient-centric clinical repository that acts as an Electronic Patient Record (EPR).

D) *Consumer Application:* A graphical user interface has been developed specifically for the inCASA project as an example of a Consumer Application that can be integrated to the system. The inCASA Consumer Application (CA) provides a single point of access to the inCASA platform for the professional inCASA Pilot stakeholders (clinicians, operators, social workers, psychologists, etc.). The inCASA Consumer Application is a Web Portal that may be used to view the socio-medical data and alerts of patients, store notes on a patient, add patient questionnaires scores and perform various other actions that are customised in each Pilot site using the application according to their requirements. It is important to note that a Role-Based Access Control (RBAC) has been applied in order to distinguish the views and the actions allowed for the various Professional Stakeholders. This interface is used by the service centre operators to monitor elderly patients and manage the alarm conditions reported by the SPP. In addition to the alarms it is possible to display the Telecare and Telehealth measurements in a tabular or graphical form in order to evaluate their trend. An alarm can have many levels of severity, shown differently by the user interface. For example, in the Italian pilot, scenarios such as the front door being left open, the alarm is sent via email to the ATC software, which in turn sends an SMS to the monitored elderly person. Thereafter the inCASA platform continues to monitor the evolution of the scenario and if the problem persists raises the severity of the alarm. If the door still remains open; the alarm is escalated to the call centre operator to call the elderly person by phone.

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The inCASA system integrates activity and health status monitoring to the persons' home. Besides the vital sign monitoring devices, home monitoring sensors are included. An example scenario of environmental sensors is shown in Figure 37. The activity hub acts as a gateway between the Personal Area Network (PAN) and the Wide Area Network (WAN) based on Internet protocols and is a generic low-cost bi-directional gateway between the WAN-based HTTP-XML-traffic and the PAN short-range wireless connectivity. Several radio interfaces have been required to implement the WPAN protocol to link all of the environmental monitoring sensors used in the inCASA network.

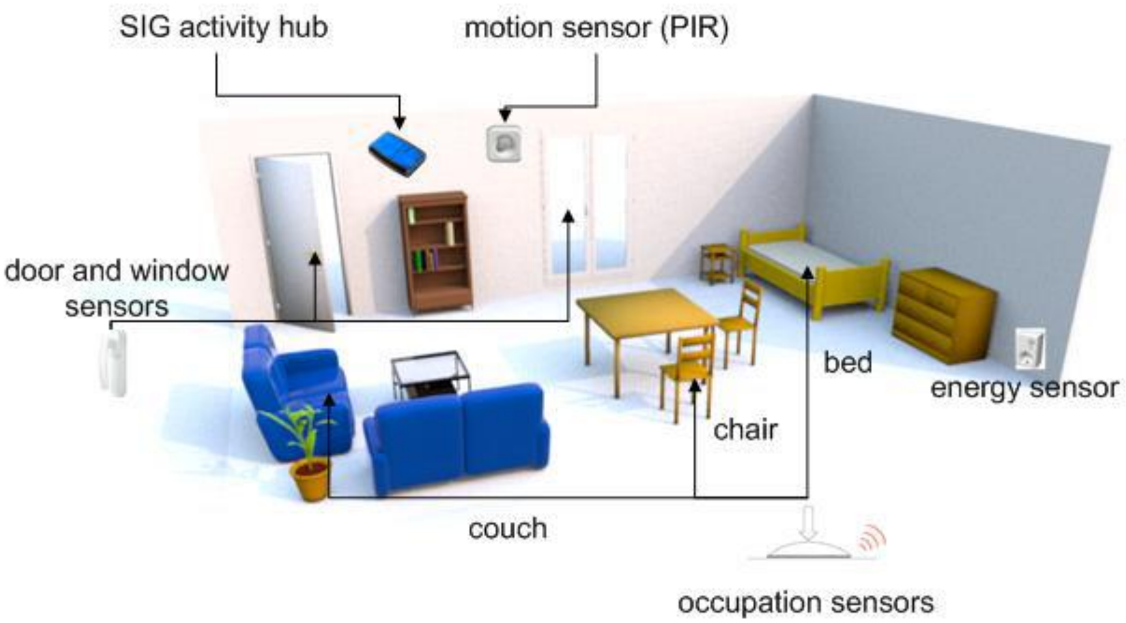


Figure 37 - The inCASA Home Infrastructure

The following are the sensors used for the Tele-Care application:

Parameter	Basic sensor set	Extension	Preferred technology
Door / Window contact	X		ZigBee
Movement	X		ZigBee
Presence	X		ZigBee
Chair contact	X		EnOcean
Bed contact	X		EnOcean
Activity	X		Wireless M-Bus
Temperature		X	ZigBee
Humidity		X	ZigBee
Gas		X	ZigBee
Flood		X	ZigBee
Smoke		X	ZigBee

Figure 38 - TeleCare sensors selection

The following are the devices used to monitor each chronic disease:

	Cholestherol Meter	Pulse Oximeter	Blood Pressure Mon	Glucometer	Scale	HbA1c Meter	ECG Meter	Heart Rate Meter	Activity Monitor	Thermometer	Spirometer
Asthma		N	N					O	N	O	N
Chronic Obstructive Pulmonary Disease (COPD)		N	N				O	O	N	O	N
Congestive heart Failure (CHF)	N	N	N		N		N	O	N	O	O
Coronary Artery Disease (CAD)	N	O	N	O			N	N	N	O	
Diabetes Mellitus			N	N	N	N		N	N	O	
Major Depression			N					N	N	O	
Stroke			N		N			N	N	O	

N Necessary parameter to be monitored (> 90% of cases)
O Optional parameter to be monitored (< 90% of cases), depending on diagnostic.

Figure 39 - TeleHealth devices selection

3.2 Implementation: basic component developed

The InCASA platform comprises a number of software components. Market and technical cooperation may be necessary to deploy the platform in the market. Technical cooperation is important as the installation of the different components of the platform and the running of services may require the expertise from different partners within the consortium.

Table 6 identifies ownership and IPR of individual components of the inCASA platform to define joint ownership for purposes of commercialisation or use in further research and development projects.

Owner Organisation	inCASA components	Home Base Station	Remote Service provider	User's Applications
Santer Reply	SPP (Reasoner)		X	
	SPP (Mediator)		X	
	SPP (EPR)		X	
Telefónica I+D	Sara Client	X		
CNet	LinkSmart Client	X		
	LinkSmart Server		X	
SIG	Activity Hub	X		
NTUA	Consumer application			X

Table 6 – inCASA main components and ownership

The inCASA technology solutions and expertise are distributed among these partners:

- Telefonica I+D is the owner of the Sara Client and Sara Service solutions as used in the home base station and the remote service provider applications;
- CNet and In-JeT are the co-owners of LinkSmart, developed in the framework of the EU Hydra project, used to make data interoperable among the different platform components;
- Santer is the owner of the Smart Personal Platform used in the Remote Service Provider applications;
- SIG is the owner of the activity hub;
- NTUA is the owner of the Consumer Application which was used as the single point of Web access to the inCASA platform by the Professional stakeholders.

The inCASA project also demonstrated interoperability with components from other parties. This included integrating an external consumer application provided by In-JeT. In-JeT is the owner of the LinkWatch patient front-end which was used together with the inCASA solutions in the Skive Transferability Desk.

3.3 Integration and openness

The inCASA platform has been developed based on adoption of international standards for message formats, message protocols and nomenclature for communication between the separate components.

IEEE 11073 has been used for communication of measurements and alarm events from the devices to the hub or gateway. This includes IEEE 11073-10101 nomenclature for the terms and IEEE 11073-20601 for the data model and protocols. Specific devices are defined by the IEEE 11073-104xx device specialisations. This includes: IEEE 11073-10471 (Independent living activity hub), IEEE 11073-10407 (Blood pressure monitor).

The communication between the other components of the architecture is realised by implementing the transactions defined by the IHE Patient Care Device integration profile (IHE PCD).

Figure 40 shows how measurements were transmitted from the Home Base Station to the Remote Service Provider by implementing the PCD-01 (Communicate PCD Data) transaction, as profiled by Continua for the WAN interface. The integration between the Consumer Applications and the Remote Service Provider is performed by implementing the PCD-02 (Subscribe to PCD Data) and PCD-04 (Report Alarm) transactions.

All IHE transmission of data, measurements and alarms, are transmitted using HL7 (version 2) messages and exchanged through Web Services defined by WSDL interface.

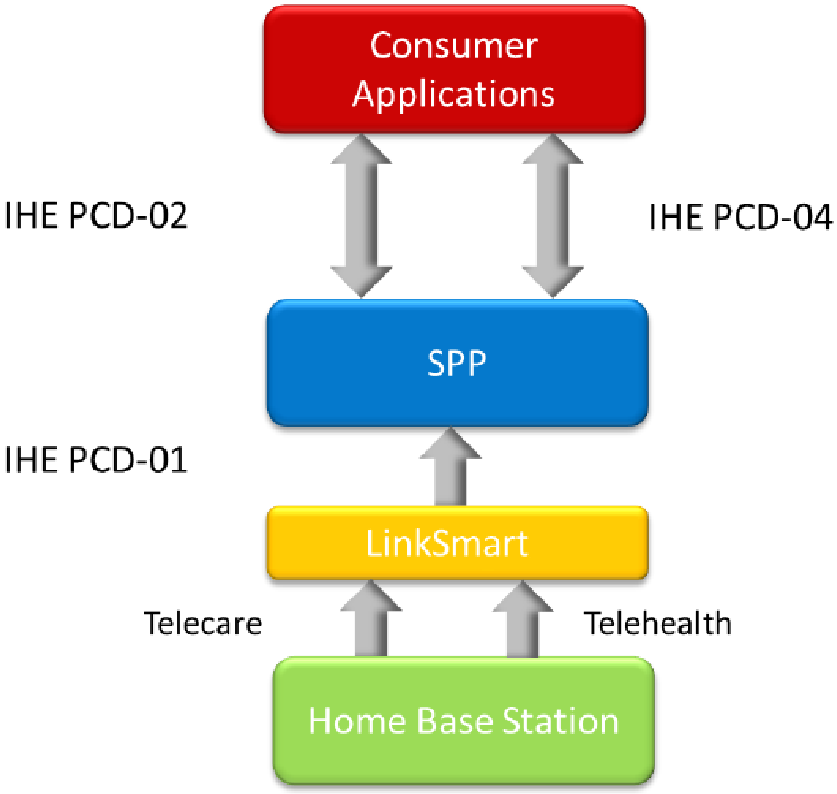


Figure 40 - inCASA Components Integration

The main benefit from this approach is that Telecare and Telehealth measurements are transmitted in a homogeneous way within the inCASA platform, even if they originated from proprietary systems. The integration of other medical or environmental devices is made transparent by the fact that collected data can be transmitted without affecting the communication interfaces: it is sufficient to code the measurements according to the rules defined by the appropriate nomenclature.

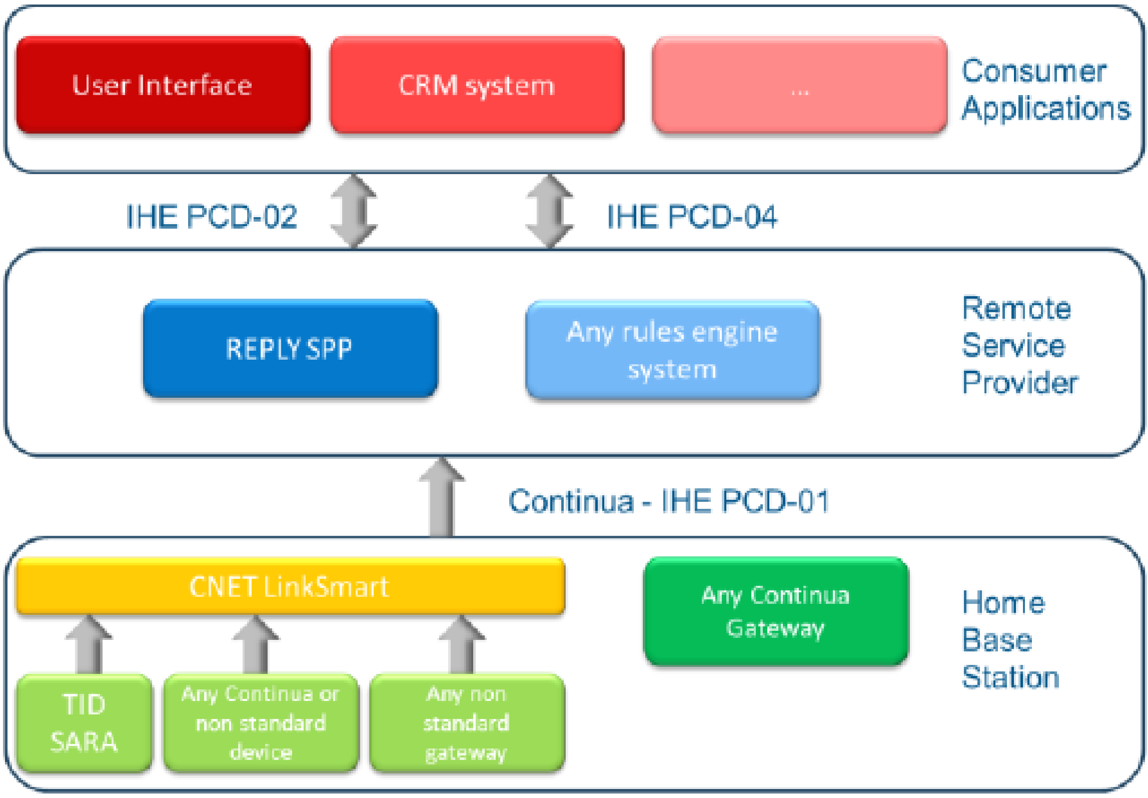


Figure 41 - The interoperability of the inCASA architecture

Although the IEEE 11073 standards define an interoperable plug and play architecture for Continua compliant devices (sensors and gateways) inCASA has incorporated a middleware layer (LinkSmart support legacy and proprietary sensors and applications.

Adopting standard interfaces and coding systems has guaranteed the realisation of an open and interoperable platform inside which it is possible to easily integrate new components. Figure 42 shows the main blocks of the inCASA platform: and how modules have been added or replaced for the different pilot sites to provide equivalent functionalities and create the platform required meeting the requirements of the pilot.

3.4 Pilot Deployment

The inCASA platform was designed in an open and modular way, in order to fulfil different needs of the different pilot organisations.

Pilot deployment followed the same architectural approach, but the specific implementation was differentiated as shown in Figure 42.

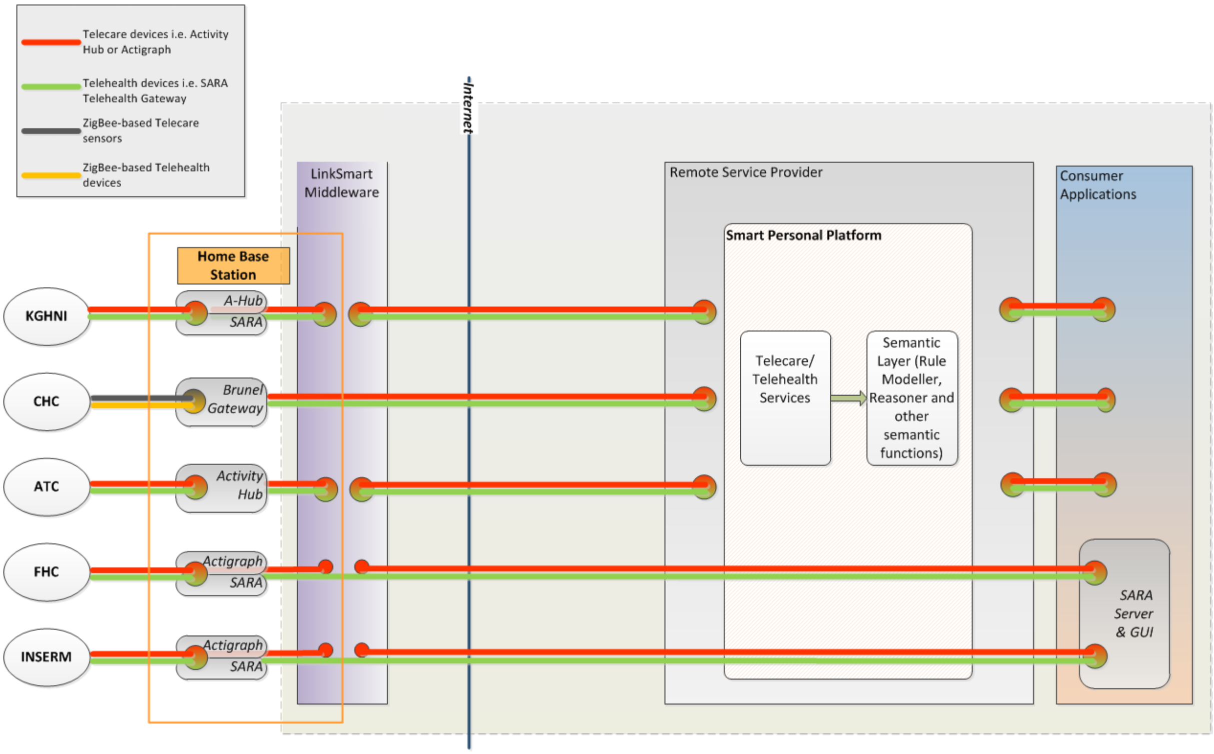


Figure 42 - Pilots Architecture

Each pilot collected data using different hubs, depending on technical or economic reasons. Data were communicated using LinkSmart Middleware in almost all cases (except CHC), and processed by the Smart Personal Platform except for cases where the level of reasoning was related only to the detection of an alert outside threshold. Presentation of data was provided by specific consumer applications: the most used was the one developed by NTUA.

KGHNI

KGHNI deployed its solution as shown in the Figure 43, in which the high-level architectural scheme is presented. Telehealth data are received by the Telehealth Gateway (SARA client) which is embedded in a portable all-in-one tablet PC that is used by the users. These computers have also a touch screen in order to improve user experience and facilitate the process of taking medical measurements. Telecare data are received by the SIG Activity Hub which stands as the Telecare Gateway component of the system. Both Telehealth and Telecare data are forwarded to the LinkSmart middleware which then transforms the received data into standard HL7 messages and sends them to the server side of the platform. The KGHNI professional stakeholders access data on the server platform using the NTUA developed Consumer Application, a Web Portal that operators can use to view the socio-medical data and alerts of the patients.

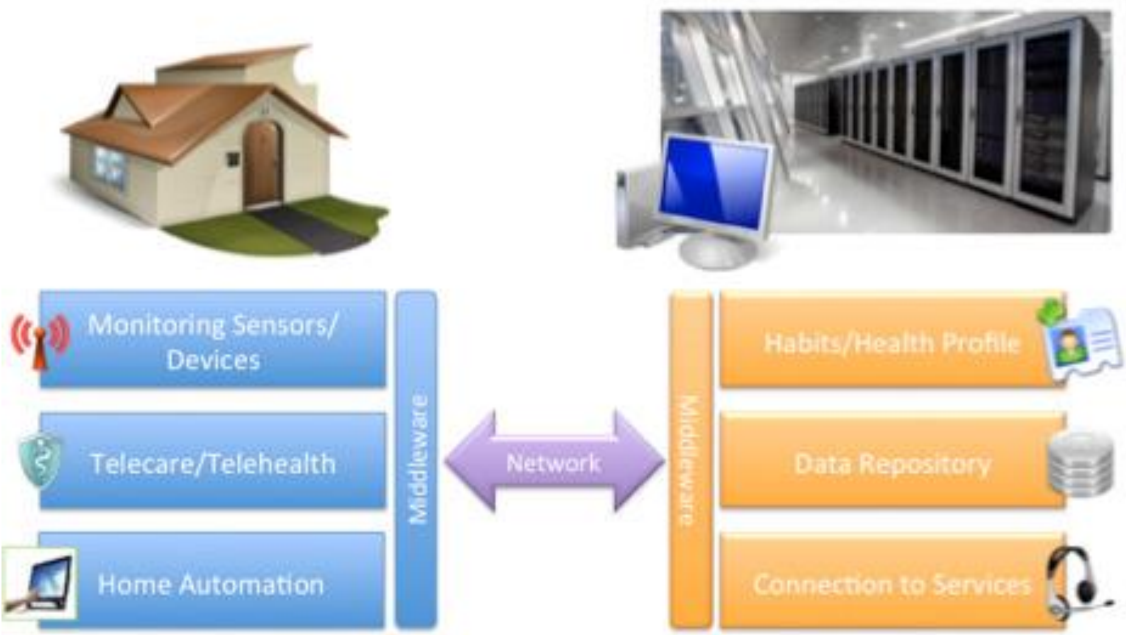


Figure 43 - The KGHNI Solution

The relevant components of the KGHNI inCASA solution are listed below:

Component	Getting data from	Sending data to
Sensor Devices (Movement/Temperature, Chair, TV usage)	Direct measurement	Telecare Gateway
Vital sign monitoring devices	Direct measurement	Telehealth Gateway
Telecare Gateway (SIG Activity Hub)	Sensor Devices	Client – side LinkSmart middleware (Home premises)
Telehealth Gateway (SARA Client)	Vital sign monitoring devices	Client – side LinkSmart middleware (Home premises)
Client – side Linksmart middleware	Both Telecare and Telehealth Gateways	Smart Personal Platform
Smart Personal Platform	Client - side LinkSmart middleware	Consumer Applications and EPR repository
Consumer Applications	Smart Personal Platform	End user's screen (Web Portal)

Table 7 – KGHNI Architecture Components

The machine hosting the KGHNI pilot server is installed at NTUA and performs the following main tasks:

- Run SPP (software provided by Reply)
- Run Consumer Application (software provided by NTUA)
- Host inCASA database

In order to support the above functionality, the server machine has the folowing software and hardware specifications. These have proven sufficient to host the solution and support the monitoring of the inCASA Pilot patients:

1. CPU: Intel® Core™2 Duo CPU E8400 at 3GHz
2. RAM: 8GB
3. Hard Disc size: 150 GB
4. Operating System: Windows Server 2008 R2 standard, Service Pack 1 (64-bit)

Figure 44 shows the architecture of the KGHNI pilot, which is fully compliant with the inCASA reference architecture. In this figure, we can also observe the way in which the inCASA components interface with each other and understand the information flow.

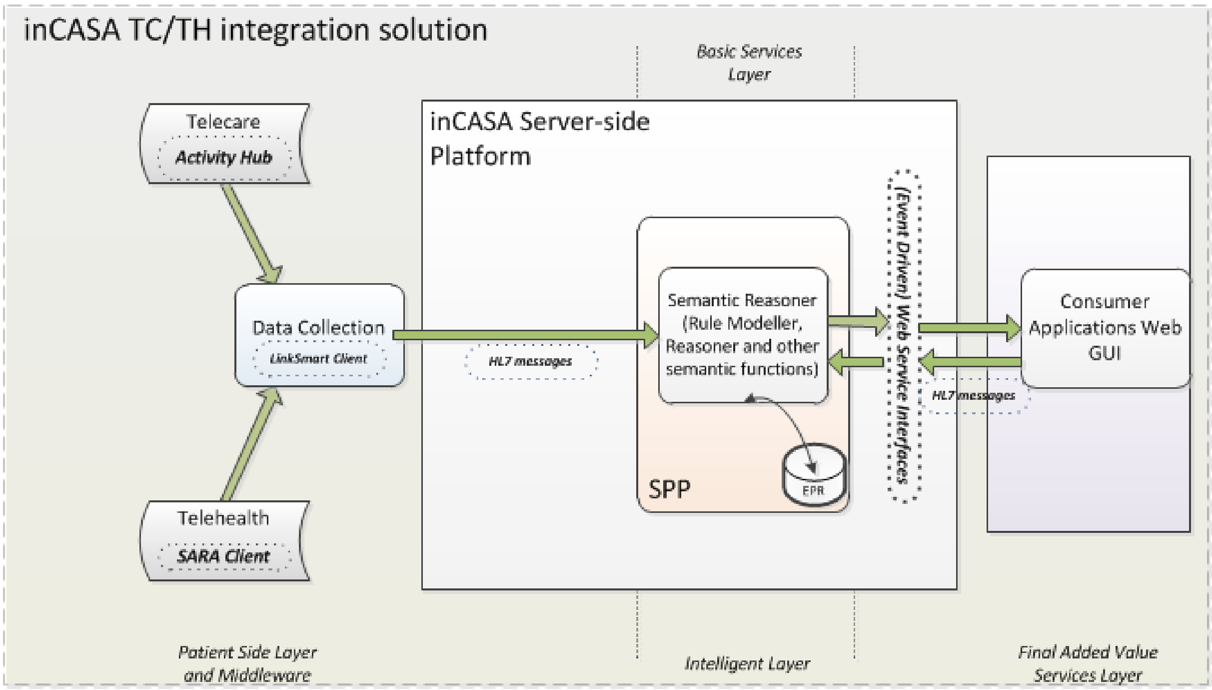


Figure 44 KGHNI architectural model

FHC

The FHC system follows a 3-layer architecture:

- A middleware layer to connect the software components that manages the sensors (in this case, a pulse oximeter plus, and in certain cases an actigraph) and human input with the underlying logic of the system;
- Basic telehealth and telecare information services;
- Semantic processing layer.

These three layers' capabilities are delivered as Applications using Web Services. The SARA client uses Web Services to send information to the server, where it is saved using the Telehealth platform services. Once saved, doctors can access the information by using the Medical Web Portal, which lets them receive the data directly on their computer, using futher web services provided by the platform.

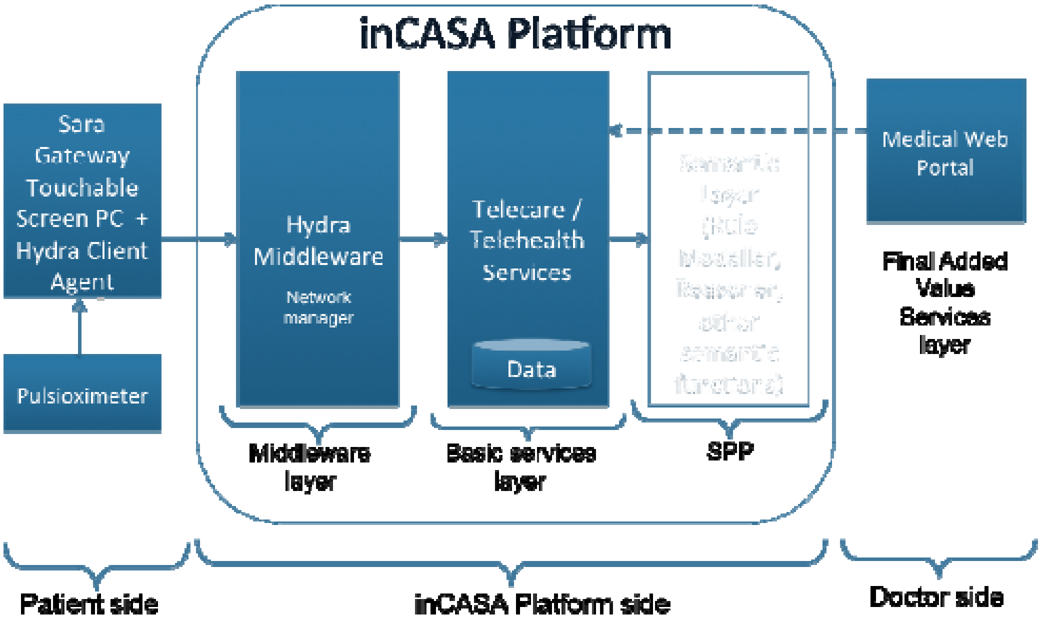


Figure 45 - The FHC Solution

Figure 45 shows the patient using sensors that communicate automatically and constantly (every 30 or 60 seconds) via Bluetooth with a tablet PC where both SARA and a LinkSmart Client Agent are installed. The use of an actigraph was also included at the FHC pilot site. Its aim is to obtain a better understanding of the activity patterns of those patients who cannot do the in-home treatment as initially prescribed.

INSERM

The inCASA system architecture for INSERM was deployed using the following devices:

- Monitoring Devices:
  - Infrared actigraph (Ambulatory Monitoring)
  - Weight scale (AND Medical)
  - PC platform (Asus, Eeetop ET1611)

- Home Gateway
- Data Connection device, Wireless GPRS/HSDPA
- One workstation (PC, HP compact) provided by INSERM to access the patient data
- Host inCASA database
- LinkSmart middleware (SW provided by CNET).

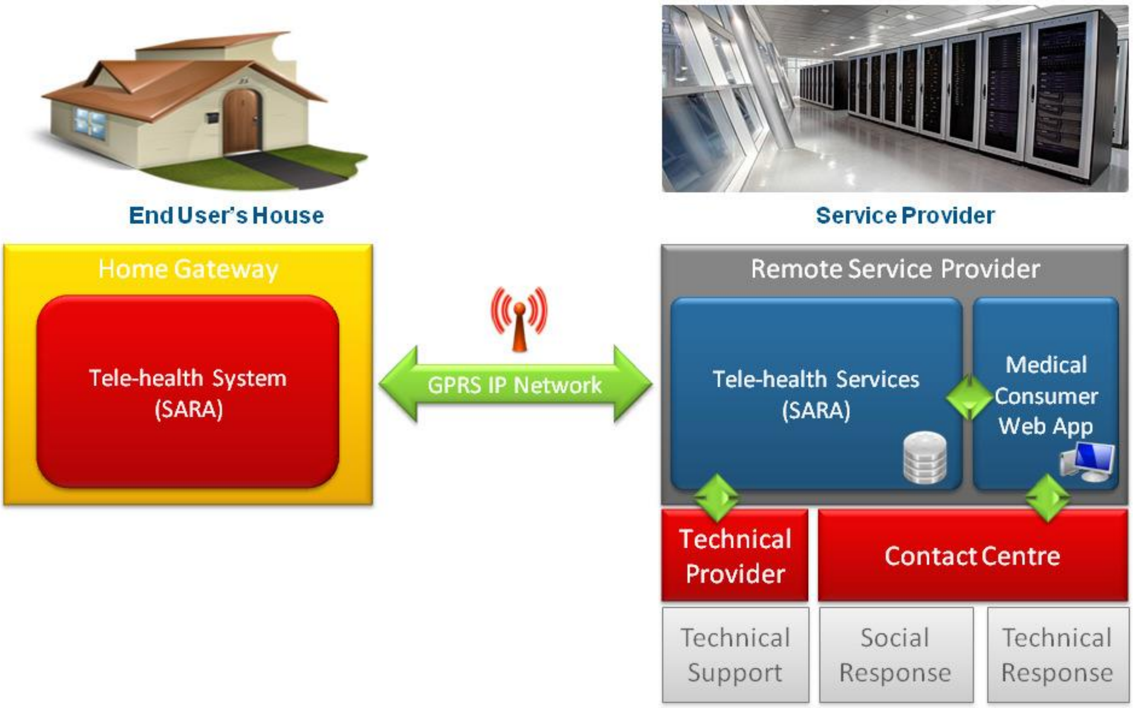


Figure 46 - The INSERM Solution

CHC

The inCASA architecture for CHC is based on the architecture as defined by the Continua Alliance and utilises standards for each of the interfaces. The Home Area Network (HAN) uses IEEE11073-20601 as underlying protocol for sensor to AHD communication of data, and use Zigbee Health Care Profile as wireless connection. These support object model descriptions of the sensor and its data that self-describe. This will simplify maintenance of the AHD as no software upgrades are necessary for new sensors to be added. Transmission of data from the home to the server at Chorleywood Health Centre is based on IHE-PCD01 as transaction message for payload and is carried over the WAN-IF using GPRS via an embedded modem in the purpose designed home gateway.

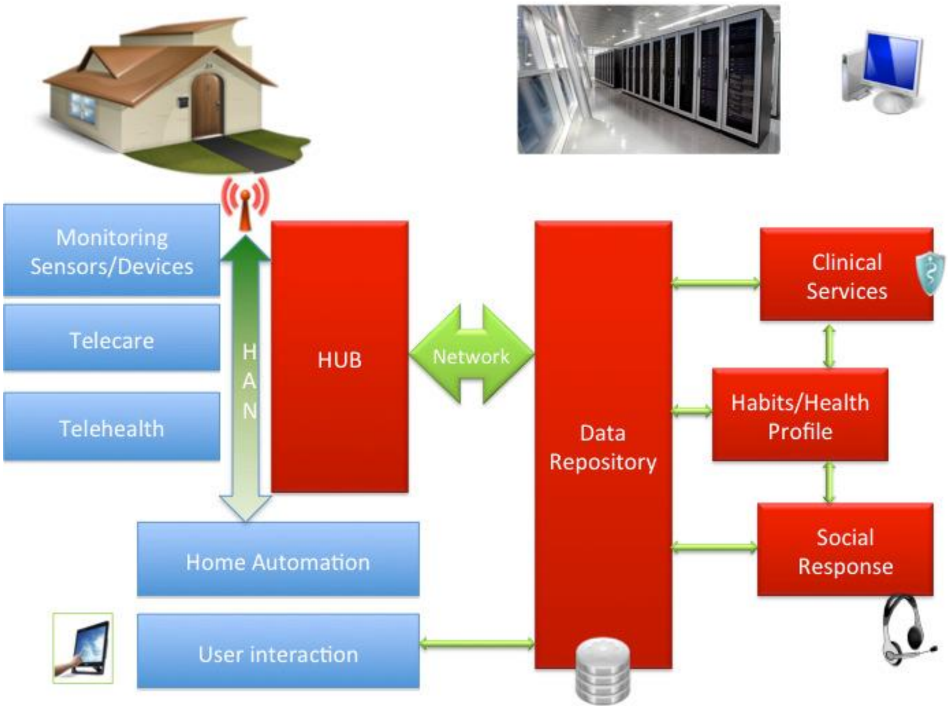


Figure 47 - The CHC Solution

The platform and sensors have been procured from Acute Technology as pre commercialisation prototypes; sensors are based on commercial devices including BP and weight sensors from A&D, medication dispenser from Pivotell, motion sensor from Optex and bed/chair sensor from Tynetec. Each sensor integrates a ZigBee wireless module using the ZHCP protocol and IEEE 11073 PHD standards.

The devices are Continua and ZigBee Alliance certified. All devices work through a simple to use home gateway that accepts ZigBee ZHCP compliant devices and transmits data over GPRS using IHE-PCD01 standard messages. This integrates directly to the Reply reasoning engine and to the patient database and clinician portal developed by Brunel for use by CHC. The portal is specially designed to manage the telehealth and telecare sensors together and to exploit the capabilities of the IEEE 11073 devices.

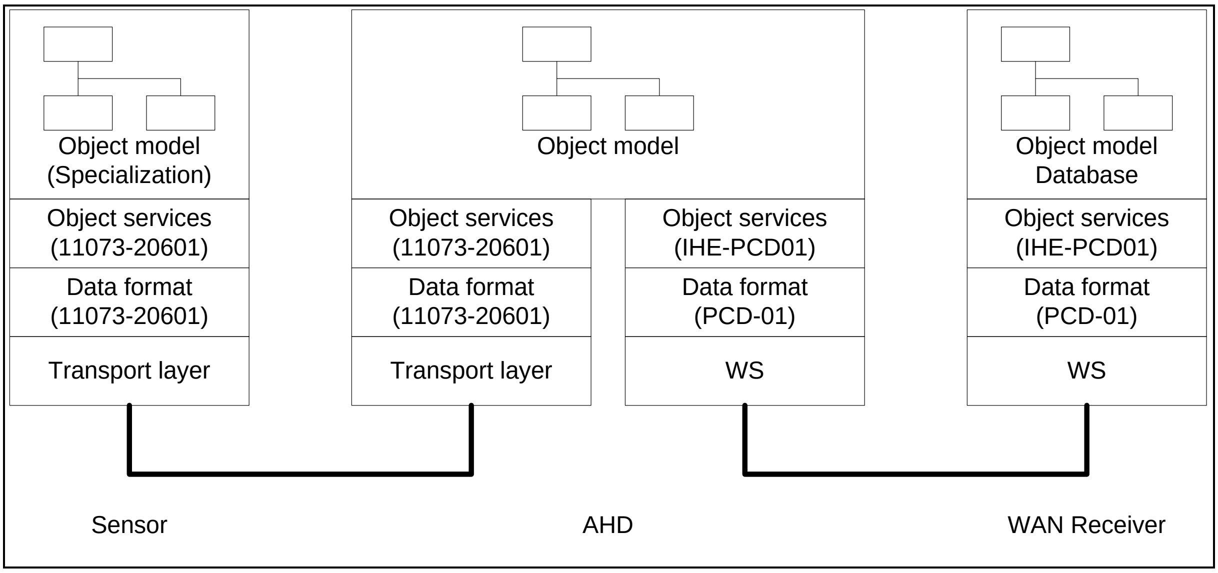


Figure 48 - CHC pilot protocol architecture

The architecture supports equally sensors for telehealth and telecare on the common platform; sensors are semantically interoperable; sensors are plug-and-play; it is an end to end architecture; the AHD acts only as a gateway and requires no upgrade as new sensors are added. The data server is located physically in CHC and supports the clinician application.

ATC

The ATC pilot solution used the Smart Personal Platform and different channels to monitor telecare data and technical data (including battery status and sensor failure), and used the LinkSmart Middleware to coordinate information. The data were sent to the Smart Personal Platform to be analysed and stored.

Alerts and other messages are sent from the SPP to the various consumer applications serving the ATC Contact Centre (service provider). In particular, an already existing Consumer Application to send SMS to users, relatives, caregivers and operators is integrated in the ATC pilot architecture. This approach was adopted as the operators were already using this application and therefore incorporating inCASA messages on this existing process would not affect the usual activity of the ATC operators. This increased effectiveness and acceptance of the new services.

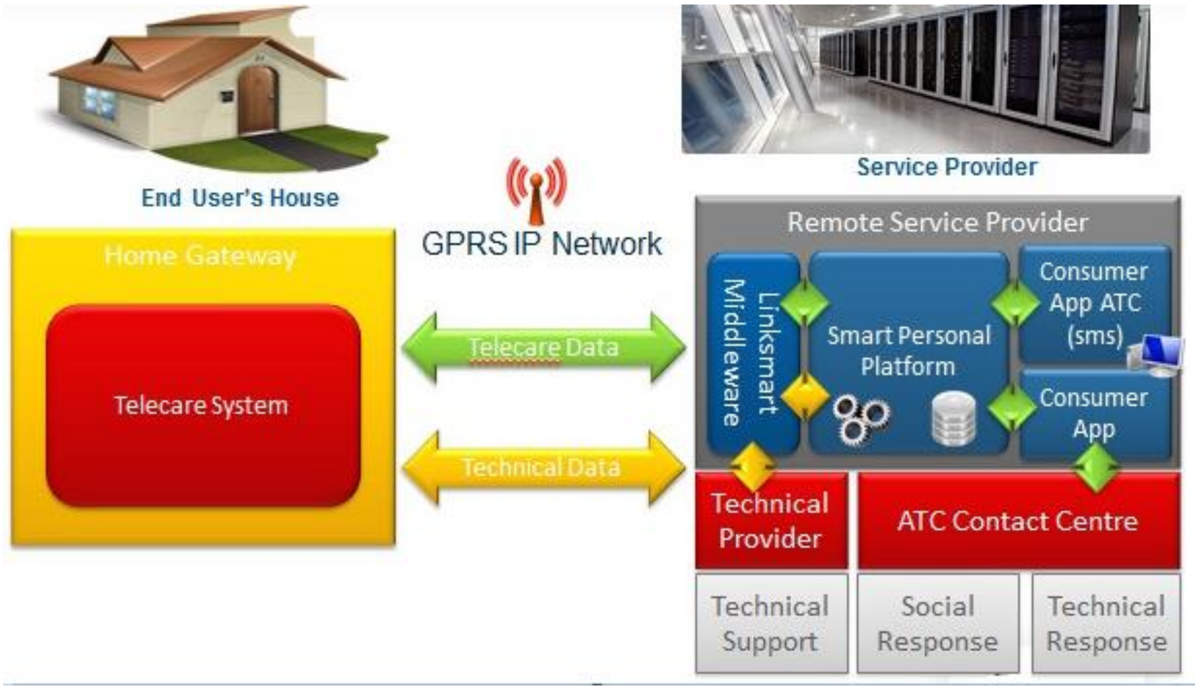


Figure 49 - The ATC Solution

A consumer application was also incorporated to display, manage and extract inCASA data.

Social Response, Technical Response and Technical Support actions are fully incorporated to support the inCASA services delivery.

The inCASA system architecture for ATC is hosted by a local Data Centre.

The Data Centre specifications and SLA are:

- Global System Availability: 99.9%
- High security and mass storage standards (HW/SW)
- 24/7 System and Operations management
- Dedicated help desk with monitoring infrastructure and problem solving dashboard with Customer Care Service available 24/7.

4 Evaluation Results

4.1 Evidence from the pilots

Between March 2012 and May 2013, 204 patients across the 5 pilot sites were enrolled into the study and their perception was measured using a questionnaire which was adapted from the Whole System demonstrator program in the UK. All pilots asked every patient / end user who took part in the inCASA study to complete the questionnaire.

Study Population

The average age of participants was 71 years. 51% were female.

Patients / end users who were enrolled into the study had a number of different clinical conditions including, COPD, CHF, Cancer, Hypertension and Dementia. In addition, end users from the ATC pilot were deemed to be socially vulnerable.

The degree of frailty of patients / end users that were enrolled onto the service was measured using the Edmonton and G8 Frailty Scales. 44% of those that were enrolled onto the service scored as of average frailty or of being very frail. Patients enrolled onto the KGHNI pilot mostly rated as not being frail despite their clinical condition.

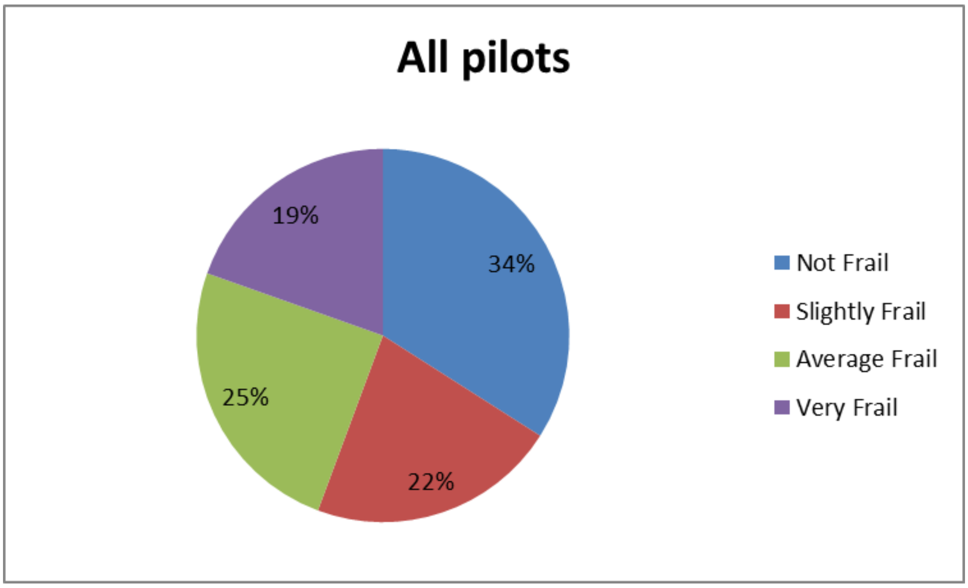


Figure 50 - All Pilots Study Population

KGHNI recruited a total of 40 patients. Patients who were included in the pilot had previously been diagnosed with Congestive Heart Failure (CHF). The average age of participants was 63. Frailty was not determined as the main characteristic of the patients within this pilot as rated by the Edmonton Scale.

FHC recruited 43 patients, 5 of whom were enrolled into a control group to participate in a tele-rehabilitation programme for patients with chronic obstructive pulmonary disease (COPD). The average age was 75.6 years old. The majority of patients had a moderate level of COPD.

INSERM recruited 37 patients who were receiving treatment for cancer. Mean age was 62.2. Patients were determined as frail using the G8 Frail Scale.

The CHC pilot enrolled 44 patients onto the service, of which 36 are were still being monitored at the end of the pilot study. Patients were included the pilot based on frailty as opposed to a specific chronic disease. The patients within the pilot were amongst the oldest taking part within the inCASA pilots with the mean age being 82. Patients were rated as being of average frailty.

The ATC pilot recruited 40 end-users who were receiving social housing support and who had been identified to be at risk of loneliness or who have safety or autonomy issues.

Patient perception, enhanced care and quality of life

Patient perception was measured using the SUTAQ questionnaire which was adopted by the Whole System demonstrator program in the UK. All pilots asked every patient / end user who took part in the inCASA study to complete the questionnaire.

A total of 150 patients across the 5 pilot sites completed the questionnaire:

- 40% of patients said that the service had increased their access to health or social care professionals. However, 36% remained undecided and 24% felt that it had not.
- 86% felt that the kit had not invaded their privacy.
- 56% felt the service had made them more actively involved in their health care.
- 88% felt that the kits could or should be recommended to others.
- 65% felt that it was not a replacement for usual care, with only 13 % saying that could be.
- 52% said that it was not as suitable as regular face to face care.

Pilots reported that the majority of their patients / end users who took part felt that the service and technology provided enhanced care that was over and above what they consider to be their normal care.

Patients reported that they were more actively involved in their own care and that the technology was a good addition to their normal health and social care and would recommend it to other patients with similar conditions.

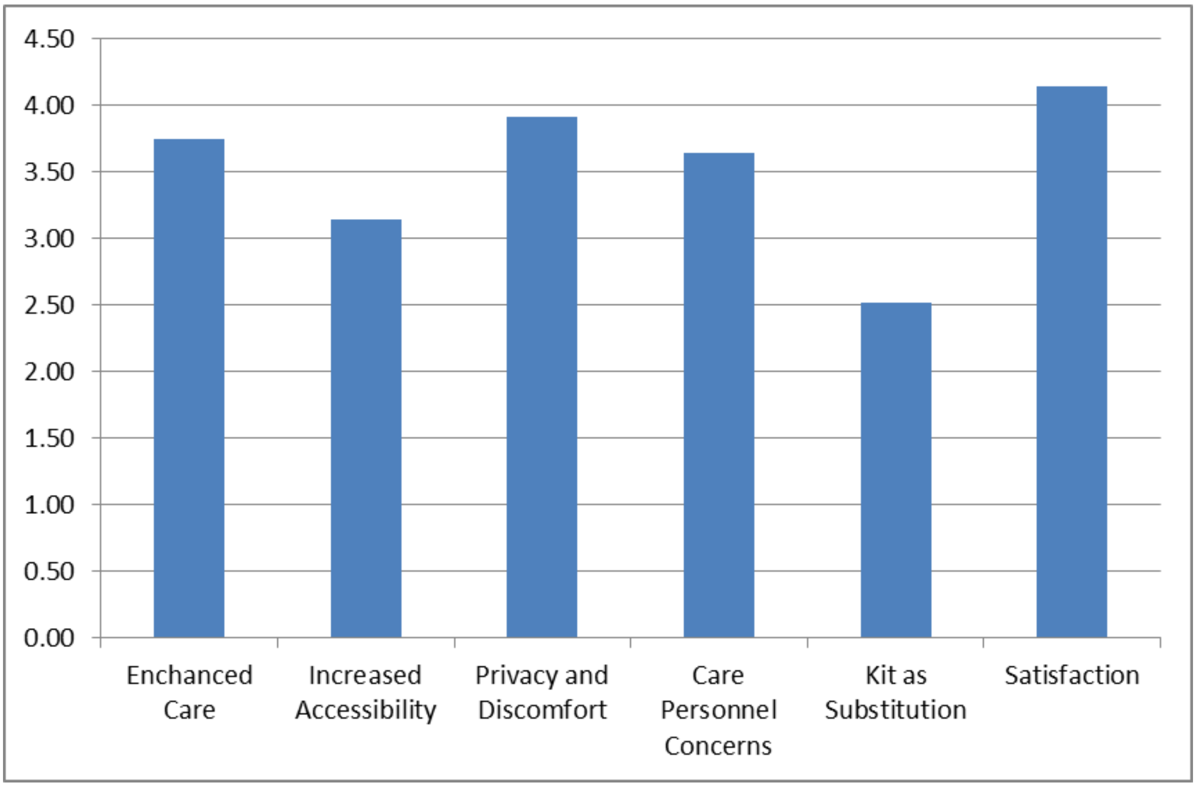


Figure 51 - Patient Perception results for all pilots

One of the most important points is that none of the patients felt that the technology had affected their privacy or made them concerned about the confidentiality of the information being exchanged through it. Only one patient felt that the technology had interfered with their daily routine.

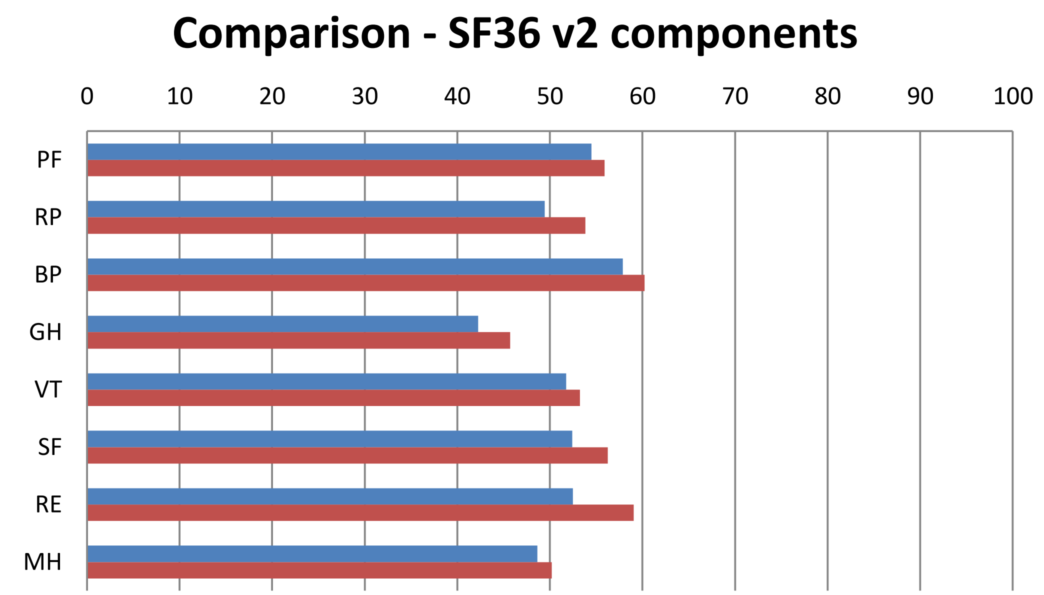
Regarding the personnel care concerns**,** almost all patients had no concerns about the level of expertise of those looking at their data collected via the technology or worried that their continuity of care was being affected.

Moreover, patients within the pilots felt that the technology provided to them as a part of inCASA, could not replace their regular health or social care, although some patients felt that the technology was as suitable as a regular face to face consultation.

At the end, the overall scoring of patient satisfaction with the inCASA pilots is very high. ATC, KGHNI and CHC pilots have all reported that patients currently enrolled on their service wish to continue being monitored.

All pilots assessed Quality of life using the SF36 v2 questionnaire. The SF36 v2 assesses the patient's quality of life over the duration of the time they are enrolled in the service.

Overall it can be observed that pilot sites that were primarily functioning as health organisations saw improvements in perception of health related scores over the time that their patients were enrolled into the service. On the other hand, the ATC pilot, which was led by social housing, saw the main improvement in the social aspects of the scale.



	MH	RE	SF	VT	GH	BP	RP	PF
Start	48,64	52,47	52,40	51,74	42,26	57,89	49,45	54,50
End	50,20	59,06	56,25	53,25	45,71	60,21	53,82	55,90

Figure 52 - Comparison - SF36 v2 Components

Specifically, the comparison of mean values of each component at baseline and endpoint are presented in Figure 52.

In particular:

- There was a 7% difference in how patients / end users scored their perception of health, indicating that they felt better about their health compared to when they first enrolled onto the service.
- This is further supported by a 6% shift in how patients reported being able to accomplish more due to their physical health.
- Patients / end users were less affected by emotional problems that impacted on their daily activities.
- Patients / end users reported feeling less depressed during the time that they were enrolled in the service.

Professional perception

Professionals who were involved in the pilots were enthusiastic with the inCASA service.

The majority of professional users (56%) who were asked to rate their overall satisfaction with the service, rated it as “Average”. 36% rated it as “Satisfied” and 8% were Very satisfied. 96% of those asked said that they would like to continue using the service. Moreover, 35% of professional users felt that the technology provided them with the information to manage their patients/end users. This outcome is noteworthy as only 27% of the professional users had used Telehealth technology before and only 6% had used Telecare before.

The following points summarise the main benefits reported by the professionals in using the service:

- The ability to respond quickly to heart failure emergencies by receiving immediate alarms
- A better understanding about the home life and personal status of the patient
- Access to more complete data about the health and habits of the patient
- The integration of multiple units and keeping everyone better informed with regard to patient condition (rehabilitation, social services, physicians, psychologists, etc.)
- The possibility to correlate medical data with habitual, environment and psychological data
- Optimisation of work time
- Being able to instantaneously identify health problems and adverse effects and being able to address them promptly

Very poor (%)	Poor (%)	Average (%)	Very Good	Excelente
0	8	60	32	0

Table 8 - Professional Usability Perception

Despite the positive responses, all pilots initially experienced some difficulties instigating the integration of services within their area and the main reasons for these difficulties have included:

- Not fully understanding what was required and which organisations to link with
- Failing to get buy-in from the different organisations earlier enough in the pilot process
- Difficulties with local organisations themselves being disrupted due to changing policies or economic challenges
- Competing interests between the organisations
- Difficulties with funding streams as a result of changing pathways
- Delays in pilot start up due to technical difficulties within the project

Moreover, all pilots reported that the introduction of the inCASA service had impacted on time in some way but the pilot also reported that having access to more information about a patient had helped improve communication between different organisations and groups.

As a result, the staff working with the patients and inCASA services suggested some possible ways in which to improve services:

- Refine the inclusion criteria – target patients who would most benefit from the service as well as take into consideration patients own feelings e.g. do they want to take part?
- Technical improvements to increase the number of functions
- Communication improvements for the medical devices used
- Extend the service to other areas of the organisation
- Include a mobile application for service to allow for remote access and transmission of data
- Improve the web portal by implementing a communication tool between different professional users in order to make communication easier and to track alerts and interventions
- Make it more personalised (add ability to set rules, thresholds, etc.)
- Establish a support process from social workers and psychologists to provide support to patients or a daily routine

Organisational impact and effectiveness

An outcome of the project for all pilots has been a series of new and redefined pathways in order to care for and respond to the new information being received. Pilots acknowledge that these pathways are still being developed and in some cases will be expanded to encompass other organisations as the service grows. Moreover, all 4 clinical pilot sites indicated that the use of the inCASA service enabled them to identify patients who were in need of clinical intervention.

During the lifespan of the inCASA pilots, all pilots have reported that the introduction of the service has created additional workload.

The Integrated technology

The technology provided was felt to be simple and easy to use. However, while many acknowledged the usefulness of the devices, there were a number of issues concerning reliability of the devices, the communications gateway, visualisation of data and the interpretation of data received from habit devices. The following summarises some of the difficulties experienced by the pilots:

- Sensor temperature, motion detection, TV usage and chair occupancy did not always send accurate values due to their sensitivity
- Issues with using a wrist pulse Oximeter
- Gateway positioning and signal strength led to communication failures
- Patient ability to use equipment
- Weight scale: not suited for older patients
- Unable to determine who is moving about the home
- Actigraph data transmission

Despite the difficulties mentioned there were many benefits that were reported and are summarised below:

- Easy to install and unobtrusive
- Good usability
- Enabled professional users to monitor and view data over time (historical data analysis)
- Possibility to correlate multi-parametric data
- Immediate notifications in the case of an urgent situation through SMS or on-screen
- Avoids taking the patient out of their home
- A new experience using ICT in telehealth.
- Being able to observe the patient experience in real time and being able to detect potential problems

Technical problems with the Telehealth devices were rare and caused no barriers to the normal operation of the pilots. The majority of the technical issues that were faced were reported in respect to the telecare sensors and the hub activity and the ability to visualise, interpret and correlate to other sensors in the home (including telehealth).

From the users' point of view, the majority felt safe about monitoring patients using the technology (safe, 57%, very safe, 10%).

Economic Impact

The cost models for each pilot differ as they are based on different funding streams and outcomes. FHC presents a hypothesis that a reduction of at least 1 or 2 days of hospitalisation per year for each group of 8 to 9 aged patients suffering from COPD could demonstrate an acceptable efficiency ratio for such a programme. At present, all patients are being followed in order to determine an estimate of the hospitalisation days that might have been avoided according to the development of their respective health status during the 12 months of the pilot as judged by the pulmonologists responsible for their care.

KGHNI calculate cost savings based on the number of re-hospitalisations avoided. The inCASA services contribute to prevention that results in measurable reduction of the hospitalisation needs, a finding that is supported by the data in the pilot's action log and individual case files of each patient. The cost of hospitalisations for CHF patients burden the national health system significantly.

INSERM calculated its cost benefit by evaluating the running costs of delivering the integrated service for the duration of the pilot, the costs related to the time used by staff was calculated by estimating the number of hours spent by each stakeholder in each kind of activity (training, meetings, installations and monitoring).

CHC calculated the cost of the change in resource usage of patients who were enrolled onto the service. CHC presented a number of issues to be considered within its economic reporting, but felt that the main focus on maximising costs savings was to identify and target services to those patients that would benefit the most e.g. the more frail and through the re-deployment of equipment.

ATC performed similar cost analysis on its pilot. By hypothesising that it would be able to reduce unnecessary and unplanned visits to the user as well as by reducing the number of planned visits to the user.

Ethical Consideration

The inCASA Ethical Policy has been established to set standards regarding the way inCASA partners should operate in ethical matters; this have been implemented in a set of Ethical Guidelines which directs the practical work and sets out how partners shall address the ethical issues and which questions should be asked before and during pilot execution.

The Ethical Policy helped to define the commitment of the inCASA project to ensure a working culture based on trust, integrity and transparency and to carry out all project activities with the highest standards of ethical conduct.

The main objective of the Ethical Policy is to protect the rights of the patient and resident that will participate in the inCASA pilots.

The inCASA Ethical policy contains 10 principles that ensure that the consortium conducts ethically responsible pilots:

- Respect the right to privacy and protection of data of all participants in the project and the pilots.
- Respect the right to autonomy of all participants in the project and the pilots.
- Respect the right to dignity of all participants in the project and the pilots.
- Be committed to transparency and integrity when ethical issues arise.
- Respect and abide with international, European, national and local legal and ethical requirements.
- Obtain ethical approval from national ethical committees as required in relation to the execution of the pilots.
- Obtain written informed consent from all participants in the pilots.
- Adhere to the Ethical Guidelines set out in D2.3 National country policies and ethical package.
- Report all ethical issues encountered before and during the pilot execution to the inCASA Ethical Board for further consideration, without any delay.

- Address all questions related to ethical issues raised by the Ethical Board without any delay.

For this final evaluation report, as reported in the methodology, evaluation questionnaires were used (e.g. SUTAQ, Professional Perception and the SF-36). These questionnaires include questions related to the ethical issues identified for the Ethical Guideline Check List (e.g. privacy and data protection, surveillance, autonomy, dignity, and informed consent).

The results from the questionnaires show that overall the project and the pilots did not violate any ethical rights. However, some patients expressed minor concerns in relation to privacy and data protection and autonomy.

4.2 Alarm triggering in the integrated pathways

As the pilots were based in organisations of varying types, with widely differing scenarios, used different system architectures, and had different aims and study populations it was decided that it would be difficult to summarise the outcomes (e.g. process flow, clinical outcome) for all pilots together, and instead each pilot will report its outcomes separately.

4.2.1 KGHNI

KGHNI deployed a service monitoring health, social and psychological condition simultaneously via the analysis of the following parameters:

- Body Weight
- Blood Pressure
- Pulse Oximetry
- Heart Rate
- Chair Occupancy, TV Usage, Indoor Movement
- Indoor Temperature
- Psychological parameters to determine depression status

This integrated analysis required the close cooperation between the Cardiology, Social and Psychiatric Units of the hospital.

One core aspect of the inCASA platform was the ability to analyse the received data and generate alarms in accordance with the designed alarms protocol. In summary, this protocol can be described as follows per monitored parameter:

- *Body Weight*: An alarm was generated when an increase of more than 1 kg per day was observed for two consecutive days. This could be an indication of body fluid retention and should be properly handled by the medical team through a medication dosage adjustment.
- *Blood Pressure*: An alarm was generated when a value out of the clinical thresholds with regard to the Systolic Blood Pressure was received. These thresholds could be configured per person. Alarms of this category should be treated as of high priority and severity from the medical team.
- *Oximetry*: An alarm was generated when a value out of the clinical thresholds with regard to the Oxygen Saturation level was received. These thresholds could be

configured per person, while the default threshold value was 90%. Alarms of this category should be treated as of high priority and severity from the medical team.

- *Heart Rate*: An alarm was generated when a value out of the clinical thresholds with regard to the Heart Rate level was received. These thresholds could be configured per person, while the default threshold values were 50 beats per minute (Low), 100 beats per minute (High) and 130 beats per minute (Very High). Alarms of this category should be treated as of high priority and severity from the medical team.
- *Chair Occupancy, TV Usage and Indoor Movement*: An alarm was generated in case of deviation from the stored habitual profile which was built during the first two weeks of the inCASA monitoring period. The deviation threshold could be set per patient. This kind of alarms was analysed by the multi-disciplinary socio-medical team and mainly triggered a phone-call intervention by the social workers who tried to understand more deeply the reasons for the recorded alteration in behaviour. After this first level intervention, the whole case manager professional team decided the next actions if it was proven to be such need.
- *Indoor Temperature:* Temperature was monitored to assess the level of comfort within the patient's house; this is an important parameter for the well-being of elderly people suffering from CHF. When an alert appeared, social workers informed the patients and reminded them of the importance of an appropriate indoor environment concerning their well-being.
- Z*ung Self-Rating Depression Scale (SDS) and Beck Depression Inventory (BDI):* The use of these two well recognised depression monitoring questionnaires is targeted to the discovery of early depression signs among the patients. The correlation of heart failure and depression is already well established in the literature and that is why the KGHNI pilot emphasised on this aspect. When thresholds were exceeded in this case, expert psychologists intervened and scheduled phone or live consultation sessions with the patients after having obtained a summary report from the medical team describing the health status of the patient in order to have a prior overall estimation of their situation.

During the inCASA Pilot life, 67 alarms were generated which can be divided as shown in Table 9. We note that heart rate alarms were the dominant alerts. In two of these cases, the inCASA alert was lifesaving as it resulted in timely intervention with the appropriate surgical procedure (Implantable Cardioverter Defibrillator).

Six patients were found to have early depression – commonly the ones who had experienced a recent and serious cardiac episode. Psychologists intervened in each of these cases offering supportive psychotherapy.

It is observed that 10 alerts resulted in no further intervention from the professional team. This could happen if measurements returned to normal values before an intervention action was performed or when alerts were generated by a sensor malfunction (e.g. temperature values lower than 0 °C).

The most challenging interventions were those that required integrated case review and would include the inCASA data in the summary.

Alert type	Intervention	Reason	Total No
Blood Pressure	Clinical Intervention (Doctor and/or Nurse)	Outside of Clinical Thresholds	7
Heart Rate	Clinical Intervention (Doctor and/or Nurse)	Outside of Clinical Thresholds	14
SpO_2	Clinical Intervention (Doctor and/or Nurse)	Outside of Clinical Thresholds	5
Weight	Clinical Intervention (Nurse)	Outside of Habits Rules	1
Depression Signs	Psychological Intervention	Outside of Psychological Thresholds	6
TV	Social Intervention	Deviation from the stored habitual profile	3
Chair	Social Intervention	Deviation from the stored habitual profile	3
Home Temperature	Social Intervention	Outside of Home Environment Thresholds	2
Missing or invalid measurements	Technical Call	Technical Error	8
Missing or invalid measurements	Technical Home Visit	Technical Error	6
Missing measurements	Social Intervention	Not performed measurements	2
ANY	No intervention required	No further intervention required	10

Table 9 Alerts analysis

The alerts produced by the platform were presented in the Professional Web Portal combined with useful information such as: the value that produced the alert; the severity/priority which was computed by the embedded reasoning mechanism according to the specified rules; the alert’s phase and the current state.

Type	Value	Timestamp	Severity/Priority	Phase	State
Heart rate	48	2013-03-04 at 14:40:30	H-PH	end	inactive

Figure 53 Heart Rate alarm example

The above alerts can be also presented in the following Figure 54 Alerts Classification, where we summarise the alarms reasons that finally triggered an intervention from the KGHNI Professional team. For each alarm reason, the respective counter is depicted in the graph.

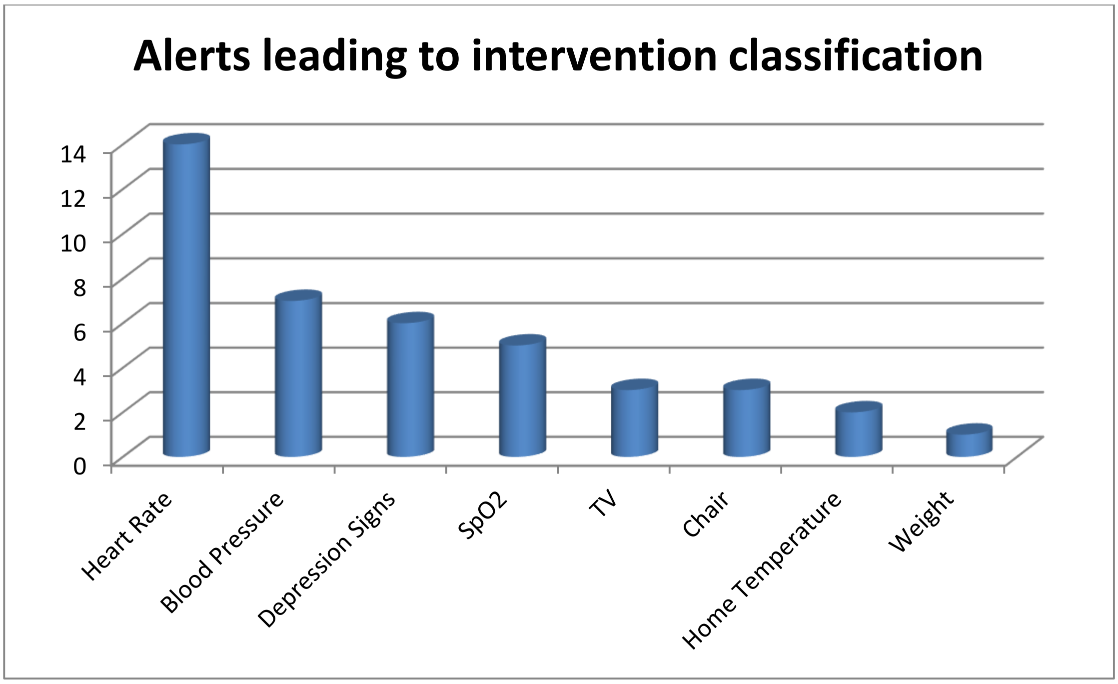


Figure 54 Alerts Classification

The interventions included various types of actions, which can be mainly grouped as follows:

- Medication dosage adjustment, close patient follow-up in case of clinical alarms
- Surgical operations (2 times during the Pilot life) in case of high emergency heart failure episodes
- Social worker call or at home visit in case of habits change or in case of loss of interest for the program.
- Psychotherapy sessions set up in case of depression signs. This kind of intervention has been the most time consuming, as the solution often requires an extensive period of therapy. Indeed, three out of the six patients are still being seen by the Psychologists on a weekly basis after the end of the project.

Finally, we report on the changes made to the alarm protocols during the Pilot phase based on the Lessons Learnt:

- In the first phase, there was only one upper threshold for heart rate set at 100 BPM. From experience, it was decided to add a further level of "Very High" heart rate with a threshold of 130 BPM in order to handle appropriately the severe emergency episodes.
- In the first phase, Diastolic Blood Pressure (BP) was also included in the alarm parameters. KGHNI Cardiologists decided to omit it as it did not provide reliable alerts. Systolic BP was retained however the medical team continued to observe the trend of the Diastolic BP for each patient in case of alert from other parameters.

An example of the clinical effectiveness of the KGHNI Pilot involving a multi-disciplinary group of Professionals was patient #17.

This patient had a Heart Rate that exceeded set thresholds on several occasions (Figure 55) and so triggered an intervention by the nurse. The patient was examined and, taking into consideration the medical history and other tests such as Holter monitoring and cardiac catheterisation, the cardiologists decided to proceed with providing an Implantable Cardioverter Defibrillator (ICD).

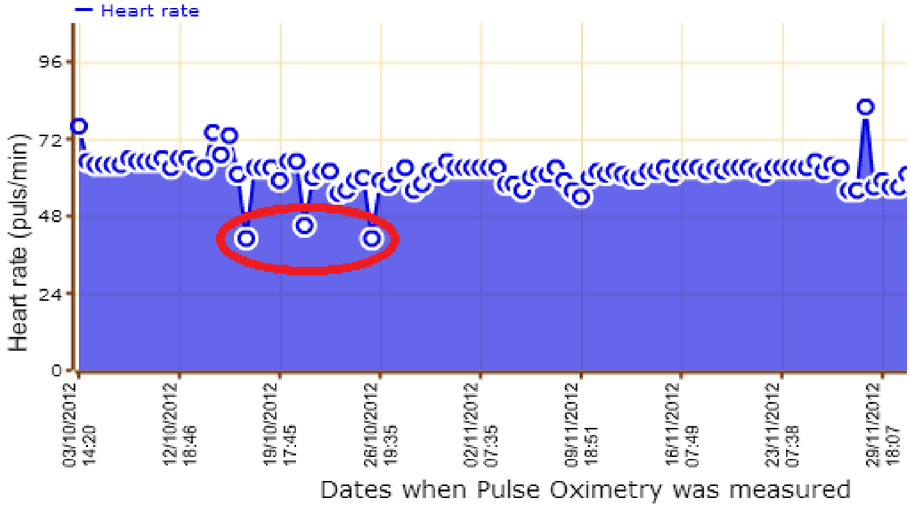


Figure 55 - Heart rate measurement graph

The operation was successful. The patient initially felt discouraged by his health problem as he had not experienced a cardiac episode for a long time. The mild depression was determined in the weekly monitoring questionnaires and this observation triggered the intervention of the psychologist who scheduled a session with the patient. No special medication was given to the patient as the early signs of depression were handled immediately through the appropriate and scientific human interaction. The depression monitoring graph, in which the critical point of intervention is marked with a red circle in Figure 56, reveals that the early signs of depression were successfully and immediately managed and the psychological condition of the patient returned to normal. It was important that the Psychologist was aware of the health problem of the patient and had consulted the responsible Cardiologist before organising the sessions with the patient.

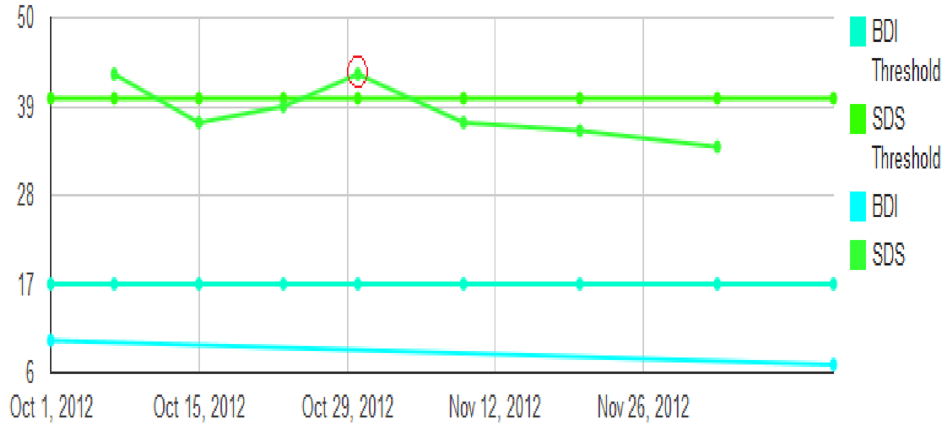


Figure 56 - Depression measurement graph

4.2.2 FHC

At the FHC pilot site, the definition of "Alert" is directly related to the type of intervention, which consists of in-home training activities to be developed in a certain period of time by each patient (no more than four weeks). For each period of active exercise (1 hour approximately), the kit provides 'snapshots' of SpO_2 and heart rate measurements (one per minute). Thus, there are none 'emergency' alerts but alerts derived from the lack of data to be monitored on remote basis, due to a lower (or non-existing) level of activity.

Figure 57 FHC Clinical Portal

Scheduled activity consists of exercises to be done in accordance with the scheduled training (for example, three times per day, each two/three days, for a training period of four weeks). Physicians and the physiotherapist could then access the data gathered by the inCASA platform to determine if exercises had been done according to the protocol assigned to each patient. The physiotherapist visited the patient at home on a weekly basis to check on progress. If no alerts were reported then this could be as a result of the weekly check by the physiotherapist on the patient.

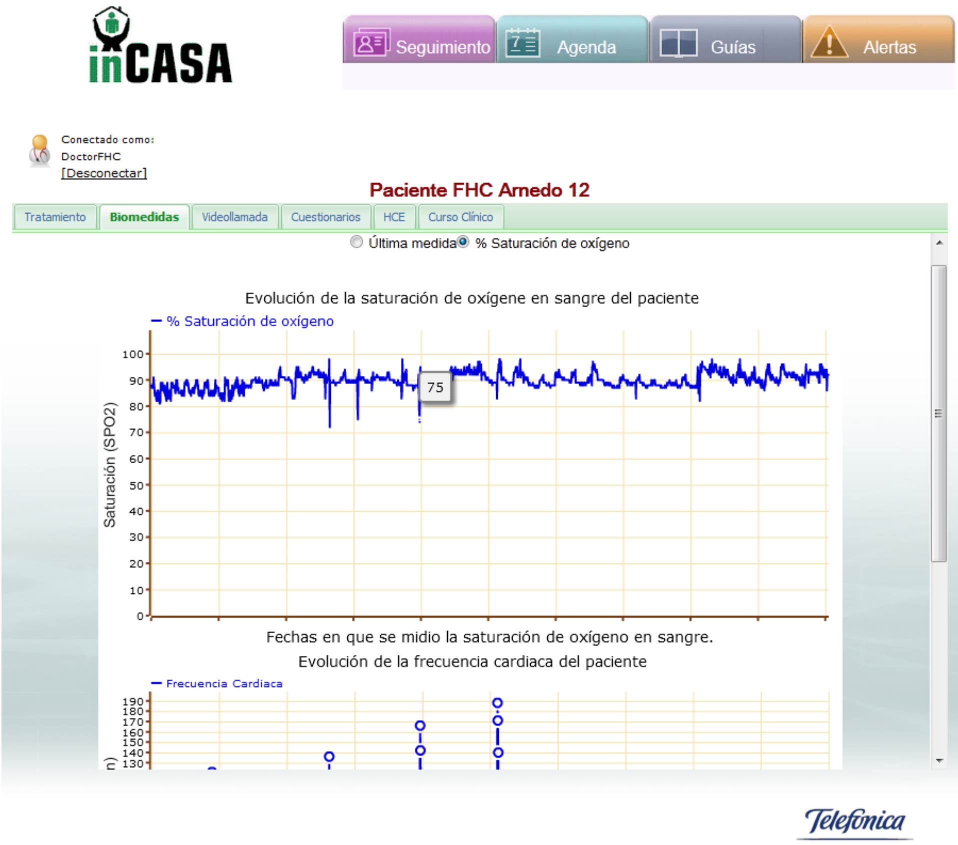


Figure 58 FHC Graphical Representation on Clinical Portal

The remote monitoring system allowed unexpected levels of SpO_2, to be detected. Typically this was when the oxygen saturation fell below the minimum level set for each patient (<90), so that the physicians at the Hospital could be aware of the condition of each patient during the in-home training period. The initial protocol established whether, when such alerts would arise, the physiotherapist should visit the patient to check on the clinical status of the patient and what advice to give.

Depending on the type of event, the physiotherapist would warn the physicians on health issues or social worker on social issues that might require further action. For example, a lack of data might alert the physiotherapist of a case of dementia that had not been detected during the initial training phase at the hospital gym. Much effort was given to establish the correct level of effort to be invested in each exercise by each patient.

Thanks to intensive and specific training at hospital gym, plus visual help provided to each patient consisting of the ‘Dyspnoea scale’ graphic included in the inCASA solution that was visible during the exercises, no significant ‘emergency’ alarms concerning these issues were reported.

Figure 59 FHC Alarms

An absence of exercise by the patient was also considered an “alarm” as it could indicate unexpected events unknown to the hospital services (perhaps the patient was deceased). As many patients were elderly and had severe COPD, several died during the pilot. One patient died after completing the training phase at the hospital gym (week one) but just before starting training at home (week two) – this was noticed by the installation team upon arrival at the patient’s home to install the equipment. This second type of “alarm” caused the initial protocol to be revised in order to ensure the most up to date information was available to commence the second phase of the training. If a patient dies outside the hospital, primary care is responsible to register the death, and this can take a significant period of time to complete. Therefore, a telephone call and check of the clinical record were included as steps prior to sending the installation team to the patients’ home. In addition a social worker made a telephone call to the patient to introduce themselves and a visit was arranged for the physiotherapist to visit patient’s home to check everything was alright.

One of the main outcomes of the pilot was the need to define further alarms to include health and social events, as it was seen that malfunction of equipment could be caused by reasons other than those linked to hardware or software problems, but social ones (for example, a patient's relative turning off the equipment because of too many alarms and causing the installation team to visit patient's home to determine no malfunction, rather a lack of expertise for the user to manage minor technical issues). The protocol was therefore changed in order to allow not only clinical or social issues but also technical ones to be reported by phone to the physiotherapist, and the physiotherapist would determine the type of resources to be provided to solve the situation as soon as possible.
Finally, the clinical alarms were revised to include clinical measurements performed at the end of the in-home training period. This included spirometry that was performed at the hospital, after a period of six-to-twelve months.

We report the following clinical case study.

Patient W is a 78 year old male. He is married and lives with his wife in a village with less than 10,000 inhabitants about 10 kilometres from the Hospital. He is retired but has worked as a professional truck driver for many years in the shoe industry, so he is used to having an independent life. Nevertheless, he has told his doctor that due to his current health status (he suffers moderate level COPD), he has a very sedentary way of life.

In 1998, he suffered a heart attack and needed surgical intervention. In October 2007 he also suffered an episode of visual alteration. Two years ago, he received a stent placement. He also suffers hypothyroidism, hypercholesterolemia and severe arteriosclerosis.

He does not drink alcohol, but smokes 10 cigarettes per day.

He is under regular surveillance and must attend regular appointments with the Pulmonologist at the Hospital. He has no hospital admissions in the past six months but is treated with inhalators at home as he suffers symptoms of severe dyspnoea.

His specialist offered him to participate in the inCASA project as part of his treatment after having studied his case with the rehabilitation specialist. Their aim was to offer to this patient the opportunity to receive specialised training in in-home respiratory rehabilitation so that he might obtain benefits for his health status, despite the chronic nature of COPD. inCASA offers significant benefits to this patient, as after the completion of the intervention he will no need to be concerned about the distance to the hospital gym.

Clinical data gathered at his first consultation, held in June 2012, was BODE index equal to "2" (Body mass index: 28, spirometer –FEV1 60.6:1, dyspnoea grade two in MRC scale 1, 6 minutes walking test : 465 m, more than 350:0).

In July, 2012, he started the hospital training phase. In Sept., 2012, he started the second phase at home. He finished in October 2012. No significant alarms were reported during the in-home training period, including during the weekly visit by the physiotherapist. No social issues arose during the in-home training period (the social evaluation test showed an acceptable social status for this patient).

After having completed all the prescribed training activities, at the final consultation held in November 2012, BODE index equal to "1" (Body mass index: 27.7:0, spirometer –FEV1 91:0, dyspnoea grade two in MRC scale 1, 6 minutes walking test : 435 m, more than 350:0).

During the period of the in-home respiratory rehabilitation programme and beyond, he suffered neither exacerbation episodes nor hospital admissions. His illness has stabilised over the next 12 months with no signs of clinical deterioration. Nevertheless, due to the chronic nature of COPD, he will continue regular clinical checks and, if necessary, he could repeat the in-home respiratory rehabilitation training programme.

4.2.3 INSERM

For the INSERM pilot four alarms thresholds were defined in order to detect abnormal events:

- Body weight monitoring: an alert was generated if the measurements decreased by 5% or more compared to the highest previous value. This threshold corresponds to the first grade of toxicity according to the NCI CTC toxicity scale.
- Symptoms: an alert was generated when one of the cluster scores was higher than 5.
- Activity: the rest-activity rhythm was considered altered when the dichotomy index was lower than 97.5%.
- Missing data: an alert was generated when no data was received during the last 48 hours.

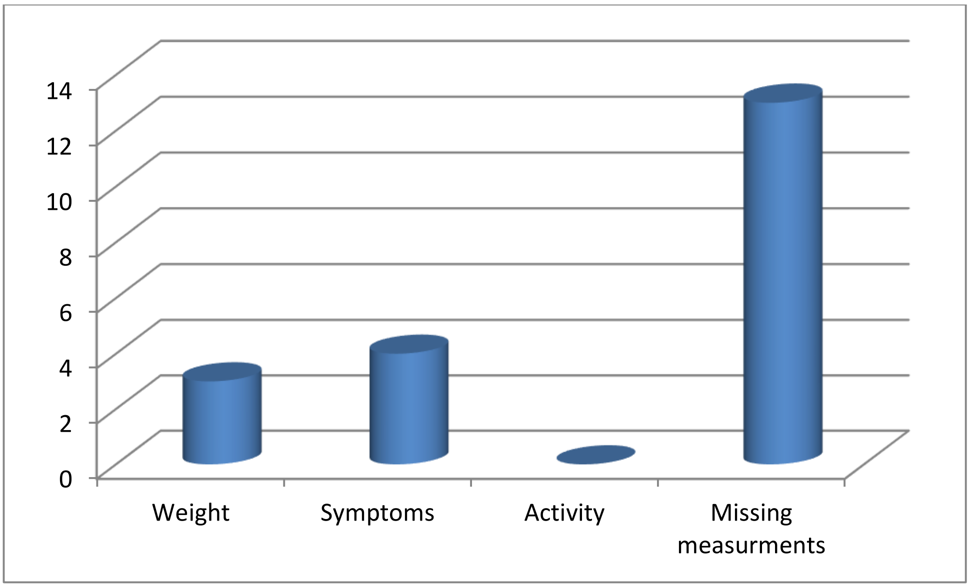


Figure 60 Number of alarms detected by nurses

During the pilot phase, 20 abnormal events were detected by nurses and followed up by a patient call:

- 13 alarms for data missing for more than 48 hours
- 3 alarms for weight decrease by 5% or more
- alarms for symptoms clusters scores higher than 5

These alerts resulted in several kinds of interventions:

- 2 hospitalisations for toxicity
- 3 false alerts (patients not at home)

- 9 technical interventions (data transmission problem), including one home visit and seven technical calls
- Alarms (weight or symptoms) were not followed by any intervention after the nurse call.

Some alarms were not detected by the nurses due to organisational or technical issues (inadequate display of data on web portal or web portal failure).

The thresholds and parameters were reviewed six months after the beginning of the pilot phase. The alarm thresholds for symptoms clusters seemed too high as several patients were hospitalised as an emergency without alarms being generated. The threshold was therefore lowered to 5 instead of 7, which increased the number of alarms generated for symptoms severity.

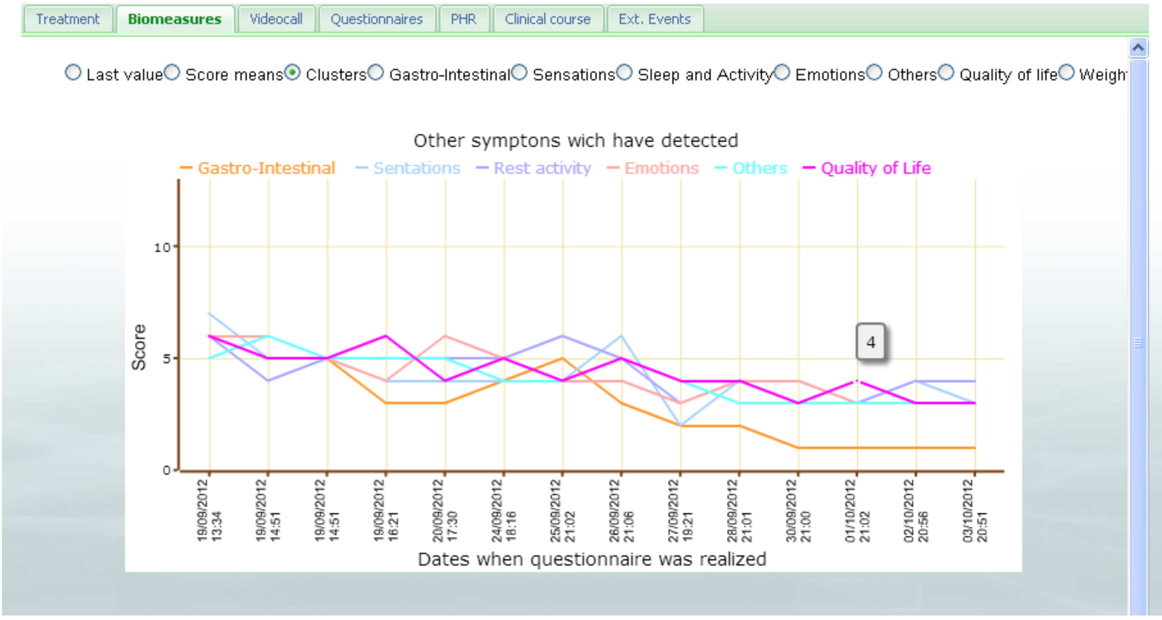


Figure 61 Visualisation of symptoms scores changes on web portal

Each alarm detected by a nurse was followed up by a call to the patient to obtain more information about the event.

The following case study refers to a cancer patient of the INSERM pilot. This patient was treated at home by chrono-modulated chemotherapy for a colorectal cancer. One chemotherapy course is administrated during four days every three weeks. Considering the high level of frailty of this patient, there is a risk of severe toxicity which can lead to a severe alteration of the general health condition and an emergency situation.

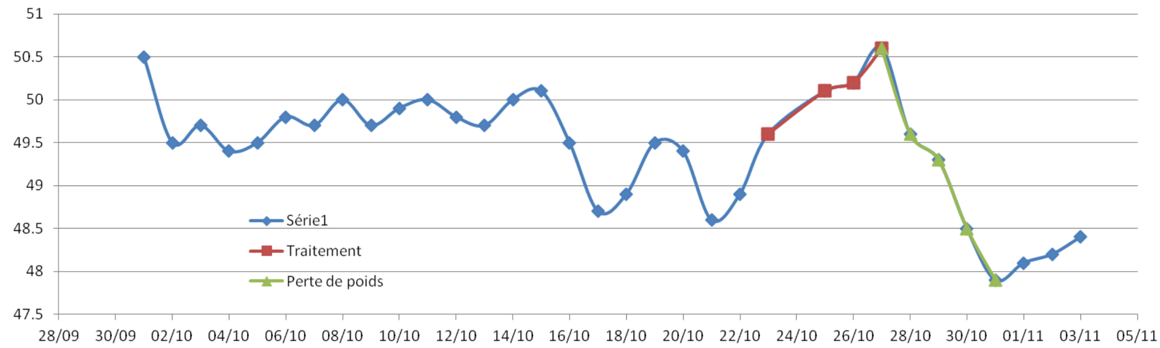


Figure 62 Body weight changes during chemotherapy

After the administration of chemotherapy, the weight loss decreased by 5.3% in 4 days, the rest-activity and quality of life cluster scores were higher than 5 and the other symptoms severity scores increased. The rest-activity rhythm looked much altered from the end of the treatment and the dichotomy index posteriori calculated was equal to 93.0%.

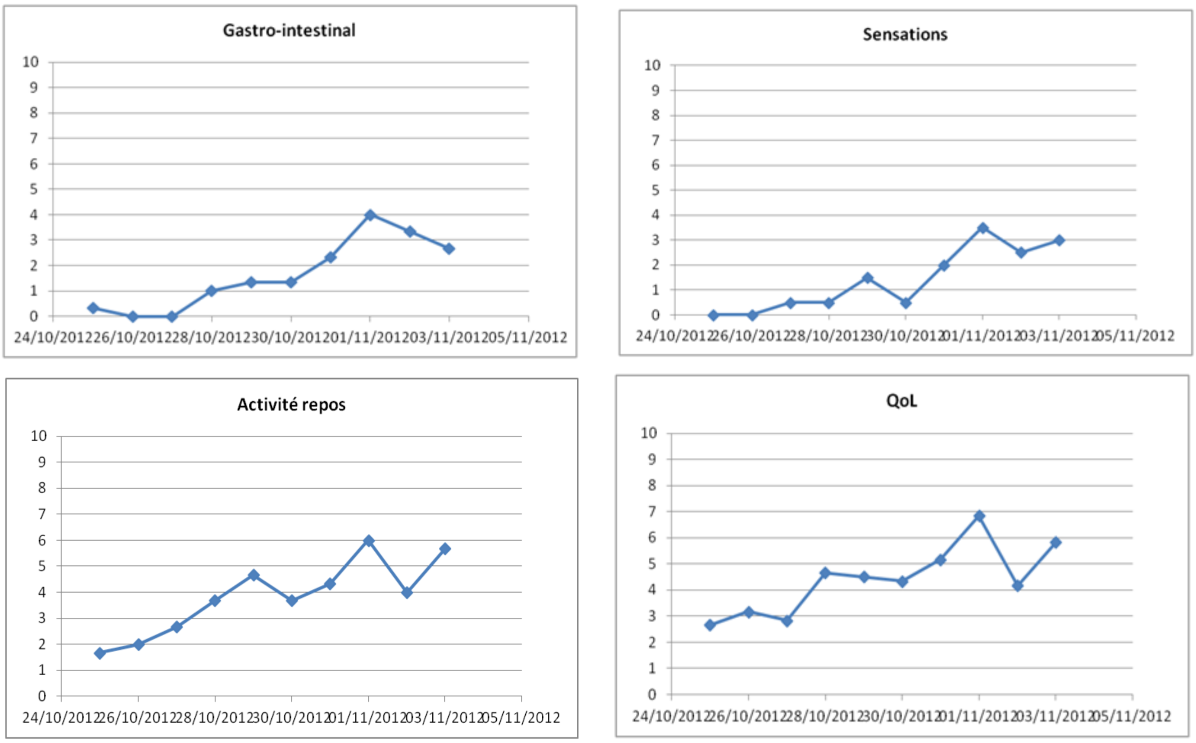


Figure 63 Symptoms clusters during chemotherapy

The nurses were alerted by the measurements that exceeded the alarm thresholds. A nurse called the patient who complained about severe fatigue and diarrhoea. She advised him to come to the hospital to see the oncologist who found the patient in grade 4 of toxicity and decided to hospitalise him in order to prevent dehydration. The oncologist also prescribed medication and parental nutrition to help him to recover faster.

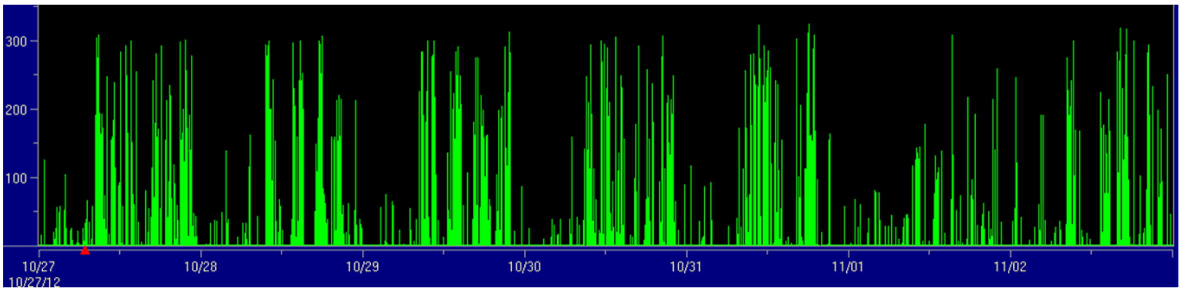


Figure 64 Rest-activity rhythm during chemotherapy

4.2.4 CHC

For the CHC pilot the main aim of the alarm/notification protocol was to provide an efficient way for clinicians to manage incoming data from the patient devices and to prioritise those patients whose data was deemed to be outside of defined thresholds.

Typically data collected from telecare devices is used to alert of sudden change for example a fall, or flood, or fire. Our service was concerned with looking at changes to the trend in the patient data over a period of time and not for sudden deterioration or acute exacerbations. Data from the telecare devices is collected passively, which is different to telehealth data, which requires a patient to do something actively in order for data to be acquired and transmitted.

The alarm/notification system within the clinical portal had to manage the different types of data within a single platform and visualise in a way that was easy and usable for the professionals. Specifically the system was designed to:

1. Highlight to the clinician a change in a physiological parameter of a patient that is outside of pre-defined thresholds over a period of time.
2. Highlight to the clinician a change in "normal" habits behaviour as gathered from the different telehealth devices.

Upper and lower thresholds were set for each of the following physiological measurements:

- Systolic and diastolic blood pressure
- SpO_2
- Weight
- Blood Glucose

The clinician could also specify a change over a period of days. If a measurement falls outside of a rule, the measurement(s) in question is highlighted on the clinical portal. Alert thresholds can be changed as necessary.

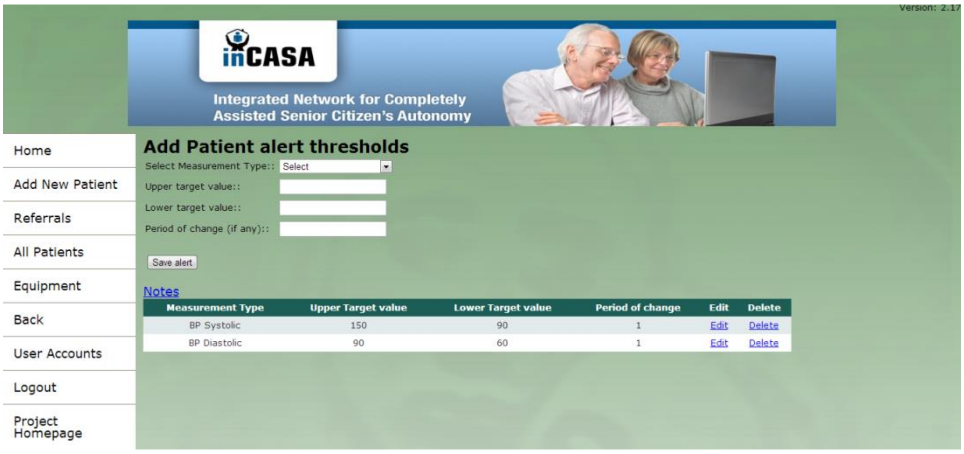


Figure 65 Setting Alert Thresholds

The protocol specifies that thresholds are not set for patient data during the first 5 days of monitoring, after this time and based on the data that is being received; personalised thresholds are set for each patient.

Physiological data that falls outside of the thresholds is colour coded on the clinical portal to make it easy for the clinicians to detect, as illustrated in Figure 66.

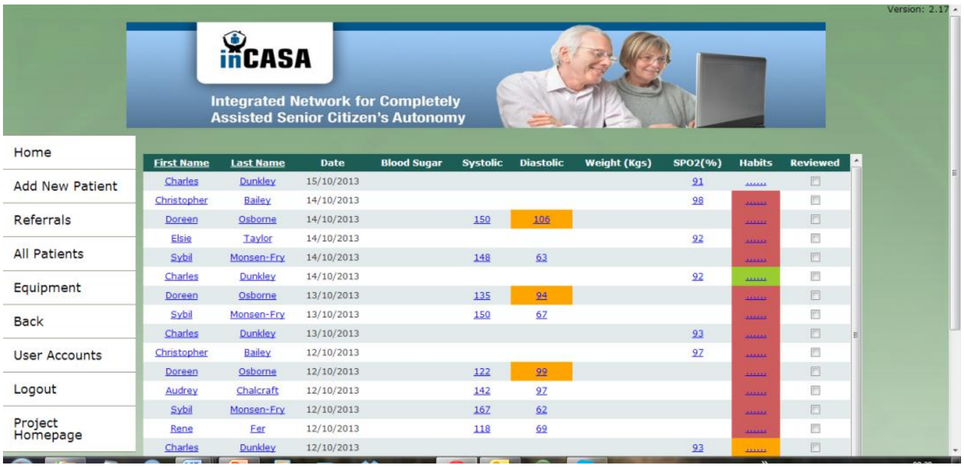
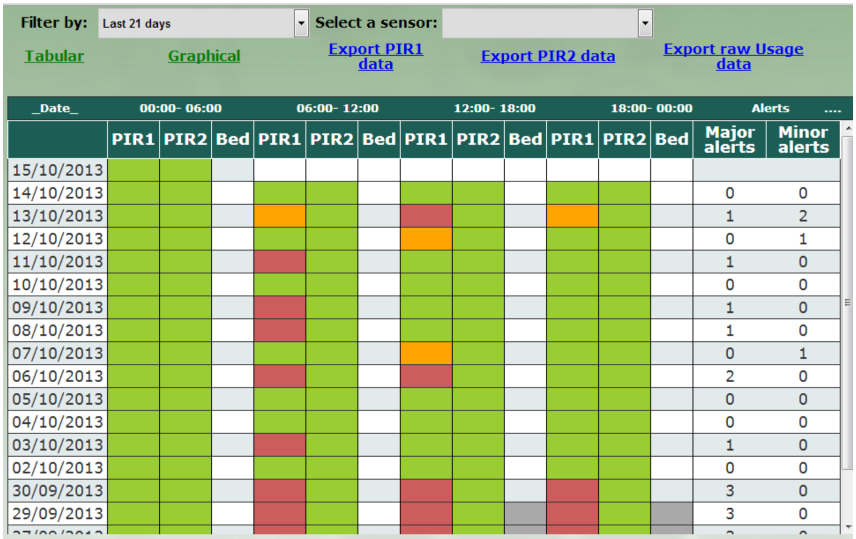


Figure 66 Alert Notification Screen

For the Habits Data Alert Protocol we determined the following parameters as important from habits sensor data:

- Number of sensor events for a given period
- Bed/chair occupancy for a given period
- Bed-time and get-up time
- Time to next sensor event

In order to detect deviations from "normal" patterns, each day was divided into four periods: 00:00-06:00, 06:00-12:00, 12:00-18:00, and 18:00-24:00. Deviation from the norm is detected by comparing the number of movements in a period with the threshold values for that period.



Date	00:00- 06:00			06:00- 12:00			12:00- 18:00			18:00- 00:00			Alerts	....
	PIR1	PIR2	Bed	PIR1	PIR2	Bed	PIR1	PIR2	Bed	PIR1	PIR2	Bed	Major alerts	Minor alerts
15/10/2013														
14/10/2013													0	0
13/10/2013													1	2
12/10/2013													0	1
11/10/2013													1	0
10/10/2013													0	0
09/10/2013													1	0
08/10/2013													1	0
07/10/2013													0	1
06/10/2013													2	0
05/10/2013													0	0
04/10/2013													0	0
03/10/2013													1	0
02/10/2013													0	0
30/09/2013													3	0
29/09/2013													3	0

Figure 67 Habits Alert Screen

Both under- and over-activity can convey important information about the well-being of a subject. For example, under-activity may be due to fall, depression, longer time in bed, or due to absence for a prolonged interval (e.g. subject is out or away). Over-activity may be a sign of discomfort, onset of dementia, or due to a visitor.

Data that falls outside of the thresholds is colour coded on the clinical portal to make it easy for the clinicians to detect.

Over the period of monitoring for each patient (on average 123 days) there was an average of 18 alerts a day. Only 4% of the alerts led to a clinical or social intervention. The majority of alerts were generated by the bed/chair sensors, which appeared to have technical difficulties with drift of settings, leading to false alerts for over and under activity.

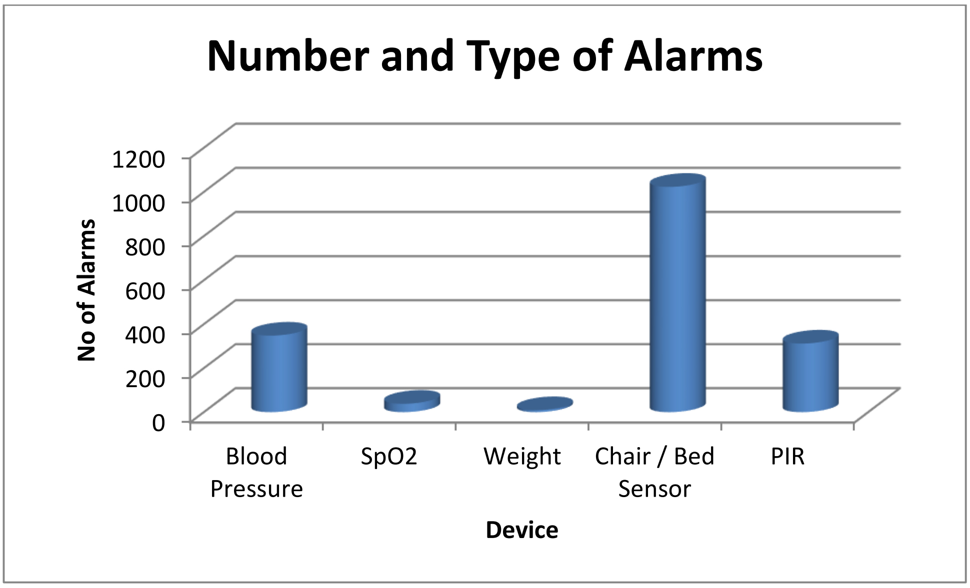


Figure 68 Number and Type of Alerts

8% of the missing data alerts were attributed to the patient having difficulty using the physiological devices. Based on the feedback from patients we updated our patient training material to be simpler to follow and understand.

Type of Alert	Intervention types	Reason for alert	Total No
Blood Pressure	Clinical Intervention	Outside of Clinical Thresholds	45
Blood Pressure	No Intervention	Outside of Clinical Thresholds'	303
SpO_2	Clinical Intervention / Community	Outside of Clinical Thresholds	67
SpO_2	Clinical Intervention	Outside of Clinical Thresholds	36
Weight	Clinical Intervention	Outside of Clinical Thresholds	2
Weight	Clinical Intervention	Outside of Clinical	7

		Thresholds	
Missing Physiological Data	Technical Visit	Technical Issue	42
Missing Physiological Data	No Intervention	No Data sent	359
Missing Physiological Data	Patient Call	Patient Training	52
Chair / Bed Sensor	No Intervention	Sensitivity	1023
Chair / Bed Sensor	Clinical Intervention		2
Chair / Bed Sensor	Technical Visit	Technical Issue	24
PIR	No Intervention	Technical Issue	307
PIR	Technical Visit	Technical Issue	5
PIR	Patient Call	Patient Error	4
Total			2276

Table 10 Alerts and Interventions

During the pilot we continued to review the alarms and notifications protocols. As an outcome of the study we have developed requirements for a more advanced rule engine for physiological measurements which uses nested rules to apply greater filters on the incoming data.

The following is a case that demonstrates how there can be correlation between habits and physiological data for a COPD patient in the CHC pilot.

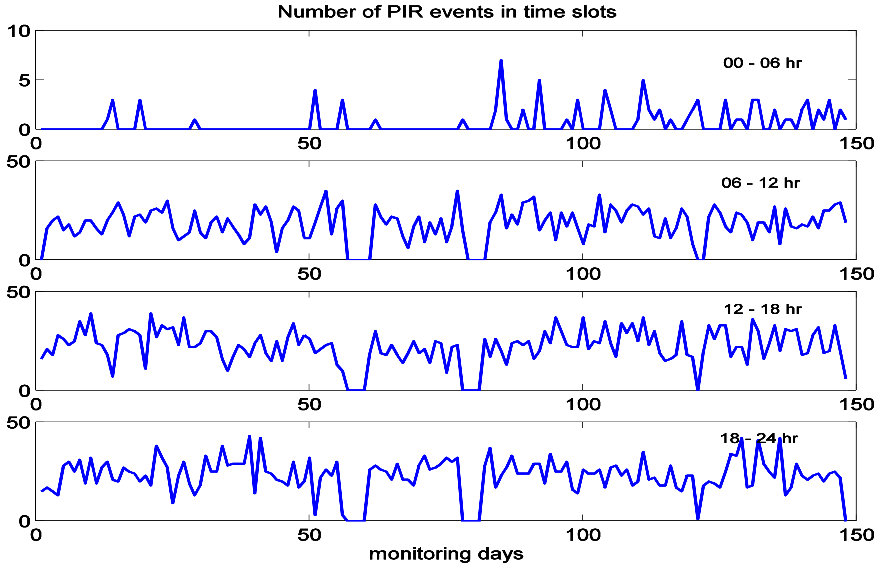


Figure 69 - Number of PIR events in time slots

Figure 69 shows data for the number of PIR events in a specific time interval. The upper trace shows PIR night-time activity, between 00:00 and 06:00 and it can be seen how this patient started to get up earlier after day 80. This increased the PIR event counts for time slot 1. There were also an increased number of PIR events in time slot 3 from monitoring day 90 onwards. This change in habits behaviour correlated to an observed change in the frequency of low SpO_2 levels for the patient (Figure 70). The outcome of the identification of habits change was that the patient was referred to pulmonary rehab and was given oxygen therapy.

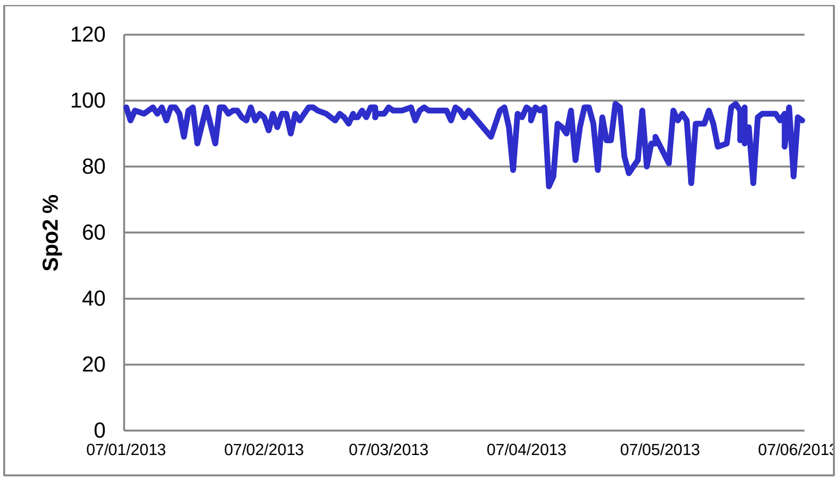


Figure 70 - Sp02 Measurement

4.2.5 ATC

ATC pilot defined its “Alert” based on the “Normal Habits Model”, and as the repeating of a single or complex action (like sitting on a chair or going out of the home) or a pathway (a

sequence of actions like going out of bedroom to the toilet every day after getting up from bed) for several times at about the same time during a week.
So, an “Alert” is a message triggered by an event out of “normal habits profile” or an “emergency” event, with relevance for the operator and which needs an action.

In general, the protocol to handle an alarm is as follows:

- Measurement Taken: an Alarm is triggered;
- Alert: the contact centre will call the user or a relative;
- Case Conference: in case of necessity there will be an escalation on social workers;
- Further Actions: the Social worker will contact the user and will handle the case;
- Continue Monitoring: the measures will continue to be taken.

Therefore, this protocol it able to identify some main scenarios; for a generic sensor the protocol will be as follows:

- A sensor monitoring a condition (e.g. temperature/humidity sensor, indoor movement sensor, etc.) detects an anomalous event.
- The inCasa platform sends an alert to the Consumer Application that shows the alert to an operator at the ATC Contact Centre.
- The operator calls the user (and a relative, a neighbour or the social services if the user doesn’t answer).
- The operator can enter a note associated to the alert, and marks it as “handled” (or “forwarded to” in case the alert is given to social services). The modified alert is sent from the Consumer Application to the EPR.
- When the situation returns to normal, as given by the sensor measurements, the inCasa platform communicates the update to the alert (e.g. alert definitively closed) to the Consumer Application that shows it to the operator at the ATC Contact Centre.

The Habit Change Alarm follows a similar principle for its protocol:

- A sensor monitoring a habit change (e.g. changes in bed occupancy, TV watching, etc.), detects a significant habit change over a given report time period (a week or a month).
- The inCasa platform, through weekly/monthly reports, sends an alert to the Consumer Application that shows the alert to the ATC operator.
- The operator calls the user (a relative, neighbour or the social services if the user doesn’t answer) or forwards the alert to social services.
- In case the habit change is confirmed, the operator can ask the inCasa platform to update the habits model of the user.
-

Moreover, it is possible to identify a specific protocol in case of an alarm such as the “door open”. If the user didn’t close the door, after 30 minutes inCASA platform sends an alert update (e.g. higher priority) to the Consumer Application that explicitly shows the alert to ATC Call Centre.
First of all, the operator makes a call to the user, to understand directly if there is a problem. If the user doesn’t answer on mobile or home phone, the operator calls one of the

neighbours known to the social workers at the beginning of the project, to determine their availability in case of problems. If this call also fails, the third effort is to call a relative of the user. If all the three calls are unsuccessful, the operator alerts the social worker, who will go directly to the user's home or to some of the places that the user usually frequents (gardens, cafés, clubs, or other meeting places). The escalation numbers are provided in Table 11.

N° alarms	843
N° calls to users	501
N° calls to neighbours	54
N° calls to relatives	96
N° calls to social workers	150
N° interventions by social workers	90

Table 11 ATC Pathway Escalation figures

When the door is closed again, the inCASA platform sends an alert update (e.g. alert definitively closed) to the ATC Call Centre (through the Consumer Application), so that the operator is aware that the situation has returned to normal.
If the door is not closed after a given time (e.g. 3-5 hours), the inCASA platform sends an alert update (e.g. higher priority) to the ATC Call Centre (through the Consumer Application), so that the operator may decide the best course of action.
The last scenario applies in the case of a technical emergency. The pathway similar.

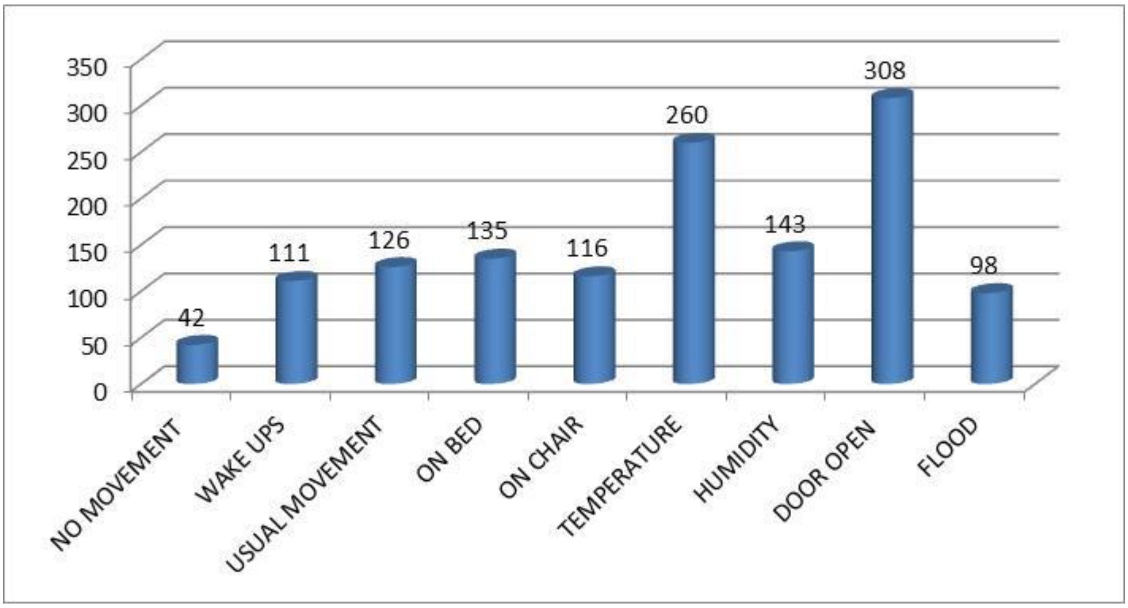


Figure 71 Percentage of alerts per sensor managed by ATC Call Centre operators

From a numerical point of view the most activated sensor that triggered an alarm was the door, with 308 occurrences (Figure 71). All alarms have had a favourable outcome through direct contact with the user or with a relative. However in one case, a defect in the sensor mounting resulted in 43 false occurrences for the same user, as shown in Figure 72.

The alarm, in this case, was reset after the fault was corrected.

DoorOpen evento cronologia degli avvisi per il utente at 2012-04-17 at 13:36:52

Tipo	Servizio	Codice/Evento	Stato	Fase	Gravita	Priorità	Data	Ora	Commenti
DoorOpen	SPP_ALARM	500 - Door_open_since_30_minutes	start	active	H	PL	2012-04-17	13:36:52	Door is open since 30 minutes.
DoorOpen	SPP_ALARM	501 - Door_open_since_1_hour	escalate	active	H	PM	2012-04-17	14:06:53	Door is open since 1 hour.
DoorOpen	SPP_ALARM	502 - Door_open_since_3_hours	escalate	active	H	PH	2012-04-17	16:06:56	Door is open since 3 hours.
DoorOpen	SPP_ALARM	-	end	inactive	H	PH	2012-04-18	11:43:18	Terminated. Unknown state
DoorOpen	SPP_ALARM	503 - Door_closed	end	inactive	H	PH	2012-04-18	17:05:16	Door has been closed.

Figure 72 Alarm Notification Screen

The same sensor presented the same problem (36 occurrences) for another user. Initially the contact centre operator reported in the comments (Figure 73) that the sensor was broken or not operating correctly. After further investigation by the technical team and social workers, it became evident that the user was leaving the door open intentionally in order to be contacted by the operator. In this instance it was decided that a psychological intervention was required.

DoorOpen evento cronologia degli avvisi per il utente at 2012-04-26 at 19:56:20

Tipo	Servizio	Codice/Evento	Stato	Fase	Gravita	Priorità	Data	Ora	Commenti
DoorOpen	SPP_ALARM	500 - Door_open_since_30_minutes	update	active	H	PL	2012-04-26	19:56:20	CONTATTATA SIG.RA:LA PORTA E' PERFETTAMENTE CHIUSA.PROBABILE DIFETTO DI ISTALLAZIONE SENSORI.
DoorOpen	SPP_ALARM	500 - Door_open_since_30_minutes	start	active	H	PL	2012-05-08	18:18:30	Door is open since 30 minutes.
DoorOpen	SPP_ALARM	501 - Door_open_since_1_hour	escalate	active	H	PM	2012-05-08	18:48:30	Door is open since 1 hour.
DoorOpen	SPP_ALARM	502 - Door_open_since_3_hours	escalate	active	H	PH	2012-05-08	20:48:33	Door is open since 3 hours.
DoorOpen	SPP_ALARM	503 - Door_closed	end	inactive	H	PH	2012-05-10	10:41:03	Door has been closed.

Figure 73 Door Alarm Intentionally Triggered

The "water" alarm (98 messages) was found to be a result of repeated alarms for the same user. Investigation revealed that the alarms were being triggered by a blocked waste pipe in the kitchen.

The "temperature" Alarms (260 messages) and " Humidity" Alarms (143 reports) were carefully monitored by social services in order to ensure the health of the users in case help was required but no intervention was necessary.

The “No Movement” alarm (42 occurrences) was handled following the established protocols with a first call from the ATC contact centre and in a very few cases with an escalation to the Social Workers.

The other alarms have not resulted in specific problems or the need for intervention; they were all handled via the ATC contact centre by a phone call to the user or to their relatives.

During the pilot phase there were no substantial changes to the Alarm protocol; as reported the majority of alarms were handled through the ATC contact centre and in some cases with the escalation to the Social Workers to check the status of the user. Even the case of intentional triggering of the alarm was well handled by the current alarms protocol.

4.3 Evidence from the Transferability Desk

The capability of the inCASA solution to be packaged and transferred to countries other than the pilot countries was demonstrated by implementing a transferability desk, i.e. the project was implemented in a green field site in a limited time period. The Danish Municipality of Skive was selected because it already had integrated social care and healthcare in the same organisation. This town was offered the opportunity to test the inCASA platform for three months. The aim and objective was to define a Skive Transferability Desk which would test how well the inCASA platform and enabled services might be transferred to a new organisation in a new country and use that experience to create a Transferability Toolkit which could be used by future customers of the inCASA solution.

The main criterion for choosing an external stakeholder was that the integration of social care and healthcare was already in place within the hosting organisation. In Denmark, long term healthcare and social care is the responsibility of the municipalities and the combined services are entrusted to one local authority. The administrative units responsible for delivering the services are, albeit composed of staff with different skills, very closely coordinated and with many overlapping tasks and responsibilities. It is thus a suitable location to perform an integrated pilot. The Danish Municipality of Skive was therefore contacted as they have experience and expertise with integrating healthcare and social care.

The aims and objectives for the Skive Transferability Desk can be viewed from two interrelated perspectives; the inCASA consortium and Skive Municipality.

For the inCASA consortium, the aims of deploying the Skive Transferability Desk were to evaluate and validate how easily the inCASA solution may be transferred to other stakeholders. It also considered how it had supported the integration of telecare and telehealth services. Thus, the Skive Transferability Desk would provide the consortium with an opportunity to evaluate the exploitation potential of the inCASA solution at a higher level.

Who	Experience and knowledge gained	Lesson Learned	Analysis of the Lesson Learned
IN-JET	Easy transferability of inCASA platform	The inCASA platform was sourced, installed, configured and put into operation in 5 weeks.	The inCASA platform is easily transferable and actual deployment in a new site (and country) can be achieved in a relatively short period of time.
IN-JET	The SPP server software was easily transferable	inCASA partners were able to transfer, install, configure and deploy in one day.	The SPP server software is easily adaptable and transferable to new hosting environment.
IN-JET	When end-user or professional user reported error or problems with using the system it was useful to be able to support and monitor the system remotely.	The remote TeamViewer tool was used in connection with the inCASA installation in Skive. With this tool the In-JeT technician had remote access to the system and could control it as if he was sitting in front of the system.	Using TeamViewer gave the technician a good opportunity to troubleshoot the system and solve the issues remotely thereby saving time and thus making support more efficient.
REPLY	HL7 communication protocol makes deployment easier	The SPP can easily be configured to handle data from new devices.	Once scenarios have been defined it was easy to configure the SPP to handle data from new devices using HL7 protocol.
CNET	Installation and configuration can become unnecessary complex for machine maintainer.	There is a need of graphic interface in order to merge configuration when used by several applications.	All software needs configuration and installation
CNET	To ensure the increased software quality and test on non-development machines.	Made it easier to detect errors and bugs before deployment. Also detected error and bugs found on non-development machines.	Good to extend quality checks and specialized tests from the errors and bugs commonly identified during the installation, testing and pilot phase. This will help to minimize efforts that are put into troubleshooting and support once deployed.

Figure 74 - Lesson Learned

Skive Municipality, had the aims and objectives to evaluate the inCASA solution by testing it with different telecare and telehealth services. However, the objective was not to evaluate clinical outcomes, rather user and organisational perspectives, focusing on user friendliness of the system and the ways in which it can improve the integration of different workflows.

In summary, the objectives of the Skive Transferability Desk were to:

- Evaluate and validate the transferability capabilities of the inCASA solution (simplicity and ease of transference)
- Evaluate how well inCASA can be incorporated in and support an organisation with integrated social care and healthcare services (telecare and telehealth)
- Assess the exploitation potential of the inCASA solution at a higher level
- Combine health and social monitoring at home on a single platform, which is easy to use for the patient
- Allow the care teams to share information across organisational boundaries, i.e. between primary and secondary care and between healthcare team and social teams
- Create better utilisation of resources through optimised integrated workflows
- Allow the patient and relatives to be involved in the management of their disease through access to data, instructional material and direct video contact to the care team
- Provide instant video access to a single Contact Desk for patients with anxiety and need for advice.

Therefore, the Skive Transferability Desk has been designed in cooperation with representatives from Skive Municipality in order to define their needs and requirements. Best practices were used from the inCASA pilots to define use cases and technical requirements.

Who	Experience and knowledge gained	Lesson Learned	Analysis of the Lesson Learned
NTUA	Implementing web interfaces for the elderly users	In the Skive test, it is the first time in the inCASA project that the elderly patients use the Consumer Applications to view their own data. The lesson learned denotes that the interface design should take care of all the details in order to provide a full user friendly platform. For example, in the initial deployment of the Consumer Applications, the fact that the elderly people mainly use touch screens was not taken into account and the offered functionality assumed that keyboard or mouse would be available. This was taken into account in the revised version, now in use by Skive.	When designing Web interfaces for the elderly persons, there should be a deep investigation on their needs, on their level of technology familiarization and on the means they use to access a Web application (Tablet, Touch-Screen PC etc)
Skive	End-users feel unsure if they have done a given measurement correctly if they can't see the data instantly.	A pop-up window was added which displays and the measurement results and asks the end-user to confirm by pressing "OK". This added function made end-users feel much more confident, reassured and comfortable with the system and the correctness of their measurements	End-users are generally quite concerned with accuracy and needs confirmation that they carry out their measurements and use the system correctly. A simple function that displays the result and enables them to confirm alleviated their concerns and increased their confidence.
Skive	Printing of data/measurements	It would be a help if the end-user could get a print out of his or hers measurements which they can bring the results to the doctor or hospital. A print function was added to the CA (in line with the LL above). While working it is too complex for some end-users.	This would be particularly useful if the end-user needs or wishes to show their measurement result to a carer how is does not have access to the system. Functions on the CA must be extremely simple if all end-users should be able to use them.

Figure 75 - Lesson Learned

The Skive Transferability Desk included 19 end-users (patients). All were frail, elderly people (over 65 years of age) suffering from either Chronic Obstructive Pulmonary Disease (COPD) or Diabetes Type II. Professional end-users included social care and healthcare personnel thus representing both the social and the healthcare sector.

Skive Municipality was responsible for recruiting the patients for the two cycles. The first cycle consisted of five patients diagnosed with Diabetes Type II and five diagnosed with COPD. The second cycle consisted of four patients diagnosed with Diabetes Type II and five diagnosed with COPD i.e. totalling nineteen participants divided between the two groups/cycles. The selected participants belonged to a particularly frail group of elderly patients with chronic disease between the ages of 63 and 84.

Who	Experience and knowledge gained	Lesson Learned	Analysis of the Lesson Learned
NTUA	Telecare vs. telehealth	It was proven that designing Telecare graphs is always more difficult than the respective Telehealth graphs. Habits monitoring or environmental monitoring may have a big data diversity which turns them difficult to be visualized compared to the health measurements which tend to follow a pattern (usually, 1 measurement per day per TH device). It is even more difficult when the requirement is to provide TC-TH graphs in a unified graph.	The outcome of the trial denotes that during the analysis phase most of the time should be spent on the Telecare requirements in order to clarify how data should be visualized in an efficient way. It is considered that the Telehealth part is always easier and requires less time for analysis and implementation.
IN-JET	Many elderly end-users who are very frail and inexperienced with ICT cannot handle too much information at one time	It is necessary to take the individual's health and situation into consideration when planning installations in their homes as they get overwhelmed very easily with both equipment and the information (instructions). Allowing the installations and introduction of different devices to take place over several days made the end-user feel better and less overwhelmed.	Installations and introductions and instructions to different devices may be too much for the end-user to handle all at once. If several devices are to be used it is better to introduce one device at a time in order to avoid overwhelming the end-user. Sufficient time should be allowed for end-user to learn how to use the equipment and feel comfortable using it.

Figure 76 - Lesson Learned

Installation in the participant's home was carried out by IN-JET and organised in coordination with Skive Municipality and the participants. Prior to installation, the system and the devices were tested and installation was therefore a simple and straightforward procedure. A representative from Skive Municipality was present during the installation in the participant's home and was thus able to observe how the different devices were installed. Installations were carried out during the first week of each cycle. A representative from Skive Municipality was able to carry out the installations in the participant's home for the second cycle with remote support from INJET when necessary. The main reason for this approach was that experiences from the first cycle showed that most participants were overwhelmed with two people present during installation. The fact that installations were simple allowed a representative (who was not a technical expert) from Skive Municipality to perform them and thereby make the process less overwhelming for participants.

In addition to collecting evaluation of the transferability activities the inCASA partners, evaluation data was also collected from Skive. The main objective was to evaluate the capability of the inCASA solution to be transferred to countries and sites other than the inCASA pilot countries and sites. The overall results of the transferability and the usability of the inCASA solution have been positive. Of particular note is that the inCASA platform was sourced, installed, configured and put into operation in Skive Municipality in only 5 weeks. This demonstrates that transferring the inCASA solution to a new setting (and country) can be done relatively easily and quickly.

In addition, the professional users feel that it enables better integration of existing workflows and cooperation with other professionals across sectors. All end-users found that it was easy to use the system (taking measurements, using the touch screen and seeing data on the Consumer Application) based on the simple instructions they were given when it was installed. Even those end-users who were more reluctant to use the technology and/or who had no experience found it simple and user-friendly.

Based on the work and experiences with deploying the inCASA platform in Skive, a Transferability Toolkit has been created. The Toolkit aims to provide customers with a practical tool to ensure that all the necessary preparations prior to deployment are in place.

The Evaluation

The professional users in Skive were asked to evaluate the inCASA Transferability Desk at the end of the testing period by completing a questionnaire. In addition, some of the professional users have provided a written evaluation not based on the questionnaire. The professional users who have participated in the evaluation represent both homecare nurses, physiotherapists, GPs, and social and healthcare workers. In other words, they are the professional users from both the social care and the healthcare sector.

Care workers, home nurses and GPs all felt that the system improved the workflow and integration between the different social and healthcare personnel. One factor adding to this result was the easy access they all had to the health data of a patient at any time which increased efficiency.

In one incident, the GP had contacted the home nurse because he needed a patient's blood glucose data. The home nurse had referred the GP to the Consumer Application which not only saved time but also gave the GP a better overview of all historical data. In general, the access to historical data and the representation of data in graphical form in the Consumer Application was highlighted as a positive factor which made it easier to gain an overview of the health status and data of the patient.

The professional users found that the system is simple and easy to use. It provides a straightforward and practical overview of the data and their relevance, which makes it easier to provide guidance to the end-user, thereby adding value to their skills and professionalism. Being able to go through the data with the end-user, particularly using the visual presentation in forms of graphs, was regarded as having a positive impact on the end-user's understanding of their condition, how to manage it and to assume more responsibility for their health.

The homecare nurses also found that it helped to create a joint goal of improving the health status of the individual, i.e. by being able to follow the measurement results over time (improvements vs. deteriorations), and that it encouraged greater focus on prevention. In addition, some end-users expressed that they felt more secure and safe because of the increased focus on the individual's measurements and thereby (daily) health situation. The issue which was considered essential for a system like inCASA to have a significant positive impact is that the end-user must be able to use it themselves. In couple of cases, the home nurse had carried out all the measurements for the end-users who perhaps therefore assumed a lower level of responsibility for their condition compared to end-users who took measurements themselves.

Similarly, the professional users noted that some of the end-users were too frail or technophobic to use the system; this illustrates how crucial it is to have a careful selection process and that assumptions about which end-users may or may not accept it or who find it easy to use or not may sometimes prove wrong.

Moreover, telecare and telehealth must always only be used as an addition or complement to, and not a replacement of traditional social and healthcare. Nevertheless, when end-users are willing and able to use these types of services, great benefits can be achieved for both the end-user and the professionals involved, as telecare and telehealth can optimise existing and enable new social care and healthcare services.

The end-users that participated in the Skive Transferability Desk have provided a written evaluation of their experiences with using the inCASA solution which focused on the usability qualities of the system. Secondary, they were asked to provide information how they thought that using the system had changed how they managed their condition. In this regard, it is important to note that the Skive Transferability Desk was not intended to provide a clinical evaluation or validation of the inCASA enabled services. Nevertheless, the individual end-user experience of how the monitoring and self-management of their health condition is very important, and undoubtedly it has an influence on how usable and useful they found the system.

All end-users found that it was easy to use the system (taking measurements, using the touch screen and seeing data on the Consumer Application) based on the simple instructions that they were given when it was installed. Even those end-users who were more reluctant to use the technology and/or who had no experience found it simple and user-friendly.

One end-user who had no experience whatsoever and who was not at all interested in ICT had still agreed to participate "in order to test if it can help others". The home nurse carried out the measurements for him, but in the evaluation he still said that it seemed very easy to use and that he undoubtedly would have been able to use it himself, especially because he actually became more interested in the equipment and the measurements as time went by. This user also found that being able to see his data with the home nurse was useful and interesting; being able to look at the data and discuss with the home nurse was considered very positive. Moreover, he felt more secure and comfortable in his daily life and with respect to his condition because he could always check his values which was reassuring, particularly when they were good (no need to worry), and he had also gained a better understanding of his condition.

The evaluation from this particular end-user, who was perhaps the most reluctant, is interesting as his comments are representative; other users have similar positive comments about the benefits of the system. His comments about the usability and accessibility of the system also indicate that proper training, support and sufficient time to become familiar and confident with the system may overcome initial user acceptance barriers. Not least because the benefits related to the health status of the individual e.g. better monitoring, reassurance, understanding, engagement, empowerment, responsibility, improved dialogue/cooperation with carers, and self-management, seem apparent even to the most reluctant of end-users.

The other end-users all expressed similar comments and some also highlighted the advantages of being able to see the connection between different parameters, e.g. between diet and blood pressure or how exercise and diet have an effect on their health condition. It also motivated them to improve their lifestyle. Their understanding of their condition and how their behaviour/lifestyle can actually affect their health status and lead to feelings of empowerment, increased reassurance and security. When asked if and why they would recommend the system, several end-users commented that by using the system they could potentially enable themselves to stay at home rather than living in a nursing home or being hospitalised.

4.4 The Business Model

The definition of the inCASA Value Chain helped to better assess the inCASA business potential for all the partners related to all the possible stakeholders. The inCASA stakeholders basically consist of the following organisations whose business collaboration allows the service to be deployed in the market:

- End users
- Care providers
- IT companies / Service aggregators

Figure 77, provides an overview of the inCASA value-chain with its stakeholders and relationships. The actual deployment will vary depending on the local context and healthcare system organisation, as it is not the same in each European Country or region.

End Users

End users can be divided in two groups: Private End Users and Professional End Users. Private End Users are the patients, relatives, friends, next-door neighbours, maids and even patient organisations. This users' group uses telecare and telehealth systems for distance monitoring of disease and social conditions.

The second group of primary stakeholders is formed by the professional care providers. This includes doctors and nurses, hospitals, health clinics, private or public rehabilitation centres and local health agencies. The professional end users use the applications to access information on the patient, and to decide on management.

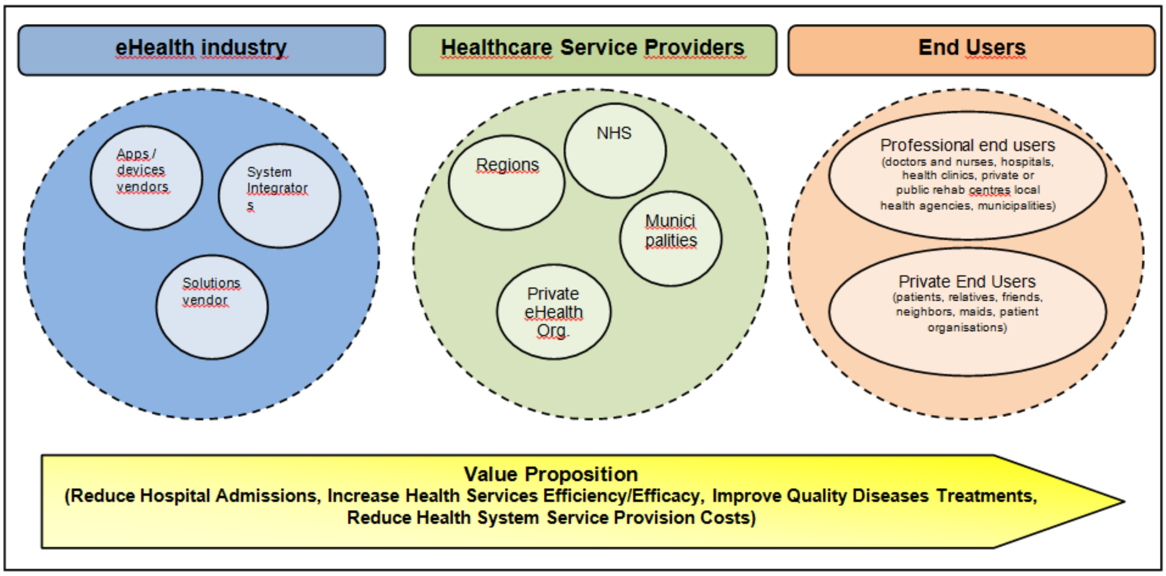


Figure 77 - inCASA Value Chain

Care Providers

The care providers assume responsibility to provide the services, healthcare and social services, to its users, through the services of the professional users. This group includes national and regional healthcare providers that provide ambulatory medical services and hospital care. Healthcare providers may also include local municipalities depending on the organisation of the local health services. These are the deployer organisations that decide which remote monitoring health and social care services are offered to local community. They would negotiate with industry representatives and invest procure inCASA services.

This category also includes the commercial Service Providers including private firms providing social and home healthcare services as well as private hospitals and insurance groups.

eHealth Industry

This group comprises companies having different expertise and competences. The system integrators are companies specialised in offering a complete package of Telemonitoring platform and services, and having expertise on technology and a strong business orientation. Typically such companies include large telecom providers, or software consulting firms. They are the reference companies to healthcare providers to deploy the eHealth services by aggregating all the relevant technical and technological expertise and assets to provide the services to end-users.

This group also includes service solution providers which are companies with technical and technological expertise to promote and guide the market deployment of eHealth services solutions. The eHealth industry also comprises software applications developers and device manufacturers/distributors that contribute to the eHealth business by providing components of the whole platform.

inCASA business organisation model

One of the main challenges relating to the inCASA services market deployment is the choice of business model to adopt in order to enter the market. Two competing business models are considered:

- **A centralised approach, based on a new (European) start-up, comprising interested partners:** The major advantage of this model is related to the reduced difficulty to co-ordinate certain sensitive actions such as financing, strategy formulation and decision making. A more centralised European start-up creates a unique brand for inCASA and visibility for inCASA as a provider of advanced ICT solutions to the health sector.
- **A decentralised approach based on local/national business organisation relying on one or more inCASA project partners:** This is the preferred and chosen model by the inCASA project partners, where each partner, interested in deploying inCASA services, will follow an autonomous strategy in its target (Local/National) markets. The inCASA decentralised business organisation relies on

strategic alliances between the eHealth industry actors to assemble the enabling technology and technical expertise to deploy inCASA services for customers. In the decentralised model, the local partner takes care inCASA market deployment by:

- Identifying potential inCASA adopters;
- Marketing inCASA products and services;
- Organising and aggregating expertise to set up the inCASA technologies to provide the services. Partners' aggregation may take the form of temporary business collaboration, formalised in specific agreements, with the project partners owning the technologies/expertise required and interested to make business. The business collaboration can then open to additional firms interested to market inCASA services.

As stated, this model has been chosen because of the significant differences between each country involved. The Country Level analysis that was performed proved how the e-Health market, even with similarities linked to the final intent, is different in terms of stakeholders and processes for the Value Creation. For this reason, in order to maximise the impact, the decentralised model will allow a G-Local approach to be followed. This approach is intended to provide to the overall consortium, and so to each partner, a Global strategy to approach the market and exploit the inCASA services and benefits; while the global strategy leads each partner's intent and market deployment to the "Local" part of the strategy and will permit its specialisation for the single country to meet the local demand and needs.

As a general approach derived from the Value Proposition, the idea is to involve, for each country, from two different points of view, the local health authority to push the inCASA solution and so prove the economic benefits and the End-Users, both professional and private, and show them the advantage of the services offered in term of better quality of life, well-being and safeness, and to generate a demand request; the pull.

This model will rely on a cooperation agreement between the project consortium members stating contractual rights and obligations.

Financial Structure

The decentralised model will allow each partner to define a Local strategy following the Global one; the following presents an overview of the global financial structure identified by the industrial partners, by macro-category:

Revenues**:** This index is evaluated on the total number of users, both using Tele-care and Tele-health services, depending on the specific type of devices deployed, and the number of sensors and devices installed.

The expectation, from the partners involved in the market deployment, is that the inCASA system will be introduced to 400 patients during the first year; and during the following four years the expectation is that patient numbers will increase to reach around 10,000 patients, mostly in the Spanish market. Annual average percentage increase is estimated as 136%, with enrolment in year two and year three anticipated to give a percentage increase of 200% and 188% respectively.

Three types of service are proposed by the inCASA solution: Tele-Care, Tele-Health, and integrated Telecare and Telehealth.

The Telecare kit weights, as average, about the 40% of the integrated kit and the price is around 650€. The Telehealth kit weights for the 50% of the whole system and the price is around 950€ instead.

The revenue stream will arise from three sources: Telecare accounting for 17% of the total; Telehealth accounting for the 41%; and the Integrated Service accounting for 42%.

The CAGR evaluated over the first five years of running services as a mean has a value of 81%. Following the growth trend over the first five years (around 53%), the expected CAGR after 10 years will be of 38%.

These numbers are estimated on the patient numbers as presented and distributed across the three classes of services.

Infrastructure Development Costs**:** These are the costs related to the organisation of the back-end structure, such as: Hardware and Software, Personnel, Marketing, New Infrastructure Set-Up, etc. This cost is expected to impact on the total costs by 60%.

The infrastructure cost will vary for each industrial partner depending on the adopted model; on average this cost account is estimated at €580k:

- Telefonica has an average estimation on five years of €380k with a cost increase of 21% per year.
- In-jet, with a growth rate of 9% per year has an estimation of €170k.
- The infrastructure cost for CNet account for an estimation over the five year of €500k, with a growth rate of 32%.
- Reply has a percentage increase of 40% with an estimation of €1.2M over the five years. The costs for Reply include setting up a new data-centre to collect the patient data as the user numbers increase.

Home Infrastructure Costs**:** These refer to the costs required to set up the necessary infrastructure for the Home services, such as: sensors and devices in patient's home (the Tele-Care and Tele-Health Kit). On average this kind of cost impacts on the total costs by 40%.

The average yearly cost increase is about 24% with a value of about €200k

- For Telefonica the average cost accounts for about €48K with a growth rate of 3%.
- In-jet, with a growth rate of 8% per year has an average estimation of €70k.
- For CNet the Home infrastructure cost accounts for about €500k with a growth rate of 37%.
- Reply has a percentage increase of 28% with an average estimation of €132k over the five years.

On average, each pilot having End-Users paying a fee for the services will Break-Even after 13 months of activity.

5 Dissemination activity

5.1 Press, Publications and Articles

Press Releases by KGHNI

KGHNI prepared numerous press releases in the preliminary phase (1st year) of the project in order to raise awareness to the target stakeholders and announce future activities.

KGHNI released these announcements in various types of web site:

- Wide audience media, like the Greek national newspaper "Proto Thema". The relevant web link (in Greek language) is: http://www.protothema.gr/health-and-life/article/101412/shmantikh-symmetoxh-se-ereynhtiko-programma-gia-to-nosokomeio-agia-olga-/
- Media focused on the healthcare sector, like EUmedline which is a well-known Greek portal. The relevant web link (in Greek language) is: http://www.eumedline.eu/post/TO-KWNSTANTOPOYLEIO-STO-EYRWPAIKO-PROGRAMMA-inCASA/
- Political news and analysis media like the website elzoni.gr. In this release, the inCASA project is presented as an innovative EU project combining Medicine with modern ICT technologies. The relevant web link (in Greek language) is: http://www.elzoni.gr/html/ent/933/ent.5933.asp

Le Figaro publication, 23/02/2013, France

An article on the inCASA French pilot progress and perspective was published in the French widely known national newspaper "Le Figaro" on February 23th, written by Francis Levi, INSERM pilot coordinator and director of the INSERM's unit «Rythmes biologiques et cancers». In this article, the idea of domomedicine is explained and how inCASA platform has already achieved made the remote monitoring of INSERM patients suffering from cancer more efficient

KGHNI press releases

KGHNI invited local/national media to cover the Greek national event, which led to various inCASA related press releases, mainly in healthcare related Greek web sites, even if general purpose media also mentioned the Greek event that was hosted in KGHNI and co-organised by the hospital and NTUA. Some indicative links are stated below (in Greek):

- xtypos.eu[2] website
- frontpages.gr[3] website

[2] http://www.xtypos.eu/xt/index.php?option=com_content&view=article&id=22016:2013-02-15-09-46-00&catid=63:2011-01-12-11-22-27&Itemid=136

Article for the Telemedicare conference, by REPLY

A paper describing the inCASA project in terms of objectives, architecture (functional, physical and software), interoperability between its main blocks and results achieved till now.

http://incasa-project.eu/downloads/papers/Santer%20Reply-Telemedicare%202012-inCASA%20project.pdf

Joint Journal Publications

Joint publications for presenting the results of inCASA are planned. There will be joint submission in the autumn of 2013 to the following journals:

- “BMJ (British Medical Journal)”
- “Plus Medicine”
- “Health Services Journal”
- “Telemedicine and eHealth”

These publications will seek to summarise the inCASA Pilot evaluation results, provide the lessons learnt from the testing of the platform and discuss the recommendations for future deployment of similar eHealth, Telehealth and/or Telecare solutions.

5.2 Dissemination Activities

inCASA Web site

In May 2010, 1 month after the beginning of the project, the inCASA web site was deployed at the address: http://incasa-project.eu/. Partner IN-JET was responsible for the hosting and the initial deployment while NTUA, IN-JET and the rest of the consortium constantly updated the inCASA web site content during the following years. The web site was the major means of disseminating partners’ activities and promoting the inCASA outcomes and perspectives.

ATC Video

ATC prepared a video presentation of the inCASA project, in which the goals, the organisation, the target users, the technology used and the involved human resources of the Italian pilot are demonstrated.

The video about the ATC pilot was a very useful tool for the dissemination of the project - aiming at facilitating the acceptance of the technological solution.

[3] http://www.frontpages.gr/d/20130225/200/%CE%A3%CF%85%CE%BD%CE%B5%CE%AF%CE%B4%CE%B7%CF%83%CE%B7

ATC provided merchandising material (Mug, pen, T-shirt and block-notes with inCASA Logo) for free to elderly people involved in the video production.

The video can be viewed at youtube: http://www.youtube.com/watch?v=MrdT6KkIaK8

inCASA Video from TID

TID has elaborated a video to disseminate the value of the inCASA SARA platform.

The video (in Spanish) is also uploaded in youtube: http://www.youtube.com/watch?v=Jioq50grsWU. The same video was also produced in English in order to target the UK market. It can be found at: http://bcove.me/6l2m5p97

Twitter account from FHC

FHC has created a **Twitter** account[4], initially to support organisation of the national event, but it can now be used as a means for further dissemination of the inCASA project results and of FHC activities.

inCASA UK Pilot Flyer

A flyer describing inCASA and the UK pilot was developed for the American Telemedicine Association Meeting and Trade Show in Austin, Texas 5th – 7th May 2013.

5.3 Events Summary

Following are summarised all the dissemination events in which the inCASA partners participated (or plan to attend in the near future):

1. **14th Panhellenic Conference on Informatics (PCI2010),** Submitted and presented the paper "*An Integrated Architecture for Remote Healthcare Monitoring*" to PCI2010 – written by G. Lamprinakos, E. Kosmatos, D. Kaklamani, I.S. Venieris (NTUA).

   The paper was included in the proceedings and published on IEEE Xplore digital library, Tripoli, Greece, on 10 - 12 September 2010.

2. **Royal Society of Medicine: GP Forum**. Dr Russell Jones presented a discussion on the aims of inCASA to General Practitioners within the UK, London 16/09/2010

3. **East Midlands Clinical Commissioning Group**, Dr Russell Jones presented a discussion on the aims of inCASA to Commissioning Groups within the UK, Nottingham 26/10/2010

4 https://twitter.com/incasa_spain

4. **The Telecare Services Association (TSA) 2010** Conference. The TSA is the UK industry body for telecare and telehealth, and the largest industry specific network in Europe. The TSA Conference is the largest industry specific Conference relating to telecare and telehealth in Europe. Dr Russell Jones held a workshop to present the inCASA Project, http://www.telecare.org.uk/conference, UK, 16/11/2010

5. **Telemedicine and eHealth 2010,** Royal Society of Medicine, Dr Russell Jones presented early inCASA results. London 13/12/2010

6. **Continua European workshop** on personal health monitoring, Members of CNET participated in a Continua European workshop on personal health, Denmark 18/01/2011

7. **Conference on «Domomedicine», Entretiens Telecom Paristech**, Paris. INSERM introduced the inCASA solution to broad audiences by giving a tutorial: **"**Technologies applicatives d'interaction et de coordination des intervenants au domicile – Domomédecine, Paris 11/02/2011

8. **Continua Webinar**, CNET Presented the inCASA project during the Continua Webinar, 03/03/2011, Online, Global

9. **FASTWEB Training Session** CNET undertook a FASTWEB training session in which they presented inCASA results to a large Italian telecommunications company, Rome 09-10/03/2011

10. **Didcott Health Centre Clinician Forum**. CHC presented the inCASA project at a clinician forum in Oxford. The aim of the presentation was to share and encourage uptake of telehealth within the Oxfordshire area. UK, 08/04/2011

11. **Open meeting for Spanish healthcare professionals focused on Patients' Risks Management** (http://fhcalahorra.com/noticias-fhc/2846-ii-jornadas-de-seguridad-de-los-pacientes-en-fhc), at Calahorra. FHC presented the inCASA project and its current status to health professionals, La Rioja, Spain, 11-13/04/2011,

12. **Diabetology Specialist Group** CHC presented the project at the Diabetology Group in Churchill Hospital, Oxford to engage and promote remote health care monitoring within the Oxfordshire area, UK, 21/04/2011

13. **Congreso Nacional Hospitales - 2011** Presentation to 17th Congreso Nacional Hospitales -2011, FHC Explained experience as part of inCASA project and how it can help chronic patients to improve their quality life in the "17th Spanish National Hospitals Conference, focused on innovation activities within the healthcare sector" (http://www.17congresohospitales.org/), Madrid, Spain 26-29/04/2011

14. **(TSA) Standards Forum** - CHC presented to The Telecare Services Association (TSA) Standards Forum, 28/05/2011, http://www.telecare.org.uk/forum

15. **SANIT 2011 http://www.sanit.org/,** INVENT contributed to dissemination of inCASA results by attending to SANIT is the biggest institutional Italian event and a meeting point for all the "Healthcare Stakeholders". During that event INVENT took the chance to disseminate inCASA initiative, distribute the official leaflet and exchange opinions and experiences to health professionals, big enterprises, SME and public authorities representatives., Rome (Italy) 14-16/06/2011, INVENT

16. **Moving life project Kick-off-Meeting**, INVENT presented the inCASA project and reported its current achievements to the Movinglife (http://www.moving-life.eu/news.php) consortium, during the Movinglife project Kick-off-Meeting. Movinglife is a FP7 Support Action, that delivers roadmaps for technological research, implementation practice and policy support with the aim of accelerating the establishment, acceptance and wide use of mobile eHealth solutions that will support lifestyle changes among citizens and improve disease management globally, Madrid, 07/09/2011

17. **6th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS'20116th).** SIG Presented the paper entitled "Wireless Network and Gateway Architectures for Home Care Applications" which was accepted for publication in the IDAACS Conference (http://idaacs.net/2011/), Prague, Czech Republic, 15-17/09/2011

18. **AAL forum 2011**, Poster Presentation Represented inCASA project in the AAL forum 2011 (http://www.aalforum.eu/2011-2), an event that attracted many healthcare specialists. The inCASA poster was visited by many people and the inCASA representatives handed out 100+ fliers, Lecce, Italy 26-28/09/2011

19. **Presentation to BMT**, inCASA project results have been presented within the BMT 2011- http://www.nncn.uni-freiburg.de/termine-en/bmt2011/view?set_language=en (German National Conference on health technology).SIG prepared also an inCASA poster presentation for this purpose, Freiburg, 27-30/09/2011

20. **Presentation to conference of the Multi-organism Thematic Institute for Health Technologies,** Presented the project to the yearly conference of the Multi-organism Thematic Institute for Health Technologies, the main public organisation in this area, which gathers all the national research institutions (INSERM, CNRS, INRIA,…), Tours, France, 03-04/10/2011

21. **2nd International ICST Conference on Wireless Mobile Communication and Healthcare - MobiHealth 2011**, Presented the scientific technical paper: *Using SOA for a Combined Telecare and Telehealth Platform for Monitoring of Elderly People*,

Written by: *G. Lamprinakos, S. Asanin, P. Rosengren, D Kaklamani, I. Venieris,* which was published in the proceedings of the MobiHealth 2011 conference (http://mobihealth.name/2011/) and which promotes the advantages of the inCASA technical architecture from a Service Oriented point of view (SOA-based middleware). Kos Island, Greece 5-7/10/ 2011

22. **Presentation to Domomedicine seminar**, INSERM presented inCASA project to the Domomedicine seminar which Francis Levi organised on behalf of the Academy of Technologies of France, Paris, France 6-7/10/2011

23. **Presentation to GP meeting**, Reply presented the inCASA project at a General Practitioner's meeting, Cagliari, Italy, 07/10/2011

24. **Presentation to Innovabilità event**, Reply presented the inCASA project on an Italian Event called "Innovabilità" http://www.provincia.milano.it/export/sites/default/affari_sociali/Eventi/innovabilita4.html). This is a cycle of seminaries on various topics related to elderly and disabilities organised by a Local Public Authority: The Province of Milano, Milan, Italy, 27/10/2011

25. **Presentation to Austrian Academy of Sciences – Institute for Technology Assessment (OAW),** within Value Ageing project. Andrea Guarise, a senior consultant from INVENT, has been intern at the OAW, as a seconded within the project Value Ageing, a Marie Curie Industry-Academia Partnerships and Pathways Action funded within the scope of the Seventh Framework Programme (FP7) of the European Commission (http://www.valueageing.eu/). He presented inCASA project, objectives and achievements to OAW audience, including researchers, professors and some students with interest in e-health domain. The presentation has aroused much curiosity and interest to that audience. , Vienna 13/12/2011

26. **Presentation to a National Sweden Conference**, CNET presented the inCASA approach on a national Conference in Sweden, resulting in an invitation to three national workshops addressing "Technology for Independent Life"., 2011

27. **Presentation to Paul Brousse hospital**, INSERM presented the inCASA project and its innovative characteristics in local audience in France. INSERM presented the project at a dissemination conference held at the Medical Oncology Department, Paul Brousse hospital, Villejuif, within the framework of "Domomedicine".Villejuif, France, 02/02/2012

28. **Presentation to PICADO consortium**, INSERM presented the project to the PICADO consortium, within the framework of "Domomedicine". Villejuif, France, 02/03/2012

29. **Presentation of an inCASA video to Telefonica business units**, TID prepared a video of inCASA presenting the project to the different business units within the

company. The whole company is quite interested in the concept of combining Telehealth and Telecare data. Spain 2012

30. **International Congress on Telehealth and Telecare 2012**, NTUA presented inCASA perspective in the "International Congress on Telehealth and Telecare 2012" held in London through a poster presentation, entitled "The inCASA project: improving the quality of life and social care for the ageing population". The Congress had a wide audience and is considered among the most appreciated Telehealth/Telecare events in Europe. London, UK, 06/03/2012

31. **Welfare Technology Day ("Velfærdsteknologidag") 25 April 2012**

    Website: http://www.innovationfur.dk/index.php/da/presse-2/135-velfaerdsteknologi

    Meeting and workshop in Fur, Denmark, regarding welfare technologies, i.e. assisted living and healthcare technologies, aimed at the elderly and nursing home. At this meeting, IN-JET were able to create awareness and interest in the inCASA project. In particular, a good contact with Skive municipality (in particular the healthcare and social care authorities in Skive) was established; Skive is looking at implementing combined telecare and telehealth solutions for the elderly. Based on the contact established at this meeting, SKIVE agreed to test the transferability of the inCASA solution in 2013 as part of WP7.

32. **Value Ageing initiative**, INVENT presented inCASA project at QUEEN'S UNIVERSITY OF BELFAST (QUB) within Value Ageing initiative, an IAPP Marie Curie Action, in May 2012. According to Value Ageing plan, a INVENT researcher has been seconded for some months to QUB, and he had the chance to present inCASA solution to QUB audience, including professors and PhD students, QUEEN'S UNIVERSITY OF BELFAST, May 2012

33. **ASCO annual meeting**, inCASA Poster presentation by INSERM at the annual meeting of the American Society for Clinical Oncology., Chicago, U.S.A, 02/06/2012

34. **Italian ICT & Active Ageing event,** INVENT, together with Reply, organised the participation and the presentation of inCASA project to the Italian event "ICT&Active Ageing: progetti e nuove tecnologie per il sostegno dell'invecchiamento attivo", held in Rome on 7th of June 2012, Rome, Italy, 07/06/2012.

35. **People's Meeting" (Folkemødet) 16-17 June 2012** http://www.brk.dk/folkemoedet/Sider/Folkemoedet.aspx In June, IN-JET gave a presentation at a "People's Meeting" (Folkemødet) in Allinge, on the island of Bornholm, Denmark. The meeting attracted representatives various domains, including different government parties (various ministers participated including the prime minister), regions, municipalities, industry, unions and organisations and represented a unique opportunity to discuss the many challenges and opportunities for

the future of the Danish welfare society, including assisted living technologies, telehealth and telecare for the elderly.

36. **TeleMediCare 2012 conference**, A paper describing the inCASA project in terms of objectives, architecture (functional, physical and software), interoperability between its main blocks and results achieved has been submitted and presented in the TeleMediCare 2012 conference by REPLY. The conference, was organised by PTUD (Desio University Technological Centre) and IITM (International Institute of TeleMedicine), Desio Hospital, Italy, 01/10/2012

37. **Smart City Exhibition**. Presentation of the inCASA Project at the Smart City Exhibition by the coordinator Massimo Caprino. Bologna, Italy, 30/10/2012 http://www.youtube.com/watch?v=AeVT28GFvPA

38. **eHealth Services: The inCASA program**, Organisation of a seminar by CHC for the inCASA pilot presentation, focusing on: Developing integrated health and social services, Adopting standards driven technology, Telemedicine Programme. Key invited stakeholders included Primary Care Trusts, Hospital Trusts, Social Services, General Practitioners and SMEs. Green College, Oxford, England, 29/11/2012

39. **EHTEL 2012 Symposium Fact not Fiction: The future of eHealth is already here**, CHC participated towards the dissemination of the inCASA project. EESC, Rue Van Maerlant 2, Brussels, Belgium, 06-07/12/2012

40. **Technical and Academic Meeting,** SIG was invited to an information meeting about the inCASA architecture within the Offenburg University of Applied Sciences. Prof. Dr. Hoppe, Deputy Director of Peter Osypka Institute, and some of his students participated in the meeting. In the meeting, Prof. Sikora from the partner SIG presented the various aspects of the inCASA project at Offenburg University, Germany. 13/02/2013

41. **Annual meeting of the Spanish Internal Medicine Society**, Jesús Castiella, FHC Medical Coordinator, has been in charge of the dissemination of the inCASA project in the COPD group of the annual meeting of the Spanish Internal Medicine Society, held on March, 7th and 8th, 2013 at Zaragoza (Spain), Zaragoza, Spain, 07-08/03/2013

42. **Third Annual International Congress on Telehealth and Telecare, 2013**, CHC co-authored with NTUA and KGHNI an inCASA paper that was accepted for presentation at the Third Annual International Congress on Telehealth and Telecare, entitled "*Presenting evaluation results from the usage of the inCASA Remote Healthcare Monitoring Platform*" July 1st 2013

43. **Third Annual International Congress on Telehealth and Telecare, 2013**, CHC co-authored with Brunel University an inCASA paper that was accepted for presentation at the Third Annual International Congress on Telehealth and Telecare, entitles "

Monitoring Habits and Physiological data in the frail elderly". The results were presented at the conference on July 2nd 2013

44. **Ambient Intelligence Advanced Technologies in Support of Healthcare and Assisted Living", on 26-27th September, 2013**
    CHC and Brunel University presented the inCASA project at a clustering event in Heraklion, Crete. The event is supported by the EU Commission and will include presentations from 26 European funded projects.

45. **CP EXPO "Community Protection", 29-31 October 2013**
    Santer Reply participated in CP EXPO of the Liguria Region. In this context, October 29-31, 2013 in Genova, the team will present the project INCASA and future scenarios of international importance within the workshop entitled "*New infrastructure and services for smart communities*"

46. **The eHealth Observatory 2-3 December 2013**
    Website: http://2013.e-sundhedsobservatoriet.dk/In-JeT plans to participate in a large annual national event, The eHealth Observatory (in Danish "E-sundhedsobservatoriet") with the intention of presenting the inCASA solution for exploitation purposes on the Danish market. The eHealth Observatory is a part of the Danish Centre for Health Informatics at Aalborg University in Denmark. The Danish Centre for Health Informatics contributes to research and understanding of the interrelationship between health problems, the organisation of the health system and information technology.

    The eHealth Observatory is aimed at both primary and secondary healthcare providers, e.g. the municipalities and regions (including hospitals), as well as patients, relatives, healthcare professionals and decision makers on various levels. As such, the conference represents a unique opportunity to reach all stakeholders within the Danish health and social care system and, as the title suggests, particularly stakeholders involved in eHealth.

5.4 National Events

47. **Greek National Event – "e-Health Services: The inCASA project**", The Greek national exploitation event, a Stand-alone event entitled "e-Health Services: The inCASA project" was co-organised by NTUA and KGHNI at the KGHNI premises on the 8th of February, 2013 under the auspices of the Greek Ministry of Health and the 1st Regional Health Authority of Attiki. Participators included Municipal (local) authorities, Health Care Authorities, SMEs providing services in the Health sector, Professors, Doctors, ICT researchers, Social workers, Psychologists. Moreover, a significant number of local elderly people attended the event. A total number of 163

persons were registered to the event which finally had a great impact on the audience, on the hospital, on the local society and on the involved authorities. As a post event action, KGHNI invited local/national media to cover the event, something that led to various inCASA related press releases, mainly in healthcare related Greek web sites, and even general purpose media mentioned also the Greek event. KGHNI premises, Athens, Greece, 08/02/2013

48. **French National Event: “Systems Medicine for improving patient care”** INSERM participated in the first French event by leading a round table in the framework of the European project CASyM organised in Lyon Biovision on March 26th. The round table title was “Systems Medicine for improving patient care”. The state of the art of the inCASA project and the activities of the French Pilot were presented. The participants found the project quite innovative and posed many questions about patient education, patient perception and satisfaction and economic aspects. The second part of the round table allowed defining priority issues and actions to be implemented for improving patient care in a short, mid or long term and with a low, middle or high impact, Lyon, France 26/03/2013

49. **UK National Event: “Co-ordinated Care: Meeting the Needs of Patients, Driving Better Integration”** CHC and Brunel University organised an inCASA Master class, under the subject: “Delivering integrated Care for the frail elderly using interoperable technology platforms and collaborative health and social care services”. The event was attended by over 150 delegates. The event was undertaken within a Public Service Event - “Co-ordinated Care: Meeting the Needs of Patients, Driving Better Integration” - http://www.publicserviceevents.co.uk/overview/256/co-ordinated-care which was held on the 29th of March 2013, in Birmingham. The event was chosen as a place to present the inCASA project as it was specifically focused on showcasing real life examples, initiatives and best practice case studies in order for delegates to explore how to turn the integration rhetoric into a reality

50. **French National Event: “Technological Innovations for Health: is there a place for the user?”**: INSERM participated in a round table during the annual meeting of ITMO TS (Thematic Institute Technologies for Health) in Bordeaux on April 10th 2013. This meeting brought together actors contributing to a high level of academic research and carrying valuable innovations. The main topic was the technological innovations for health. Dr. Francis Lévi presented the inCASA project, the context and preliminary results of the French pilot and the INSERM recent activities in Domomedicine domain. The participants were very enthusiastic regarding the prospects of the inCASA services as the pilot was one of the first successful Domomedicine experiments.

51. **Swedish National Event – “The Vitalis Conference**”. The Swedish event took place at the Vitalis exhibition and conference at The Swedish Exhibition Centre in Gothenburg, Sweden 16th-18th April. As the Vitalis has the focus on eHealth issues, CNet participated with an inCASA exhibition as foundation for visitors to inspire and

get inspired. Vitalis is a place to meet colleagues and partners from Sweden and the Nordic region where the health care sector is currently faced by great challenges and there's a need to invest in competence, know-how and new tools such as the inCASA platform. Vitalis is by far the largest eHealth event in Scandinavia and it broke the record on the number of visitors from previous years. The number of people visiting the conference went up with 32% to a total of 4027 unique visitors!

52. **Italian National Event – "e-Health Forum".** The Italian national exploitation event was co-organised by Santer Reply, Invent and ATC Torino during the e-Health Forum (http://www.ehealthforum.it/node/4736) in Rome at the ATA Hotel Villa Pamphili premises on the 28th of May, 2013 in Rome. The event has more than 1,000 members, 560 participants including 28 speakers. Numbers of great importance than those recorded by the 5th edition of the eHealth Conference, which was held at the ATA Hotel Villa Pamphili in Rome on Tuesday 28th May. In a stand staged for inCASA all day, REPLY, INVENT and ATC had met different stakeholders, interested to the inCASA solution within a specific stand dedicated to the demo of the solution. In the afternoon the partners presented details of the inCASA approach within a dedicated workshop: http://www.ehealthforum.it/node/4823

53. **German national event – "German–Finnish Health Care and E-Health Forum".** The German national exploitation event was co-organised by the state organisation Baden-Württemberg International in its series of international events. In this case, the event took place in the German–Finnish Health Care and E-Health Forum June 13th and 14th in Oulu (Finland). A large delegation from the Finnish side participated, so that around 150 participants were at the forum. Generally, the feedback from the participants of the presentation of Prof. Sikora from SIG was very positive and many stakeholders showed good interest in the inCASA project, its experiences and outcomes. It was interesting to see that Finnish participants were even more concerned about the telehealth, as their major concern is the even faster demographic change of Finland in comparison with most other European countries.

54. **Spanish national event.** The Spanish national exploitation event which took place at FHC in Calahorra (La Rioja) on 20th of June, 2013, was organised by Pelayo Benito, Coordinator of the pilot at Fundación Hospital de Calahorra (FHC). Health care authorities, diverse health professionals (Doctors, nurses, nursing assistants, etc.), social workers and external SMEs providing services in the health sector participated in the event, which can be considered a great success not only for the number of people taking part but also for the quality of the information exposed. Telefónica also participated actively during the event with Jordi Rovira, representative of the inCASA project, and Unai Gómez, representative of the commercial unit of Telefónica, which is starting a pre-commercial pilot in this region. Jordi Rovira gave a presentation highlighting why the current chronic care model is failing and how systems such as inCASA could help to find efficiencies in the Healthcare system and improve quality of life of patients. This, in fact, has been shown in Calahorra's pilot, by demonstrating that rehabilitation could be carried out at patients' homes with the same level of quality

than in Hospitals. That means taking off some burden of the system and avoiding patients to move to the care centre by using ambulances or taxi depending on their state of health.

6 Lesson Learned

The work carried out within the inCASA project proved that the potential for improved outcomes, quality and efficiency of care delivery realised through eCare can be achieved, especially when bridging the organisational divide between social and health care, which currently exists in most countries. The services developed in the five pilot sites of Paris (France), Chorleywood (UK), Athens (Greece), Turin (Italy) and Calahorra (Spain), supported by the transferability desk of Skive (Denmark) provide practice-proven examples of the benefits and evidences that can be achieved through integration.

And while the issue of integrated care is receiving increasing attention at the policy level lately, it would seem that service 'silos', i.e. the separated provision of social and health care services to one target group, prevails on the ground in most regions and countries.

There are a number of reasons that can explain why integrated eCare is only slowly emerging on the ground. A major role is certainly played by the usually separated governance structures for social and health care that are mirrored in legislation and regulation, in funding and reimbursement schemes, and in the way services are provided, e.g. in terms of processes and protocols. Amongst other things, these separated governance structures can make it difficult to develop working, sustainable and economically viable service models for integrated eCare.

Four of the five carried out pilots successfully implemented the integration process, the fifth one (ATC) continues working towards that goal; all aforementioned achievements clearly show that integrated eCare can become a reality.

In the 39 months duration of our project, we followed a dedicated approach for e-service development and socio-technical innovation. This approach allowed us to learn (through the evaluation of our pilots) what the benefits of integrated service provision in different contexts are, and to better understand what it takes (in terms of hands-on approaches and work tasks) to make these benefits a reality and to achieve them on a level that stands in a positive relation to the incurred costs. The main outcomes of this learning process have gone into the guidelines for service provision and in the transferability toolkit. In the following sections, we focus on some key lessons to draw conclusions and come up with recommendations that we think can be of use at the policy level.

The spending review that Europe is facing is pushing towards a different care organisation: healthcare services, supported by ICT technologies, are moving from hospital to local service structures; this will support the integration with social services. The business exploitation of the inCASA project is also moving towards this direction.

6.1 Citizen centric organisations need to be encouraged

The inCASA pilots have the understanding of the potential benefits of integrated service delivery for service provider organisations, a concrete starting point for the future development of more closely integrated healthcare and social care systems across Europe. On each Pilot site, inCASA reported, amongst professionals and involved organisations, a strong awareness of the importance of joint cooperation between healthcare and social care. inCASA led the Consortium to focus and to highlight the big issue of creating a concrete social and healthcare integration, due to the immaturity of a common interoperability model, and due to a long history of domain-divide between social care and healthcare worlds.

4 of the 5 pilot sites were able to develop a tangible integration between local services and professional groups. Within those pilots, new pathways of care were developed, new integrated technologies were deployed and as a result, information about patients was gathered, leading to targeted and appropriate interventions and actions for the patient. In the fifth pilot, the Italian, this traditional conflict is going to be engaged by legislators; a change is going to happen in order to remove at first cultural then legal barriers that currently restrict the sharing of data and cooperation between the healthcare and social care systems. Surely the inCASA project helped to set up common pathways that will be implemented in the future contest of regional health organisation.

All pilots experienced some difficulties that hampered the integration of services within their area. Reasons for these difficulties have included:

- Not fully understanding what was required and which organisations to link with;
- Failing to get buy-in from the different organisations early enough in the pilot process;
- Difficulties with local organisations themselves being disrupted due to changing policies or economic challenges;
- Competing interests between the organisations;
- Difficulties with funding streams as a result of changing pathways;
- Delays in pilot start up due to technical difficulties within the project.

There were a number of suggestions about how to overcome some of the challenges faced with the new service. A summary of these are:

- Creating a managerial role that would direct cooperating units of the hospital;
- Looking at using other non-clinical staff to do enrolment, installation and triage;
- Developing more definitive monitoring protocols;
- Enhancing the internal promotion of the project.

Finally, all pilots managed to design and agreed integrated pathways that led to integration, but specifically, this point this is particularly underlined by those pilots close to primary care:

- CHC: developed an integrated service model for monitoring the frail elderly patient within their home. CHC designed a new pathway of care within inCASA. However, they report that working together across organisation boundaries is a complex issue. There has to be a lead contractor that can carry the main responsibility and the contractor has to be able to respond to the data and all that it implies.

- ATC: reinforce the position of remote supporting organisations, like the contact centre, as the key role enabler of the process toward the whole integrated pathways between health and social services

In particular and especially in the practice of primary care, it is necessary that the healthcare aspects are well integrated with information on social character, for a multidimensional assessment of resources and, therefore, of the needs of patients and families to be shared with the social services network that exists at the district level. In this context, the cooperation of the various involved actors is essential, and the active participation of users/patients experiencing situations of frailty is fundamental. The implementation of a multi-disciplinary model shared between the Primary Care systems, the homecare services provided by Healthcare Agencies and the intervention of the social services, will ensure effective total patient care of the individuals, whose risk profile is associated with the implementation of measured and personalised actions. The actions taken imply that, for some types of selected users/patients, it will be possible to implement a series of training, information and monitoring pathways aimed, for example, at compliance with and appropriateness of pharmacological therapy, always based upon a correlation between cognitive impairment diseases and the development of chronicity.

As a final recommendation we state that the encouragement of citizen-centric care organisations should start from a new organisation of primary care. This is also emphasised by feedback from the stakeholders. Specifically, the feedback collected from some of the most important Italian regions (see the future of the project in new forms of primary care organisations such as “case della salute” (Emilia Romagna), “CAP” (Piemonte), “CREG” (Lombardia)), that have included some of the specialised health services and basic social services. From a physical point of view, they are located in appropriate structures close to the citizen, starting from the town where hospitals are closing.

We believe we can extend this vision to a wider audience.

6.2 Common data, common vision: towards a shared frailty model

Care workers, home nurses and GPs, all felt that the system improved the workflow and integration between the different social and healthcare personnel. One added value to this result was the easy access they all had to a patient’s health data at any time which increased efficiency. In general, the access to historical data and the representation of data in graphical form in the Consumer Application was highlighted as a positive factor which made it easier to gain an overview of the patient’s health status and collected data.

Most pilots agreed that the integrated service which was introduced was easy to use and provided a large amount of useful patient data which combined health, habits and psychological data. For KGHNI and INSERM the introduction of depression monitoring was found to be very useful and the sharing of information between professionals enabled interventions to take place

CHC stated that through their work, they had identified the important issue is not which organisation establishes and owns remote monitoring, but what data is needed, which route it will take and the nature of the response. The latter may be engendered by an integrated and multi-professional group as well as by a number of agencies working in partnership. They have seen that the greatest impact is to those that were deemed to be the most in need or “frail”.

KGHNI stated that thanks to the common view it could discover correlations between the patients’ medical condition and their everyday habits and enable the consolidation of the latter as early indicators of worsening clinical status.

INSERM found the service seemed more beneficial for the patients who scored higher on the frailty scale as they were more likely to suffer from severe adverse events and they may need medical or social interventions.

All pilots reported that having access to more information about a patient had helped improve communication between different organisations and groups.

CHC, FHC, INSERM and KGHNI all reported that the use of the inCASA service enabled them to identify patients who were in need of clinical intervention in terms of prevention.

This level of accomplishment has been enabled by the Electronic Patient Record (EPR) component of the inCASA solution, introduced from health experience and adapted for social/habit data, and accessible to all the users involved in the inCASA pathways. Actually, this is a missing point in the existing informative systems, the EPR are well deployed in the Healthcare systems, but are largely missing in the social domain.

As frailty is becoming a “structured” concept (we can mention the work performed within the framework of the EU initiative "Innovation Partnership on Active and Healthy aging" EIP-AHA), the possibility to define the level of frailty from an objective point of view becomes critical for a better organisation of public care services, in a time of spending review.

inCASA project assessed the level of frailty of the involved people, but this measurement was based on self-assessment, elaborated according the Edmonton Frail Scale. A relevant feedback collected from stakeholders goes deeply in this direction: the availability of “real time” information contributing to define and update a frailty model, is the basis of future customised care services, whose access in terms of public services will depend on level of frailty. At the same time, as a pre-frailty model emerges, basic concepts will drive attention towards prevention and early diagnosis of frailty and functional decline, both physical and cognitive, in older people.

6.3 Business models for integrated eCare must be flexible

The business model has to be flexible in order to be compliant with perceived return on investments from customers.

As depicted in the above recommendation, the business model of eCare will be driven by differentiated access to services; depending on the level of frailty it could be assessed.

At this point, this statement can be considered as a future finishing line, even if the UK pilot is still working in this direction: CHC calculated the cost of the change in resource usage of patients who were enrolled onto the service. Results indicated a £19.651 reduction as compared to the same time period prior the start of the pilot. However, when evaluating the start-up costs and running costs of the pilot, we see that the costs saving is eroded. CHC presented a number of issues to be considered within its economic reporting, but felt that the main focus on maximising costs savings was to identify and target services at those patients that would benefit the most e.g. the more frail and through the re-use of equipment.

As the inCASA services did not accrue significant health benefit (as determined by SF36) and thereby cost-benefit, then the reality returns to cost reduction, driven by de-hospitalisation or process cost-reduction.

In the first case, de-hospitalisation, the common “literature” is still addressing the point. Recent data from the largest project in Europe monitoring results in telemedicine services, (Renewing Health), states that telemedicine applied to COPD produces 24% reduction in the average number of hospitalisation for a patient and 23% reduction in the average number of visits to the emergency department, but with an increasing average number of specialised and pneumologic visits. Data for CHF are even more impressive: average number of hospitalisation for patient reduced by 61% and average number of visits to emergency reduced by 45%.

In this context FHC believes that the avoidance of hospitalisations episodes, related to worsening evolution of clinical status suffered by COPD patients, are expected to be a relevant outcome of this type of tele-rehabilitation programme. FHC presents a hypothesis that a reduction of at least 1 or 2 days of hospitalisation per year for each group of 8 to 9 aged patients suffering from COPD could demonstrate an acceptable efficiency ratio for such a programme. At present, all patients are being followed in order to calculate an estimation of hospitalisation days avoided according to the development of their respective health status during next period of 12 months, after the end of the period stated by pulmonologists to check their health status.

KGHNI also calculated cost savings based on the number of re-hospitalisations avoided. The inCASA services contribute to prevention resulting in measurable reduction of the hospitalisation needs, a finding that is supported by data made available from the pilot’s action log and the individual patients’ case files; the costs of hospitalisations for CHF patients burden significantly the national health system. For a length of a 5-day admission the cost is 849 euros[5] while for a length of a 10-day admission the cost is 1868 euros[6].

- Cost savings can be realised by avoiding unnecessary visits to the outpatient clinic. Routine checks costs are usually much smaller in comparison to the treatment of emergencies or other incidents (see above).
- Costs savings can be attributed to the positive effects of combined socio-health-psychological care: these savings could be logistically appreciated based on the guidelines suggested in the related scientific bibliography and secondarily on the pertinent organisational overhead costs incurred if no effective procedures are already in place to facilitate cooperation between carers of different disciplines and across organisational units (internal/external).

[5] http://codesfordoctors.gr/Details-KEN.php?query=%CE%9A42%CE%A7&searchType=2#Open (in Greek)
[6] http://codesfordoctors.gr/Details-KEN.php?query=%CE%9A42%CE%9C&searchType=2#Open (in Greek)

On the side, the point refers to impact on workloads. On this point, approaches are different and depend on the actors involved within the process.

In fact, all pilots reported that the introduction of the service had impacted on their use of time in some way that depends much on the pilot organisation.

Much of the additional workload was undertaken by the nurses and front line staff in managing the day to day running of the service. This was especially the case where nurses were undertaking the recruitment, installation and monitoring. FHC was the only pilot that outsourced the installation of equipment to a third party. All other pilots used either their technical partners or staff within their organisation.

The CHC pilot reported that despite a high level of buy in from the general practitioners there was still some resistance to taking on the additional work required as a result of the service. This resistance had led to increased pressure on the nurses and other staff involved.

Resistance from the GPs was also reported in Italy, and can be referred as one of the causes of the lack in involved of this category into the pilot.

On the other side, we have process-cost reduction. INSERM calculated its cost effectiveness by evaluating the running costs of delivering the integrated service for the duration of the pilot, the costs related to the time used by staff was calculated by estimating the number of hours spent by each stakeholder in each kind of activities (training, meetings, installations and monitoring). According to this comparative study, INSERM calculated that the cost of one chemotherapy course is reduced by 4041 € when delivered at home with inCASA monitoring compared to conventional care, which represent a significant cost saving for the national health insurance.

ATC performed similar cost analysis on its pilot. By hypothesising that it would be able to reduce unnecessary and unplanned visits to the user as well as by reducing the number of planned visits to the user, ATC proposes a saving for each patient of about 60/euro month. The average cost suggested for this kind of telecare service is about 2/euro a day.

Starting from these figures, industrial partners elaborated their business models. Flexibility was introduced by setting up prices per service/day/person, in order to be ready to manage a negotiation based on the cash flow projection derived from operational savings, even if the impact in the first phase in negative, because of the equipment purchasing. None of the industrial partners are expected to manage the selling process according to a fee saving/sharing model.

6.4 inCASA contribution to Enhanced care: perception perspective rewards the professionals

Most pilots had heard of telehealth but only one pilot had experience of using it previously.

The majority of the inCASA users were unfamiliar with the new technologies, and in some cases user acceptance of habits monitoring sensors was a big issue. This requires the approach be more “inclusive” when presenting and implementing the service, starting from the point when first dealing with users, helping them becoming conscious of their fears and needs, and leading them to reach the maturity to understand and accept inCASA services.

From the process point of view, the recommendation would focus on patient motivational reinforcement (life-styles, therapy compliance) and on the continuous feed-back from the patient themselves by implementing available technological tools to support learning/informative activities for healthcare and social care operators and to support the interaction between them and with the patient.

Pilots reported that the majority of their patients / end users who took part felt that the service and technology provided enhanced care that was over and above what they consider to be their normal care.

Patients within the KGHNI and FHC pilot reported that the new service had helped them save time in terms of required visits to the outpatient clinic. The FHC pilot included a control group within their study. Results from the SF36 found that patients who were provided with Tele-rehabilitation treatment had a better level of perception of their quality-of-life at the end of the program, in comparison with a lower level of quality-of-life perception within the control group. In particular they found significant increases within the general perception of the health domain, which is consistent with the clinical outcomes as related to the health status of the patients. The role of relatives or selected neighbours, especially the younger ones, is quite important in order to assist them with the use of the technology and that is why they should also be trained during the installation of the equipment. In fact, if the elderly people become familiarised with the inCASA technology, they really like interacting with it and this is something positive and refreshing in their daily routine.

In some cases, despite the fact that patient perception is always rated well, results of questionnaires investigating quality of life do not always shows improvements (especially INSERM and CHC). Overall, the technology was felt to be simple and easy to use. However, while many acknowledged the usefulness of the devices, there were a number of issues concerning reliability of the devices, the communications gateway, visualisation of data and the interpretation of data received from habit devices.

Regarding professionals, as a general conclusion, the ones who were involved in the pilots were enthusiastic with the inCASA service. The majority of professional users (56%) who were asked to rate their overall satisfaction with the service, rated it as “Average”. 36% rated it as “Satisfied” (36%) and 8% were Very satisfied. 96% of those asked said that they would like to continue using the service.

The following points summarise the main benefits of using the service as reported by the professional users:

- The ability to respond quickly to heart failure emergencies by receiving immediate alarms;
- A better understanding about the patient´s home life and personal status;
- Access to more complete data about the patient´s health and habits;
- The integration of multiple units and keeping everyone better informed with regard to patient condition (rehabilitation, social services, physicians, psychologists, etc.);
- The possibility to correlate medical data with habitual, environment and psychological data;
- An optimisation of work time;

- Being able to instantaneously identify health problems and adverse effects and being able to address them promptly.

This concept is reinforced by the transferability desk of Skive municipality. Professional users feel that the platform enables better integration of existing workflows and cooperation with other professionals across sectors. This enables better cross-sectoral efforts to not only improve the existing care but also preventative care as different social and healthcare professionals (from both the primary and secondary healthcare sector) all have access to a patient's measurements and because the inCASA solution enables a more continuous monitoring of a patient's health parameters; these two factors may greatly improve preventative care.

7 Next Step

As described throughout this report, five different types of integrated eCare services were developed in inCASA, building on the project's common technological architecture. The services were implemented and tested for more than one year and the impacts on patients and clients, care professionals and provider organisations evaluated.

The experiences gained in the setting-up of the services and the evaluation outcomes not only enabled partners to continue the operation of the pilots and to start scaling-up to fully operational services, but also provided the basis for a future deployment of inCASA by further providers and in other regions of Europe.

7.1 Pilot up-scaling and sustainability

Once the interim outcomes of the pilot evaluations made it clear that the services would become a success in light of the objectives set in the beginning, the responsible project partners developed strategies how to bring their service into regular operation and (if applicable) scale it up to a larger client base than was involved in the pilot. The prime aims of the up-scaling were and are on the one hand to ensure a sustainable operation of the service after the project end and on the other hand to reach out to all clients or patients in the area of the provider that can benefit from the service.

At this time 4 of the 5 pilots have decided to continue, while the fifth one, INSERM, is still considering if to continue or not.

KGHNI expresses its will to continue with the business exploitation of the inCASA service after concluding an agreement with a subset of the inCASA industrial partners.

As a preliminary planning, the following facts are provided:

- KGHNI foresees as first phase target to procure the services the patients that can pay for the service by themselves (out of pocket payment)
- In the second phase, KGHNI would investigate an agreement with public sickness funds or/and private health insurance companies in order to cover the costs of the provided service.

Apart from the support of inCASA partners, an agreement with a Greek IT company having complete technical knowledge of the platform, taking care of the installations/de-installations and able to provide 24/7 technical support is required.

In the meanwhile KGHNI will continue to run the service, by continuing the current healthcare integrated inCASA protocol that was tested during the Pilot phase of the project.

At FHC pilot site, as a consequence of lessons learned from inCASA, the Management Board is confident that achieving relevant clinical outcomes for patients with chronic diseases is a solid reality. Thus, a new program focused on patients with chronic disease (not only frail elderly) is currently under discussion. The view of FHC is that in the future services provided by the hospital will evolve from “Focus on acute pathologies” to “Focus on chronic pluripathological patients”.

A further key point is the current lack of any strong daily relationship between health and social professionals involved in the care of frail people with more than one acute illness. Chronic pluripathological patients usually present a higher level of frailty and so of dependence. The idea of FHC is to build up a multidisciplinary team composed of two physicians, one of them with direct contact with the ambulatory unit at FHC for a regular period of time covering a time frame of between 7 to 10 hours on daily basis. Both of them are specialised in internal medicine issues, and will be in charge of the chronic pluripathological hospital unit. They will be assisted by a nurse whose role is a key point for success because he/she will be in charge of evaluating the needs of the patient, including social ones (a Social Validation questionnaire – Gijon Scale - will be used for this purpose); specific skills will be required for this purpose and are still under development.

Hospital clinicians will be a sort of “internal general practitioner” within the hospital boundaries. The approach will not only include primary care level, but also social services – both local and primary care level ones -, so that shared leadership between general practitioners at primary care level and physicians at secondary level (FHC) can be upgraded into a level of deeper integration. Thus, the project is to build up a new hospital unit named UPC (“Unidad de Patients Crónicos”) – Chronic Patients Unit - to offer multidisciplinary services to patients.

To enhance the integration with additional resources already existing within the region, the aim of FHC is to recruit relevant partners into this project, such as a medium-to-long term care hospital (Hospital Virgen del Carmen), which opened in February 2013.

Following the conclusion of the inCASA EU project, CHC plans to continue developing the service both locally within Chorleywood Health Centre and throughout the Hertfordshire and Oxfordshire area. In addition, CHC plans to use the outcomes of the inCASA pilot to enhance applications for further research and development projects in order to continue work on designing and developing service provision for the older patient in need.

Primary care clinical record systems should include frailty registers with risk scoring systems able to alert primary care clinical teams to the needs of individual patients and their carers and family.

Risk systems should provide pointers to the likelihood of falls. 40% of people over 65 years will fall each year and 40% of acute admissions are caused by or involve a fall. The use of accelerometry and gait analysis as a part of monitoring may result in recognition of an increase in risk of falling - after the fall may well be too late. In addition, the government intends to develop a new DES (Directed Enhanced Service) or DESs using £120 million of existing resources. This is some of the money removed from the Quality and Outcomes Framework (QOF) organisational domain.

One of these DESs is aimed at supporting people with long-term conditions to monitor their health remotely. As part of the contract, General Practices are to establish remote care monitoring arrangements for patients with long-term but relatively stable conditions. inCASA will be used to help identify these patients.

With the technical support of Brunel University, CHC will continue offering the service as part of its enhanced integrated care. Existing patients who are using the service are being offered the opportunity to continue if they so wish and new patients will be identified and enrolled onto the service.

The Italian pilot didn't have the possibility to realise the integration of telecare/telehealth services, but the experimental service realised in 40 frail people's homes of ATC Turin has highlighted the need of innovation into the models of socio-health assistance. This means that inCASA can begin a process of improvement in the health and welfare sector, and this was realised by one of main stakeholders of ATC, the Piedmont Region.

The main interest of Piedmont Region is to develop a solution such as inCASA in a territory with an increasing number of frail people, and according to the Regional Health Plan for the years 2012-2015, that must develop the net of home help for elderly, with a specific focusing on socio-health integration and on prevention of cognitive decline and advancement of chronic diseases.

In these interventions, it is highlighted the need, in the practice of primary care, that the health features could be integrated with social information, for a multidimensional evaluation of the resources and of the patients and their families' needs, to be shared with the social services net of the local districts.

Following a Deliberation of the Regional Council, issued in April 2012, a new model has been developed in order to provide integrated social and health services, involving general practitioners, nurses, specialist doctors, social workers. The new kind of organisation, called CAP (Centri di Assistenza Primaria, i.e. Primary Care centre) is based on the daily competence of social and health professionals, and the definition of guidelines and integrated protocols, for which the inCASA experience is a source of ideas and concrete proposals. A formal letter of this involvement from Piemonte Region toward the project has been provided in July 2013.

The starting point for this strategy is the small towns, where a process of de-hospitalisation is ongoing. ATC will provide telecare services through its contact centre, at a regional level.

INSERM has shown an interest to enlarge the pilot after the end of the project including more patients during at least six more months but it has to reinforce the collaboration with the main technical partner that was involved in that pilot site, Telefonica. The main topics of discussion relate to an increased number of patients (and related costs of equipment) and new developments of software.

The continuation of the pilot will depend on the operational and technical costs for running the service and will depend on the potential funding provided by external institutions

Based on these premises, the consortium has elaborated a collaboration agreement, which is still to be concluded, in order to support pilots in their ordinary operations, for a pre-defined period. This collaboration agreement is open for the participation of all inCASA partners willing to continue the collaboration. Industrial partners will provide technical support to the pilot willing to continue and enhance the service after the pilot end. This collaboration agreement is needed, especially for those partners not directly impacted in the exploitation activities, in the specific pilots in France and Greece.

7.2 Future initiatives in the European Context.

As described in the inCASA business plan, markets will be addressed by industrial partners starting from the counties where they are based: Italy, Spain and Denmark.

Regarding Spain, the initiative will be driven by the experience of FHC Calahorra, and extended to the regions and driven by Telefonica.

Regarding Denmark, the initiative will be driven by the experience of Skive exploitation desk and driven by IN-JET together with CNET.

Regarding Italy, apart from the enhancement of the ATC pilot, Santer will enhance the project in the aspect of the smart ageing initiatives that the government is setting up in order to support the participation to Horizon2020. As mentioned before, the OPLON project (OPportunities for healthy and active LONgevity) has been approved as a “flag” project in the domain of “smart ageing”[7], and inCASA represents, in terms of building blocks, the main background knowledge brought to the project.

Following this line of action, the participation to the EIP-AHA initiatives has been announced, together with the main endorsing partners (Emilia Romagna region), as reference sites for Italy on the topic.

Other common dissemination actions are in discussion with other EC projects on the same topic (eg: CommonWell and United4Health).

[7] http://hubmiur.pubblica.istruzione.it/web/ricerca/dettaglio-news/-/dettaglioNews/viewDettaglio/28502/11213

8 List of beneficiaries and contact points

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Table 12 - List of Beneficiaries and Contact Points

9 References

[1] D2.5 Annex - National Pilot Blueprint Package Update[8]

[2] D2.6 Requirements Consolidation and Prioritisation Iteration 3

[3] D3.1 System and Functional Specifications

[4] D4.1 Core Monitoring System Implementation

[5] D4.2 Remote Monitoring Device Implementation

[6] D4.3 Advanced Monitoring System Implementation

[7] D5.3 Integrated Home Sensor Network and Healthcare Provider Platform

[8] D5.4 Descriptions of installation and extensions

[9] D6.1 inCASA European Pilot: aims, sample, methodology

[10] D6.2 Pre-Pilot Installation Reports

[11] D6.3 All Pilot Installation Report

[12] D6.6 Pilot Evaluation and inCASA Platform Validation and Recommendation

[13] D7.3 Business Plan

[14] D7.5 The inCASA Transfer Toolkit and Transferability Activities

[15] TeleMediCare 2012 –inCASA project – Smart Telemonitoring

[16] "Prevention of functional decline and frailty", by Innovation Partnership on Active and Healthy Ageing" (EIP-AHA), released the 6th of November 2012.

[17] Renewing Health, by ARSENAL, c/o eHealth Forum, Rome, 28th of May 2013

[8] http://www.incasa-project.eu/viewpage.php?page_id=4